The 1,000-Year Rain: Lessons Learned in the Boulder County, Colorado, Assessor's Office

Jerry Roberts, Cynthia Braddock, and Rachel Parrinello

(Orthogonal photography courtesy of Pictometry International Corp.)

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When an extraordinary disaster strikes, even the best emergency plans may need rethinking. During the week of September 9, 2013, a slow-moving cold front stalled over Colorado, meeting with warm humid monsoonal air from the south and causing heavy, slow-moving rains and catastrophic flooding along Colorado's Front Range, from the Colorado Springs area north to Fort Collins. Precipitation continued to increase on September 11 and 12. Boulder County was worst hit, with 9.08 inches of rain on September 12 and up to 17 inches by September 15. These amounts are comparable to Boulder County's average annual precipitation (20.7 inches).

On September 11 at 11:00 a.m., because of precipitation during the preceding days, current weather conditions, and the predicted weather hazard outlook, the severe weather protocol was implemented by the Emergency Operations Center. By 4:00 p.m. that day, rains that had started earlier were not letting up, and the risk of flooding conditions was imminent in certain parts of the county. By early morning September 12, all the major drainages in Boulder County were flooding. The county had flash flooding responses prepared for all the drainages, but no plan for all the drainages flooding at once.

Sadly, four deaths were confirmed in Boulder County because of the flood emergency. More than 1,600 people were evacuated, with more than 300 homes destroyed and thousands more damaged. A total of nearly 900 square miles (2,300 kilometers) was damaged by flooding. Between 100 and 150 miles of road were destroyed, most of them in the mountain valley drainages, essentially isolating almost all the mountain communities in Boulder County for days and, in some instances, weeks. President Obama declared a state of emergency for 3 Colorado counties (Boulder, El Paso, and Larimer) with another 12 counties (Adams, Arapahoe, City and County of Broomfield, Clear Creek, City and County of Denver, Fremont, Jefferson, Morgan, Logan, Pueblo, Washington, and Weld) added by September 16 (see figure 1).

The Colorado National Guard launched a military operation dubbed "Operation Centennial Raging Waters," involving almost 700 personnel and the biggest domestic helicopter airlift mission since Hurricane Katrina. Across numerous

Figure 1. Colorado Disaster Declaration as of 9-15-2013 (FEMA-3365-EM)

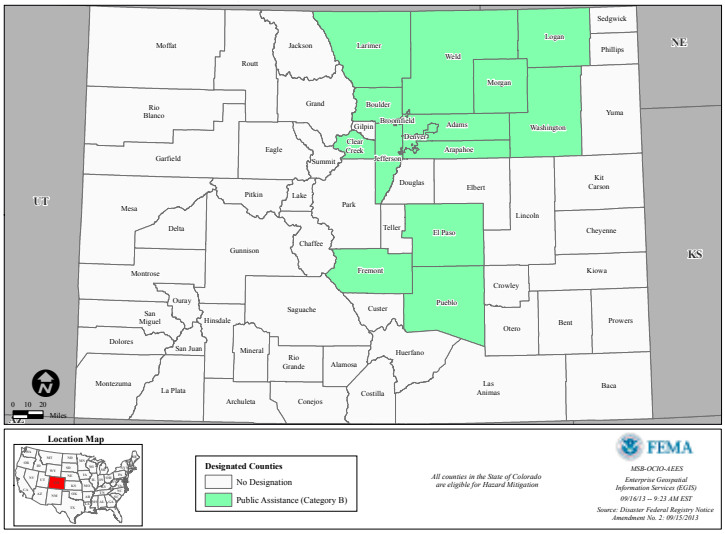

**Figure courtesy of FEMA (http://www.fema.gov/disaster/3365)*

Front Range counties, as of September 16, more than 2,400 people and hundreds of pets had been rescued by 21 National Guard helicopters. In Boulder County, at least 1,000 people and 300 pets were rescued by air and ground, despite rescue efforts being hampered by continuing rain and a low cloud ceiling. A Boulder County Assessor's Office staff member was evacuated from her home by National Guard helicopter, and another staff member was isolated in her mountain community for several days. Both are safe and their homes are standing, but many of their neighbors and friends were not so fortunate.

