area Digital Elevation Model was created using this terrain data, as well as a 100 year flood depth grid (see Figure 27 later on in this section) derived from FEMA's National Flood Hazard Layer (NFHL) data. This enhanced data input allows Hazus to more accurately approximate floodplain boundaries and their associated flood depths for a 100-year flood event. In addition to these custom datasets we also created User Defined Structures (UDS points) for all parcels that were impacted by the FEMA effective floodplains. The Hazus analysis was then performed at every one of these locations to estimate the flood damages associated with the impacted structures.

The flood depth grid and the parcel centroid points served as the primary inputs into Hazus. This data was converted to parcel centroid (point) data and spatially corrected to ensure geographical accuracy of the points and the associated structures in all areas within the designated 100-year floodplain. In some cases there were multiple, distinctly different, structures within a single designated parcel. In these cases, points were generated on top of each individual structure and the total appraised value of the parcel was divided up equally among the structures. Important attributes, such as year built and land use, were missing for many parcels throughout the planning area. In these cases the average value of the associated census block was used in the risk assessment

A 100-year flood scenario was defined in Hazus and losses were calculated for each point that intersected the depth grid based on the Hazus depth damage curves for specific structure attributes (such as foundation type, building type, and first flood height). Figure 28 later in this section presents the results of the Hazus 100-year flood scenario structural loss analyses for the participating communities in this plan.

A number of variables are included in Hazus analyses in order to arrive at the estimated values of loss due to flooding. For this reason, it is important to note that the Hazus loss estimates detailed below should not be used as a precise measure, but rather viewed from the perspective of the potential magnitudes of expected losses. When calculating structural losses, Hazus breaks loss values into two categories: direct economic losses and indirect economic losses. Direct economic losses are the estimated costs to repair or replace the damage caused to a building and its contents. These values are organized in terms of Building Losses and Building Content Losses. Indirect economic losses include Inventory Losses and other losses associated with business interruption and the inability to operate a business because of the damage sustained during the flood.

The loss patterns show areas where resources and people are concentrated in and near the floodplain, making those areas of high potential loss and clear priority areas for focused mitigation action. Hazus estimates that for the planning area, at least 222 buildings will be moderately damaged in a 100-year flood event. The total appraised structural losses are over $14 million. There are three critical facilities estimated to be affected in this event, with a total appraised structural loss of over $980,000.

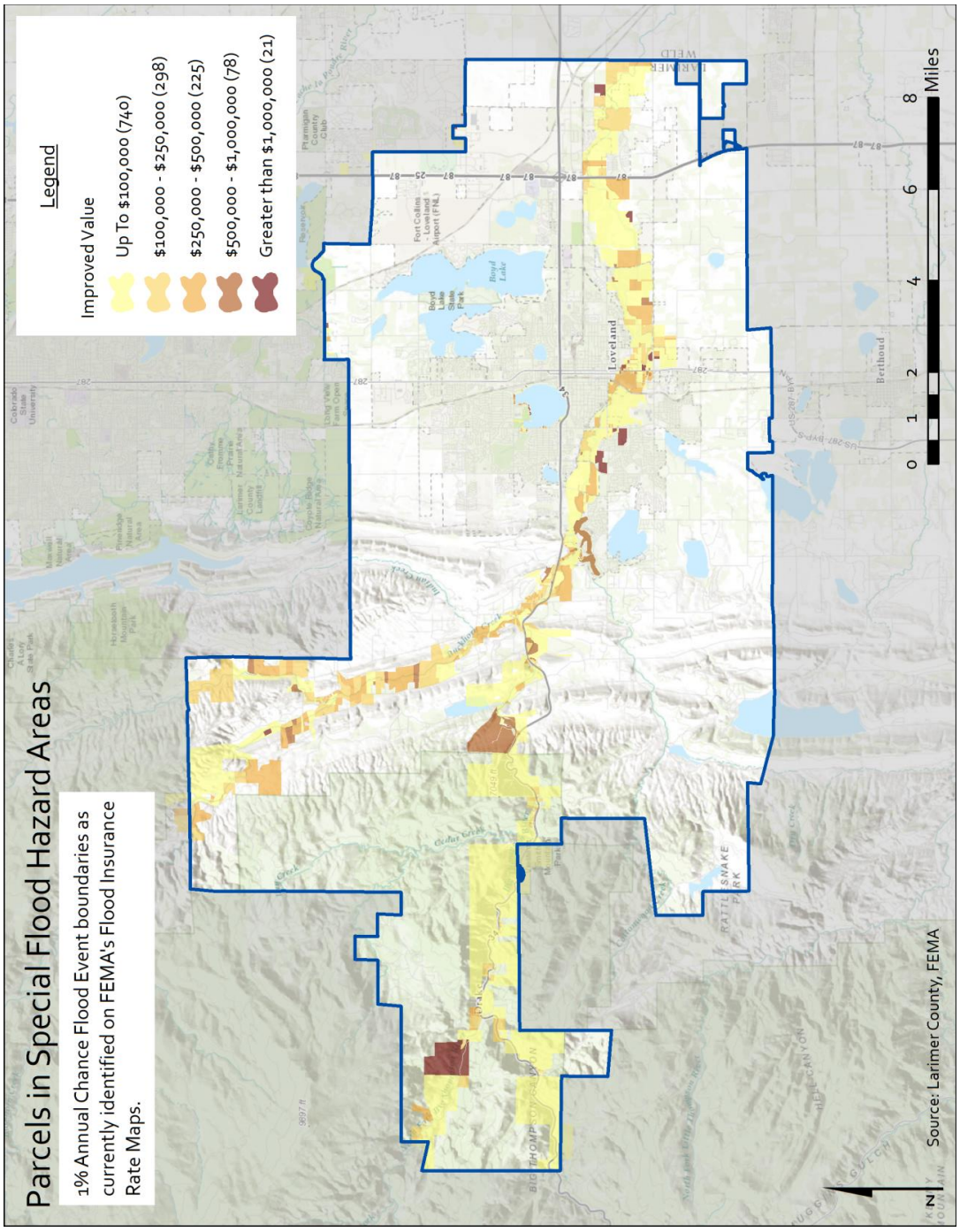

Figure 26. Parcels Impacted by the 1% Annual Chance Flood Event

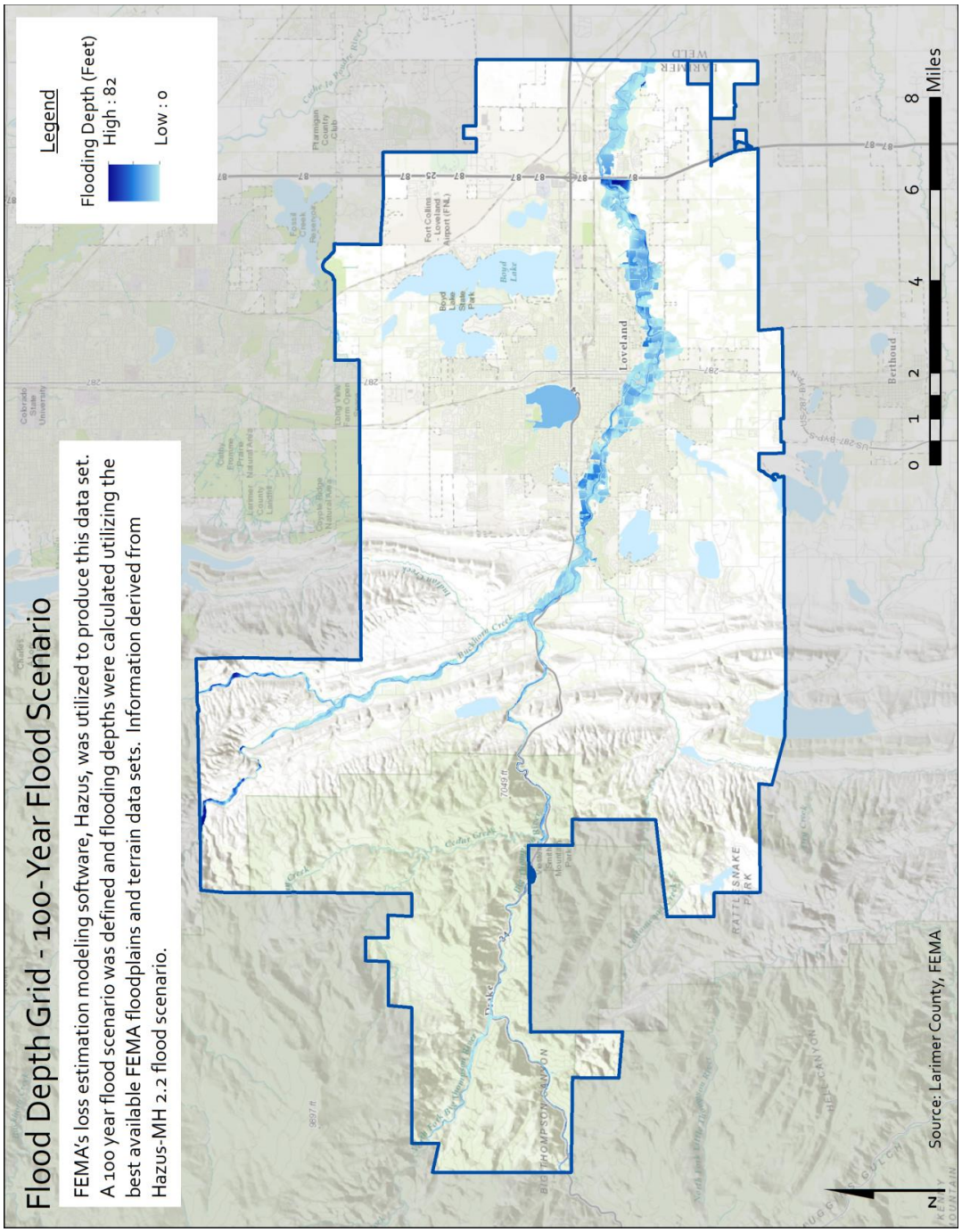

Figure 27. Flood Depth Grid for the 100-Year Flood Scenario

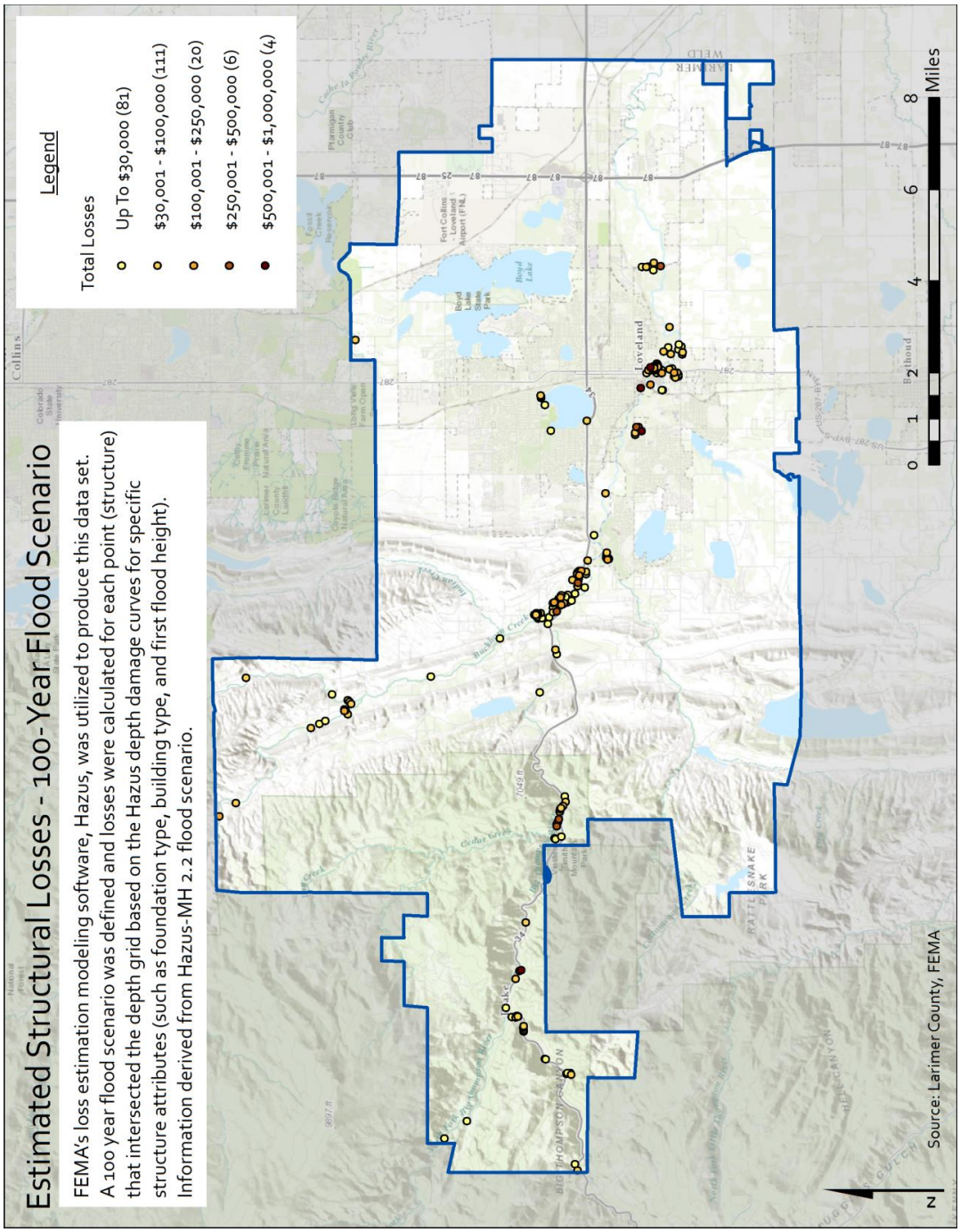

Figure 28. 100-Year Flood Scenario Estimated Structural Losses

Developmental Impacts

Current development and population growth trends necessitate a heightened awareness for communities to understand that the impact of flooding will likely increase over time. As population continues to increase in the planning area, development trajectories can be expected to put more people and property (both private and public) at risk when flooding events occur. The Loveland Growth Management Area shows future development taking place in pockets of the 1% Annual Chance Floodplain (SFHA). It is essential that zoning and land use plans take into account not only the dollar amount of damage that buildings near waterways could incur, but also the added risk of floodplain development activity that alters the natural floodplain of the area (for example, narrowing the floodplains by building new structures close to rivers and streams or adding impervious surfaces which increase run-off). The participating communities should plan for the likelihood of increased exposure of property and humans to flood events.

Mitigation against flood events is accomplished through sensible floodplain management and regulations as well as identifying flood prone areas, tributary watersheds that experience instability or sediment loading problems, and channel instability hazards. This involves strategies to modify flooding and to modify infrastructure to decrease the likelihood of damage. To modify the impact of flooding, measures must be taken to decrease susceptibility to flood damage and disruptions. Natural and cultural resources must also be protected and managed. Coordination with mitigation plans by Floodplain Managers will increase effectiveness of flood mitigation projects. City and County Planners will be valuable resources to incorporate flood mitigation plans into their respective plans.

Existing floodplain management ordinances are intended to address methods and practices to minimize flood damage to new and substantial home improvement projects as well as to address zoning and subdivision ordinances and state regulations. Currently, the City of Loveland and Larimer County participate in the National Flood Insurance Program (NFIP) and continue to support floodplain management activity at the local scale.

The greatest protection against flooding is afforded by quality construction and compliance with local ordinances, which exceed NFIP requirements. Code adoption by local jurisdictions, compliance by builders, and local government inspection of new homes can greatly reduce the risk of flooding. Moving forward, participating communities should continue to support monitoring, analysis, modeling, and the development of decision-support systems and geographic information applications for floodplain management activities.

In addition to land-use planning, zoning, and codes applicable to new development, flood mitigation measures include structural and non-structural measures to address susceptibility of existing structures. Flood mitigation measures such as acquisition, relocation, elevation-in-place, wet/dry flood proofing, and enhanced storm drainage systems all have the potential to effectively reduce the impact of flooding in the planning area.

Future Hazard Events

Frequency of previously reported flood events in the region provides an acceptable framework for determining the probability of future flood occurrence. The probability that the City will experience a flood event can be difficult to predict or quantify.

As the planning area has already experienced, severe flooding has the potential to inflict significant damage to people and property in the district. Mitigating flood damage requires that communities remain diligent and notify local officials of potential flood (and flash flood) prone areas near infrastructure such as roads, bridges, and buildings. While the potential for flooding is always present, the entire planning area has existing land-use policies and regulations for development to help lessen potential damage due to floods.

In addition to increasing drought potential (and therefore increasing runoff), climate change has the potential to intensify rain events and storms in the Colorado region. These events can lead to increased infrastructure damage, injury, illness, and death. Additionally, warmer temperatures in the winters may cause increased precipitation to fall as rain instead of snow in mountain regions of Colorado. This may lead to elevated stream flows and increased flood risk across the state. As climate science and data evolves it will be important for communities to address how our changing climate will affect how water moves through local streams and regional landscapes. Community-specific flood loss estimates and risk assessment maps are provided in the Community Profiles of this report.

Hazardous Materials

Hazard Profile (Risk Rank #7)

A hazardous material (also known as HAZMAT) is defined by the U.S. Department of Transportation as "a threat that poses an unreasonable risk to health and safety of operating or emergency personnel, the public, and/or the environment if not property controlled during handling, storage, manufacturing, processing, packaging, use, disposal, or transportation."

Hazardous materials are defined and regulated in the United States primarily by laws and regulations administered by the U.S. Environmental Protection Agency (EPA), the U.S. Occupational Safety and Health Administration (OSHA), the U.S. Department of Transportation (DOT), and the U.S. Nuclear Regulatory Commission (NRC). Each has its own definition of a "hazardous material."

For the purpose of tracking and managing hazardous materials, the DOT divides regulated hazardous materials into nine classes. These classes are outlined in Table 24 in Appendix E.

Hazardous materials that are being transported must have specific packaging and labeling. Specific safety regulations also apply when handling and storing hazardous materials at fixed facilities. In general, there are three recognized sources for HAZMAT incidents within the planning area: delivery lines, fixed storage facilities and use locations, and transportation lines. Once a HAZMAT incident occurs, the area impacts will depend on the nature of the chemical and climate conditions. All areas should be considered at risk. However, some areas, such as those close to aquifers and other water supplies can expect greater impacts if a spill occurred in the area.

Transportation of hazardous materials through the planning area happens at all times of day by way of rail, road, and air. Roadway transport accounts for the largest amount of hazardous materials moving though the region. That said, rail cars are able to carry much larger quantities of hazardous materials than trucks or cars and can be associated with a greater risk.

Title 42, Article 20 of the Colorado Revised Statutes governs the routing of hazardous materials by motor vehicles on all public roads in the state. Colorado Department of Transportation (CDOT) Policy Directive 1903.0 (effective 5/20/2010), and CDOT Procedural Directive 1903.1 (effective 2/3/2011), govern CDOT's role in the designation of hazmat routes. In order to designate a state highway in Colorado as hazmat route, CDOT staff members, local governments, or private entities must request the Mobility Section of the Division of Transportation Development to perform an analysis of the route. To perform this analysis the Mobility Section convenes a "Hazmat Advisory Team" to determine if the proposed route meets the required criteria. If the required criteria are met and approved by the Transportation Commission, CDOT will file a petition with the Colorado State Patrol for approval. Once the Colorado State Patrol approves the petition, the route is designated a hazmat route.

The required criteria that the route must meet before it is brought before the Transportation Commission are as follows:

- The route(s) under consideration are feasible, practicable, and not unreasonably expensive for such transportation.
- The route(s) is continuous within a jurisdiction and from one jurisdiction to another.
- The route(s) does not unreasonably burden interstate or intrastate commerce.

- The route(s) designation is not arbitrary or intended by the petitioner merely to divert the transportation of hazardous materials to other communities.
- The route(s) designation will not interfere with the pickup or delivery of hazardous materials.
- The route(s) designation is consistent with all applicable state and federal laws and regulations; and
- The route(s) provides greater safety to the public than other feasible routes. Considerations include but are not limited to:
    - AADT, crash and fatality rates
    - Population within a one-mile swath of each side of the highway
    - Locations of schools, hospitals, sensitive environmental areas, rivers, lakes, etc.
    - Emergency response capabilities on the route
    - Condition of the route, i.e., vertical and horizontal alignment, pavement condition, level of access to the route, etc.

Colorado State Patrol Hazardous Materials Unit

(303) 273-1900

Http://csp.state.co.hazmat.html

Troop 8-C is the Hazardous Materials Section of the Colorado State Patrol. Their mission is to contribute to the safety of hazardous materials transportation in order to protect citizens and the environment. Twenty-eight troopers trained a Hazardous Materials Technicians are deployed throughout the state.

Local Hazardous Materials Response Teams (most often housed in local fire departments and fire protection districts) are the designated emergency response authority for hazardous substance incidents in all areas of the planning area except on highways, where the State Patrol has jurisdiction.

For security reasons, it is not within the scope of this plan to map the locations of all industrial and commercial fixed sites.

The following CDOT map shows the state's designated nuclear, hazardous materials, and gasoline, diesel fuel, and liquid petroleum gas routes, many of which pass through the eastern portion of the planning area.

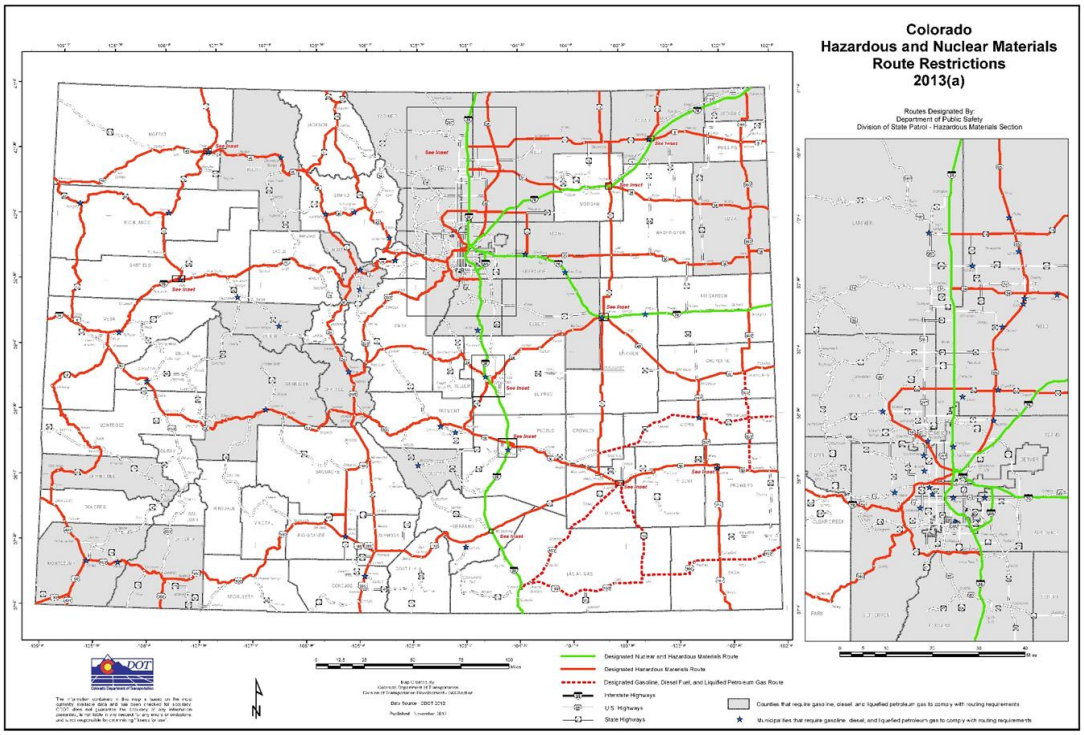

Figure 29. Colorado Hazardous and Nuclear Materials Route Restrictions

Previous Occurrences

According to the National Fire Incident Reporting System (NFIRS), there have been 13 incidents tracked in the planning area between July 1, 2014 and July 1, 2015. These incidents are as follows:

- 2 - Gasoline or other Flammable Liquid Spill
- 9 - Gas Leaks (Natural Gas or LPG)
- 1 - Chemical Spill or Leak
- 1 - Carbon Monoxide Incident

Larimer County has experienced a total of 204 HAZMAT incidents between 1971 and 2015, as reported by the Pipeline and Hazardous Materials Safety Administration's (PHMSA). The large majority of these incidents have occurred while the materials were moving along a highway (either in transit, loading, or unloading).

Inventory Exposed

We can't accurately predict when or where a HAZMAT incident may occur. Therefore, for the purpose of this Plan, all existing and future buildings, facilities, and populations in the planning area are considered to be equally exposed and could be potentially impacted. This includes 100% of the participating communities' population, and all buildings and infrastructure within the planning area.

When hazardous materials are being transported they are particularly vulnerable to transportation related accidents, misuse, or terrorist threats. Most hazardous materials are transported in large quantities in order to reduce costs and security is difficult to maintain around moving vehicles that cross jurisdictional boundaries. When transported close to populated areas or critical infrastructure, HAZMAT releases can have serious consequences. The inventory that is most often exposed to HAZMAT risks are railways, roadways, and fixed facilities that contain hazardous materials, and all assets that lie within a mile of the potential release areas.

The City Emergency Manager is currently coordinating with local rail companies and others in the area to enhance reporting of hazardous materials being transported via rail. It is vital that this information is shared as the rail line runs directly through downtown Loveland and therefore presents a great risk to the community.

Loss Estimations

HAZMAT related events have the potential to occur throughout the planning area every year. The intensity and magnitude of these incidents depend on weather conditions, the location of the event, the time of day, and the process by which the materials are released. *Was is raining when the event happened? Were the hazardous materials being transported by rail when they were released or were they at a fixed facility? Did the spill happen during rush hour traffic or in the middle of the night?* All of these considerations matter when determining the risk and potential damages associated with a HAZMAT incident.

HAZMAT events have the potential to threaten lives and disrupt business activity. Moreover, HAZMAT incidents can cause serious environmental contamination to non-renewable resources such as air, ground, and water sources.

Developmental Impacts

As communities within the planning area continue to experience population growth and development over time, it is anticipated that there will be increased exposure to potential life loss, injuries, and environmental damage resulting from a hazardous materials incident. Serious considerations must be made concerning land use and regulations as increasing development pressures push residential and commercial investment closer to railways and identified hazardous and nuclear materials routes.

Future Hazard Events

As with most hazards that have limited spatial predictability or warning time, the probability of future occurrences of Hazmat events is difficult to predict. However, as development continues to encroach into existing industrial areas and becomes denser along high-risk designated hazardous materials transportation routes, the risk of future occurrences becomes greater. Even if the frequency of HAZMAT spills remains the same over time, population growth will increase the probability of a disaster event.

There are a few hazardous material storage areas across the planning area that are of potential concern to the City Emergency Manager. Efforts to mitigate or eliminate these risks are on-going.

Landslide / Rockfall

Hazard Profile (Risk Rank #12)

Landslides and rockfall are one of the most common geologic hazards in Colorado and are characterized by the downward and outward movement of loose material on slopes. They include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on and over steepened slopes is the primary reason for a landslide, landslides are often prompted by the occurrence of other disasters such as seismic activity of heavy rainfall. Other contributing factors include the following:

- Erosion by rivers creating over-steepened slopes
- Rock and soil slopes weakened through saturation by snowmelt or heavy rains
- Earthquakes creating stresses that make weak slopes fail
- Excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from manmade structures stressing weak slopes
- Floods or long duration precipitation events creating saturated, unstable soils that are more susceptible to failure

Slope material often becomes saturated with water and may develop a debris or mudflow. If the ground is saturated, the water weakens the soil and rock by reducing cohesion and friction between particles. Cohesion, which is the tendency of soil particles to "stick" to each other, and friction affect the strength of the material in the slope and contribute to a slope's ability to resist down slope movement. Saturation also increases the weight of the slope materials and, like the addition of material on the upper portion of a slope, increases the gravitational force on the slope. Undercutting of a slope reduces the slope's resistance to the force of gravity by removing much-needed support at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible loosening of rock, thereby weakening the rock and making it susceptible to slope failure. The resulting slurry of rock and mud can pick up trees, houses, and cars, and block bridges and tributaries, causing flooding along its path. Additionally, removal of vegetation can leave a slope much more susceptible to superficial landslides because of the loss of the stabilizing root systems.

Geologists identify active landslides and areas subject to slope instability so that they may be avoided or mitigated. Together, geologists and civil engineers develop and implement measures to improve the stability of slopes, repair existing landslides, and prevent damage from future landslides. Slope stability can be improved by removing material from the top of the slope, adding material or retaining structures to the base of the slope, and reducing the degree of saturation by improving drainage within the slope.

The following Figures show the currently identified hazard areas for landslide and rockfall. It should be noted that the identification and mapping of these hazard areas are a work in progress and are ongoing.

Previous Occurrences

According to the Colorado Geological Survey (CGS) there have been 186 historical landslides in Larimer County. Table 25 in Appendix E lists major landslide incidents in Larimer County between 1989 and 2004 according to the Colorado Department of Transportation.

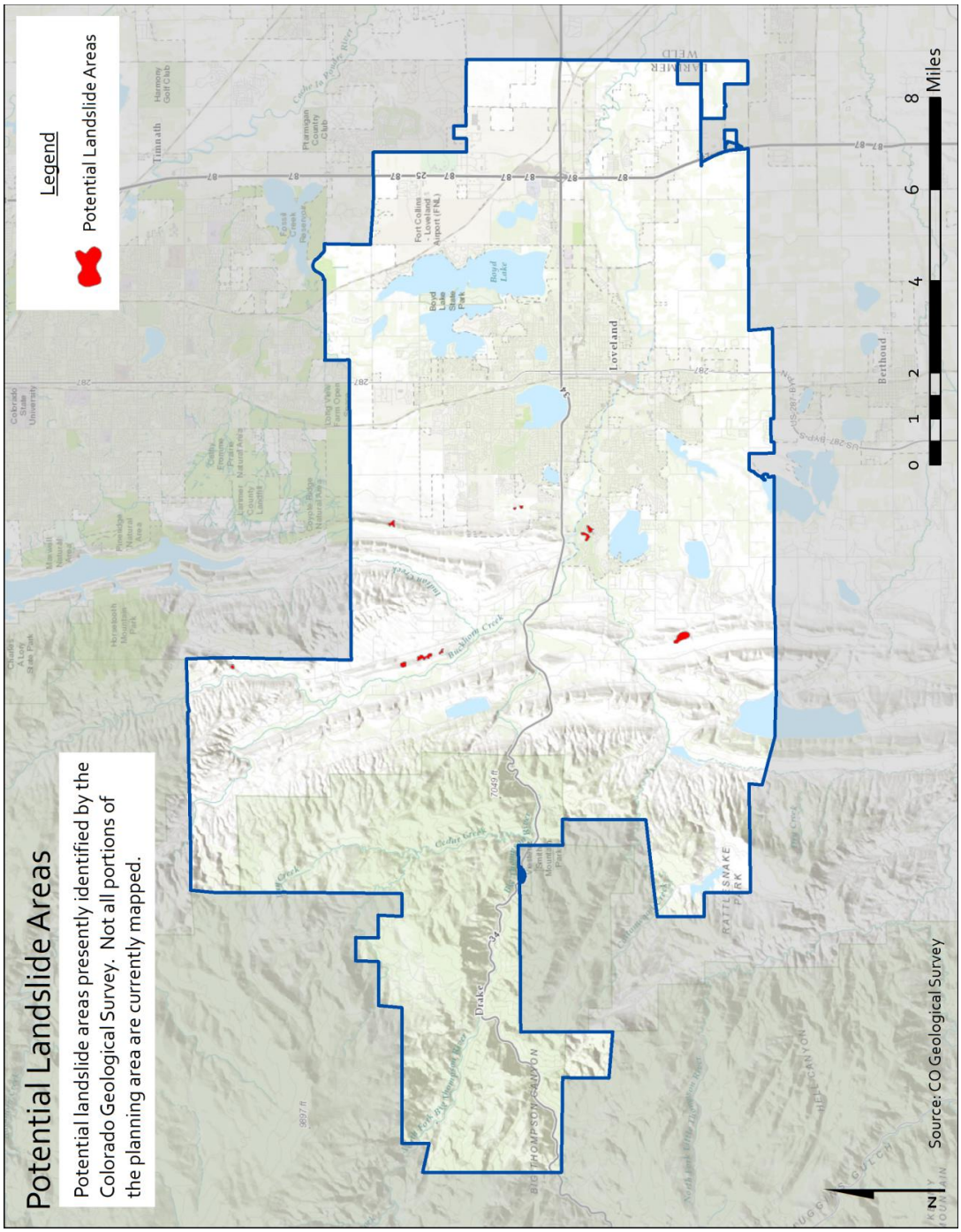

Figure 30. Potential Landslide Areas

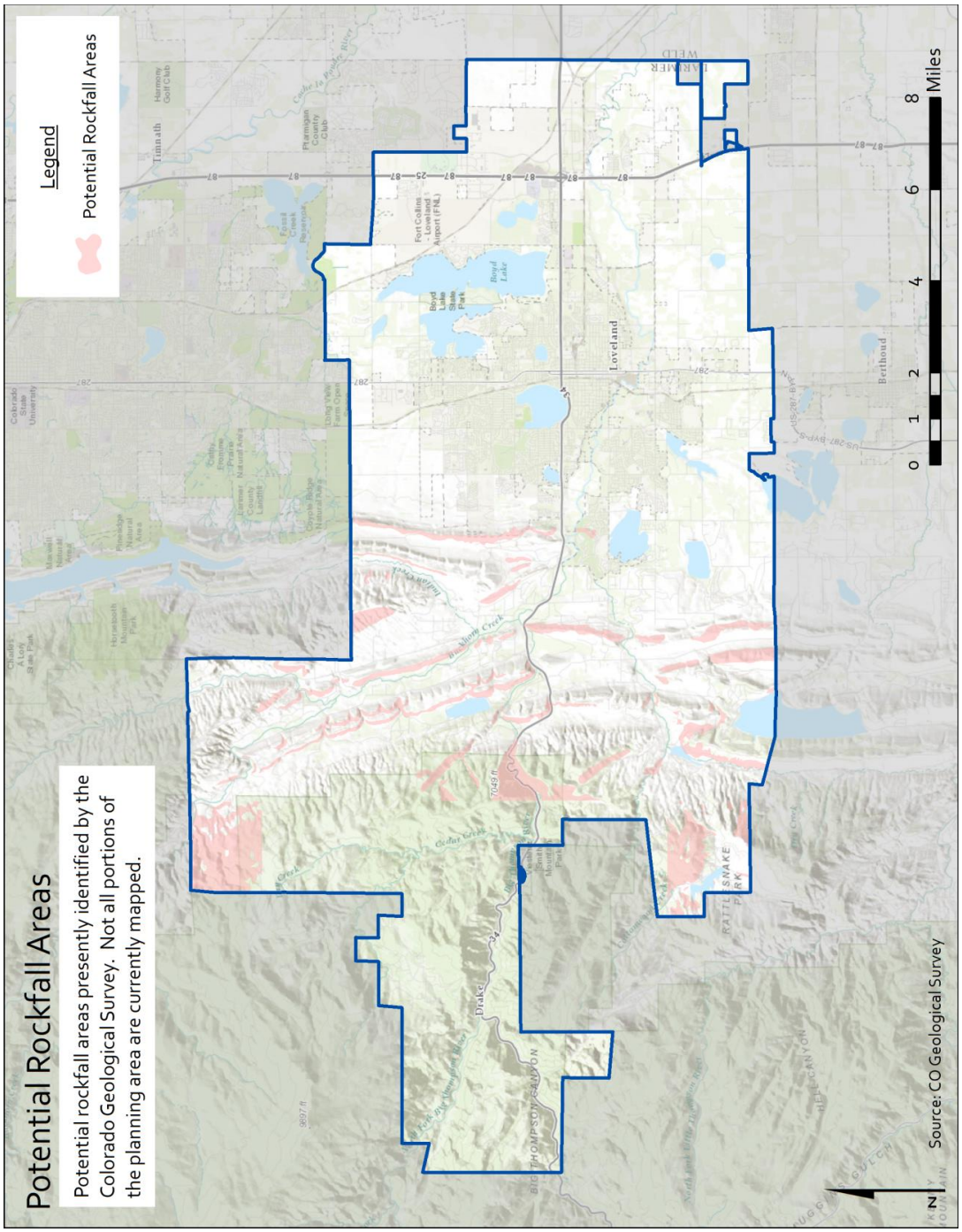

Figure 31- Potential Rockfall Areas

Inventory Exposed

There are a number of locations across the planning area that are vulnerable to landslides and rockfall. As population growth brings new development into available land in the planning area, more inventory assets may become exposed as well. The following figures show historical and currently identified potential landslide and rockfall areas within the planning area. Potential landslide areas are sparse and scattered just west of Loveland near I-34. Areas near the western portion of the planning area are more susceptible to rockfall events.

Exposure analysis utilizing best available data from CGS indicates there are 38 parcels and no critical facilities in the planning area that have the potential to be affected by landslides. The appraised structural value of the affected parcels is over $5 million. Note that this does not include the total miles of landslide prone infrastructure and utilities that are also exposed to this hazard. The figure following this section presents this information.

CGS data was also used to estimate Potential Rockfall area impacts. The exposure analysis estimates that there are 706 parcels and no critical facilities in the planning area that are prone to rockfall. The appraised value of all exposed structures is almost $162 million. Again it should be noted that this does not include the total miles of landslide prone infrastructure and utilities that are also exposed to this hazard. The figure following this section presents this information.

Loss Estimations

Besides knowing the structures exposed to these hazards have the potential to incur losses, there is currently no detailed model or method to help estimate potential losses. The best way to attempt to quantify losses is by looking at the historical event data, which is quite limited for this hazard.

Developmental Impacts

Rapid and sustained population growth has contributed to increasing trends in landslide and rockfall hazard risk, exposure, and vulnerability across the planning area. It is very likely that future development will lead to the intersection of landslides and rockslides-prone areas. As development pressures continue in un-developed areas, vulnerability to landslides and rockfalls may increase. There is a relatively small number of parcels located in the northwest portion of the Loveland Growth Management Area that are at risk of potential landslide and rockfall areas.

Typically, the process of landslides and rockslides do not limit land use, especially if efforts are made to minimize it. Landslide and rockfall impacts can be reduced and controlled by road bank slope design, surface drainage management, and re-vegetation on disturbed lands. Ground modification and structural solutions can help mitigate the threats of localized landslides and rockslides. Proper drainage and water management are also important to prevent increasing vulnerability to landslide and rockslide hazards.

Future Hazard Events

Due to the uncertainty associated with existing data, it is challenging to accurately calculate probability for future events related to landslide and rockfall hazards. It can be assured however, that these hazards will continue to alter the landscape of the region in the future.

Overall, the probability of future occurrences of rockslide and landslide events within the planning area is moderate. Many areas in the western portion of the area are prone to these types of hazard events

due to their proximity to previous landslide events, their location at the base or top of steep slopes and drainage basins, or their location on infill or steep slope cuts. Individual assessments of landslide-prone areas are recommended in the future. Moreover, as development and population increase, many more structures (and people) will be exposed to future landslide and rockfall events.

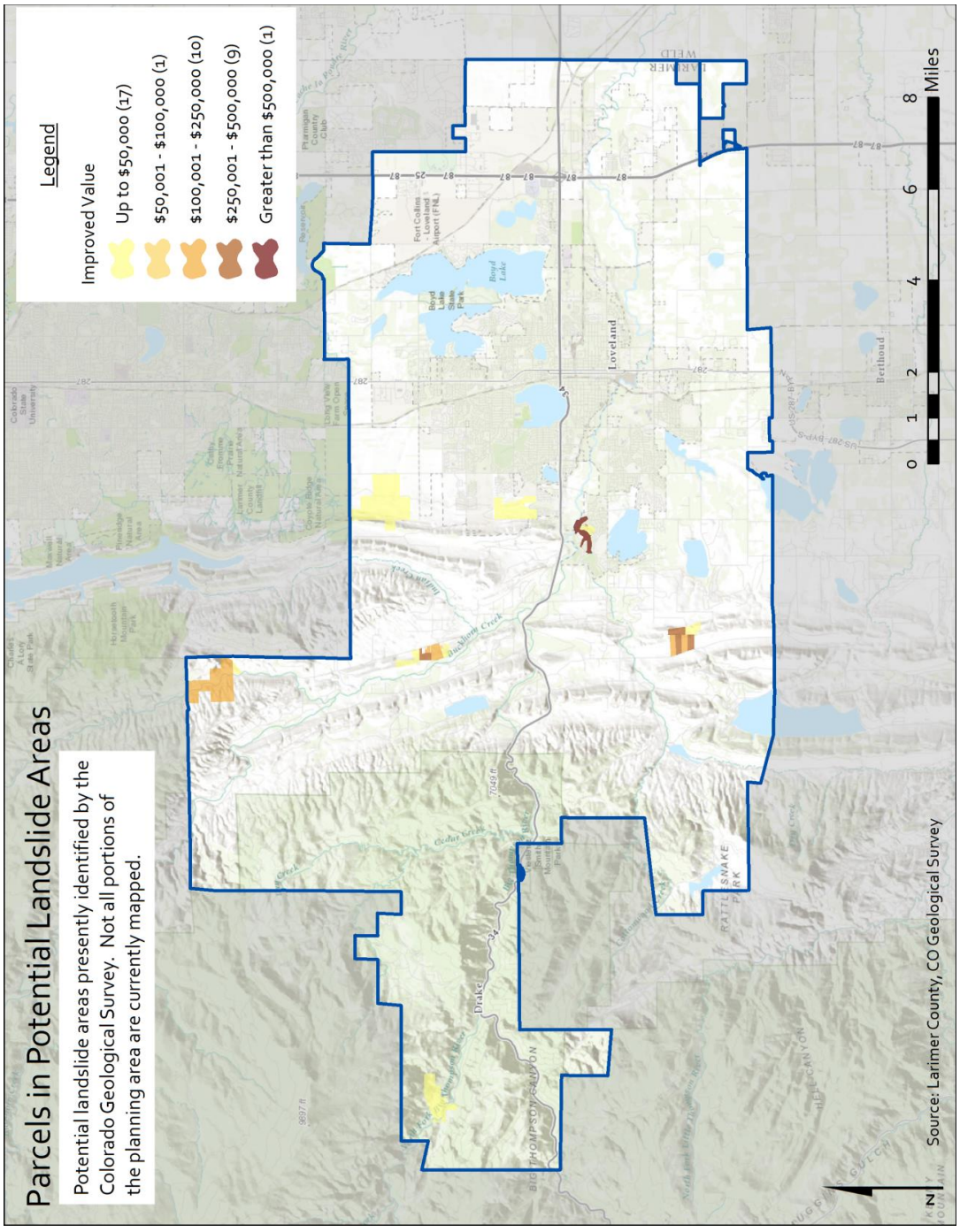

Figure 32. Parcels in Potential Landslide Areas

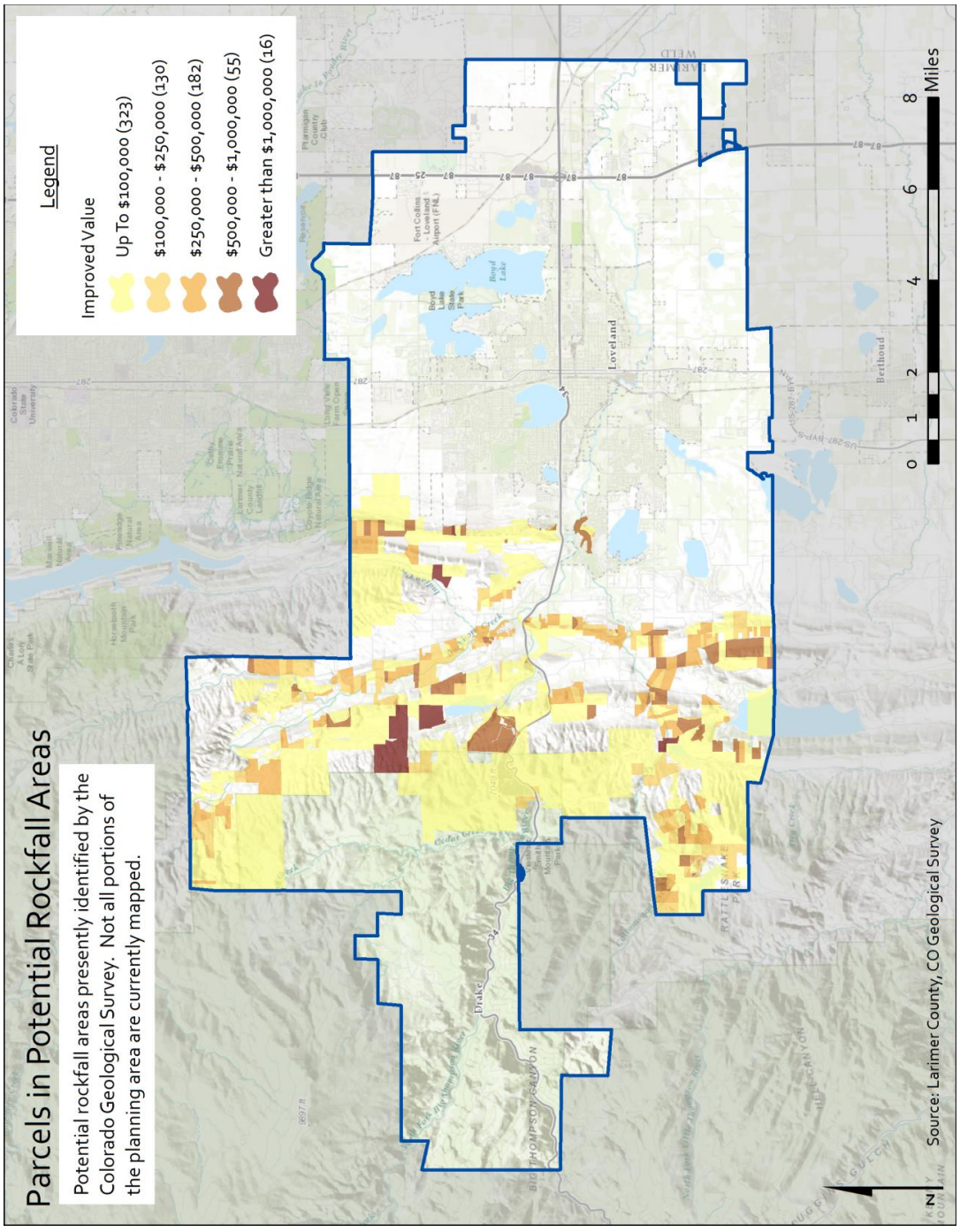

Figure 33. Parcels in Potential Rockfall Areas

Other Geologic Hazards

Hazard Profile (Risk Rank #11)

'Other Geologic Hazards' is a broad term that includes a number of hazards and related data sets. Hazards include: collapsible soils, expansive soils, land subsidence, and a broader 'geologic' hazard grouping as defined by Larimer County.

Collapsible Soils describe soils that can quickly settle or collapse the ground. This settling of the ground can cause damage to manmade structures. The most common type of collapsible soil is Hydrocompactive soil. This type of soil occurs in semi-arid to arid climates and consist of low density and low moisture content soil. The soil grains in these areas are not compact tightly together but rather stacked loosely. These soils are considered strong while in a dry state. However, when moisture is introduced the stacked soil grains can collapse causing ground surface subsidence or settlement.[8] The figure following this section presents a map identifying the locations within the planning area that have potential for collapsible soil. These at-risk areas are scattered across the lowlands of the planning area.

Expansive Soils describes soils that contain minerals that are capable of absorbing water. As the soil absorbs water it expands and increases in volume. The change in soil volume can cause damage to man-made structures such as foundations. As the soils begin to dry they will then shrink. The shrinking of the soils can deplete the structural support of soil and cause damaging subsidence. The figure following this section presents a map identifying the locations within the planning area that have potential for expansive soil. Although the entire planning area is defined as having at least a 'Low' risk rating, a large portion of the City is rated by CGS as having a 'Moderate' risk.

Land subsidence can occur rapidly due to sinkholes, the collapse of underground mines, or during an earthquake. Subsidence can also take place slowly, becoming evident over the time span of many years. Soils that tend to collapse and settle are those characterized by low-density materials that shrink in volume when they become wet and/or are subjected to weight from development. Subsidence events, depending on their location, can pose significant risks to health, safety, and local agricultural economies and interruption to transportation, and other services. Causes of subsidence include, but are not limited to, the removal or reduction of sub-surface fluids (water, oil, gas, etc.), mine subsidence, and hydro compaction. Of these causes, hydro compaction and mine subsidence usually manifest as localized events, while fluid removal may occur either locally or regionally.

There are hundreds of abandoned underground coal mines scattered throughout Colorado that present potential subsidence hazards to structures and surface improvements. The Colorado Geological Society (CGS) operates the Colorado Mine Subsidence Information Center (MSIC), which is the repository for all of the known existing maps of inactive or abandoned coal mines in the state. Subsidence tends to be problematic along the Colorado Front Range, Western Slope, and in the central mountains near Eagle and Garfield Counties.[9] The figure following this section presents a map identifying the locations within the planning area that have potential for land subsidence. There are two pockets of risk that have currently been identified west of the City in the LFRA.

[8] Colorado Geological Survey (CGS)
[9] 2013 Colorado Natural Hazards Mitigation Plan

Other geologic hazards to mention include erosion and deposition, which is the removal and transportation of earth materials from one location to another by water, wind, waves, or moving ice. It occurs when soil is removed at a greater rate than it is formed. The natural geologic process of erosion has occurred since the Earth's formation and continues at a very slow and uniform rate. Soil erosion hazard is the term used to describe how likely it is for soil in a given area to erode. It depends on the inherent properties of the soil, the topography, vegetative cover, soil disturbance (including over-grazing, drought, flooding, wind, etc.), and rainfall intensity.

Although soil erosion is a natural process, rapid erosion can lead to a serious loss of topsoil and a reduction of cropland productivity. It can also contribute to the pollution of adjacent watercourses, wetlands, and lakes. During the processes of wind and water erosion, infrastructure and mechanical equipment can be damaged by soil build-up and dust. Additionally, blowing soils can affect human and animal health and create public safety hazards.

Soil erosion and deposition have the potential to cause substantial losses to a community's assets. Erosion and deposition alone pose little harm; however, when assets are placed in close proximity to erosion and deposition-prone environments such as a valley near a stream or riverbed, hazard vulnerability increases significantly. For example, when heavy rain and snowmelt result in increased stream flow, the erosion of riverbanks can pose significant risks to transportation infrastructure, including roads and bridges. Severe erosion can remove earth from beneath bridges, roads, and foundations of structures adjacent to streams. The deposition of material can block culverts, aggravate flooding, destroy crops and lawns, and reduce capacity in water reservoirs.

A final data set, produced by Larimer County, that we can utilize as part of our risk assessment into Other Geological Hazards is a geospatial hazard risk classification data set. This data classifies most of the planning area into Low, Moderate, and Severe Geologic Hazard zones. The figure following this section presents a map of this data.