In the months following these evacuations, routines changed drastically for families living in affected areas—everything from lack of potable water due to destroyed wells, to road and bridge closures doubling families' commute times to work and school, to debris and sanitation issues, to concerns about mental health and counseling resources for affected communities.

Colorado National Guardsmen respond to floods in Boulder County, Colorado, United States. *(photo courtesy of United States Department of Defense)*

Past Emergencies Prompted Planning

In terms of emergency planning, previous experience in Boulder County had involved wildfires, four of them significant, during the last 20 years. Of course, despite last fall's heavy precipitation and flooding, the county still needs to watch for wildfire conditions. After the Fourmile wildfire, which burned 6,181 acres in Boulder County in September 2010, county officials and staff met for several years and developed what was considered to be a first-rate response and recovery plan.

In terms of emergency preparedness, however, there is always something unique about a natural disaster that cannot be prepared for. Fires are a very different kind of emergency than floods, although they are interrelated. Fires set up soil and vegetation conditions that can make flash flooding a concern.

Wildfires have helped the Boulder County Assessor's Office develop and maintain an internal emergency response plan. The staff in the assessor's office comprises 45 people, with a total parcel count of more than 120,000 properties. Key elements of the response plan are as follows:

- Identifying the staff member who responds to emergencies and structuring the response.
- Understanding how and why the office's business process has a bearing on the emergency process as a whole.
- Determining the office's business and data partners and working on these relationships before a natural disaster occurs. Data partners include other Boulder County offices and departments (e.g., Transportation, Parks and Open Space, Land Use/Planning, and County Surveyor), state and federal agencies, special districts (such as fire and water districts), nonprofit organizations, and cities and towns within Boulder County.
- Having the appropriate software, including remote-access software capabilities for key staff, and ensuring that staff is comfortable with the tools for visualizing and understanding the data.
- Maintaining the data so that they are as current as possible, knowing what data are on hand, appreciating their caveats and limitations, and understanding how to query the data.

Major floods have occurred in Boulder County throughout the past century, however not recently. After the last major flood in 1969, the City of Boulder and Boulder County started putting emergency preparedness technology into place, including flash flood warning systems (sirens or loud speakers), reverse 911 calling systems, and precipitation and streamflow gauges, and also enacting building permit guidelines to

Wildfires such as the Fourmile fire of 2010 can create conditions that increase the severity of flooding. *(photo by Rod Moraga)*

reduce property damage, particularly in the 100-year floodplain. The City of Boulder acquired many properties along the floodway to create wide bike and pedestrian paths next to the creeks that sit below unobstructed bridges. This work over many years has helped reduce flood damage within the City of Boulder.

In unincorporated areas of Boulder County, the mountain canyons (and areas where those canyons open up onto the plains) were some of the hardest hit areas during the September 2013 flood. With large amounts of uninterrupted rain over a series of days, the ground became saturated and unstable, and the water moved quickly downstream. Landslides and falling rocks and boulders were hazards within mountain canyon roadways, and both natural and man-made debris were carried far and wide, even onto the flat plains areas of the county.

Thus, the scale and magnitude of the 2013 flood event challenged even the lessons learned from previous wildfire and flood emergencies.

Left: After flood (October 2013) versus Right: Before flood (May 2011)—near intersection of Lefthand Canyon Drive and U.S. Highway 36, north of Boulder, Colorado.
(Orthogonal photography courtesy of Pictometry International Corp.)

One reason Boulder County's Federal Emergency Management Agency (FEMA) disaster declaration occurred so quickly in September 2013 was that the Boulder County GIS staff had recently updated the county's FEMA Multi-Hazard Mitigation Plan, which included property value data, broken down by 100- and 500-year flood zones, property types, and jurisdictions within the county. These data were given to FEMA the day after the agency requested them and led to a quick response by state and federal agencies. Based on this experience, the assessor's office has determined that this FEMA multi-hazard data report and related assessor's data will be updated every year.

The Assessor's Role in Major Disasters

Nature does not stop to consider how inconvenient its timing is. The flood of September 2013 caught the Boulder County Assessor's Office in the midst of valuation hearings at the County Board of Equalization (where property owners who have appealed to the assessor and disagree with the assessor's determination can appeal to a higher level). The office was also approaching important annual year-end deadlines: the final certification of 2013 values to special taxing districts, cities, and the State of Colorado, and the delivery of the tax roll to the County Treasurer. The flood added work, stress, and urgency to the staff's already heavy workload.

Nevertheless, the assessor's office has an important role in emergency response and recovery. The assessor's database contains the most complete information about properties, including such critical information as ownership, mailing address, property address, and characteristics of buildings and land. Staff members are highly adept at gathering field data, have excellent communication skills, and are proficient with mapping, database, and geographic information systems (GIS) technologies. During post-flood damage assessment work, appraisers spent countless hours gathering photographs and field notes, visiting with property owners, and documenting the flood's impact on the assessment database, property values, and county property tax revenues. Ultimately, sharing property information with the public and other agencies is the core of assessment work.

In the immediate hours after the flood event, the office's first response was to provide support to the Emergency Operations Center. Staff members were encouraged to work shifts providing GIS support to the emergency response team. The flood severely affected transportation routes in the county, so many GIS staff worked remotely from their homes. Many other staff members generously volunteered their time, working in the Emergency Operations Center's call center. Staff's knowledge of the geography of the county was immensely helpful during the initial stages of the emergency.

State Law on Changes in Valuation

The assessor's office primary responsibility is to ensure that properties are valued accurately and equitably. Determining the impact of the flood on property values was the next responsibility. State law in Colorado controls how changes in valuation are made. For example, after a natural disaster, agricultural properties are not prorated for destruction, and owners have five years to demonstrate that they are back in business before they are reviewed for loss of agricultural classification. Business personal property does not get prorated in the year of destruction; it gets removed the next year. In a reappraisal year when values are set, the assessor can reflect only value loss due to destruction of buildings. In intervening

years the assessor can reflect only the value change due to unusual conditions, including natural disasters. Also, a residential property damaged or destroyed by a natural disaster retains its classification as it is rebuilt; it reverts to vacant land status only if it is not rebuilt after five years.

The year 2013 was a reappraisal year, and at the time of the flood values for properties had already been set. The assessor, Jerry Roberts, met with other assessors in Colorado whose jurisdictions had also been affected by the flood, and with JoAnn Groff, the State of Colorado Property Tax Administrator, to agree on a set of guidelines for determining whether or not a property was losing value due to destruction. The guideline for 2013 residential proration of value for destruction caused by flooding is shown in figure 2.

Properties identified as destroyed in 2013 were prorated from the official day of the flood, September 12. Once criteria for defining a destroyed home had been established, attention was focused on how to accomplish this work. A core team was created and scheduled to meet twice a day. Every morning the team met to verify who would be in the field and where they would go. The team met again at the end of the day to decompress with the staff who had been in the field and to set the schedule for the next day. Staff members who would be performing fieldwork were fitted with face masks, and if they were not current with vaccinations, they received a tetanus shot. Field staff were expected to wear jeans and boots. Even though the office had done a great deal of planning and technology was in place, staff members went into the field with clipboards and pencils, cameras, measuring tapes, and paper field maps generated by the GIS staff.

Left: after flood (October 2013) versus right: before flood (May 2011)—along Apple Valley Road, north of Lyons, Colorado.
(Orthogonal photography courtesy of Pictometry International Corp.)

Data Collection

Data collection was difficult. Access to properties ranged from unsafe to inaccessible except by foot. Roads were washed out; bridges were compromised; buildings had been made unsafe by water damage; there was standing water and water in places it had not been before; and mud and rock debris from landslides was everywhere. Sometimes the level of damage or destruction to buildings was hard to discover at first glance. Some buildings were obviously off their foundations, had cracked foundations, and were undercut by

Figure 2. Guideline for 2013 residential proration of value for destruction caused by flooding

GUIDELINE FOR 2013 RESIDENTIAL PRORATION OF VALUE FOR DESTRUCTION CAUSED BY FLOODING

Buildings with major physical damage caused by flooding will be prorated for 2013 starting on 9/12/2013 for the remainder of 2013 (254 days taxable at 100% "livable or useable" and 111 days at 100% "not livable or useable."). Properties to be prorated should be described as follows:

Consider property 100% uninhabitable if <u>one or more</u> of the following applies:

Destroyed

- Structure is leveled
- Building leaning
- Two or more exterior walls collapsed
- Second floor leaning or gone
- Flooded first floor (water/mud)
- Water above first floor door knobs
- Two or more basement walls collapsed
- Moved off foundation
- Collapsed walls and/or roof
- Exits blocked/windows broken by debris or mud flows into the dwelling
- Basically uninhabitable and/or dangerous conditions

Left: after flood (October 2013) versus right: before flood (May 2011—North of Lyons, Colorado. *(Orthogonal photography courtesy of Pictometry International Corp.).*

water. But many looked fine, and the only way to tell was to get close enough to walk around the structure or be allowed inside by the property owners to measure the height of the waterlines on the walls.

It was quickly apparent that the emotional state of the assessment staff had to be dealt with. It was very traumatic to spend day after day in the field viewing the flood damage and speaking to homeowners who were affected. The assessor's staff was often the first official county presence on a property. Property owners were in shock and needed to tell their stories. This was repeated day after day, so the solution was to limit how many consecutive days staff could be in the field.

An added wrinkle was the limited number of staff. Staff had to attend hearings with the County Board of Equalization at the same time. To alleviate some of the strain, two temporary staff members were hired. Fortunately one temporary staff member was a recent retiree who was very familiar with the office's processes, equipment, software, and geography. Staff worked diligently during this difficult period and did its best to prioritize work. As appraisers finished their county board hearings, they felt responsible for their assigned areas and neighborhoods. Thus some properties were visited several times, and some properties were not visited at all.

The assessor's office produced and delivered the 2013 Certification of Values to taxing authorities and the 2013 tax roll to the County Treasurer. Fortunately there are mechanisms that allow the office to correct the tax roll, as a few more destroyed properties were uncovered after the tax roll was delivered in December 2013. The Boulder County Assessor's Office staff worked collaboratively, professionally, and diligently in the final months of 2013.

A New Year with New Responsibilities

January 1, 2014 rolled around, and a new set of responsibilities had to be met. In an intervening year, values can be

Jamestown, Colorado, Sept.15, 2013—The small mountain town of 300 was cut off because of the Boulder County flood. FEMA Urban Search & Rescue teams deployed to the state to help with rescue operations. *(photo by Steve Zumwalt, FEMA)*

modified only as a result of unusual conditions, one of which is damage due to natural disasters. It is "business as usual" for the office to review properties to ensure that values reflect their condition on January 1, though this year the workload has been much heavier. The first step was to review the properties destroyed in 2013 to verify their status as of January 1, 2014. For some of the hardest hit areas, the value of destroyed buildings came off the assessment role completely,

Arapahoe at 1st street on Sept.13, 2013. Flood brought debris onto the road and caused serious damage.

but some property owners had pulled permits and were already rebuilding. For some homes, the long-term status is still unknown because they are candidates for buyouts by FEMA due to their location in the newly created floodway.

The office also started reviewing all newly issued permits. The influx of newly created flood-related permits by cities and the county meant that, in some cases, the permit data were not descriptive enough for the appraisal staff to accurately determine the property's status on January 1, 2014, the Colorado assessment date. This meant a new wave of field visits, in the early months of 2014, to flood-affected properties to verify their condition. To assist with flood-related fieldwork and data entry, the two temporary staff members were kept on the payroll. The office relied on property owners self-reporting damage through a web-based form. The office also received numerous phone calls and visits from property owners. Using GIS to identify properties potentially affected by the flood, the office also sent a letter to property owners asking them to contact the office with an updated property status.

New attributes in the assessment system were created to track damaged properties; a *dummy* permit type was also developed for properties with destruction or damage that would need to be reviewed for 2015. Existing criteria from the Natural Weather Service were used to establish major and minor flood impact categories. For the most highly impacted properties, attributes were created to calculate a market adjustment to the entire property to reflect the impact not only on the buildings but also on the land. All these new attributes and workflows needed to be documented; staff required training; and the quality of the work had to be checked for accuracy over time. As a result, maintenance and updating of flood-related assessment data will be part of the staff's workload for years to come.