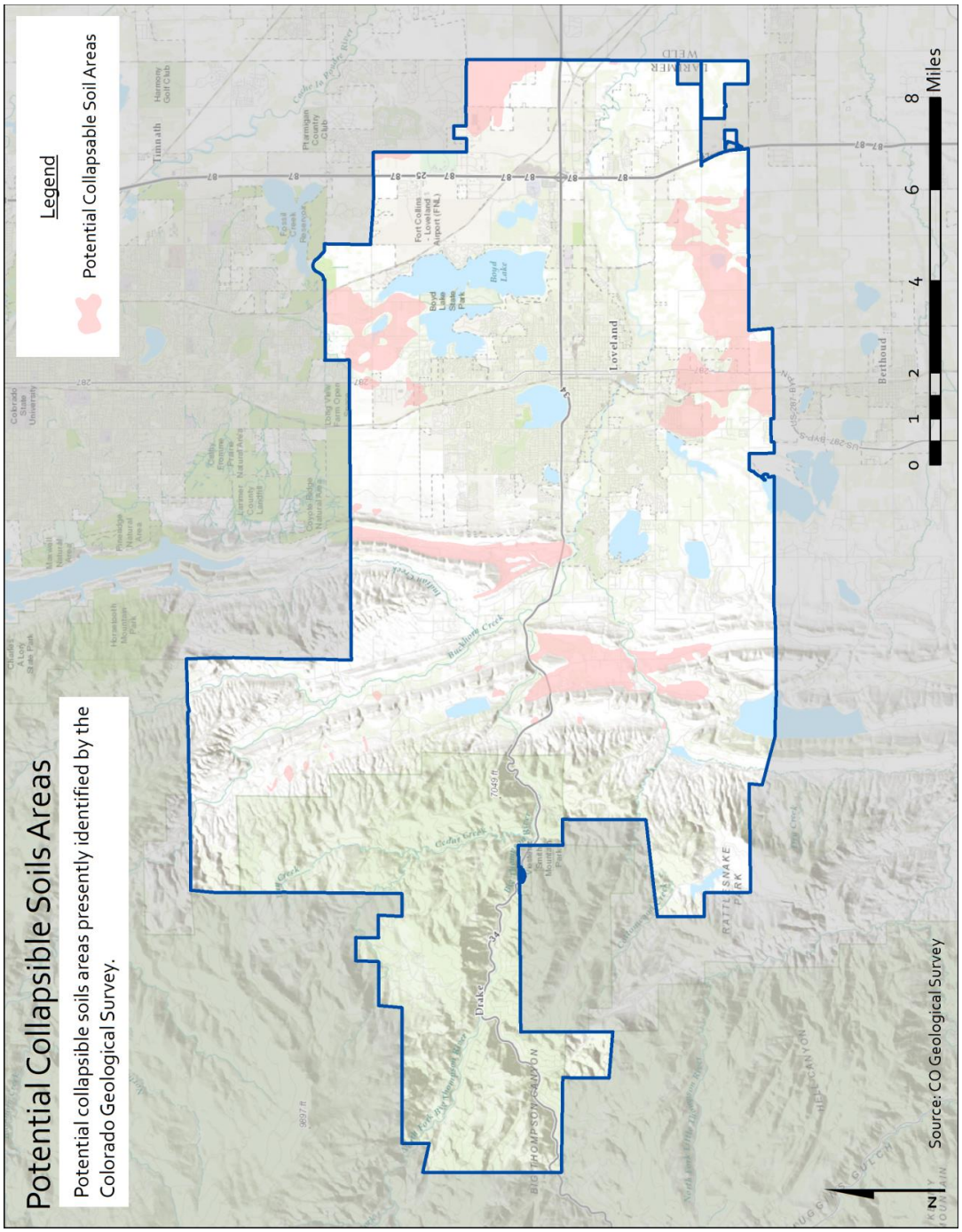

Figure 34. Potential Collapsible Soils Areas

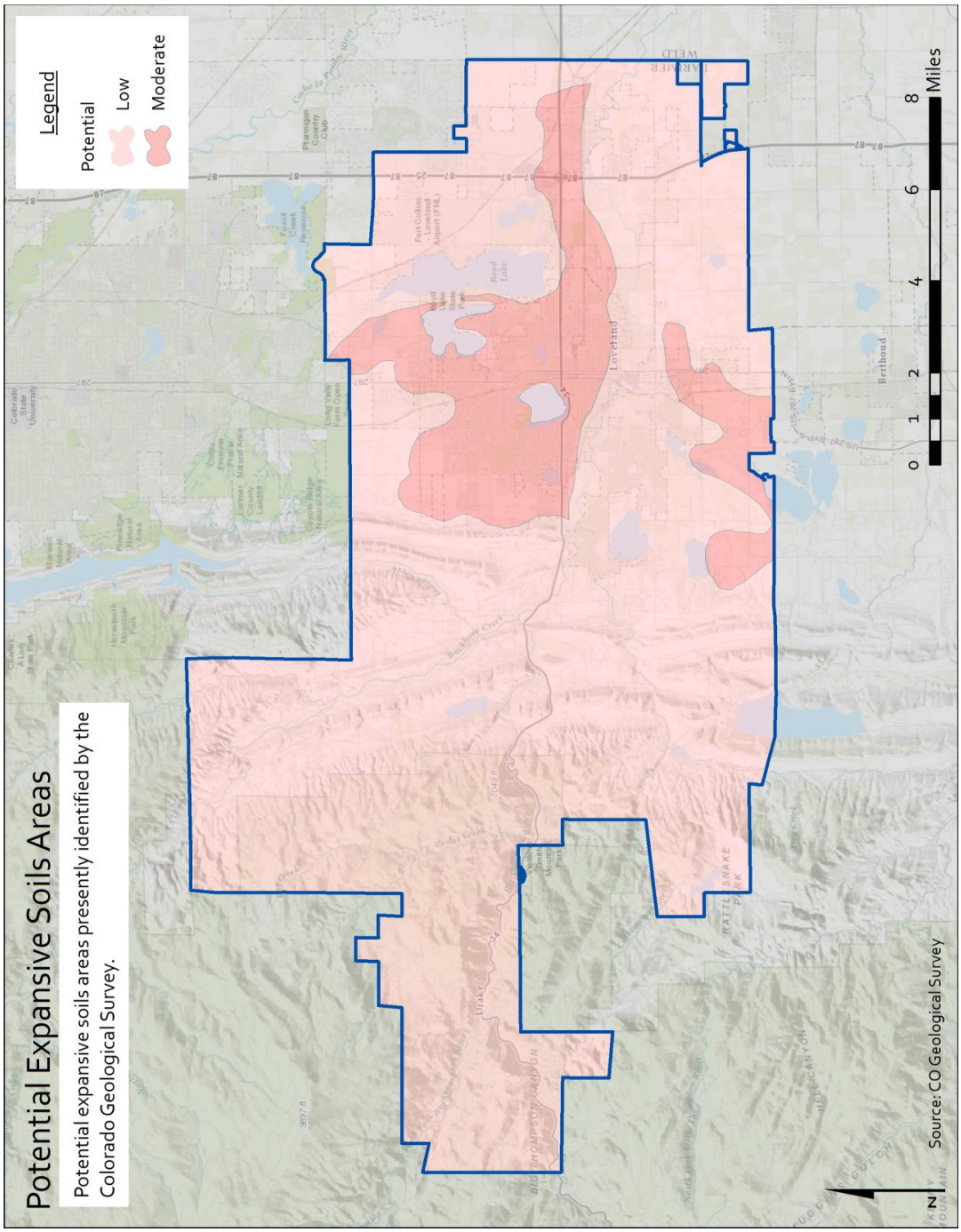

Figure 35. Potential Expansive Soils Areas

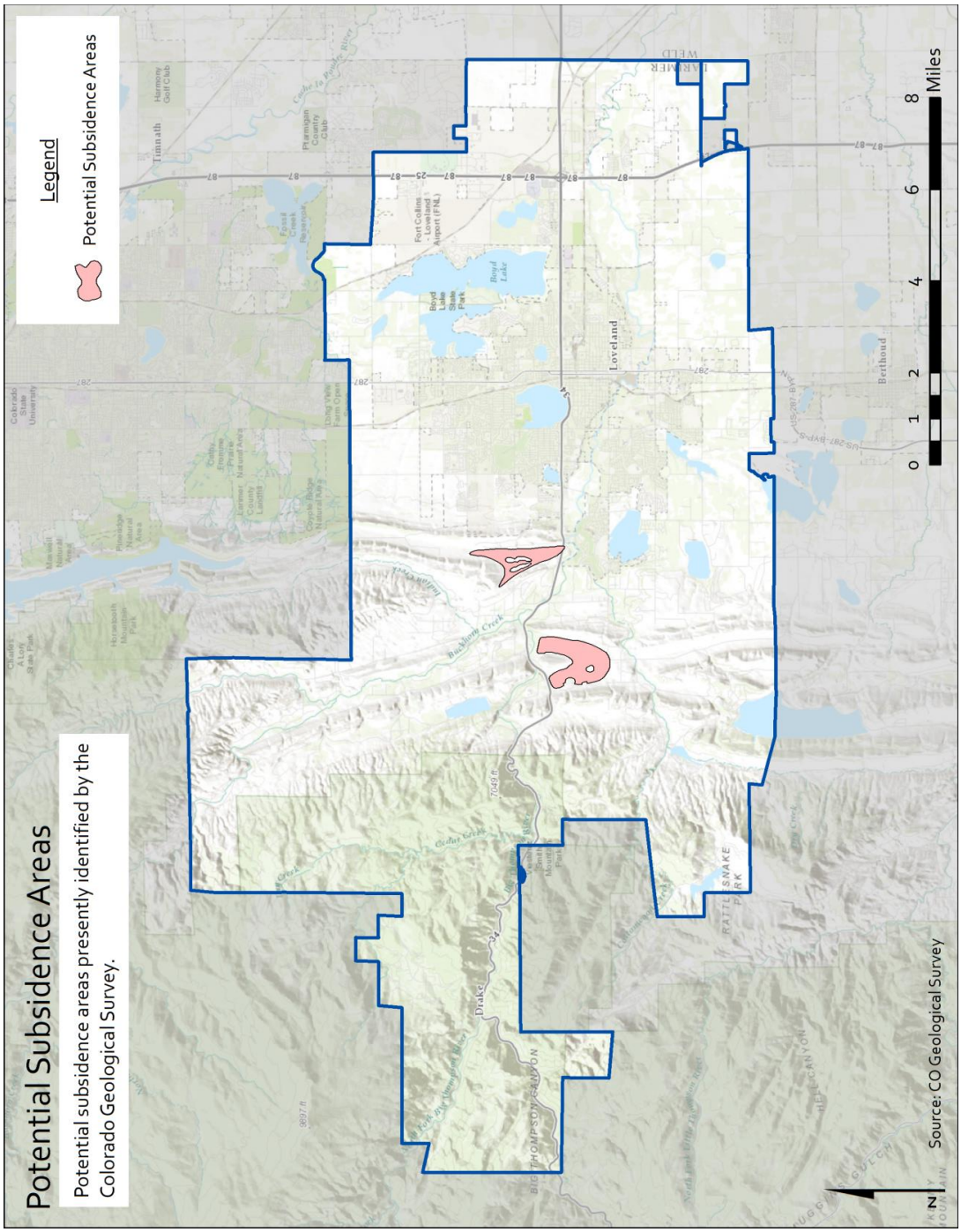

Figure 36. Potential Subsidence Areas

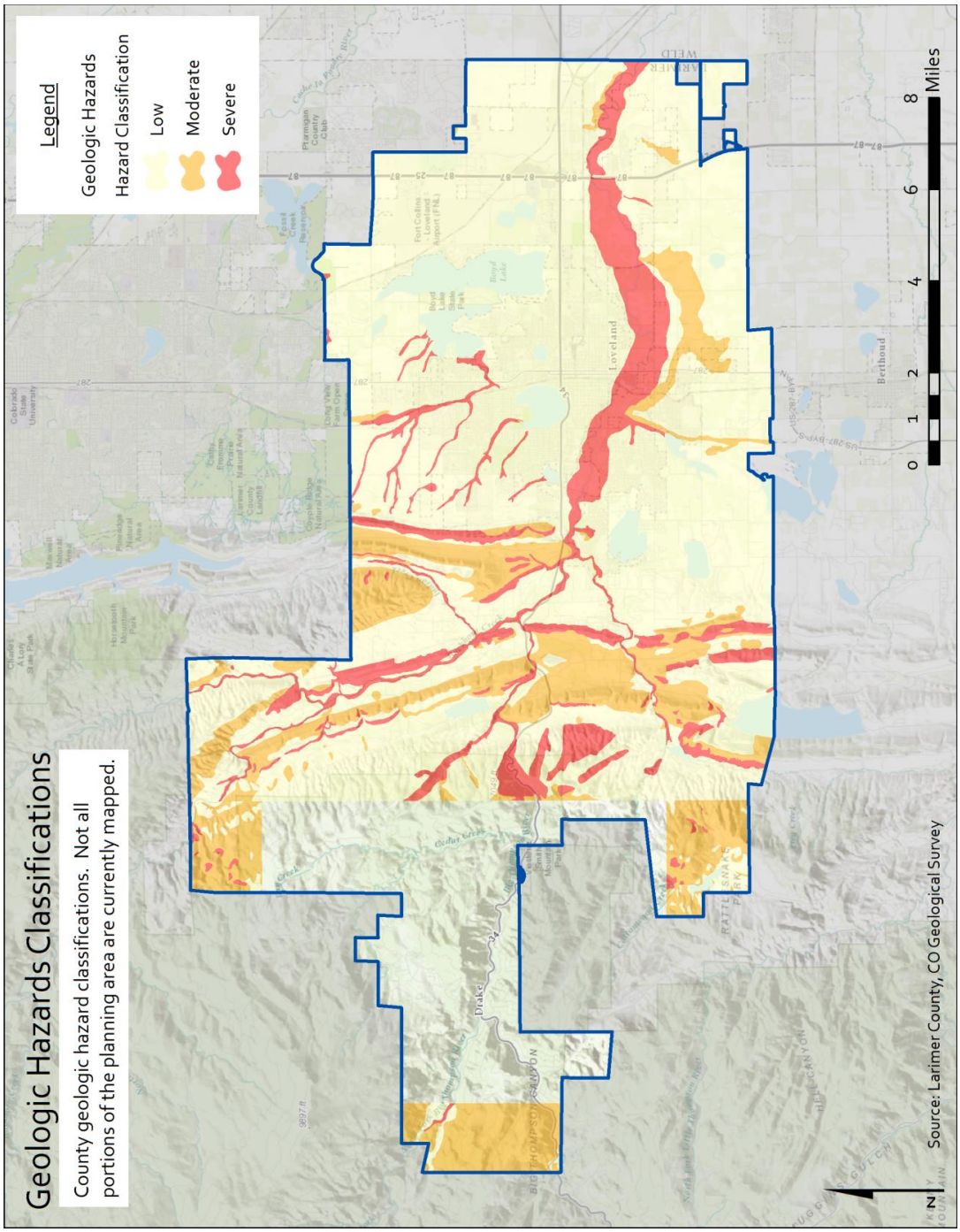

Figure 37. Geologic Hazards Classifications

Previous Occurrences

There are no historical records indicating specific occurrences of these other geologic hazards previously profiled, but it is known that they have affected structures and infrastructure across the planning area.

Inventory Exposed

Buildings and infrastructure located in the planning area may be vulnerable to the impacts of all of these geologic hazard events. Damages to property due to these other geologic hazards are usually classified as cosmetic, functional, or structural. Cosmetic damages refer to flight problems where only the physical appearance of a structure is affected (e.g. cracking in plaster or drywall). Functional damages refers to situations where the use of a structure has been impacted due to subsidence. Structural damages include situations where entire foundations require replacement due to subsidence-caused cracking of supporting walls and footings.

CGS provides us with the best available data to estimate potential exposure. These estimates show that there are 2,826 parcels in the planning area that are exposed to potential collapsible soils. This involves over $2.4 billion in assessed structural improvements. A total of 7 critical facilities are included in this count, which have a collective assessed structural value of over $43.5 million. The figure following this section identifies where those parcels are located within the planning area, and to what extent the improved value damage would be.

CGS data also tell us that for moderate expansive soils risk, 23,529 parcels in the planning area are at risk with a total appraised structural loss of over $13 billion. A total of 185 critical facilities are included in this count, with an appraised structural value of almost $705 million. The figure following this section presents where those parcels are located across the planning area. The higher levels of risk are mostly located within the City of Loveland boundaries. In addition, there is a small area near the southwest portion of the planning area boundary (just north of Berthoud) that is considered to be of moderate risk for expansive soils

It is estimated that 136 parcels and no critical facilities in the planning area are exposed to potential subsidence areas (as currently identified). The total appraised structural value of these buildings is estimated to be over $37 million. This information is also mapped in the figure following this section, showing where these at-risk parcels are located. There are two areas near Highway 34 that are more vulnerable to subsidence.

In analyzing our remaining geologic hazards data provided by Larimer County, there are 3,540 parcels that fall in the 'Severe' hazard classification areas. The appraised structural value for all of these parcels is expected to be almost $5.2 billion. A total of 28 critical facilities are also exposed and included in this previous count, with a total appraised structural value of over $87 million. The final figure following this section shows these parcels located in 'Severe' geologic hazard areas.

As has been mentioned for many of the hazards profiled in this MMP, as population growth brings new development onto available land in the region, more inventory assets may become exposed to these other geologic hazards.

Loss Estimations

As noticed in the data provided, the expansive soils hazard has the highest potential to damage the largest number of parcels within the planning area and produce the highest amount of economic loss. Besides knowing the structures exposed to these hazards have the potential to incur losses, there is currently no detailed model or method to help estimate potential losses. The best way to attempt to quantify losses is by looking at the historical event data, which is quite limited for this hazard.

Developmental Impacts

Rapid and sustained population growth across the planning area has contributed to increasing trends in geologic hazard risk, exposure, and vulnerability. Continued water and mineral resource extraction have the potential to exacerbate geologic hazards further and planning efforts should remain pro-active towards assessing changing geologic hazard risks.

Based on past and projected population growth, it is very likely that future development will lead to the intersection of geologic hazard areas. There are a number of parcels located in the Loveland Growth Management Area that are at risk of potential collapsible soil and expansive soil area hazards.

Typically, the process of erosion does not limit land use, especially if efforts are made to minimize it. Erosion impacts can be reduced and controlled by surface drainage management, re-vegetation on disturbed lands, controlling stream-carried eroded materials in sediment catchment basins, and riprapping of erosion-prone stream banks (especially adjacent to structures). Ground modification and structural solutions can help mitigate the threats of localized erosion and deposition. Proper drainage and water management are also important to prevent increasing vulnerability to erosion and deposition hazards.

Future Hazard Events

Due to the lack of data pertaining to damaging geologic hazards, it is not possible to attempt to calculate any type of probability for future events. It can be assured though, that these hazards will continue to impact the landscape of the participating communities going forward

In areas where climate change results in decreased precipitation in the summer months and reduced surface-water supplies, communities are often forced to pump more ground water to meet their needs. In Colorado, the major aquifers are composed primarily of compressed clay and silt, soil types that are prone to compact when ground-water is pumped. Based on analysis of CGS data, all portions of the planning area face risk as it pertains to geologic hazards. It is important that these communities consider future mitigation actions that will address this hazard, particularly in rapidly growing areas. Changing climate norms are expected to affect soil resources in many ways. During hot, dry years annual grasses that stabilize and protect topsoil often fail to germinate or do not grow well. This leaves soil surfaces highly vulnerable to erosion from wind and precipitation. Without the availability of nutrient-rich topsoil, crops struggle to survive and flourish. As discussed previously, higher rates of erosion can have a profound effect on agricultural production and on the economies of rural areas.