Overload of Flood Data

Data Gathering and Resources

The data sources used during the flood incident changed as the situation evolved over time. Data consumed during the immediate first *days* of the emergency were different in content and scope from the data used during the early *weeks* of the flood event. Data sources continued to change and expand during the *months* that followed, as more in-depth analysis occurred. Throughout the entire flood event, there was actually too much information (a better problem than not enough information).

During the first days (and weeks), initial geographic data on flood damage and severity was first available via social media and networks, such as Twitter, Flickr, and Facebook. Traditional media, such as television and newspaper, and their related Internet sites also provided incredible coverage of the event. It takes time to mine these Internet sites for relevant data, and all information and damage reports (including photographs) needed to be verified by assessor staff. However, this was a good place to start data-gathering efforts, especially in the earliest days when roads were closed and travel was not safe. The information gathered using social media data methods was usually "one property at a time," which made for slow going, and data needed to be verified.

In the case of a catastrophic emergency event such as a flood, in the assessor's office, per Colorado law, the primary goal is to assess individual properties in the year of the emergency, determining whether or not the property meets the official criteria of destruction.

As emergency and first responders, military personnel, and search and rescue groups expanded their reach into the field immediately following the flood, lists of affected properties and damage reports began to trickle into Boulder County offices, including the assessor's office. These reports came in a variety of formats, including paper lists, spreadsheets, and geotagged points. The lists were long with all sorts of interesting information including (but not limited to) blocked roads due to landslides and debris, bridges out, culverts blocked with mud, lost pets, helicopter landing sites, and abandoned vehicles. Such diverse data points are important to certain users but not necessarily to all users for all purposes.

In the case of a catastrophic emergency event such as a flood, in the assessor's office, per Colorado law, the primary goal is to assess individual properties in the year of the emergency, determining whether or not the property meets the official criteria of destruction. The criteria for a determining a destroyed property is high. In sifting through such diverse damage reports in the first weeks, the office gained an appreciation for the grand extent of the flood event, but the data itself usually did not provide enough evidence about whether (or not) each specific property met the *high bar* for a destroyed property under Colorado law.

Sources of early flood damage reports and flood damage imagery, *used for internal purposes only*, included Urban Search & Rescue, Rocky Mountain Rescue, American Red Cross, FEMA Incident Management Team and individual assistance reports, Colorado Civil Patrol aerial photography, Colorado Air National Guard helicopter flight videography, and lists of affected properties from charitable and religious relief agencies from their respective offices' fieldwork.

Of course, these data provided a broad scope and better understanding of the flood event; however, the data were not usually at the detailed scale of individual property damage assessment. Often, lists generated in the field contained errors or omissions regarding the property address, which made linking such tabular data (gathered by emergency workers in the field) to the assessor's database a big challenge. And of course, the lists and the data were constantly changing, especially during the chaotic circumstances in the first weeks and months after the flood. The assessor's office staff needed to verify and link all outside tabular data sources to the internal assessment database, using key fields such as ownership, address, or parcel number with care, including an understanding of the possible relationships within the data lists themselves (possibly one-to-one, one-to-many, or many-to-many relationships in the data).

Data Classification

Another challenge was the definition of property damage classification, to individual buildings, by various organizations and agencies, depending on the organization's business process and reason for gathering the damage assessment data in the first place, as well as the original level of damage assessment detail. For example, initial damage assessment by search and rescue personnel was quick and not as detailed as later damage assessments, because those rescuers were focused on saving lives, not necessarily on individual property assessment.

The American Red Cross's definition of properties (Destroyed, Major, Minor, Affected, and Inaccessible) differs slightly from FEMA's classification of properties (Destroyed [Red], Major [Orange], Minor [Yellow], and Affected [Green]). Even within Boulder County departments, the classifications of properties by the county Land Use Department (Unsafe [Red], Limited Entry [Orange], Habitable [Yellow], and Inspected [Green]) differed from the assessor's office classification (Destroyed [2013] and/or Destroyed [2014], as well as Affected [2013] and/or Affected 2014]). This difference is due partly to the assessor's office statutory guidelines, definitions, and timeframes related to property assessment in Colorado. The assessor's office business process and legal framework is quite different from that of the Land Use Department.

In addition, Boulder County internal damage assessment classifications did not necessarily match outside private companies' assessment systems, such as those used for private insurance purposes. In retrospect, it is easy to understand how and why the many damage assessment classification systems and damage assessment lists varied across organizations and over time. During the months following the flood, this was a frustration and challenge for many data consumers, including the assessor's office. There were many data sets available over time, but of course there was no one set of data that provided the whole picture for any one stakeholder or business process. As a result, the assessor's office needed to work very hard to understand the data itself, including its limitations.

FEMA and the National Geospatial-Intelligence Agency (NGA) provided some of the earliest regional flood-related initial base layers, including inundation zones, flood extents, and some imagery. The flood event crossed many Front Range Colorado county boundaries, and so assistance from the State of Colorado Office of Emergency Management as well as the Federal Government was necessary and appreciated. Within Boulder County departments, collectively many base GIS layers were useful during and after the flood:

- hydrological features and watersheds
- parcels and related tabular data
- diverse and robust transportation features
- address points
- base layers such as elevation
- the Public Land Survey System
- political boundaries for towns and cities
- infrastructure layers such as utilities, hospitals, schools and shelters.

All these base layers constitute the GIS infrastructure that gives newly received tabular and geographic data its meaning and context during an emergency.

Data Coordination

The specific precipitation data unique to the September 2013 meteorological event were not immediately available in the first days after the flood. With time, National Weather Service precipitation totals were obtained that were then overlaid with hydrological features, watersheds, and elevation change, confirming which canyons and valleys were most affected by heavy precipitation and stream flow throughout the county. As new data sets have been created within Boulder County, it has been a full-time job to determine who is the data authority for each data set and to coordinate the organization, naming, and storage of the data in meaningful ways, including metadata whenever possible. The county GIS strategy team has done an excellent job coordinating flood-related mapping and data requests, including answering the questions, What data set is needed? Who is requesting it? Who is the data authority for this data set? When are the data needed? Are the data for internal or external use?

More on Data Gathering and Aggregation

Another example of flood-related tabular data linked to geographic data is building permits. With time, the office was able to obtain flood-related building permit data from the

local jurisdictions (or their permit contractors). The building permit data were linked to specific parcels to help the appraisal staff understand and visualize the extent and type of damage to a property. Of course, building permits are not available for all areas, especially after a catastrophic emergency, and victims of a flood may not apply for a permit for work done to their property.

In addition, for internal purposes only, FEMA individual assistance reports were linked to parcel data and mapped. Again, even when FEMA individual assistance reports were linked to specific parcels, those individual assistance lists were not necessarily indicative of specific damage to the properties listed. For example, residents at the address listed might have been displaced from their homes by road closures, minor damage to their homes, or health concerns. Finally, the county allowed residents to self-report flood damage, including photographs and contact information for follow-up, via an online form on the public county website.

As data sources kept changing, data continued to be linked to the assessment database and verified. This was an iterative process, which has been repeated from September 2013 until the present. As data have been refreshed, staff needed a way to geographically visualize the multitude of relevant internal and external data sources, such as

- hydrological features
- inundation zones
- legal flood zones (pre-flood FEMA zones)
- geo-tagged photographs from fieldwork
- relevant damage reports from outside sources
- addresses, ownership, and parcels
- the office's internal damage assessments/classifications
- pre- and post-flood imagery.

Because the geographic scale, variability, and concentration of these data layers made consistent display and cartography a challenge, it was not feasible to simply print paper maps adequately showing all attributes at all scales. Relevant layers were published to staff via a simple product called ArcReader, through which staff could visualize updated features interactively at their desktops. Simply releasing hundreds of data sets, spreadsheets, and GIS layers to staff, without first placing them in a geographic context, would be overwhelming and waste staff time. It was important to dispatch the data thoughtfully, making sense of incoming and outgoing data and the office's business processes and role in the larger recovery efforts.

Even though the office was inundated with data and much of the data was helpful, in the end the Boulder County appraisal staff simply needed to see the affected properties with their own eyes, whenever possible. Several primary sources of remotely sensed imagery were used, including post-flood satellite, oblique, and orthogonal imagery.