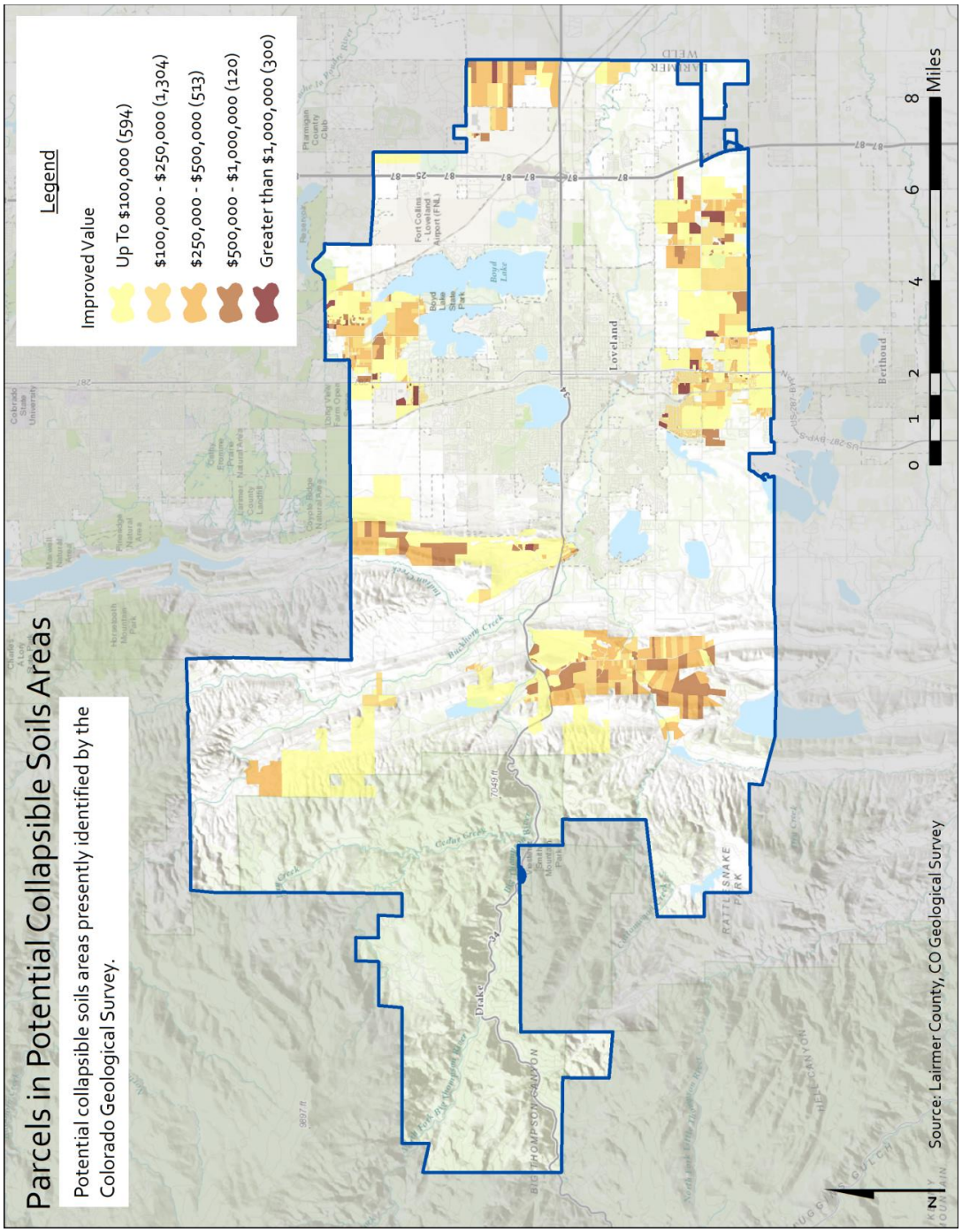

Figure 38. Parcels in Potential Collapsible Soils Areas

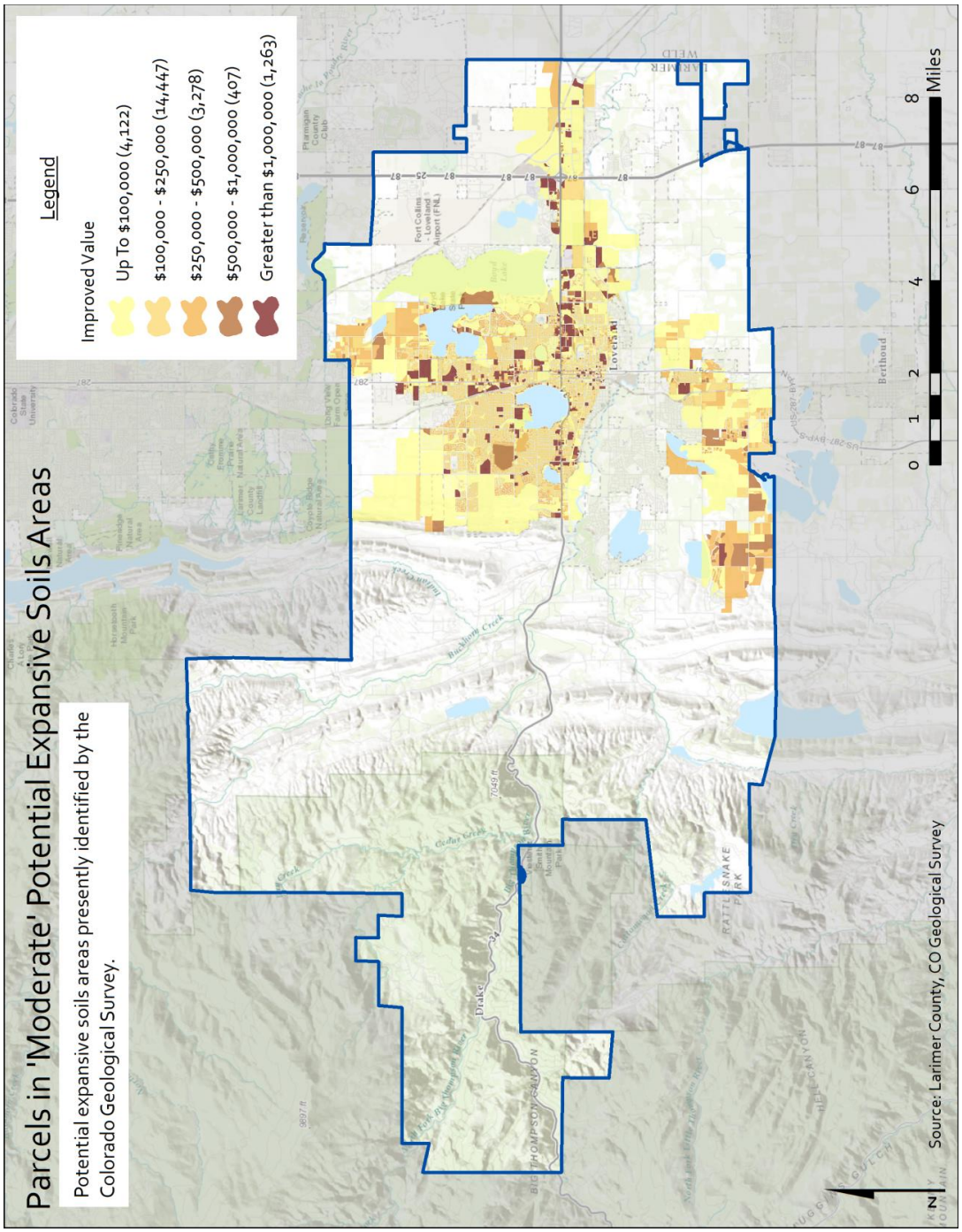

Figure 39. Parcels in 'Moderate' Potential Expansive Soils Areas

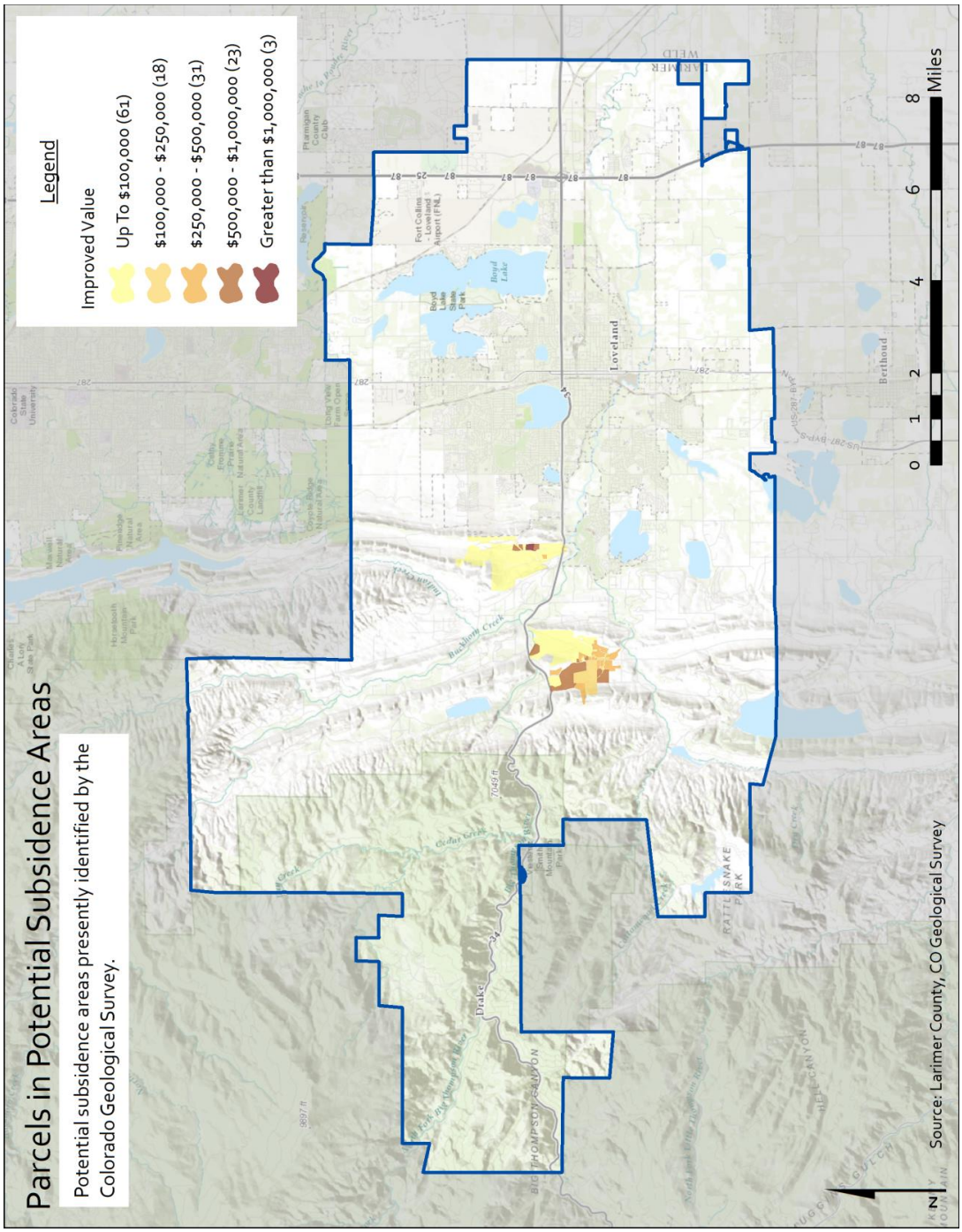

Figure 40. Parcels in Potential Subsidence Areas

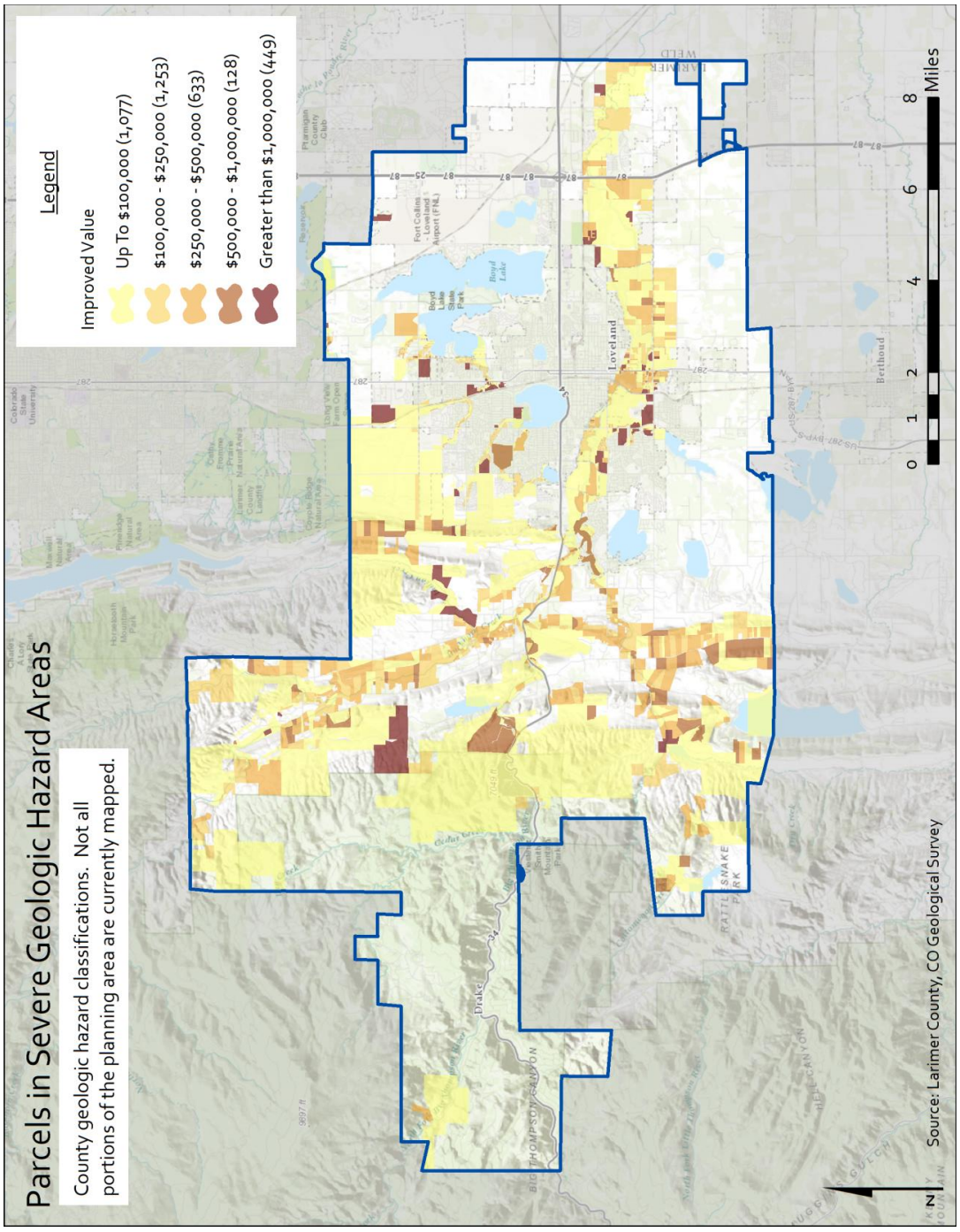

Figure 41. Parcels is Severe Geologic Hazard Areas

Spring / Summer Storms

Hazard Profile (Risk Rank #5)

Spring is the season of the year that involves the transition period from winter to summer. As a result of this transition period, temperatures can swing back and forth causing extreme weather changes. Severe weather events occurring in the spring include heavy snow, thunderstorms, lightning, hail, strong winds, tornadoes and flooding. Summer storms consist typically of thunderstorms, lightning, and hail.

Lightning strikes can be hazardous under the right conditions and locations. Large hail can damage crops, dent vehicles, break windows, and injure or kill livestock, pets, and people. Strong winds can take down trees and damage property and infrastructure.

The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Of the estimated 100,000 thunderstorms that occur each year in the United States, about 10 percent are classified as severe. The National Weather Service considers a thunderstorm severe if it produces hail at least 3/4 inch in diameter, winds of 58 MPH or stronger, or a tornado. Every thunderstorm needs three basic components: (1) moisture to form clouds and rain, (2) unstable air which is warm air that rises rapidly, and (3) lift, which is a cold or warm front capable of lifting air to help form thunderstorms.

Thunderstorms can produce strong winds, heavy rains, sleet, hail, snow, or even no precipitation at all. Thunderstorms are characterized by the presence of lightning and its audio effect on the Earth's atmosphere. Thunderstorms experience fast upward movement of warm air that contains moisture. When the air moves upwards it begins to cool and condense forming cumulonimbus clouds. Once the air cools enough to reach saturation water droplets and ice form and begin to fall. These falling droplets and ice create a downdraft of cold air, in turn causing rain, strong winds, and occasionally fog.

There are four types of thunderstorms: supercell, multicell lines, multicell cluster, and single cell. The strongest type of thunderstorm is the super cell and is associated with severe weather. Supercells are deep constantly rotating current of rising air called a mesocyclone.

Lightning, although not considered severe by the National Weather Service definition, can accompany heavy rain during thunderstorms. Lightning develops when ice particles in a cloud collide with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the base of the cloud attract positive charges at the surface of the Earth. Invisible to the human eye, the negatively charged area of the cloud sends a charge called a stepped leader toward the ground. Once it gets close enough, a channel develops between the cloud and the ground. Lightning is the electrical transfer through this channel. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. The rapid expansion of the heated air causes thunder.

The following figure depicts average cloud-to-ground lightning incidence in the US (or lightning flash densities) between 1997 and 2012.

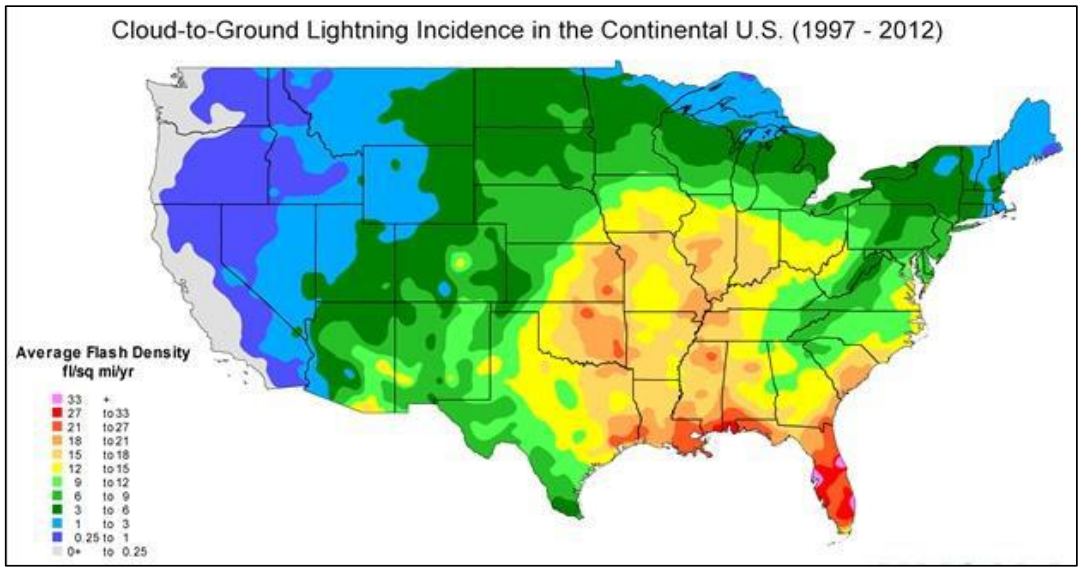

Figure 42. Average Lightning Flash Density in the U.S. (Source: NOAA Lightning Safety Statistics)

Although the state of Colorado ranks 32nd in terms of its cloud-to-ground lightning flash densities between 1997-2012, the state ranks 2nd in the country in terms of death rate from lightning per million people (between 2003 - 2012). Colorado's lightning death rate per million people from 2003-2012 is 0.51, second only to the state of Wyoming.

The following figure shows lightning flash densities for the State of Colorado for the years 1994 through 2014. Produced by National Weather Service, using data from Vaisala, the image is the result of contouring over 8 million cloud-to-ground lightning flashes for the State of Colorado and averaging annually. The result of the analysis is a picture of average lightning flashes/km^2 per year from 1994 through 2014 (the year 2000 was not included in the dataset).

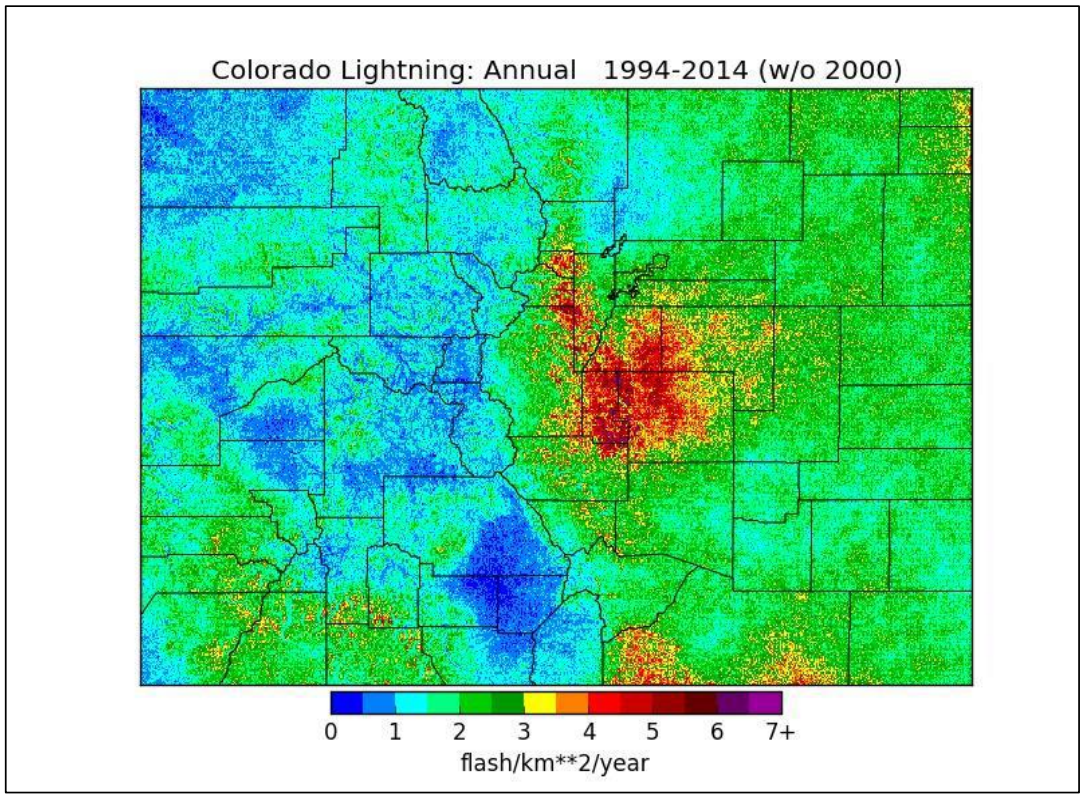

Figure 43. Colorado Lightning Flash Density Map

In general, the flash density map shows a wide range of values across the State of Colorado, ranging from less than 0.5 flashes/year/km$_2$ over the south central portion of the state to over 6.5 flashes/year/km$_2$ over the east central part of the state. It is interesting to see that the planning area is affected by some of the lowest flash rates across the entire state. The higher density of lightning flashes located in the central area of the state is driven by the topography of the area. Where the higher terrain of the Plains intersects with the Rocky Mountains conditions are ripe for lightning events. Here, moist air from lower altitudes initiates and sustains convection systems as they move off of the mountain slopes, generating thunderstorms.

Hail is precipitation that is formed when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere. The super cooled raindrops grow into balls of ice, which pose a hazard to property, people, livestock, and crops when they fall back to the earth.

Figure 44. Hail Event

Severe Wind events typically develop with strong pressure gradients and gusty frontal passages. The closer and stronger two systems (one high pressure, one low pressure) are, the stronger the pressure gradient, and therefore, the stronger the winds are.

Although severe wind events often garner less attention in the local media than tornadoes do, damaging **straight line winds** (or downbursts) can injure and kill animals and humans. Straight-line winds, which can cause more widespread damage than a tornado, occur when air is carried into a storm's updraft, cools rapidly, and comes rushing to the ground. Cold air is denser than warm air, and therefore, wants to fall to the surface. On warm summer days, when the cold air can no longer be supported up by the storm's updraft, or when an exceptional downdraft develops, the air crashes to the ground in the form of strong winds. These winds are forced horizontally when they reach the ground and can cause significant damage. These types of strong winds can also be referred to as straight-line winds. Downbursts with a diameter of less than 2.5 miles are called microbursts and those with a diameter of 2.5 miles or greater are called macrobursts. A "derecho" is a series of downbursts associated with a line of thunderstorms.

Previous Occurrences

National Oceanic and Atmospheric Administration (NOAA) data was used to document the following spring and summer storm events that have occurred within or nearby the planning area. NOAA's National Centers for Environmental Information (NCEI – formerly known as National Climatic Data Center [NCDC]) documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. NCEI receives this information from The National Weather service, who obtains their

information from a variety of sources, which include but are not limited to: county, state and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry and the general public, among others. Historical event data is tracked at the county level.

Thunderstorm

According to countywide NCEI data, there have been 17 injuries and 2 deaths in Larimer County due to thunderstorm wind. There have been 117 thunderstorm wind events reported in Larimer County between 1955 and 2014. Of the 117 incidents, 5 reported property losses totaling $76,500 and no crop losses. Based on the historic data showing hazardous impacts near the planning area, there is a great potential for hail events to occur at any given time. Table 26 in Appendix E provides the records of any NCEI events that included documented losses.

Lightning

According to NCEI, here have been 43 lightning events in Larimer County between 1996 and 2014, causing 55 reported injuries, 8 deaths, $217,000 worth of property damage, and $15,000 worth of crop damage. Based on the historic data showing hazardous impacts near the planning area, there is a great potential for lightning events to occur at any given time, especially during the summer months when residents are likely to be working and playing outdoors. Table 27 in Appendix E provides the records of any NCEI events that included documented losses.

Hail

On a countywide scale, there have been 473 hail events reported in Larimer County between 1955 and 2015. Of the 473 incidents, 10 reported property losses totaling $2,560,000 and 12 reported crop losses totaling $1,835,500. Based on the historic data showing hazardous impacts on the county, there is a great potential for hail events to occur at any given time. The following figure shows historically damaging hail events in and around the planning area. Table 28 in Appendix E provides the records of any NCEI events that included documented losses.

Windstorm

Based on data provided by NCDC's Storm Events Database, 233 severe wind events have occurred in Larimer County between 1996 and 2015. There have been no deaths, 10 injuries, $13,565,000 in property damage, and $50,000 in crop damage. Severe winds affect all portions of the planning area. A following figure presents locations of historically damaging severe wind events. Table 29 in Appendix E provides the records of any NCEI events that included documented losses.

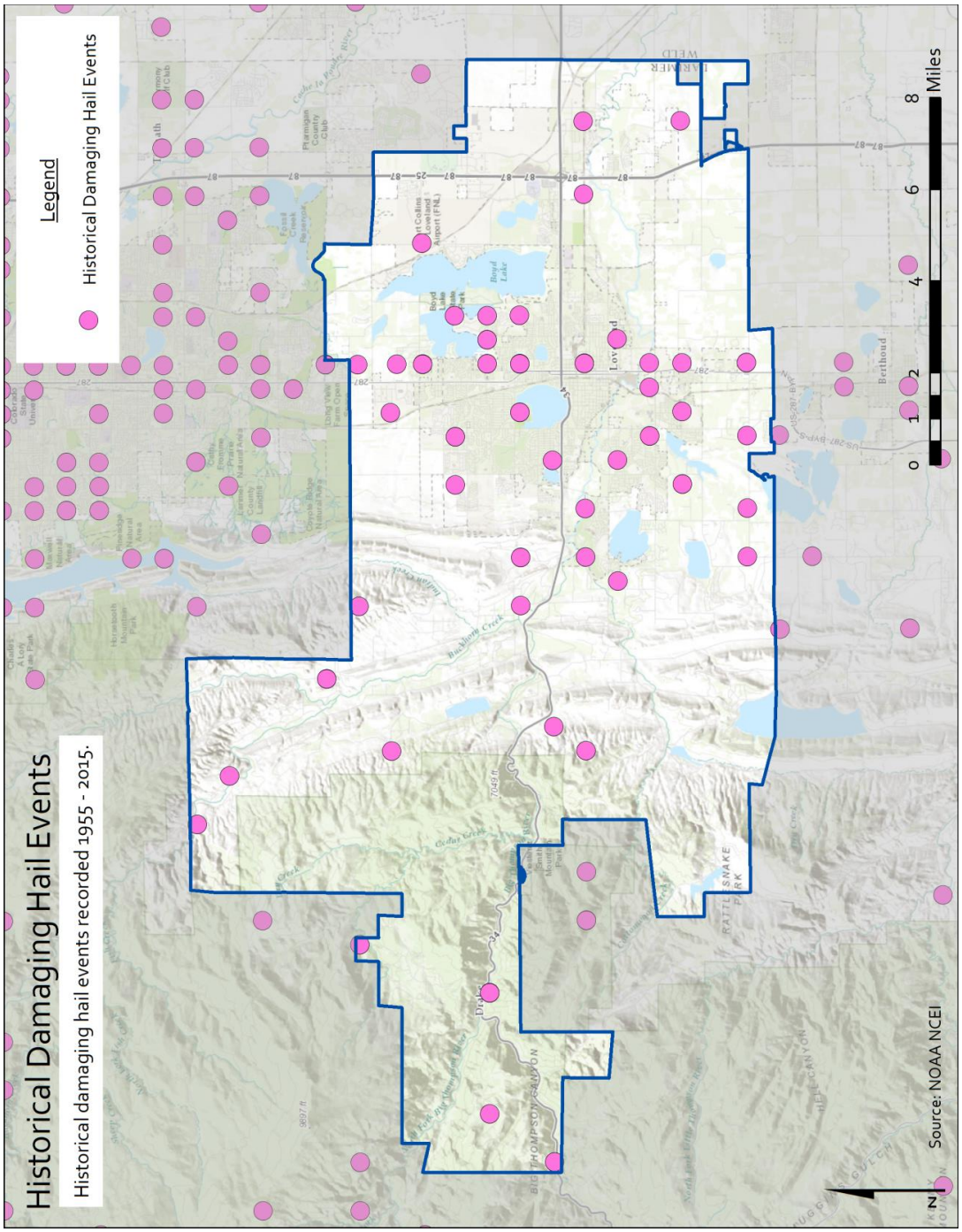

Figure 45. Historically Damaging Hail Events

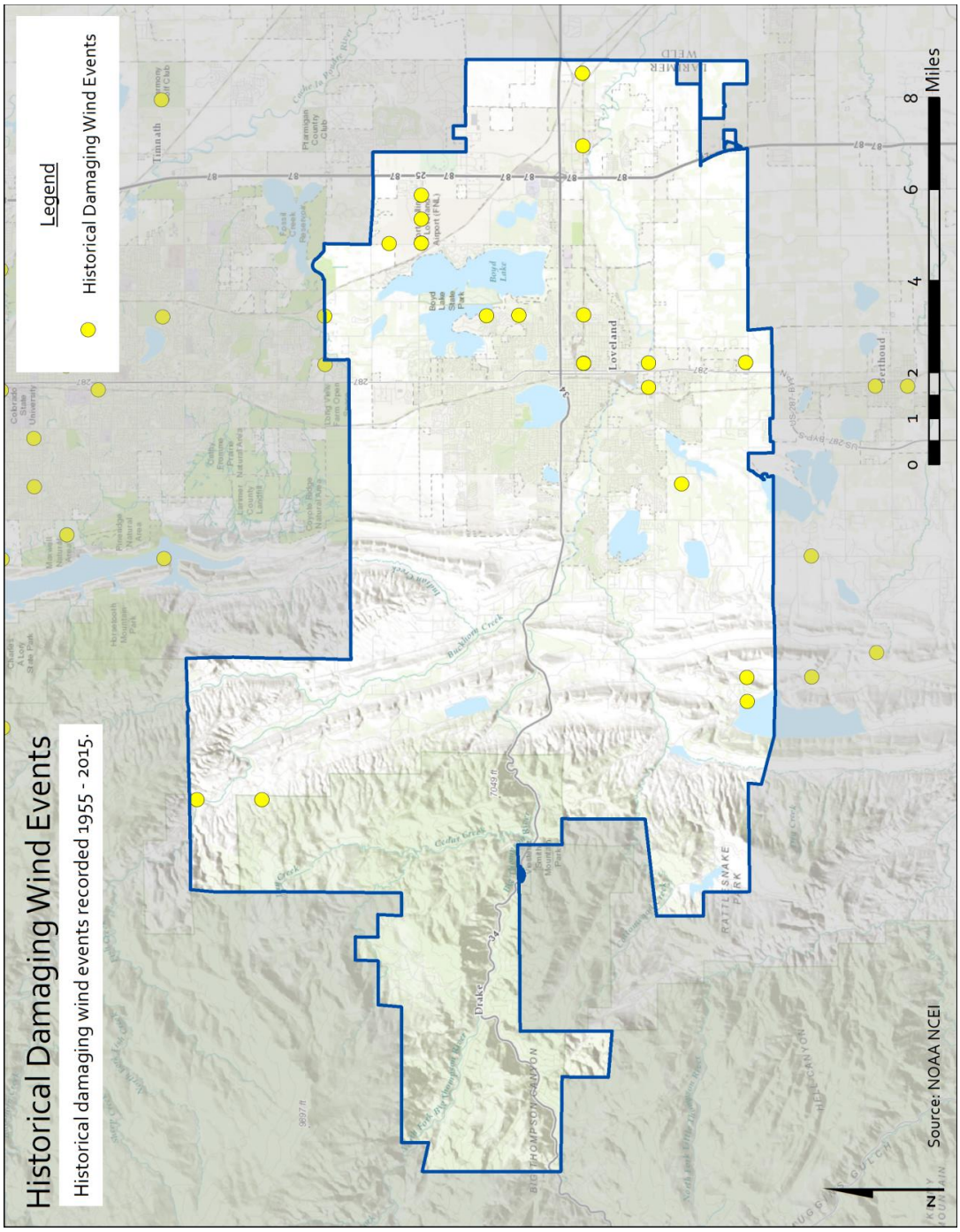

Figure 46. Historically Damaging Wind Events

Inventory Exposed

All assets, including buildings and infrastructure, located within the planning area can be considered at risk from spring and summer storms. Damages primarily occur as a result of high winds, lightning strikes, hail, snow-loading, and flooding. Most structures should be able to provide adequate protection from hail but those structures could suffer broken windows and dented exteriors. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out.

Inventory assets exposed to severe wind is dependent on the age of the building, type, construction material used, and condition of the structure. Possible losses to critical infrastructure include:

- Electric power disruption
- Communication disruption

Loss Estimations

Spring and summer storms affect the entire planning area, including all above-ground structures and infrastructure. Although losses to structures are typically minimal and covered by insurance, there can be impacts with lost time, maintenance costs, and losses to contents within these structures. Historical losses due to thunderstorms and lightning, specifically, seem to be fairly minimal. However, losses due to hail and severe winds can be significant. These will most likely impact automobiles and agriculture.

Developmental Impacts

All future structures built in the planning area will likely be exposed to spring and summer extremes and damage. Since the previous statement is assumed to be uniform for the planning area, the location of development does not increase or reduce the risk necessarily. All participating communities must adhere to building codes, and therefore, new development can be built to current standards to account for adverse weather.

All future structures built within the planning area will likely be exposed to severe wind damage. As with other large extent hazards, increased development trends within the Loveland Growth Management Area and along the I-25 corridors will increase the vulnerability of these areas. All participating communities must continue to adhere to building codes and to facilitate new development that is built to the highest design standards to account for heavy winds.

Due to the nature of severe wind events, not all communities within the planning area are expected to be impacted equally. For example, older homes, which are often subject to less advanced building codes, suffer increased vulnerability to wind over time. Mobile homes, which are most often occupied by low-income, socially vulnerable residents, are the most dangerous places during a windstorm. As communities continue to grow, it is important that local agencies monitor the inventory and locations of mobile homes, particularly in areas of high wind risk. Moreover, when discussing mitigation actions for straight-line winds, communities or geographic locations with large numbers of mobile homes deserve added attention.

Future Hazard Events

In some instances, spring and summer storms can be predicted with a reasonable level of certainty. Through the identification of various indicators of weather systems, and by tracking these indicators, warning time for storms can be as much as a week in advance. Unfortunately, this is not always the case. Understanding the historical frequency, duration, and spatial extent of severe summer weather

assists in determining the likelihood and potential severity of future occurrences. The characteristics of past spring and summer events provide benchmarks for projecting similar conditions into the future. The probability that communities in the planning area will experience a spring or summer storm event can be difficult to quantify. However, based on historical records and frequencies there is nearly a 100% chance of this type of event will occur somewhere within the planning area at least once every year.

Tornado

Hazard Profile (Risk Rank #4)

Tornadoes in Colorado are most often generated by thunderstorm activity when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touchdown briefly, but even small, short-lived tornadoes can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size, and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Each year, an average of over eight hundred tornadoes are reported nationwide, resulting in an average of eighty deaths and fifteen hundred injuries (NOAA, 2002). The majority of Colorado tornadoes occur in the eastern plains.

Tornadoes were previously classified by their intensity using the Fujita (F) Scale, with F0 being the least intense and F6 being the most intense. The Fujita Scale (seen as Table 30 in Appendix E) is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure.

On February 1, 2007, the Fujita scale was decommissioned in favor of the more accurate Enhanced Fujita Scale (aka the EF Scale). The EF-Scale measures tornado strength and associated damages and classifies tornadoes into six intensity categories, as E. The scale was revised to reflect better examinations of tornado damage surveys, so as to align wind speeds more closely with associated storm damage. The new scale takes into account how most structures are designed, and is thought to be a much more accurate representation of the surface wind speeds in the most violent tornadoes.

The Storm Prediction Center has developed damage indicators to be used with the Enhanced Fujita Scale for different types of buildings. These indicators can be also be used to classify any high wind event. Indicators for different building types are shown in Tables 32, 33, 34, and 35 in Appendix E.

Previous Occurrences

Colorado, lying just west of "tornado alley," is fortunate to experience less frequent and intense tornadoes than its neighboring states to the east. However, tornadoes remain a significant hazard in the region. Tornadoes are the most intense storm on earth having been recorded at velocities exceeding 315 mph. The phenomena results in a destructive rotating column of air ranging in diameter from a few yards to greater than a mile, usually associated with a downward extension of cumulonimbus clouds.

NOAA data was used to document the following tornado events that have occurred within or nearby the planning area. NOAA's National Centers for Environmental Information (NCEI – formerly known as National Climatic Data Center [NCDC]) documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. NCEI receives this information from The National Weather service, who obtains their information from a variety of sources, which include but are not limited to:

county, state and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry and the general public, among others. Historical event data is tracked at the county level.

Using the NCEI data, it has been recorded that five tornadoes have touched down directly within the planning area from 1983 to 1993. These events caused no reported injuries or deaths and only minimal reported property damage. All five tornadoes were a magnitude one or less according to the EF Scale. This data is presented in Table 36 of Appendix E. Utilizing available geospatial data, between 1950 and 2015, a total of 509 tornadoes have touched down within 50 miles of the planning area. All recorded tornadoes within this are were of F3 magnitude or less.

On May 28, 2008, an EF-3 tornado swept through 39 miles in the town of Windsor and parts of Weld County, which is located just east of the planning area. The Windsor tornado moved in a northwesterly direction at speeds above 165 miles per hour, and at times the funnel was up to a ½ mile wide. An estimated $193.5 million in insured damages (and $12 – 15 million in uninsured damages) were reported from approximately 24,000 auto and homeowner claims, making the event Colorado's most expensive tornado. One person was killed and 14 were injured as a result of the tornado. This event is reported to have caused a $125 million economic impact on the community. This takes into account loss in business revenues, jobs, rebuilding, and businesses that would not reopen.[10]

Many portions of the planning area have the potential to be affected by tornadoes. Historically, tornadoes have been relatively small on the EF Scale but F1 tornadoes can still produce dangerous winds up to 112mph. High winds can cause damage to buildings (tearing shingles from roofs, tearing awnings, collapsing structures, etc.).

The following figure depicts historical tornado tracks and events that have occurred in and nearby the planning area. The map illustrates where tornadoes have touched down between 1950 and 2015.

[10] Windsor/Weld Tornado – Final Recovery Report (10/15/2009)

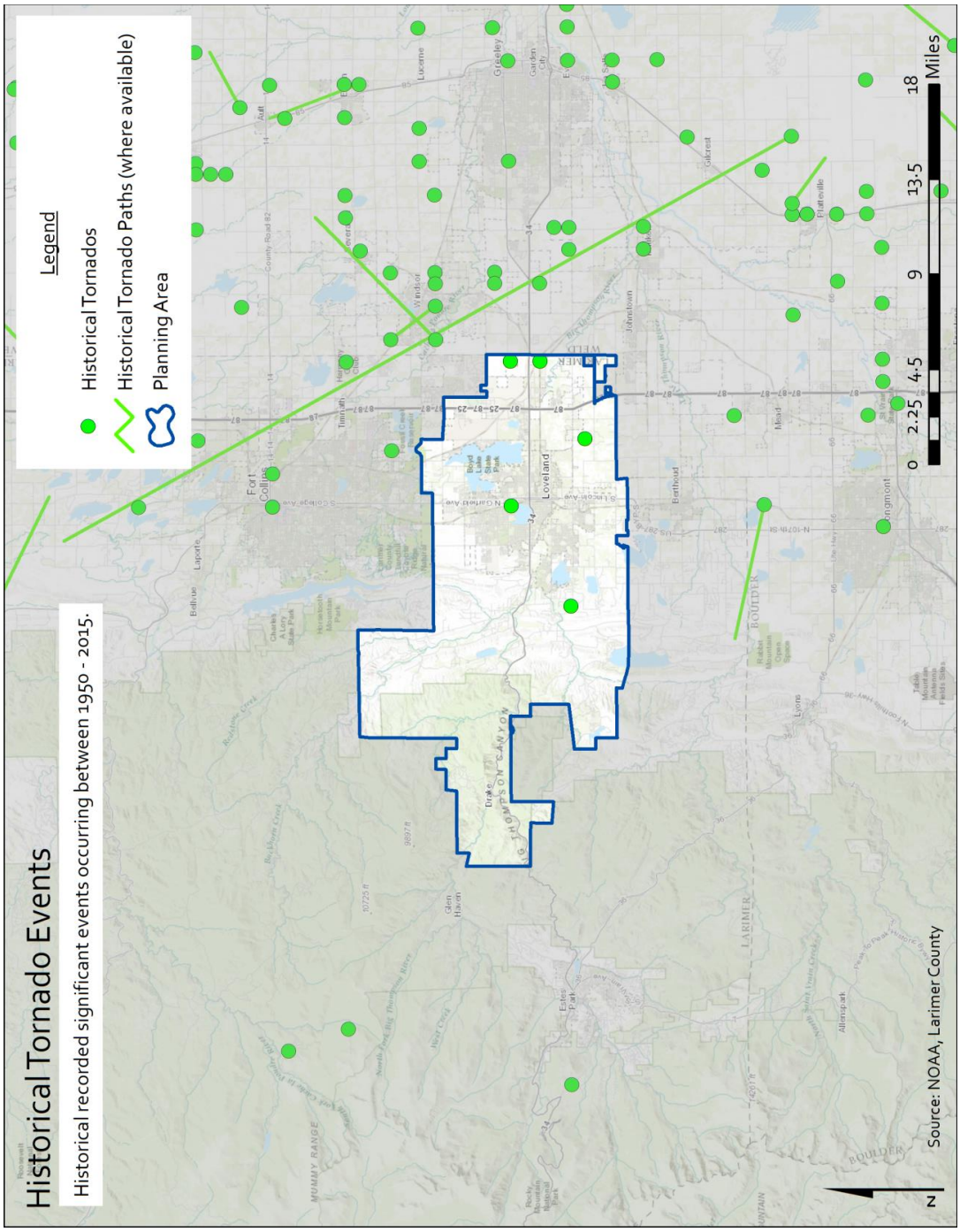

Figure 47. Historical Tornados

Inventory Exposed

Inventory assets exposed to tornados are dependent on the age of the building, type, construction material used, and condition of the structure. Possible losses to critical infrastructure include:

- Electric power disruption
- Communication disruption
- Water and fuel shortages
- Road closures
- Damaged infrastructure components, such as sewer lift stations and treatment plants
- Damage to homes, structures, and shelters

All assets in the planning area (outside of homes in the foothills), including buildings and infrastructure, located within the planning area can be considered at risk from tornadoes.

Loss Estimations

Generally, tornadoes destroy private, commercial, and public property. Additional costs stem from debris removal, maintenance, repair, and response. Indirect costs include loss of industrial and commercial productivity as a result of damage to infrastructure, facilities, or interruption of services. Because no specific loss estimation exists for tornado hazards, potential losses are related to historical property damage and injuries/deaths.

Over the last 61 years there have been no deaths reported in the planning area due to a tornado event. During the same time period, there have been no reported injuries from tornadoes. Recorded monetary losses to property and crops are small to nonexistent.

Developmental Impacts

All future structures built in the planning area (outside of the foothills) could likely be exposed to tornado and severe wind damage. As with other large extent hazards, increased development trends will increase the vulnerability of these areas. Participating communities must continue to adhere to building codes and to facilitate new development that is built to the highest design standards to account for tornadoes and severe wind.

Due to the nature of tornadoes, not all communities are expected to be impacted equally. For example, older homes, which are often subject to less advanced building codes, suffer increased vulnerability to tornadoes over time. Mobile homes, which are most often occupied by low-income, socially vulnerable residents, are the most dangerous places during a tornado. Studies indicate that 45% of all fatalities during tornadoes occur in mobile homes, compared to 26% in traditional site-built homes.

Future Hazard Events

Reported tornadoes in the planning area over the past 61 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of participating communities experiencing a tornado associated with damages or injuries can be difficult to quantify. But historic frequency suggests that there is a chance of this type of event occurring somewhere in the area each year.

Utility Disruption

Hazard Profile

Utility disruption is defined as the interruption or loss of electricity, gas, communications, or water to a facility of a community for a period of time that compromises the integrity of the location, threatens human life, safety, and health, or interferes with vital services. Utility disruption may occur as a secondary effect of another hazard, or as the result of construction, accident, or terrorism. Severe summer and winter storms, and tornadoes and floods can bring trees and tree limbs down onto power lines. These events also cause serious safety hazards to the general public and emergency responders. For the purpose of the 2016 Plan, attention has been given to the following utility sources:

- Electricity
- Natural Gas
- Communications
- Water

Extended electrical outages can directly impact other utility systems, particularly water and wastewater systems. In areas where telephone service is provided by above-ground lines that share poles with electrical distribution lines, telecommunications providers may not be able to make repairs to the telephone system until electrical utilities restore power lines to a safe condition. Electrical outages can also adversely affect the availability of fueling facilities that require electrical power to physically move the fuel. The impacts of electric utility disruptions are felt most significantly by the general public during the winter and the summer due to heating and cooling demands. However, any extended electric disruption can lead to local economic losses when computers, lighting, refrigeration, gas pumps, and other equipment are without power during business hours.

The majority of homes in the participating communities are heated with natural gas. However, propane is a common heating fuel in the rural regions. A large diameter natural gas pipeline travels through the planning area along the Interstate 25 corridor. The distribution of natural gas through this pipeline could potentially be disrupted by an earthquake, construction accident, transportation accident, or serious fire along the corridor. The impacts of gas utility disruption can be severe in rural areas where a single-source heating is the norm.

Disruptions of communication systems happen frequently, especially now that society is more dependent on multiple means of communication. For example, when telephone lines are out of service, credit card and many internet transactions cannot be made. The potential loss of cellular phone communication has occurred in localized events but it has not yet been regionally experienced. Severe storms or atmospheric/solar activity have the potential to impact radio communications. Typically, local and regional communications plans address the need for redundancy within the local, regional, and state-wide communication systems.

Finally, the disruption of water utilities and systems often requires notification of the public and businesses in order to: curtail usage; boil available water; use bottled water; etc. This may also impact local firefighting activities.

Previous Occurrences

A number of major power outages have been recorded by the City of Loveland Water and Power Department. The most recent major events are displayed in the Table below. For the purpose of this study, major outages are defined using an index for each outage that is defined as follows:

$$Index = \frac{\text{Interruption Duration X Customers Interrupted}}{\text{Total Customers Served}},$$

where total customers served is the number of meters in the City of Loveland electric service area on the last day of the corresponding year. Any outage that had an index greater than one, meaning it is equivalent to every customer being out of power for one minute, is considered major for the purposes of this study. In general, these types of events account for about 10% of the system outages for the City of Loveland Water & Power.

Table 15. Most Recent Major Outages (City of Loveland Water & Power)

Year	# of Major Events* in Given Year	Average Affected Customer for Major Events* (customers)	Average Duration for Major Events* (min)	OEEE 1366 Major Event Day Exclusions
2013	7	883.14	136.87	9/13/2013
2014	10	567.1	255.68	None
2015	9	812.89	164.34	None

**Major event days are defined as described above and is specific to this study.*

Inventory Exposed

All assets, including buildings and infrastructure, located in the planning area are considered at risk from the impacts of utility disruption events. Utility disruption events of most concern include those large-scale disruption events that could potentially last for more than three days. Events of this magnitude could cause major disruptions to vital services, some of which would include hospitals, fuel suppliers, food suppliers, and the agricultural community.

Loss Estimations

Utility disruption events have the potential to threaten lives and disrupt business activity. However, monetary losses and casualty estimates are not available/reported.

Developmental Impacts

As development expands into undeveloped areas, participating communities may face higher risks of utility disruption. Sprawling development and the subsequent extension of utilities may increase the vulnerability of the participating communities to utility disruption due to increased demand and increased exposure of utility lines. In developed areas, increased population densities and economic activity over time has potential to put additional stress on already overtaxed utility systems.

Future Hazard Events

Utility disruptions are a normal part of life and are unpredictable; they happen for a number of reasons and can be expected to continue in the future. In general, utility outages result from failures in the distribution system as opposed to shortages of supply. Distribution systems are most susceptible to

failure during extreme hot and cold temperatures as well as during violent weather conditions. Regional utility failures can threaten human life, particularly when outages affect hospitals, nursing homes, or other healthcare facilities. As both population and climate variability increase across the State of Colorado, and put more pressure on aging distribution systems, it is likely that utility disturbance events will continue to occur in and around the planning area. The City of Loveland and Loveland Fire Rescue Authority strive to reduce the impacts of these events.

Winter Storm

Hazard Profile (Risk Rank #2)

Winter storms can cause hazardous driving conditions, communications and electrical power failure, community isolation, and can adversely affect business continuity. This type of snow-related weather may include one or more of the following winter factors:

Winter storms can include blizzards, heavy snow, ice storms, and extreme cold.

Blizzards as defined by the National Weather Service, are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for 3 hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. Ground blizzards can develop when strong winds lift snow off the ground and severely reduce visibilities.

Heavy snow, in large quantities, may fall during winter storms. Six inches or more in 12 hours or eight inches or more in 24 hours constitutes conditions that may significantly hamper travel or create hazardous conditions. The National Weather Service issues warnings for such events. Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences. Heavy wet snow before the leaves fall from the trees in the fall or after the trees have leafed out in the spring may cause problems with broken tree branches and power outages.

Ice storms develop when a layer of warm (above freezing), moist air aloft coincides with a shallow cold (below freezing) pool of air at the surface. As snow falls into the warm layer of air, it melts to rain, and then freezes on contact when hitting the frozen ground or cold objects at the surface, creating a smooth layer of ice. This phenomenon is called freezing rain. Similarly, sleet occurs when the rain in the warm layer subsequently freezes into pellets while falling through a cold layer of air at or near the Earth's surface. Extended periods of freezing rain can lead to accumulations of ice on roadways, walkways, power lines, trees, and buildings. Almost any accumulation can make driving and walking hazardous. Thick accumulations can bring down trees and power lines.

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months within the planning area. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop.

Previous Occurrences

NOAA archives past "Significant" winter storm, winter weather, and blizzard events in the NCDC Storm Events Database if the event has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet, and ice) and meets or exceeds locally/regionally defined twelve or twenty-four hour warning criteria for at least one of the precipitation elements on a widespread or localized basis.

NOAA data was used to document the following winter storm events that have occurred within Larimer County. NOAA's National Centers for Environmental Information (NCEI – formerly known as National

Climatic Data Center [NCDC]) documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. NCEI receives this information from The National Weather service, who obtains their information from a variety of sources, which include but are not limited to: county, state and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry and the general public, among others.

According to NCEI data for Larimer County, there has been one reported death due to a winter storm event. This took place in September 2004 between Boulder and Larimer County. Storm event records show that there have been no injuries or crop damage, but $15.5 million in property damage between 1996 and 2015. There have been 179 winter storms reported near the planning area between 1996 and 2015. There have also been 88 winter weather events and 8 blizzard events recorded near the planning area. The NCEI storm database categorizes storm location by both elevation and regional location. Therefore winter storms can occur across in multiple locations and elevations at the same time. Table 37 in Appendix E includes information on historic winter storms in the county that have resulted in losses.

In 2007 and 2009, large snow storms caused approximately $400,000 each in snow debris removal. In 2011, an ice storm caused wide-spread power outages that lasted nearly a week in some areas and caused multiple structural fires.

Inventory Exposed

All assets, including buildings and infrastructure, located in the planning area can be considered at risk from winter storms. Damages primarily occur as a result of high winds, lightning strikes, hail, snow-loading, and flooding. Most structures, including the community's critical facilities, should be able to provide adequate protection from these damages. Those facilities with back-up generators are better equipped to handle a severe winter weather situation should the power go out.

Loss Estimations

Winter storms affect the entire planning area and its jurisdictions including all above-ground structures and infrastructure. Although losses to structures are typically minimal and covered by insurance, there can be impacts with lost time, maintenance costs, and contents within structures. A timely forecast may not be able to mitigate the property loss, but could reduce the casualties and associated injury.

Developmental Impacts

All future structures built in the planning area will likely be exposed to severe weather extremes and damage. Since the previous statement is assumed to be uniform for the area, the location of development does not increase or reduce the risk necessarily. Participating communities must adhere to building codes, and therefore, new development can be built to current standards to account for adverse weather. Additionally, as homes go up in more remote parts of the planning area, accessing those rural residents may become impossible should sheltering or emergency services be needed in an extreme event.

Future Hazard Events

Severe winter storms can be predicted with a reasonable level of certainty. Through the identification of various indicators of weather systems, and by tracking these indicators, warning time for snow

storms can be as much as a week in advance. Understanding the historical frequency, duration, and spatial extent of severe winter weather assists in determining the likelihood and potential severity of future occurrences. The characteristics of past severe winter events provide benchmarks for projecting similar conditions into the future. The probability that participating communities will experience a severe winter storm event can be difficult to quantify. However, based on historical records and frequencies there is nearly a 100% chance of this type of event will occur somewhere in the planning area at least once every year.

As a result of global climate change, the United States is already experiencing more intense rain and snowstorms. The amount of snow falling in the heaviest one percent of storms has risen nearly 74% nationally, between 1958 and 2011. As participating communities prepare for regional changes in climate, it will be important to consider scenarios in which larger amounts of snow will fall over shorter periods of time. The impacts have the potential to affect infrastructure, public safety, and the local economy in a diversity of (potentially) negative ways.

Section 6: Plan Implementation & Maintenance

Having a plan for monitoring, evaluating, and updating the MMP's Mitigation Strategy and MMA database is critical to maximizing its value. Ensuring effective implementation of mitigation activities paves the way for continued momentum after the planning process and gives direction for the future. This section explains who will be responsible for MMP implementation and maintenance activities, and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continual basis.

Mitigation Strategy Implementation

The MMA database was built with implementation in mind. Each Department determined whether they would "lead" and "support" each action, and will incorporate their respective actions into their departmental strategic plans.

During the final project meeting held with the M-Team, it was determined that implementation of this MMP would begin immediately upon approval of the final draft. As a first step, the M-Team will convene a Mitigation Strategy and Master Plan (MSMP) Committee. This MSMP Committee will be comprised of all Departments that have taken leadership of projects in the MMA database that were prioritized as being 'High'.

The initial task of this committee will be to determine ways to implement the 'High' projects that were identified as having the greatest ease of implementation within a defined period of time. The committee will work with City Council to identify funding sources through grants, the annual budgeting process, or the 5-year Capital Improvement Plan. Following that effort, additional departmental representation will be added to the MSMP Committee with the task of finding resources and methods to implement other projects identified in the MMA database.

Annual Reporting and Updates

As this MMP is a new planning document for the City and LRFA, there are no past meetings, reporting, or MMP updates to touch on. All reporting relating to the Larimer County HMP (2016) are cited in that plan document.

The City and LRFA had developed the following Plan Maintenance and Implementation Strategy during the recent Larimer County HMP (2016) update.

City of Loveland

- Mitigation actions will be reviewed and updated annually by the Office of Emergency Management.
- Mitigation actions, activities, and information will be integrated into existing public education programs and shared via website and/or social media.

Loveland Fire Rescue Authority

- LFRA mitigation actions will be reviewed by OEM on an annual basis.
- Changes to LFRA mitigation actions and priorities will be made in the document and available for public comment.

During the final project meeting held with the M-Team, the topic of MMP maintenance was also discussed. It was determined that the MMP Committee will be tasked with scheduling regular quarterly meetings. This topic will be fairly fluid as the committee is initially convened and as its membership expands over the next year. Identifying plans to ensure regular reviews, edits, and updates to the MMA database will be determined by the committee. It is anticipated that portions of that process will align with the City's yearly budgeting process. Departments may define their own additional internal workflows to ensure that the MMA Database remains relevant and that it can meld into existing internal workflows.

Besides the annual review process, the MSMP Committee may be asked to hold ad-hoc MMA database review meetings following any major disaster events.

Continued Public Participation

Following the annual MMP reviews, public outreach efforts will occur to update the public on progress relating to local mitigation efforts. The City's Emergency Manager, in coordination with the MMP Steering Committee, will coordinate with the City's Public Information Office to develop a yearly mitigation public outreach effort. The intent of this effort is to update the public on completed mitigation actions, those which are in-progress or funded/scheduled, newly identified actions in the MMA, and currently prioritizations of those projects within the MMA.

Reporting of Mitigation Actions

Within the Larimer County HMP (2016), status updates for mitigation actions specific to the City of Loveland/LFRA from the 2010 Northern Colorado Regional Hazard Mitigation Plan were provided. These are located in Appendix E of the Larimer County plan.

Another component of the Larimer County HMP (2016) planning process was the identification of new or on-going actions. These actions are included below and are also incorporated into the MMA database presented in Section 5.

City of Loveland

1. Replace chlorine gas water disinfection with sodium hypo chlorite.
2. Raise the base height of Railroad Avenue and add a second bridge.
3. Identify bridges that can provide a safe vantage point for gauge reading, purchase and installation of gauges.
4. Develop an 18 acre solar facility to be located on city-owned property between West 22nd and West 29th Streets, west of Mehaffey Park.
5. Develop a 2.4 acre substation to be located on the city-owned property between West 22nd and West 29th Streets, west of Mehaffey Park. The City elected to participate in the FEMA Alternate Program and build this substation project rather than rebuild the Idylwilde Dam and Penstock that was damaged during the 2013 Flood.
6. Determine which and how many city vehicles should have GPS locators and have them installed. Install 800 MHz radios in all city vehicles.

Loveland Fire Rescue Authority

1. Develop Community Wildfire Protection Plans (CWPPs) for the unincorporated areas of LFRA that do not currently have these plans.