Data Mapping

The first source was the post-flood satellite imagery, but its limitations included cloud cover/fog, low resolution, and incomplete coverage of affected areas. Using handheld cameras, staff took many of their post-flood fieldwork photos using geo-enabled cameras, so that these photos could be converted to mapped points with photographs included. By mid-October 2013, a private company had flown over most of Boulder County, gathering the post-flood oblique and orthogonal images, which were delivered to staff by early November. These images were the most beneficial because they allowed much of the damage analysis work to be performed at desktop. Especially useful was the ability to compare pre- and post-flood imagery from the same location and direction, side by side, in a web viewer, allowing appraisal staff to assess not only building changes but also changes to land.

Later in the flood recovery, remotely sensed LIDAR (light detection and ranging) data were processed to a point at which they could be compared to pre-flood LIDAR. LIDAR measures distance by illuminating a target (in this case the land) with a laser and analyzing the reflected light. It creates a high-resolution surface from which elevation or a digital terrain model can be derived. The post-processed, post-flood LIDAR data clearly showed areas of soil erosion (loss) in red, with areas of soil aggregation (gain) in green. Especially in canyon areas, staff was able to visualize in red the areas where soil had been carved away, above areas in green where soil had been redeposited in new locations. Entire stream channels have developed, and LIDAR data have helped visualize these changes.

Throughout the flood recovery, the office has been trying to make sense of incoming data, but it has also received numerous requests for post-flood data. As always, the assessor's

LIDAR visualization shows areas of soil erosion and aggregation.

database and parcel layer provide basics such as ownership, mailing address, site address, property values, and property characteristics. This is true before, during, and after a major emergency. It is helpful to designate a primary emergency data coordinator (point person) to track outside data sources and coordinate most external data requests, so that redundancy of effort is minimized. This system also allows other staff to keep the "wheels on the bus" regarding everyday business processes.

Data Aggregation and Sharing

The office has shared its assessment and parcel data, as well as damage classifications, with

- affected towns and cities
- contractors working for the jurisdictions
- fire districts and water districts
- other county departments such as Public Health, Housing & Human Services, Clerk & Recorder, and County Treasurer
- other levels of government such as the State of Colorado and the Federal Government
- graduate students and teachers
- newspapers and media sources.

Colorado is an open records request state, so the office often needed to work with county attorneys regarding sensitive post-flood data requests by outside sources.

Elected officials and organizational leaders should be kept in the loop about outside data requests following an emergency. Public information officers can help disseminate data. Even as the office balanced the need to share data with others, for the public benefit it also wanted to be respectful to flood victims and considerate of their safety and privacy. Much of the flood information received by the office needed to be confirmed and verified before it could be released to the public. Whenever possible, especially when releasing flood damage data to media sources, the office aggregated damage reports by area (instead of listing specific property addresses of destroyed homes). It is a major challenge to help data users understand (1) the limitations of data during an emergency, including the metadata and structure, and (2) the constantly changing nature of the data over time.

Preparing for Future Emergencies

As mentioned previously, land records information from the county assessor's database (along with the master parcel layer) provide some of the most requested and most important base layers utilized in local government, regardless of whether it's an emergency. Cadastral information and associated GIS data support not only administration of public programs such as transportation, land use, resource, and economic planning, but also emergency services personnel and decision making during and after natural disasters. It is important therefore to know the structure and limitations of the assessment database, to understand how the assessment calendar and assessor's office business processes affect the currency of available data, and to recognize the role of the assessor's office in ongoing larger community flood recovery efforts.

Because the assessor's giant relational assessment database inherently contains complex relationships among the objects within it, the data should be shared with emergency partners and these inherent relationships within the data explained. Complex parcel attribute relationships most often go beyond a simple one-to-one relationship (1:1), for example, one parcel to many owners or multiple permits related to multiple parcels.

Throughout the year, communication and collaboration with data-sharing partners (such as other county departments, cities and towns, special districts, charitable organizations, and regional, state, and federal levels of government), even when there is no emergency, builds familiarity and relationships among staff and makes it easier to work together during an emergency to exchange data sets.