Appendix A: Mitigation Actions – Planning Projects

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
31	Expand outreach activities that are focused on hazards and their mitigation. Train businesses about risk assessment, disaster recovery and continuity of operations (communications, alternate systems, alternate sites). Increase education and awareness relating to structures in the floodplain or other hazard areas.	Outreach & Public Education	H	1
138	Establish evacuation procedures and planning process for airport facilities.	Planning	H	1
145	Formalize site-specific disaster plans for Theater and all large public gathering locations.	Planning	H	1
185	Have Human Resources produce new/updated evacuation plans for all City buildings.	Planning	H	1
20	Evaluate homes/developments in Wildland Urban Interface (WUI) for response planning.	Plans & Documents	H	1
37	Initiate a Wilson Bridge feasibility planning study.	Plans & Documents	H	1
88	Revise flood management plan annually.	Plans & Documents	H	1
156A	Identify which bridges can provide a safe vantage point for gauge reading.	Plans & Documents	H	1
85	Ensure that all political leaders are trained on emergency contingency plans annually.	Training & Exercises	H	1
87	Establish on-call hazard mitigation staff and contractors to provide annual training for key players.	Training & Exercises	H	1
130	Regularly test all city backup generators under real-world conditions to ensure proper function and capability.	Training & Exercises	H	1
182	Provide annual snowfighter training sessions	Training & Exercises	H	1
33	Reevaluate and identify critical/essential facilities citywide, study their vulnerabilities, how they could be impacted by cascading failures, and potential mitigation actions.	Plans & Documents	H	2
39	Initiative for a public sheltering plan for indoor and outdoor facilities.	Plans & Documents	H	2

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
155	Liaison with the County to map the County's Wildland Urban Interface (WUI).	Plans & Documents	H	2
98A	Big Thompson Area G (I-25 area): Obtain precise floodway mapping of this area.	Plans & Documents	H	2
23	Manage contaminated runnoff for live burn training areas.	Training & Exercises	H	2
120	Improve relationships with homeless shelters; develop strategy for emergency housing.	Outreach & Public Education	H	3
160	Review potential for waste diversion and/or new landfill.	Plans & Documents	H	3
214	Form a resilience working group with community leaders and decision makers to ensure collaboration on improving the planning area's resilience to natural disasters.	Outreach & Public Education	M	1
164	Join FEMA's High Water Mark initiative and install high water placards along the Big Thompson Rivers in flood-impacted areas to educate and inform community members about the risk from flooding.	Planning	M	1
165	Support development of long-range community plans for unincorporated communities that were impacted by the recent fires and floods.	Planning	M	1
184	Enhance/improve on current community evacuation plan.	Planning	M	1
212	Evaluate and implement transportation asset management to identify infrastructure that needs to be replaced.	Plans & Documents	M	1
112A	Complete 287 bridge feasibility study.	Plans & Documents	M	1
9	Increase frequency of WMD training.	Training & Exercises	M	1
98B	Big Thompson Area G (I-25 area): Encourage conservation easements in order to maintain the open, rural feel of adjacent lands. Provide incentives to private extraction companies to plan for and implement the restoration and enhancement of the river corridor. Work with adjacent landowners to voluntarily control erosion by maintaining vegetated buffer strips along the riparian corridor.	Outreach & Public Education	M	2

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
168	Review and update the Transportation Master Plan to mitigate hazard risks, evaluate U.S. Route 34 access as a critical component of the transportation network, and identify a redundant route parallel to I-25.	Planning	M	2
170	Liaison with County for Larimer Connects Community Outreach program that includes the development of community connections through coursework, education and outreach throughout all of Larimer County to increase overall community knowledge, education, and readiness leading to a culture of community resilience at the lost local level. The project components involve three phases: 1) community assessment and identification of resources, 2) synthesis of available data, and 3) implementation of the program.	Planning	M	2
22	Review the Governor's Wildfire Task Force study (building requirements, access, vegetation) to find implementation strategies & opportunities.	Plans & Documents	M	2
124	Prioritize water/power maintenance backlog according to associated risk & vulnerabilities.	Plans & Documents	M	2
152	Evaluate gated communities to determine needs for gate keys and electrical back up.	Plans & Documents	M	2
172	Assess all unfinished recovery projects for possible mitigation opportunities and implement alternatives when appropriate.	Plans & Documents	M	2
177	Create a 50-year master plan to relocate essential water and wastewater facilities out of the 500-year floodplain or use other mitigations to reduce risk.	Plans & Documents	M	2
181	Update floodplain maps for 100-year and 500-year floods and work with the State and FEMA to update FIRMs in order to provide the planner and the general public with a better understanding of flood risks.	Plans & Documents	M	2

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
186	Perform a study to determine potential best practices/ability/need for a disaster reserve fund.	Plans & Documents	M	2
215	Hire an Exercise & Training specialist under OEM to prepare city staff for all hazard emergencies	Training & Exercises	M	2
149	Proactively stimulate interest among property owners to relocate outside of floodplains or other hazard areas (i.e. - direct solicitation to invite owners to meetings, purchase at pre-flood value).	Outreach & Public Education	M	3
176	For Glen Haven, Drake, Waltonia: Coordinate with cell phone service providers to identify potential solutions for expanding and improving cellular networks in these communities. Additionally, consider other possible sources to connect the community to neighboring areas and the county.	Planning	M	3
1	Implement a program to monitor and purchase at-risk commercial and residential structures and properties in the 100-year floodplain and other hazard areas.	Plans & Documents	M	3
51	Review Urban Land Institute (ULI) regional resilience work group recommendations for implementation strategies and opportunities.	Plans & Documents	M	3
151	Evaluate secondary emergency egress for existing sub-divisions, specifically: signage, defensible space, weight loads, stormwater facility conditions, and snow storage.	Plans & Documents	M	3
142	Assess space utilization of Cultural Services - determine if can serve for storage or DAC.	Planning	L	1
24A	Implement drone training/certification.	Training & Exercises	L	1

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
202	Conduct a study to identify potential water holdbacks/unintended levees to help reduce the threat of cascading failures.	Planning	L	2
43	Implement an Urban Forestry Program that address hazard trees.	Plans & Documents	L	2
161	Develop plan for preparing/responding to the emerald ash borer infestation. (This should be a plan for more than just one kind of infestation)	Plans & Documents	L	3
204	Incentivize development for growth areas around the airport.	Outreach & Public Education	TBD	

Appendix B: Mitigation Actions – Policy and Procedure Projects

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
34	Improve emergency communications & notifications across city employees (including field teams) and partners, such as implementation of a texting system.	Alerts, Warnings, & Notifications	H	1
121	Broaden communications (down to mid-level managers) during post-disaster/recovery activities relating to available resources/missions.	Intra-Departmental Communications	H	1
15	Provide clarity as to signature authority for contracts and agreements (as opposed to purchasing authority).	Mandates, Codes, & Rules	H	1
19	Adopt sprinkler regulations / tax credits for installation.	Mandates, Codes, & Rules	H	1
44	Clarify emergency spending policy on increased spending limit during times of emergency response (re-evaluate mid-year budget caps).	Mandates, Codes, & Rules	H	1
73	Establish and maintain protocols for effective fire dispatch equipment.	Mandates, Codes, & Rules	H	1
78	Ensure that all "educational", "institutional" and "hazard occupancies" receive and meet annual fire permit requirements.	Mandates, Codes, & Rules	H	1
105	Establish recovery plan, operations and procedures similar to EOC efforts during disaster response.	Policy & Procedure	H	1
183	Implementation of 'all clear' placards system for all city facilities for evacuations/search and provide training	Policy & Procedure	H	1
211	Work with BTWC to obtain voting rights for the City of Loveland.	Policy & Procedure	H	1
216	Hire a full time grant specialist for the benefit of all city departments and to address projects related to preparedness, response, recovery, and mitigation. The position itself can be partially funded by the grants we receive.	Staffing	H	1
153	Amend Larimer County Urban Area Street Standards connectivity standards or establish standards unique to Loveland to require greater street connectivity (multiple routes into subdivisions).	Mandates, Codes, & Rules	H	2

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
154	Review oil & gas regulations to determine if changes/updates are needed.	Mandates, Codes, & Rules	H	2
11	Continue to monitor police and fire staff size to remain proportionate to City's growth and hazard risk.	Staffing	H	2
80	Ensure enforcement of all applicable fire codes in conjunction with applicable building codes, monitoring the inspection data, by improving enforcement staffing levels.	Staffing	H	2
45	Re-evaluate on-call contracts to review FEMA requirements.	Mandates, Codes, & Rules	H	3
187	Focus on identifying ways to improve relationships with the railroad companies to improve reporting/information sharing relating to transported materials that may be hazardous.	Policy & Procedure	H	3
147	Use a commercial real estate database to identify relocation (COOP) or emergency operations locations (public & private).	Alerts, Warnings, & Notifications	M	1
91	Review zoning codes and development standards to limit the risks to development in hazard areas.	Mandates, Codes, & Rules	M	1
171	Liaison with County to develop velocity and depth criteria for all floodplains in Larimer County and incorporate criteria into floodplain regulations.	Mandates, Codes, & Rules	M	1
156C	Connect gauges to automatic warning systems/flashing light alert system.	Alerts, Warnings, & Notifications	M	2
46	Implement Ranger Programs through a joint response agreement with Larimer County.	Intra-Departmental Communications	M	2
49	Establish emergency cross-departmental staffing plan to enable utilization and capture of similar staff skills across departments (i.e. GIS/field teams/CDL drivers/PIO).	Intra-Departmental Communications	M	2
135	Expand use and training of video media system utilized to store institutional memory and to improve procedural documentation.	Intra-Departmental Communications	M	2
21	Develop and adopt hillside development regulations.	Mandates, Codes, & Rules	M	2

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
150	Incorporate FireWise provisions into land use and building codes at a subdivision scale.	Mandates, Codes, & Rules	M	2
166	Liaison with County to update Larimer County Land Use, Wildfire and Building Codes with recommendations approved by the Board of Commissioners, Planning Commission, and Flood Review Board to decrease future risk and disaster losses and reflect the latest IFBC.	Mandates, Codes, & Rules	M	2
175	Develop consistent standards for floodplains and floodways in the Loveland Fire Rescue Authority service area (between Johnstown, Loveland, and Larimer County) that minimize risk to life and property.	Mandates, Codes, & Rules	M	2
218	Set up disaster relief fund for individual assistance.	Mandates, Codes, & Rules	M	2
107	Create or identify a recovery manager position to assist the emergency manager, pre-disaster.	Policy & Procedure	M	2
210	Review policies pertaining to injection well drilling and use, to mitigate potential impacts to water resources.	Policy & Procedure	M	2
12	Consolidate City vital records into a single location.	Vital Record Protection	M	2
141	Formalize and improve post disaster event record collection (i.e. - video, photo).	Vital Record Protection	M	2
99	Big Thompson Buffer Area : Establish a transfer of development rights program that allows for an increase in density on the development parcel in return for the easement on the buffer area.	Mandates, Codes, & Rules	M	3
173	Properly locate snow storage areas.	Mandates, Codes, & Rules	M	3
117	Establish quarterly mid-level manager meetings to improve communication.	Intra-Departmental Communications	L	1
24C	Implement drone joint-use of police/fire drone.	Intra-Departmental Communications	L	1
50	Strengthen trail design standards as secondary egress for emergency response.	Mandates, Codes, & Rules	L	1

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
143	Increase City PIO staffing (new employee or staff sharing during disasters).	Policy & Procedure	L	1
144	Formalize crowd-sourcing and social media information distribution during times of disaster.	Policy & Procedure	L	1
18	Integrated EM program with Larimer County and Fort Collins , as a minimum	Intra-Departmental Communications	L	2
13	Update code provisions to allow, in very prescribed and very limited emergency circumstances, the ability for a council member or other governing body member to attend meetings electronically.	Mandates, Codes, & Rules	L	2
205	Re-implement the previous remote TSA screening process.	Policy & Procedure	L	2
207	Begin planning of private facility rooftop solar program.	Policy & Procedure	L	2
116	Scan remaining hardcopy records/documents.	Vital Record Protection	L	2

Appendix C: Mitigation Actions – Purchase, Install, or Construct Projects

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
72	Standardize fire apparatus design.	Equipment, Services, & Supplies	H	1
74	Manage base fire equipment schedule/inventory on capital replacement planning.	Equipment, Services, & Supplies	H	1
156B	Purchase and install stream/river gauges and/or cameras.	Equipment, Services, & Supplies	H	1
40	Install permanent gates from major access points to trailheads/river parks.	Infrastructure	H	1
128	Inspect all water sewer crossings and finish necessary upgrades.	Infrastructure	H	2
110	Eliminate chlorine gas as the method to disinfect water during the water treatment process, and replace with sodium hypo chlorite, which is in liquid form and is much safer than chlorine gas. Construct a chemical building specifically for storage and delivery of sodium hypo chlorite, when updating the water treatment process.	Purchase, Install, or Construct	H	2
2	Provide City staff training & Exercises relating to NIMS / ICS / emergency management planning / functions / resources / operations, IT system redundancy, and cross-departmental file sharing.	Training & Exercises	H	2
158	Identify new location for salt storage facility.	Acquisitions	H	3
36	Improve protection of critical IT infrastructure and management of hacking threats.	Equipment, Services, & Supplies	H	3
213	Install GPS units in all Public Works vehicles	Equipment, Services, & Supplies	H	3
198	Liaison with County to repurpose Storm Mountain 4x4 trail through Masonville for secondary vehicle egress.	Purchase, Install, or Construct	H	3
199	Liaison with County to create secondary vehicle egress on the Drake Trail.	Purchase, Install, or Construct	H	3
200	Liaison with County to create secondary vehicle egress to Cedar Cove.	Purchase, Install, or Construct	H	3

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
125	Implement broad asset management system for power. Implement diagnostic testing / preventative maintenance for electrical system (i.e. - pole testing, heat sensor testing).	Equipment, Services, & Supplies	M	1
25	Install radio site near Budweiser Center.	Infrastructure	M	1
30	Purchase of new mobile command center.	Acquisitions	M	2
38	Plan for a future northwest recreation center that could be utilized as an alternative facility for shelter or resources.	Acquisitions	M	2
29	Install hardline communication fibers for Station 8.	Equipment, Services, & Supplies	M	2
137	Construct a redundant power feed for the Waltonia/Drake circuit.	Equipment, Services, & Supplies	M	2
157	Increase amount of variable messaging signs.	Equipment, Services, & Supplies	M	2
163	Establish emergency backup power source for public works fleet.	Equipment, Services, & Supplies	M	2
16	Build a southeast fire station (1 or 2 bay) and/or an east fire station near Centerra.	Infrastructure	M	2
26	Move existing Drake communication towers to Storm Mountain.	Infrastructure	M	2
35	Install fiber line to the water treatment plant.	Infrastructure	M	2
134	Install a backup power generator for Southside lift station.	Infrastructure	M	2
139	Install Outdoor Warning System (siren).	Purchase, Install, or Construct	M	2
208	Plan now for the purchasing of additional City water rights.	Purchase, Install, or Construct	M	2
180	Pursue desired opportunities within the Growth Management Area (GMA). When the opportunity exists, acquire additional open lands within Growth Management Area (GMA) as per Plan guidelines, focusing on identified priorities such as providing water access and/or protecting floodprone areas.	Acquisitions	M	3
112C	Implement recommendations from 287 bridge feasibility study. This will likely include: 3) land acquisition, etc. and to provide the City, County, and State with an open route over the Big T River during the next large flood.	Acquisitions	M	3

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
3	Mitigate tower loss or downtime with redundancy in communications infrastructure.	Infrastructure	M	3
5	Build police sub-station or detention facility south of Big Thompson River.	Infrastructure	M	3
27	Liaison with NCRCN to expand radio coverage throughout the Big Thompson Canyon.	Infrastructure	M	3
28	Expand urban area radio coverage for improved building penetration.	Infrastructure	M	3
112B	Implement recommendations from 287 bridge feasibility study. This will likely include: 1) raising the base height of Railroad Ave roadway on both sides of the bridge, 2) constructing a second bridge to provide better flood management along Railroad Ave.,	Infrastructure	M	3
203	Construct Boyd Lake Avenue connector, designate as secondary hazmat route (remove downtown from CDOT TIMP)	Purchase, Install, or Construct	M	3
7	Determine which police fleet vehicles should have GPS locators and install them.	Equipment, Services, & Supplies	L	1
24B	Implement drone purchase.	Equipment, Services, & Supplies	L	1
133	Evaluate older wastewater lift stations and upgrade to current standards.	Infrastructure	L	1
47	Identify and build vehicular service centers south of the Big Thompson River.	Acquisitions	L	2
18b	Consider alternate location and complimentary uses for the EOC, including Fire Training Grounds, Police Training Center, Public Works Service Center, Courts.	Acquisitions	L	2
4	Invest in a vehicular hotspot cell/radio communication system for police vehicles that could be deployed when towers/cable fail.	Equipment, Services, & Supplies	L	2
6	Upgrade police fleet to 4WD vehicles.	Equipment, Services, & Supplies	L	2
8	Install 800 MHz radios in all city vehicles.	Equipment, Services, & Supplies	L	2
119	Implement smart meters across entire city.	Equipment, Services, & Supplies	L	2

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
123	Utilize GIS and other technology tools to automate entire electrical distribution system.	Equipment, Services, & Supplies	L	2
132	Evaluate backup/solar power for major intersection traffic lights.	Equipment, Services, & Supplies	L	2
140	Establish backup power for navigational aides/lights.	Equipment, Services, & Supplies	L	2
114	Develop a 2.4-acre substation to be located on the city owned property between West 22nd and West 29th Streets, west of Mehaffey Park.	Infrastructure	L	2
129	Continue work to retrofit (bury) existing above ground electrical distribution.	Infrastructure	L	2
174	Continue the regional trail along the Big Thompson River	Infrastructure	L	2
108	Establish a long-term recovery center for one stop shopping (post Disaster Assistance Center).	Purchase, Install, or Construct	L	2
113	Plan, design, and construct a second solar garden, by 2017, likely an 18-acre solar facility to be located on the city owned property between West 22nd and West 29th Streets, west of Mehaffey Park.	Purchase, Install, or Construct	L	2
41	Floodproof the public works service center.	Infrastructure	L	3
201	Plan and construct multiple bridges over the railroad track (57th Street, others).	Purchase, Install, or Construct	L	3
206	Begin planning and implementation of public facility rooftop solar.	Purchase, Install, or Construct	L	3
92	Big Thompson Area A (western GMA): Protect this area through conservation easements, negotiated management agreements and land acquisition. A landowner could grant an easement to the City or to a qualified land trust with the potential for tax benefits of the donation.	Acquisitions	TBD	
93	Big Thompson Area B (Mariana Butte Golf Course): Protect this area through conservation easements, negotiated management agreements and land acquisition. A landowner could grant an easement to the City or to a qualified land trust with the potential for tax benefits of the donation.	Acquisitions	TBD	

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
94	Big Thompson Area C (gravel mine and ponds near Namaqua Avenue): Plan for long-term protection and restoration. Work with the landowner to restore and protect this site through easement or installment purchase. Protection techniques should protect the Wilson bridge.	Acquisitions	TBD	
95	Big Thompson Area D (between Taft and Wilson): Protection techniques should be studied for this area of key parcels west of the Macy Subdivision parcel. An open, rural feel of adjacent lands should be encouraged and, where possible, ensured through the purchase or donation of conservation easements. Protection techniques should protect the Taft bridge.	Acquisitions	TBD	
54	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 22 - Jasper Lake along the Big Thompson	Infrastructure	TBD	
55	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 50 - Glen Haven along West Creek	Infrastructure	TBD	
56	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 27 - Glade Road along the Big Thompson	Infrastructure	TBD	
57	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 29 - Morey Open Space along the Big Thompson	Infrastructure	TBD	
58	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 21 - Cedar Cove along the Big Thompson	Infrastructure	TBD	
59	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 24 - Sylvan Dale along the Big Thompson	Infrastructure	TBD	

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
60	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 15 - East Drake along the Big Thompson (US 34)	Infrastructure	TBD	
61	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 14 - Drake along the Big Thompson (US 34)	Infrastructure	TBD	
62	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 18 - Idlewild along the Big Thompson (US 34)	Infrastructure	TBD	
63	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 59 - North Drake along the North Fork (CR 43)	Infrastructure	TBD	
64	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 58 - Fish Hatchery along the North Fork (CR 43)	Infrastructure	TBD	
65	Serve as liaison with external partners to implement Big Thompson Restoration Plan Update: Reach 57 - Crosier Mt. Trail along the North Fork (CR 43)	Infrastructure	TBD	
96	Big Thompson Area E (Rivers Edge ponds to 287): Protection techniques should be studied for this area with private landowners and the County. Work with landowners to regrade banks of ponds to prevent erosion and create nesting habitat for waterfowl. Protection techniques should protect the 287 bridge.	Infrastructure	TBD	

ID	Project	Category	Prioritization High[H] Medium[M] Low[L]	Ease of Implementation Scale of 1 [easy] - 3 [difficult]
97	Big Thompson Area F (287 to 402): Re-grade riverbanks to create terraces for natural erosion control, replace rip-rap containing exposed rebar, and other dangerous objects or hazardous situations. Remove weedy, non-native vegetation. Negotiate with the owner of the land (private or public) to achieve these restoration and enhancement measures. Protection measures should increase buildable area south of 402 for economic development.	Infrastructure	TBD	

Appendix D: Planning Process Documentation

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City of Loveland

City of Loveland Mitigation Strategy and Master Plan (MMP)
M-Team Kick-Off Meeting

When and Where
City Manager's Conference Room – City Hall
February 1st, 2016, 12:45 – 1:45 PM

Attendees

City of Loveland	Consultant Team
Pat Mialy	Mike Garner (Michael Baker International)
xxxxx	Jeremy Call (Logan Simpson)

Agenda

1. Welcome and Introductions
2. Project Overview
    a. What is a Mitigation Strategy and Master Plan for the City?
    b. Incorporate findings from the Urban Land Institute (ULI) Advisory Services Panel Report and the Larimer County Multi-Jurisdictional Hazard Mitigation Plan
3. Project Schedule
    a. City Department Interviews
        i. Interview departments to identify mitigation strategies currently in place, projects currently on the books, project wish-list (February/March)
        ii. Educate staff on hazard mitigation and how it relates to their department
    b. Steering Committee Meeting #1
        i. Present initial department information and gather additional input (March)
        ii. Educate committee on hazard mitigation and how it relates to their department
    c. Summarize input to-date (March/April)
        i. Determine if current strategies align with risks
    d. Steering Committee #2

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i. Present updated information and develop new mitigation strategies (April)

e. Draft strategies for Council discussion (May)

f. Stakeholder Outreach / Present strategies to public (May/June)

g. Draft Plan development (July)

h. Final Draft / Council Study Session (August)

4. Departmental Interviews
    a. How staff can help us
5. Steering Committee
    a. Membership discussion
6. Public Outreach Discussion
    a. Begin discussion on potential stakeholder outreach opportunities

Post-Meeting Action Items:

1. M-Team to help designate Departmental contacts to initiate Departmental interviews.

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City of Loveland

City of Loveland Mitigation Strategy and Master Plan (MSMP) - Project Kick-Off Meeting

When and Where
Loveland Library – Gertrude Scott Meeting Room, February 26th, 2016, 9:00 – 11:00 AM

Agenda

1. Welcome and Introductions (5 minutes)
2. Project Overview/Purpose
    a. What is a Mitigation Strategy and Master Plan for the City?
    b. Benefits to City and Individual Departments
    c. Build upon 2016 Larimer County Multi-Jurisdictional Hazard Mitigation Plan
3. Project Approach / Work Session
    a. Incorporate findings/recommendations from other recent area planning studies (in progress)
    b. Steering Committee Meeting #1 (today)
    c. City Department Interviews (March)
    d. Steering Committee Meeting #2 (March)
    e. Summarize input to-date (March/April)
    f. Steering Committee Meeting #3 (April)
    g. Draft final strategies for Council discussion (May)
    h. Stakeholder Outreach / Present strategies to public (May/June)
    i. Steering Committee Meeting #4 (June/July)
    j. Draft Plan development (July/August)
        i. Steering Committee Meeting #4 (if needed)
    k. Final Draft / Council Study Session (August)
4. Project Website – www.LovelandMSMP.com
5. Additional Questions?

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City of Loveland

City of Loveland Mitigation Strategy and Master Plan (MSMP)
Project Kick-Off Meeting

When and Where
Loveland Library – Gertrude Scott Meeting Room
February 26th, 2016, 9:00 – 11:00 AM

Attendees

Name	Representing
MIKE GARNER	MICHAEL BAKER - CONSULTANT
Pat Mialy	Loveland OEM
Jodi Lessman	Public Works
Tree Ablao	CAO
Kathy Gross	Water and Power
Dave Bottell	Parks & Rec
Jake Adler (Behalf: Rod Wensing)	
Steve Holmes	IT
SCOTT RINGLE	LFRA
Terry Andrews	CCD
Tim Brown	Police
Brent Worthington	Finance
Bob Paulsen	Development Services
STEVE ADAMS	WATER & POWER
Ned Sparks	Loveland Fire

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City of Loveland

City of Loveland Mitigation Master Plan (MMP) – Coordination Meeting

When and Where
Loveland LRFA, April 29th, 2016, 9:30 – 11:30 AM

Agenda

1. Show participation tracker
2. Review Table of Contents
3. Discuss RA
    a. Critical facilities
        i. Want to separately analyze?
        ii. How to ID?
    b. Past fire/flood losses?
    c. Historical event review/capture?
    d. Hazard profiles
        i. Utility Disruption – include?/data?
        ii. Wildland Fire – NFIRS/other data?
        iii. Civil Disturbance – include?/data?
        iv. Biological Hazards/Contagion – include?/data?
        v. Hazmat – data?
    e. Ranking hazards
    f. Growth/development areas
4. Ranking Exercise for CIP projects
    a. OK with scoring criteria? – ranking impacts 1st, then subset technically
    b. OK with consultants taking 1st shot at master project list? – then steering committee
5. Review of Mitigation Projects & Strategies
    a. Show plan review summary table

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b. Show Mitigation Strategy database
c. Subject of 'disaster fund' - continue city reserve fund to serve as this (and also to potentially pay for these mitigation projects) – increase?
d. Cultural Services (Susan) 'placard system' – citywide?
e. Obtain Year 11 CIP projects (water & power, public works)
f. Evacuation plan (public works has?)
g. Is there an existing plan/capabilities relating to downtown hazmat rail incident?

6. Project Schedule
   a. M-Team Kick-Off (2/1/16)
   b. Steering Committee Meeting #1 (2/26/16)
   c. City Department Interviews (March-April)
   d. Steering Committee Meeting #2 (5/6/16)
   e. Draft Mitigation Strategy for Review/Comment
   f. M-Team Discussion/Presentation (5/24/16)
   g. Steering Committee Meeting #3 (7/25/16)
   h. Draft Plan Available for Review/Comment
   i. City Council Study Session (8/23/16)
   j. Public Outreach/Education
7. Public Surveys/Planning Process Update?
   a. Larimer County HMP
   b. Larimer UNCF
8. Agenda for next Steering Committee Meeting
9. Project Website – www.LovelandMSMP.com

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City of Loveland

City of Loveland Mitigation Master Plan (MMP) – Steering Committee Meeting #2

When and Where
Development Center - EOC #1 & #2, Friday May 6th, 2016, 1:00 – 3:00 PM

Agenda

1. Welcome and Introductions
2. Project Updates / Current Status
3. Presentation of Risk Assessment Results
4. Mitigation Strategy Development Discussion
5. Mitigation Project List Overview
    a. Discussion
    b. Project Ranking Exercise
    c. Solicitation for Additional Projects – What are we missing?
6. Project Schedule
7. Public Outreach Plan
8. Additional Questions?

Steering Committee Post-Meeting Actions/Notes

- Please review the mitigation actions/projects that are associated with your Department and provide all edits, updates, and additional new projects by Friday, May 20th.
- Draft Plan will be made available for internal review/comments this summer
- Next meeting is July 25th

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City of Loveland

City of Loveland Mitigation Master Plan (MMP)
Steering Committee Meeting #2

When and Where
Development Center – EOC 1&2
May 6th, 2016, 1:00 – 3:00 PM

Attendees

Name	Representing
Leah Browder	Public Works
Jodi Lessman	Public Works
Brett Limbaugh	Development Services
Susan Ison	Cultural Services
Marcia Lewis	Library
Dave Bathelt	Parks & Rec.
Patty Barron	Muni Ct
Bob Paulsen	Dev. Services
Tim Brown	Police
Jason Licon	Airport
Terry Andrews	City Clerk
Karl Barton	Community & Strategic Planning
Jake Adler	City Manager
Julia Holland	Human Resources
Steve Adams	W+P
Kathy Gross	W+P
Brent Worthington	Finance
Steve Holmes	IT - for Bill Westbrook
Mark Miller	CDOT (ARE)
	LCRA / City of Loveland

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City of Loveland

City of Loveland Mitigation Master Plan (MMP) – M-Team Meeting #2

When and Where
Manager's Conference Room, Tuesday May 24th, 2016, 2:00 – 3:30 PM

Agenda

1. Welcome and Introductions
2. Project Updates / Current Status
3. Risk Assessment Overview
4. Mitigation Strategy & Goals
5. Mitigation Projects
6. Project Schedule
7. Additional Questions/Comments?

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City of Loveland Mitigation Master Plan (MMP) – Steering Committee Meeting #2

When and Where
Development Center - EOC #1 & #2, Monday July 25th, 2016, 1:00 – 3:00 PM

Agenda

1. Project Updates / Current Status
2. Survey Results
3. Master Mitigation Action database
4. Plan Implementation / Maintenance
5. Project Schedule
6. Public Outreach – Safety Expo
7. Additional Questions?
8. Thanks!

Steering Committee Post-Meeting Actions/Notes

- Draft Plan available soon for internal review/comments

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City of Loveland

City of Loveland Mitigation Master Plan (MMP)
M-Team Meeting #3

When and Where
City Manager's Conference Room – City Hall
July 26th, 2016, 2:20 – 3:20 PM

Attendees

Name	Representing
Terry Andrews	City Clerks Office
Kami Yellico	City Attorney
Julia Holland	Human Resources
Brent Worthington	Finance
Bill Westbrook	Information Technology
ELIZABETH ANDERSON	PARKS AND RECREATION
MARK MILLER	LOVELAND FIRE RESCUE AUTHORITY
Susan Ison	Cultural Services
Brett Limbaugh	DEVELOPMENT SERVICES
BOB MILLER	WATER & POWER
Bob Klinger	P.D.
SUSAN GRAFTON	Economic Development
STEVE ADAMS	City of Loveland - City Mgr
Jeremy Cox	Logan Simpson
Mike Garner	Michael Baker
Pat Mialy	EOC

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Appendix E: Risk Analysis Data

Biological Hazards/Hazmat

Table 16. Colorado Reportable Disease Statistics CDPHE, Larimer County

	Year					
Disease	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Campylobacter	91	78	49	80	62	360
Cryptosporidiosis	8	14	5	3	11	41
Giardiasis	21	16	15	13	16	81
Haemophilus Influenzae	5	4	7	3	4	23
Hepatitis B, Chronic	14	19	16	18	22	89
Hepatitis C, Chronic	115	104	94	80	80	473
INFLUENZA-Hospitalized	1	40	69	103	169	382
Kawasaki Syndrome	3	1	-	2	1	7
Meningitis Aseptic/Viral	29	24	19	6	7	85
Pertussis	8	7	79	81	79	254
Salmonellosis	34	21	37	28	39	159
Shigellosis	2	5	11	7	3	28
STEC (Shiga Toxin producing E.coli)	21	14	15	14	5	69
Strep Pneumo Invasive	16	20	17	15	18	86
Varicella (Chicken Pox)	22	29	43	20	41	155
West Nile Virus	14	2	-	-	-	16
Total	404	398	476	473	557	2,308

Table 17. Impacts to Subjects Impacted by Public Health Emergencies

Subject	Detrimental Impacts
Health and Safety of Persons in the Area as the Time of Incident	Adverse impacts are expected to be severe for unprotected personnel and moderate to light for protected personnel.
Health and Safety of Persons Responding to the Incident	Adverse impacts are expected to be severe for unprotected personnel and uncertain for trained and protected personnel, depending on the nature of the incident.
Continuity of Operations	Danger to personnel in the area of the incident may require relocation of operations and lines of succession execution.
Property, Facilities, and Infrastructure	Access to facilities and infrastructure in the area of the incident may be denied until decontamination is complete.
Delivery of Services	Stress on resources and facilities due to increased volume and demand may overwhelm and/or extensively postpone delivery of services.
The Environment	Incident may cause denial or delays in the use of some areas.
Economic and Financial Condition	Local economy and finances may be adversely affected, possibly for an extended period of time.
Regulatory and Contractual Obligations	Regulatory waivers may be needed. Fulfillment of contracts may be difficult. Demands may exceed the ability to deliver.
Reputation of, or Confidence in, Management and Response Authorities	Ability to respond and recover may be questioned and challenged if planning, response, and recovery are not timely and effective.

Table 18. Total Workdays Lost (Pandemic Influenza)

Scenario	Workdays Lost
Most Likely Scenario	144,596
Minimum Loss Scenario	121,312
Maximum Loss Scenario	180,307

Table 19. Influenza Planning Resources and Guidelines

Title	Source
Pandemic Influenza Action Plan for Schools (2009)	Colorado Department of Public Health and Environment
Infectious Diseases in Child Care and School Settings: Guidelines for Childcare Providers, School Nurses and Other Personnel (2013)	Colorado Department of Public Health and Environment
Pandemic Influenza Planning Guidelines for Hospitals (2009)	Colorado Department of Public Health and Environment
Home Care Guide: Providing Care at Home During Pandemic Flu (2009)	Colorado Department of Public Health and Environment
Guidelines for Medical Office Pandemic Readiness (2007)	Colorado Department of Public Health and Environment
Social Distancing Support Guidelines for Pandemic Readiness (2008)	Colorado Department of Public Health and Environment
Colorado Health Alert Network (HAN)	Colorado Department of Public Health and Environment
Public Health Emergency Operations Plan	Larimer County
Continuity of Operations Plan	Larimer County
Epidemiology Plan	Larimer County
Quarantine and Isolation Plan	Larimer County
Risk Communication Plan	Larimer County
Strategic National Stockpile and Mass Prophylaxis/Vaccination Point-of-Dispensing Plan	Larimer County
Mass Fatality Plan	
Incident Recovery Plan	
Pandemic Influenza Plan	

Earthquake

Table 20. Modified Mercalli intensity scale

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	PGA (g)	RICHTER SCALE MAGNITUDE
I	**Instrumental**	Detected only on seismographs	< 0.0017	< 4.2
II	**Feeble**	Some people feel it	0.0018 – 0.014	
III	**Slight**	Felt by people resting; like a truck rumbling by		
IV	**Moderate**	Felt by people walking	0.015 – 0.039	

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	PGA (g)	RICHTER SCALE MAGNITUDE
V	Slightly Strong	Sleepers awake; church bells ring	0.040 – 0.092	< 4.8
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves	0.093 – 0.18	< 5.4
VII	Very Strong	Mild alarm, walls crack, plaster falls	0.19 – 0.34	< 6.1
VIII	Destructive	Moving cars uncontrollable, masonry fractures, poorly constructed buildings damaged	0.34 – 0.65	< 6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open	0.65 – 1.24	
X	Disastrous	Ground cracks profusely, many buildings destroyed, liquefaction and landslides widespread	> 1.24	< 7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed, general triggering of other hazards	> 1.24	< 8.1
XII	Catastrophic	Total destruction, trees fall, ground rises and falls in waves	> 1.24	> 8.1

Table 21. Notable earthquake events in Colorado (1870-2015)

Date	Location	Magnitude	Intensity
1870	Pueblo/Ft. Reynolds	-	VI
1871	Lily Park, Moffat County	-	VI
1880	Aspen	-	VI
1882	North central Colorado	6.6*	VII
1891	Axial Basin (Maybell)	-	VI

Date	Location	Magnitude	Intensity
1901	Buena Vista	-	VI
1913	Ridgeway Area	-	VI
1944	Montrose/Basalt	-	VI
1955	Lake City	-	VI
1960	Montrose/Ridgeway	5.5	V
1966	NE of Denver	5.0	V
1966	CO-NM border, near Dulce, NM	5.5	VII
1967	NE Denver	5.3	VII
1967	NE Denver	5.2	VI
2011	Southwest of Trinidad	5.3	VIII

*Estimated, based on historical felt reports
Source: Colorado Geological Survey

Fire - Wildland

Table 22. Historic Wildfire Events in Planning Area

Wildfire Name	Start Date	Total Acres
Narrows	9/5/2012	2.7
Sullivan Park	4/11/2010	6.3
Cedar Creek	8/15/2006	4.6
Jug Gulch	8/15/2006	15.4
Switchback	3/3/2006	9.0
Alexander 2	7/20/2005	4.4
Drake	7/16/2005	14.0
Alexandar	7/25/2003	1.0
Pallisade	5/30/2003	10.8
Sylvondale	7/7/2001	1.7
Bobcat	6/12/2000	10,599.0
Palisade	1/22/2000	15.0
Spruce Mountain	9/8/1998	1.0
Seam Rock	8/1/1994	1.0
Palisade	7/11/1994	1.0
	7/16/1991	11.0
	9/21/1989	10.0
	6/13/1988	3.0

Wildfire Name	Start Date	Total Acres
	6/8/1988	2.0
	8/16/1987	1.5
	7/29/1987	1.7
	8/5/1986	3.0
Alexander	2/5/2013	1.1
Wildfire Name	**Start Date**	**Total Acres**

Source: United States Geological Survey

Flood

Table 23. Communities participating in the FEMA NFIP

CID	COMMUNITY NAME	COUNTY	INITIAL FIRM IDENTIFIED	CURRENT EFFECTIVE MAP DATE	NFIP Policies
080101	Larimer County	Larimer	04/02/79	02/06/13	706
080103	City of Loveland	Larimer	09/01/78	02/06/13	116
080250	Town of Johnstown	Larimer/Weld	12/19/06	12/19/06	

*Participation status current as of May 2, 2016

Table 24. Communities Participating in the FEMA CRS

Community Number	Community Name	CRS Entry Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
080103	City of Loveland	10/1/10	7	15	5	Current
080101	Larimer County	10/1/92	10	0	0	Rescinded

Table 25. CRS premium discounts

Class	Discount	Class	Discount
1	45%	6	20%
2	40%	7	15%
3	35%	8	10%
4	30%	9	5%
5	25%	10	--
SFHA (Zones A, AE, A1-A30, V, V1-V30, AO, and AH): Discount varies depending on class. SHFA (Zones A99, AR/A, AR/AE. AR/A1-A30, AR/AH, and AR/AO): 10% discount for Classes 1-6; 5% discount for Classes 7-9.* Non-SFHA (Zones B, C, X, D): 10% discount for Classes 1-6; 5% discount for Classes 7-9. *In determining CRS premium discount, all AR and A99 Zones are treated as non-SFHAs.			

Table 26. Historical flood events in the planning area (1950-2015)

Date	Location	Hazard Type	Injuries	Deaths	Property Damage	Crop Damage
4/28/1999	E Larimer Co./NW Weld Co.	Flood	0	0	$0	$0
5/1/1999	E Larimer Co./NW Weld Co.	Flood	0	0	$200,000	$0
6/18/2003	SE Larimer Co.	Flash Flood	0	0	$0	$0
6/3/2005	Loveland	Flash Flood	0	0	$0	$0
7/4/2010	Masonville	Flash Flood	0	0	$10,000	$5,000
7/7/2012	Glen Haven	Flash Flood	0	0	$10,000	$25,000
9/12/2013	Drake, Loveland	Flash Flood	0	0	$65,000,000-$70,000,000*	$0
5/23/2014	Loveland	Flash Flood	0	0	$15,000	$0
6/11/2015	Loveland	Flash Flood	0	0	$10,000	$0
		Total	**0**	**0**	**$65,245,000 - $70,245,000**	**$30,000**

Source: NOAA (NCEI) / * - current estimates provided by Loveland

Hazardous Materials

Table 27. Hazardous Materials - Classes and Descriptions

Hazard Class	Description
Class 1: Explosives	1.1 mass explosion hazard 1.2 projectile hazard 1.3 minor blast/projectile/fire 1.4 minor blast 1.5 insensitive explosives 1.6 very insensitive explosives

Hazard Class	Description
Class 2: Compressed Gases	2.1 flammable gases 2.2 non-flammable compressed 2.3 poisonous
Class 3: Flammable Liquids	Flammable (flash point below 141°) Combustible (flash point 141°-200°
Class 4: Flammable Solids	4.1 flammable solids 4.2 spontaneously combustible 4.3 dangerous when wet
Class 5: Oxidizers and Organic Peroxides	5.1 Oxidizer 5.2 Organic Peroxide
Class 6: Toxic Materials	6.1 Material that is poisonous 6.2 Infectious Agents
Class 7: Radioactive Material	Radioactive I Radioactive II Radioactive III
Class 8: Corrosive Material	Destruction of the human skin Corrode steel at a rate of 0.25 inches per year
Class 9: Miscellaneous	A material that presents a hazard during shipment but does not meet the definition of the other classes

Landslide / Rockfall

Table 28. Historical Landslide Events in Larimer County

Date	Location	Length of Incident	Description
7/25/2004	Highway 14	Closed – 24 hours	Rockslide
7/14/2004	Highway 14	Closed – 24 hours	Rockslide
4/5/2002	Highway 34	Closed – 24 hours	Rockslide
6/19/1999	Highway 14	Closed – 21 days	Large rock/landslide
2/23/1993	Highway 14	Closed – 72 hours	Avalanche/rockslide
8/1/1989	Highway 34	Closed – 8 hours	Rockslide

Spring / Summer Storm

Table 29. Historic Damaging Thunderstorm Events around the Planning Area

Date	Location	Event Type	Injuries	Deaths	Property Damage	Crop Damage
5/28/1993	Punkin Center	Thunderstorm Wind	0	0	$50,000	0
5/28/1994		Thunderstorm Wind	8	0	$500	0
5/28/1994	Loveland	Thunderstorm Wind	1	0	$500	0
6/6/1994	Loveland	Thunderstorm Wind	0	0	$500	0

Date	Location	Event Type	Injuries	Deaths	Property Damage	Crop Damage
7/28/1996	FT COLLINS	Thunderstorm Wind	2	0	0	0
8/28/2001	LOVELAND	Thunderstorm Wind	2	0	0	0
7/2/2005	LOVELAND	Thunderstorm Wind	4	2	0	0
6/26/2009	FT COLLINS/LOVELAND	Thunderstorm Wind	0	0	$25,000	0
		Total	**17**	**2**	**$76,500**	**0**

Table 30. Historic Damaging Lightning Events around the Planning Area

Date	Location	Event Type	Injuries	Deaths	Property Damage	Crop Damage
6/4/1996	FORT COLLINS	Lightning	1	0	0	0
6/10/1996	FORT COLLINS	Lightning	0	0	$10,000	0
7/23/1996	LOVELAND	Lightning	2	0	0	0
8/2/1996	FORT COLLINS	Lightning	0	0	$50,000	0
10/16/1996	FORT COLLINS	Lightning	3	0	0	0
6/14/1997	LOVELAND	Lightning	0	0	$4,000	0
8/9/1998	ESTES PARK	Lightning	6	0	0	0
6/19/1999	LIVERMORE	Lightning	1	0	0	0
7/21/1999	ESTES PARK	Lightning	2	1	0	0
8/7/1999	ESTES PARK	Lightning	2	1	0	0
10/3/2000	ESTES PARK	Lightning	2	0	0	0
8/15/2001	LOVELAND	Lightning	0	1	0	0
5/31/2003	LOVELAND	Lightning	1	1	0	0
7/26/2003	POUDRE PARK	Lightning	1	0	0	0
8/3/2003	RED FEATHER LAKES	Lightning	1	0	0	0
7/3/2005	LOVELAND	Lightning	9	0	0	0
5/29/2007	FT COLLINS	Lightning	0	0	$2,000	0
5/29/2007	FT COLLINS	Lightning	0	0	$35,000	0
10/13/2007	FT COLLINS	Lightning	0	0	$1,000	0
6/3/2008	FT COLLINS	Lightning	0	0	$4,000	0
7/8/2008	DEER RIDGE	Lightning	3	0	0	0
7/24/2008	FT COLLINS	Lightning	0	2	0	0
7/20/2010	BERTHOUD	Lightning	0	0	0	$10,000
7/22/2010	LOVELAND	Lightning	0	0	$100,000	0
5/20/2011	FT COLLINS	Lightning	0	0	$1,000	0
6/16/2011	FT COLLINS	Lightning	0	0	$5,000	0
7/6/2011	ESTES PARK	Lightning	0	0	$5,000	0

Date	Location	Event Type	Injuries	Deaths	Property Damage	Crop Damage
7/5/2013	FT COLLINS	Lightning	0	0	0	$5,000
7/18/2013	DEER RIDGE	Lightning	1	0	0	0
7/18/2013	WELLINGTON	Lightning	9	0	0	0
7/11/2014	DEER RIDGE	Lightning	7	1	0	0
7/12/2014	DEER RIDGE	Lightning	4	1	0	0
		Total	**55**	**8**	**$217,000**	**$15,000**

Table 31. Historical Damaging Hail Events around the Planning Area

Date	Location	Event Type	Injuries	Deaths	Property Damage	Crop Damage
7/16/1994	Virginia Dale	Hail	0	0	0	$50,000
7/16/1994	Virginia Dale	Hail	0	0	0	$50,000
7/16/1994	Virginia Dale	Hail	0	0	$500,000	$50,000
7/16/1994	Fort Collins	Hail	0	0	$5,000	$500
7/16/1994	Virginia Dale	Hail	0	0	$50,000	$50,000
7/16/1994	Wellington	Hail	0	0	$50,0000	$50,000
7/16/1994	Wellington	Hail	0	0	$50,0000	$500,000
7/16/1994	Wellington	Hail	0	0	$50,000	$50,000
7/16/1994	Wellington	Hail	0	0	$500,000	$5,000
7/16/1994	Fort Collins	Hail	0	0	$50,000	$5,000
6/22/2009	WELLINGTON	Hail	0	0	0	$25,000
7/20/2009	DRAKES	Hail	0	0	0	$1,000,000
		Total	**0**	**0**	**$2,560,000**	**$1,835,500**

Table 32. Historically Damaging High Wind Events

Date	Event Type	Injuries	Deaths	Property Damage	Crop Damage
10/29/1996	High Wind	0	0	$5,200,000	0
4/8/1999	High Wind	0	0	$7,200,000	0
12/17/2000	High Wind	1	0	0	0
5/20/2001	High Wind	0	0	$36,000	0
10/29/2003	High Wind	0	0	$979,000	0
11/27/2007	High Wind	1	0	0	0
12/25/2008	High Wind	0	0	$50,000	0
12/31/2008	High Wind	0	0	$25,000	0

Date	Event Type	Injuries	Deaths	Property Damage	Crop Damage
8/2/2008	High Wind	6	0	0	0
1/1/2009	High Wind	0	0	$25,000	0
1/7/2009	High Wind	0	0	$5,000	0
1/27/2009	High Wind	0	0	$25,000	0
5/4/2010	High Wind	0	0	$10,000	$50,000
11/12/2011	High Wind	1	0	0	0
11/17/2013	High Wind	0	0	$10,000	0
	Total	**10**	**0**	$13,565,000	**$50,000**

Tornado

Table 33. Fujita Tornado Damage Scale

Fujita Scale			
F-Scale Number	**Intensity Phrase**	**Wind Speed**	**Type of Damage**
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages signboards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.

Fujita Scale			
F-Scale Number	**Intensity Phrase**	**Wind Speed**	**Type of Damage**
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

Table 34. Enhanced Fujita (EF) Scale

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential Damage**
EFo	65-85	**Light damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136-165	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential Damage**
EF_5	>200	**Incredible damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yds.); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Table 35. Institutional Building Damages

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	59-88 MPH (72 MPH)
Loss of roof covering (<20%)	72-109 MPH (86 MPH)
Damage to penthouse roof and walls, loss of rooftop HVAC equipment	75-111 MPH (92 MPH)
Broken glass in windows or doors	78-115 MPH (95 MPH)
Uplift of lightweight roof deck and insulation, significant loss of roofing material (>20%)	95-136 MPH (114 MPH)
Façade components torn from structure	97-140 MPH (118 MPH)
Damage to curtain walls or other wall cladding	110-152 MPH (131 MPH)
Uplift of pre-cast concrete roof slabs	119-163 MPH (142 MPH)
Uplift of metal deck with concrete fill slab	118-170 MPH (146 MPH)
Collapse of some top building envelope	127-172 MPH (148 MPH)
Significant damage to building envelope	178-268 MPH (210 MPH)

Table 36. Educational Institution (Elementary/High Schools) Damages

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	55-83 MPH (68 MPH)
Loss of roof covering (<20%)	66-99 MPH (79 MPH)
Broken windows	71-106 MPH (87 MPH)

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Exterior door failures	83-121 MPH (101 MPH)
Uplift of metal roof decking; significant loss of roofing material (>20%); loss of rooftop HVAC	85-119 MPH (101 MPH)
Damage to or loss of wall cladding	92-127 MPH (108 MPH)
Collapse of tall masonry walls at gym, cafeteria, or auditorium	94-136 MPH (114 MPH)
Uplift or collapse of light steel roof structure	108-148 MPH (125 MPH)
Collapse of exterior walls in top floor	121-153 MPH (139 MPH)
Most interior walls of top floor collapsed	133-186 MPH (158 MPH)
Total destruction of a large section of building envelope	163-224 MPH (192 MPH)

Table 37. Metal Building System Damages

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	54-83 MPH (67 MPH)
Inward or outward collapsed of overhead doors	75-108 MPH (89 MPH)
Metal roof or wall panels pulled from the building	78-120 MPH (95 MPH)
Column anchorage failed	96-135 MPH (117 MPH)
Buckling of roof purlins	95-138 MPH (118 MPH)
Failure of X-braces in the lateral load resisting system	118-158 MPH (138 MPH)
Progressive collapse of rigid frames	120-168 MPH (143 MPH)
Total destruction of building	132-178 MPH (155 MPH)

Table 38. Electric Transmission Line Damages

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	70-98 MPH (83 MPH)
Broken wood cross member	80-114 MPH (99 MPH)
Wood poles leaning	85-130 MPH (108 MPH)
Broken wood poles	98-142 MPH (118 MPH)

Table 39. Historical Tornado Touchdowns

DATE	LOCATION	EF SCALE	INJURIES	DEATHS	ESTIMATED PROPERTY DAMAGE	ESTIMATED CROP DAMAGE
7/7/1983		F1	0	0	$30	0
8/2/1985		F1	0	0	0	0
6/25/1988		F1	0	0	0	0
6/22/1991		F0	0	0	0	0
5/28/1993		F0	0	0	0	0
	TOTALS:		**0**	**0**	**$30**	**0**

Winter Storm

Table 40. Historic Damaging Winter Storm Events in the Planning Area

Date	Location	Event Type	Injuries	Death	Property Damage	Crop Damage
3/17/2003	LARIMER and BOULDER COUNTIES BETWEEN 6000 and 9000 FEET (ZONE)	Winter Storm	0	0	$15,500,000	0
3/17/2003	LARIMER COUNTY BELOW 6000 FEET / NW WELD COUNTY (ZONE)	Blizzard	0	0	$15,500,000	0
9/4/2004	LARIMER and BOULDER COUNTIES BETWEEN 6000 and 9000 FEET (ZONE)	Winter Weather	1	0	0	0
		Total	**1**	**0**	**$15,500,000**	**0**

Appendix F: Public Hazard Risk Perceptions Survey

City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

All On Forum Responses sorted chronologically

As of July 25, 2016, 12:15 PM

Open City Hall is not a certified voting system or ballot box. As with any public comment process, participation in Open City Hall is voluntary. The responses in this record are not necessarily representative of the whole population, nor do they reflect the opinions of any government agency or elected officials.

City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

As of July 25, 2016, 12:15 PM, this forum had:

Attendees:	169
On Forum Responses:	63
All Responses:	131
Hours of Public Comment:	6.6

This topic started on June 30, 2016, 6:37 PM.

City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

Responses

Do you live in the City of Loveland, outside of the City but in the LFRA district, or elsewhere?

	%	Count
Loveland	94.5%	52
LFRA-outside of City	5.5%	3

How many times has a natural hazard disrupted your daily life in the last five years?

	%	Count
0 times	17.7%	11
1-2 times	64.5%	40
3-5 times	16.1%	10
More than 5 times	1.6%	1

Please rank the following hazards based on the overall risk that they present.