An important part of preparing assessment data for an emergency is to turn the raw tabular data into repeatable, documented processes that can be linked to parcel data. Tools utilized in *slicing and dicing* tabular assessment data include data mining tools such as SQL, Excel®, and Access®. These tabular data mining tools, along with GIS tools such as ESRI's Model Builder or Python scripting language, can result in ready-to-use GIS data layers, updated at key times in the assessment calendar.

The data should be fresh enough that they are helpful in an emergency, but not so raw that they contain data not yet been certified or verified (e.g., unconfirmed sales or uncertified/working property values). While the data are being prepared, it is important to create a data dictionary and metadata that are ready to go, including a disclaimer and description of the data schema, data disclaimer, and limitations of use. In addition, special data sets generated during an emergency likely contain sensitive data that should be screened by leadership or perhaps by county public information officers.

Throughout the year, communication and collaboration with data-sharing partners (such as other county departments, cities and towns, special districts, charitable organizations, and regional, state, and federal levels of government), even when there is no emergency, builds familiarity and relationships among staff and makes it easier to work together during an emergency to exchange data sets. The similarities and differences between the business process of the assessor and that of data-sharing partners should be acknowledged and discussed prior to emergencies.

FEMA engages in a Multi-Hazard Identification and Risk Assessment at the national level and also encourages local governments to actively participate in maintaining a ready set of multi-hazard risk and assessment data for their own local county (jurisdiction) that meets FEMA requirements for data aggregation and reporting by hazard type. Ironically, Boulder County GIS staff, across many county departments, had just finished gathering county-wide updated multi-hazard mitigation data in August 2013, just weeks before the September 2013 flood occurred. The county was able to secure crucial flood recovery funding quickly because it had up-to-date multi-hazard data reported in a standard format accepted by FEMA.

In addition to the assessor's internal data preparation, ongoing collaborative training exercises among county staff (whether at the Emergency Operations Center, at the county department level, or among GIS staff) help staff to become more comfortable with emergency scenarios, data requests, and practical issues arising during an emergency. Consider making remote access a possibility for staff during an emergency, as well as planning for staffing and communication logistical needs ahead of time by keeping staff cell phone numbers available, utilizing phone/calling trees, and preparing emergency staffing calendars/schedules.

Making a recent set of comprehensive data available on a portable and stand-alone device such as an external hard drive is a good idea. The most basic daily chores such as keeping cell phones and laptops charged and updated with the latest software, as well as keeping the fuel tank full in the car, are some of the best ways to ensure that staff have the tools needed during an emergency.

Looking Ahead with Gratitude

Although this past year has often been stressful, sad, and life-changing for Boulder County residents, assessor staff and residents are optimistic about their quality of life and resilience. Skills of collaboration, teamwork, compromise, preparation, and problem solving have been attained under the toughest conditions. Small successes, both internally within the assessor's office (such as keeping staff safe) and externally (such as homes being rebuilt and businesses reopening), are celebrated and acknowledged. The flood of 2013 has changed not only the county, its geography, and residents but also the assessor's office forever. ■

October 7, 2013—Building materials await a contractor who will rebuild a home that was damaged during flooding in the town of Lyon, Colorado. *(photo by Patsy Lynch/FEMA)*

Jerry Roberts has served as the Boulder County Assessor since 1997. He has been a member of the Assessor's Office staff since 1980. During this time, Jerry has acquired progressive experience in virtually all aspects of the office. He has been a Residential Appraiser, Land Appraiser, Review Appraiser, Commercial Department Deputy, and Mass Appraisal Deputy and Chief Deputy. In his role as review appraiser for 8 years, from 1997 to 2005, he was responsible for the development and implementation of all the multiple regression models used to predict property values.

Cynthia Braddock is Deputy Assessor at the Boulder County Assessor's Office. She has worked at the Assessor's Office since 1995. During this time, Cynthia has held the positions of Business Analyst, GIS Deputy, and various GIS and administrative titles. She has been an active member of the URISA and IAAO GIS/CAMA Conference Planning Committee for 17 years.

Rachel Parrinello is a Senior GIS Specialist in the Boulder County Assessor's Office. She has worked at the Assessor's Office since 2001. She is currently a member of the URISA and IAAO GIS/CAMA Conference Planning Committee.