Drought

	%	Count
1 Highest risk	23.8%	15
2 Moderate risk	52.4%	33
3 Lowest risk	19.0%	12

Earthquake

	%	Count
2 Moderate risk	9.5%	6
3 Lowest risk	84.1%	53

Extreme temperatures (heat and cold)

All On Forum Responses sorted chronologically

As of July 25, 2016, 12:15 PM http://www.peakdemocracy.com/3797 Page 3 of 134

City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

	%	Count
1 Highest risk	20.6%	13
2 Moderate risk	39.7%	25
3 Lowest risk	31.7%	20

Flooding (including dam/levee failure)

	%	Count
1 Highest risk	57.1%	36
2 Moderate risk	27.0%	17
3 Lowest risk	12.7%	8

Expansive soils/Undermined areas

	%	Count
1 Highest risk	3.2%	2
2 Moderate risk	46.0%	29
3 Lowest risk	46.0%	29

Severe storms (hail, lightening)

	%	Count
1 Highest risk	47.6%	30
2 Moderate risk	36.5%	23
3 Lowest risk	11.1%	7

Public health hazards (including invasive species, pests)

	%	Count
1 Highest risk	12.7%	8
2 Moderate risk	58.7%	37

All On Forum Responses sorted chronologically

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City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

	%	Count
3 Lowest risk	23.8%	15

Tornado and severe wind

	%	Count
1 Highest risk	38.1%	24
2 Moderate risk	41.3%	26
3 Lowest risk	17.5%	11

Winter storm

	%	Count
1 Highest risk	41.3%	26
2 Moderate risk	47.6%	30
3 Lowest risk	9.5%	6

Wildland fire

	%	Count
1 Highest risk	36.5%	23
2 Moderate risk	39.7%	25
3 Lowest risk	19.0%	12

How concerned are you about the following scenarios?

Not having enough food during a disaster

	%	Count
1 Not concerned	30.2%	19
2 Somewhat concerned	55.6%	35

All On Forum Responses sorted chronologically

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City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

	%	Count
3 Extremely concerned	12.7%	8

Not having access to clean water during a disaster

	%	Count
1 Not concerned	9.5%	6
2 Somewhat concerned	49.2%	31
3 Extremely concerned	41.3%	26

Not having access to medications during a disaster

	%	Count
1 Not concerned	42.9%	27
2 Somewhat concerned	31.7%	20
3 Extremely concerned	23.8%	15

Not having access to transportation in the event of an evacuation

	%	Count
1 Not concerned	57.1%	36
2 Somewhat concerned	28.6%	18
3 Extremely concerned	11.1%	7
4 I don't know/No opinion	1.6%	1

Not having power for an extended period of time

	%	Count
1 Not concerned	14.3%	9
2 Somewhat concerned	41.3%	26
3 Extremely concerned	41.3%	26

All On Forum Responses sorted chronologically

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City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

Not understanding/hearing warning sirens or other warning messages

	%	Count
1 Not concerned	41.3%	26
2 Somewhat concerned	39.7%	25
3 Extremely concerned	17.5%	11

Do you have a preparedness kit?

	%	Count
Yes	42.9%	27
No	54.0%	34
I don't know	3.2%	2

Have you taken any actions to make your home or neighborhood more resistant to hazards?

	%	Count
Yes	40.3%	25
No	46.8%	29
I don't know	12.9%	8

If you answered Yes to the previous question, please explain what you've done to make your home or neighborhood more resistant to hazards.

Answered	24
Skipped	39

around **backyard** clear crank debris down **drainage** **emergency** flood **food** **from** generator **house** keep **landscape** **least** made new power **powered** resistant roof **shingles** **trees** two **up** **water**

All On Forum Responses sorted chronologically

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City of Loveland Mitigation Master Plan - Public Risk Perception Survey

What are the greatest risks we face and what can we do as a community to build a strategy for reducing those risks in order to prevent or minimize losses and damage in the future?

What is the best way for your local emergency manager to contact you about future planning activities, surveys, meetings and announcements? Please select any options that would work well for you.

	%	Count
Newspaper announcements	40.3%	25
Social Media - Facebook and Twitter	61.3%	38
Radio announcements	35.5%	22
The City of Loveland and Larimer County websites	54.8%	34
Flyers and signs posted in public places	38.7%	24

Is there a better or additional way the emergency manager could contact you that was not previously mentioned?

Answered	39
Skipped	24

911 alerts amber **blast** **calls** cell church **direct** **e-mail** **email** **emails** **emergency** message messages **phone** **phones** **recycling** **reverse** similar text texts trash via

Do you have any additional comments?

Answered	21
Skipped	42

above **all** also any area areas **been** **communications** **conditions** disaster disasters do don **electric** from lines **lived** **loveland** near **neighborhood** **other** people plan **power** residents **s** such **system** t text than thanks **them** through **thus** **very** **what** **which**

All On Forum Responses sorted chronologically

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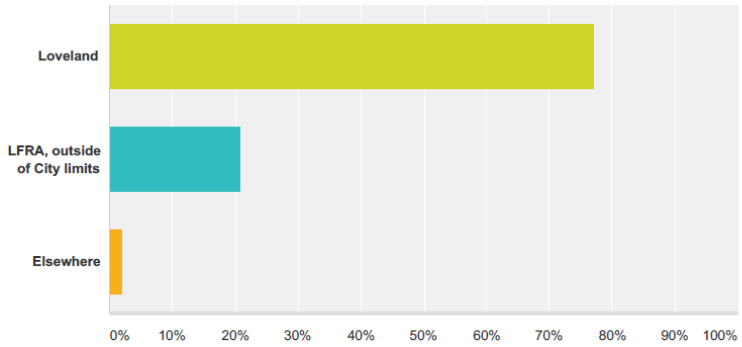
Q1 Do you live in the City of Loveland, outside of the City but in the LFRA district, or elsewhere?

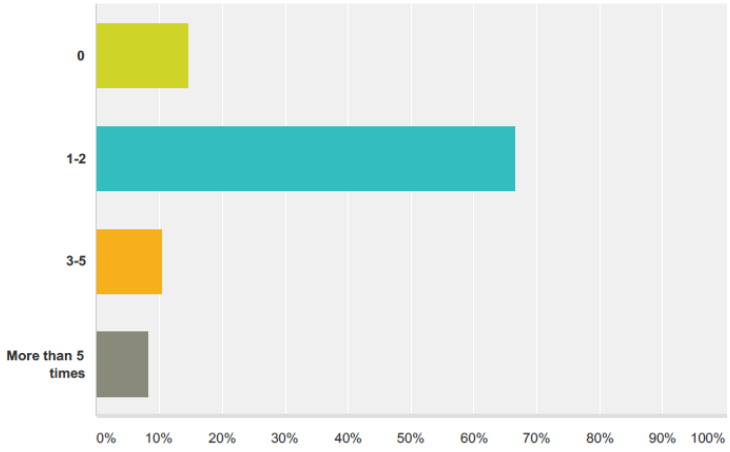
Answered: 48 Skipped: 0



Answer Choices	Responses	
Loveland	77.08%	37
LFRA, outside of City limits	20.83%	10
Elsewhere	2.08%	1
Total		48

Q2 How many times has a natural hazard disrupted your daily life in the last five years?

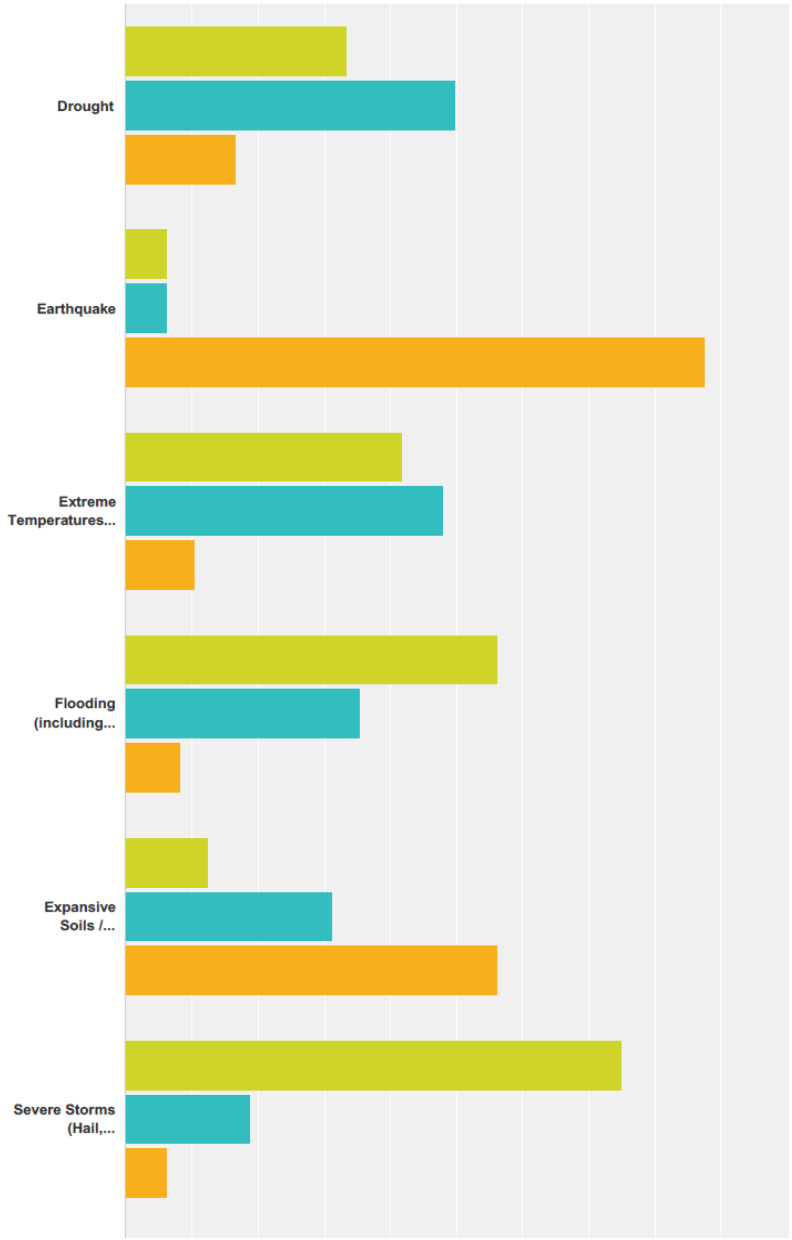
Answered: 48 Skipped: 0

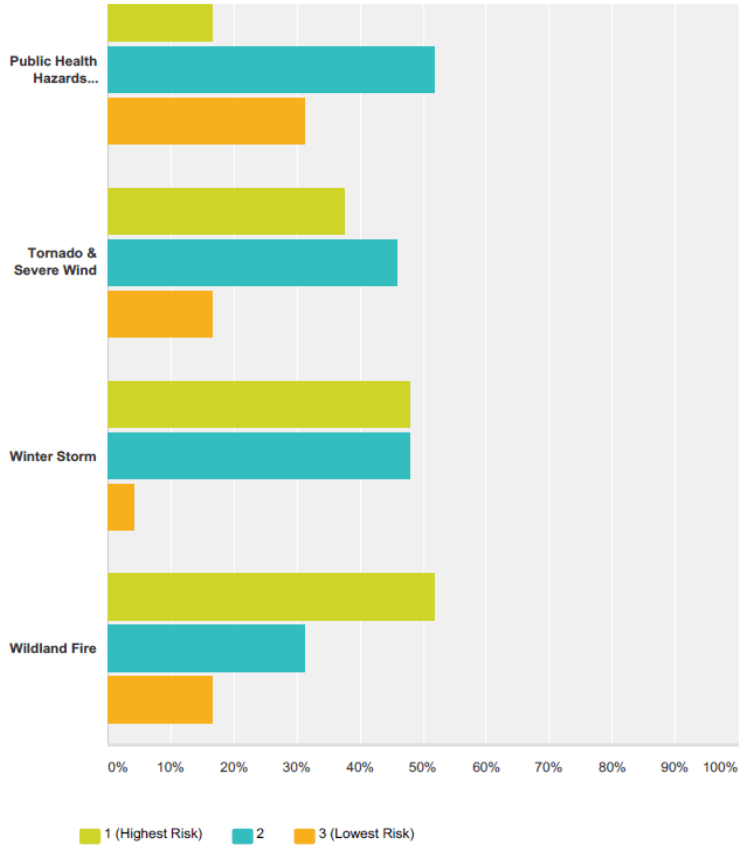


Answer Choices	Responses	
0	14.58%	7
1-2	66.67%	32
3-5	10.42%	5
More than 5 times	8.33%	4
Total		48

Q3 Please rank the following hazards based on the overall risk that they present.

Answered: 48 Skipped: 0



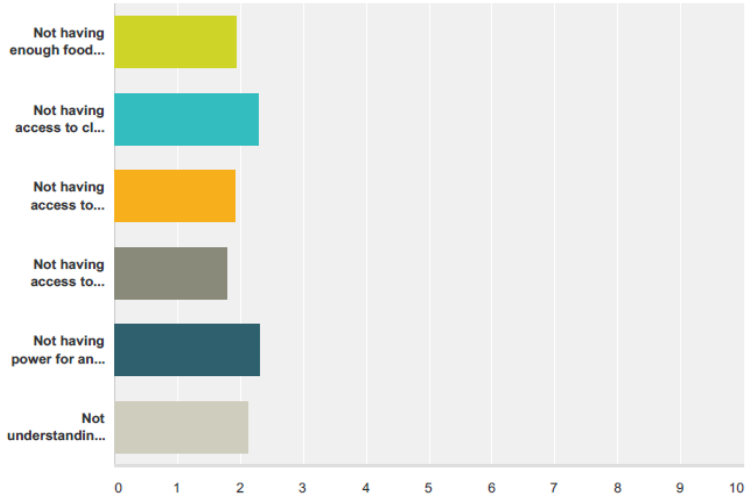


	1 (Highest Risk)	2	3 (Lowest Risk)	Total
Drought	**33.33%** 16	**50.00%** 24	**16.67%** 8	48
Earthquake	**6.25%** 3	**6.25%** 3	**87.50%** 42	48
Extreme Temperatures (Heat / Cold)	**41.67%** 20	**47.92%** 23	**10.42%** 5	48
Flooding (including dam/levee failure)	**56.25%** 27	**35.42%** 17	**8.33%** 4	48
Expansive Soils / Undermined Areas	**12.50%** 6	**31.25%** 15	**56.25%** 27	48
Severe Storms (Hail, Lightning)	**75.00%** 36	**18.75%** 9	**6.25%** 3	48
Public Health Hazards (including Invasive Species and Pests)	**16.67%** 8	**52.08%** 25	**31.25%** 15	48

Tornado & Severe Wind	**37.50%** 18	**45.83%** 22	**16.67%** 8	48
Winter Storm	**47.92%** 23	**47.92%** 23	**4.17%** 2	48
Wildland Fire	**52.08%** 25	**31.25%** 15	**16.67%** 8	48

Q4 How concerned are you about the following scenarios?

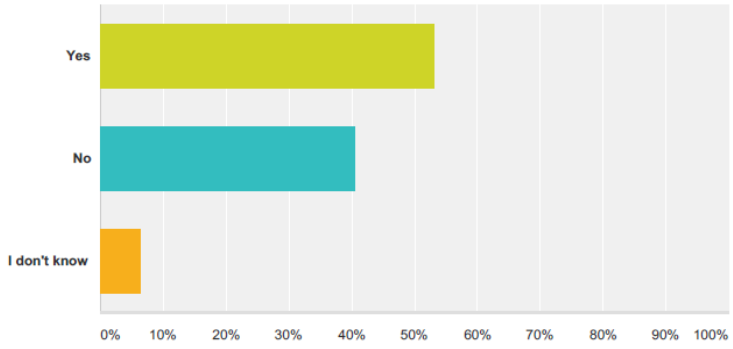
Answered: 48 Skipped: 0



	Not Concerned	Somewhat Concerned	Extremely Concerned	I don't know/no opinion	Total	Weighted Average
Not having enough food during a disaster	**25.00%** 12	**58.33%** 28	**14.58%** 7	**2.08%** 1	48	1.94
Not having access to clean water during a disaster	**10.42%** 5	**52.08%** 25	**35.42%** 17	**2.08%** 1	48	2.29
Not having access to medications during a disaster	**33.33%** 16	**45.83%** 22	**16.67%** 8	**4.17%** 2	48	1.92
Not having access to transportation in the event of an evacuation	**43.75%** 21	**37.50%** 18	**14.58%** 7	**4.17%** 2	48	1.79
Not having power for an extended period of time	**14.58%** 7	**39.58%** 19	**45.83%** 22	**0.00%** 0	48	2.31
Not understanding/hearing warning sirens or other warning messages	**20.83%** 10	**47.92%** 23	**29.17%** 14	**2.08%** 1	48	2.13

Q5 Do you have a preparedness kit?

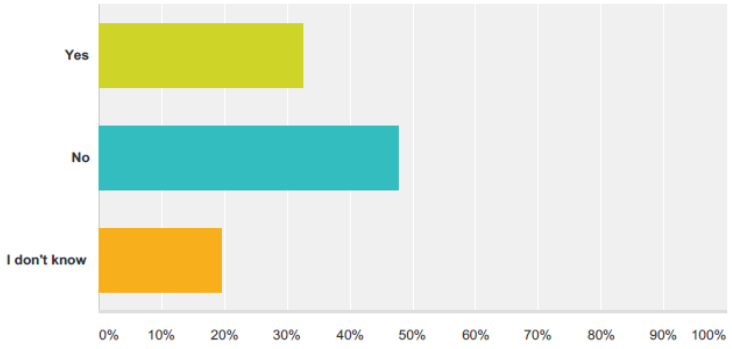
Answered: 47 Skipped: 1



Answer Choices	Responses	
Yes	53.19%	25
No	40.43%	19
I don't know	6.38%	3
Total		47

Q6 Have you taken any actions to make your home or neighborhood more resistant to hazards?

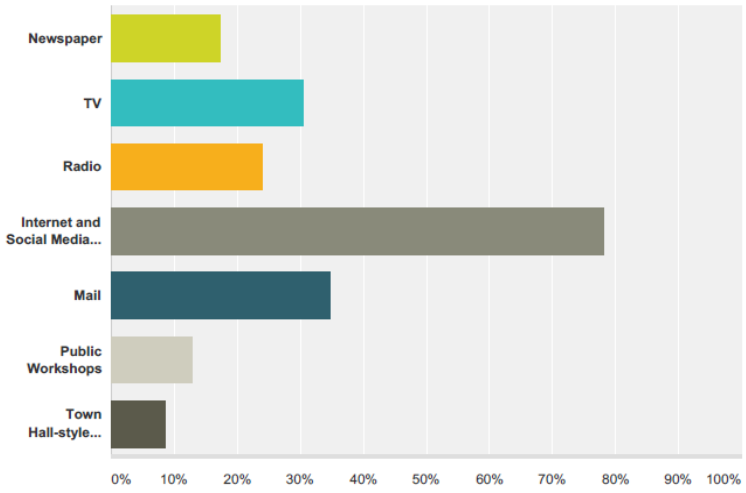
Answered: 46 Skipped: 2



Answer Choices	Responses	
Yes	32.61%	15
No	47.83%	22
I don't know	19.57%	9
Total		46

Q7 What is the most effective way for you to receive information about how to make your home and neighborhood more resistant to hazards (you may select more than one)?

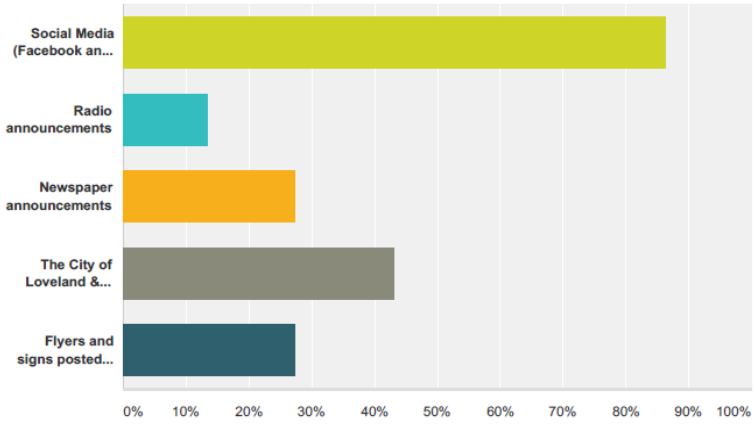
Answered: 46 Skipped: 2



Answer Choices	Responses	
Newspaper	17.39%	8
TV	30.43%	14
Radio	23.91%	11
Internet and Social Media (Twitter, Facebook)	78.26%	36
Mail	34.78%	16
Public Workshops	13.04%	6
Town Hall-style Meetings	8.70%	4
Total Respondents: 46		

Q8 What is the best way for your local emergency manager to contact you about future planning activities, surveys, meetings, and announcements? Please select any options that would work well for you.

Answered: 44 Skipped: 4

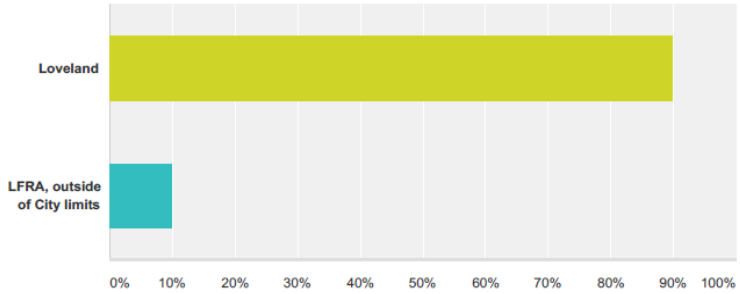


Answer Choices	Responses	
Social Media (Facebook and Twitter)	86.36%	38
Radio announcements	13.64%	6
Newspaper announcements	27.27%	12
The City of Loveland & Larimer County Websites	43.18%	19
Flyers and signs posted in public places	27.27%	12
Total Respondents: 44		

Appendix G: Business Hazard Preparedness & Recovery Survey

Q1 Is your business in the City of Loveland or outside of the City but in the LFRA district?

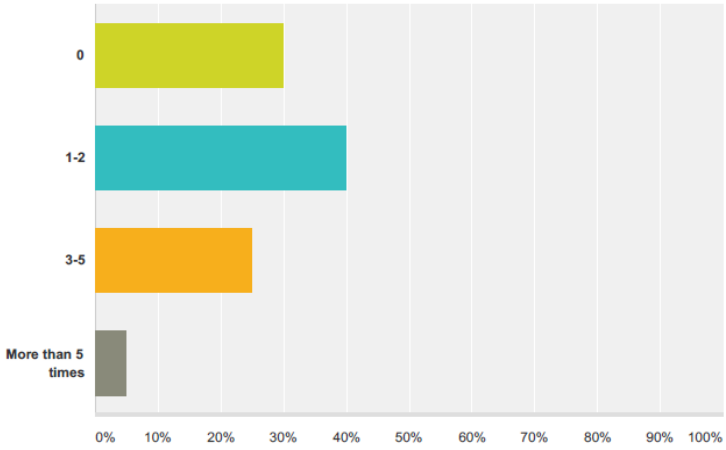
Answered: 20 Skipped: 0



Answer Choices	Responses	
Loveland	90.00%	18
LFRA, outside of City limits	10.00%	2
Total		20

Q2 How many times has a natural hazard disrupted your business in the last five years?

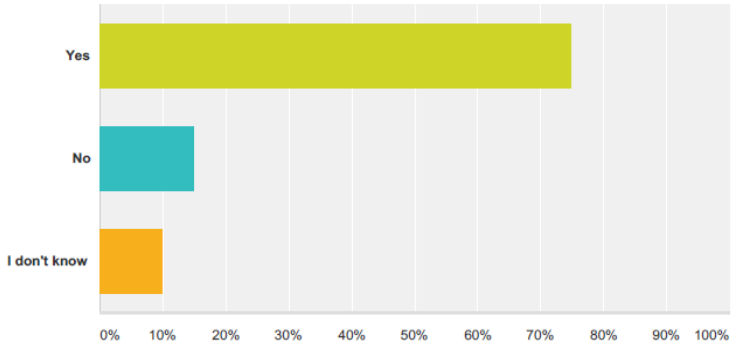
Answered: 20 Skipped: 0



Answer Choices	Responses	
0	30.00%	6
1-2	40.00%	8
3-5	25.00%	5
More than 5 times	5.00%	1
Total		20

Q3 Do you have an emergency preparedness kit at your business?

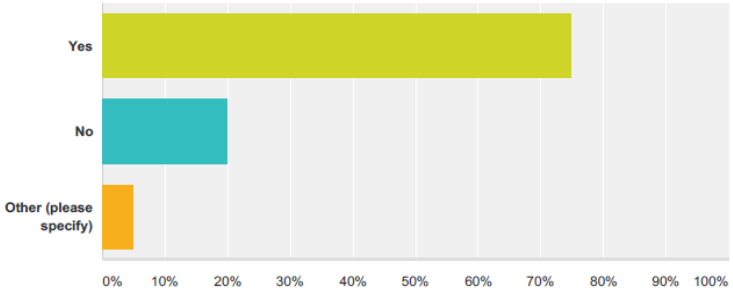
Answered: 20 Skipped: 0



Answer Choices	Responses	
Yes	75.00%	15
No	15.00%	3
I don't know	10.00%	2
Total		20

Q4 Does your business have a Continuity of Operations Plan (COOP)? (These plans are a collection of procedures and information for use by you to keep your business open during an emergency and to keep it open during disaster recovery.)

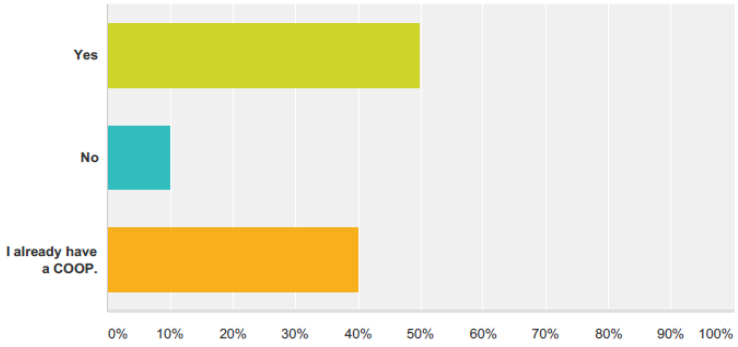
Answered: 20 Skipped: 0



Answer Choices	Responses	
Yes	75.00%	15
No	20.00%	4
Other (please specify)	5.00%	1
Total		20

Q5 Would you be interested in learning more about COOP planning?

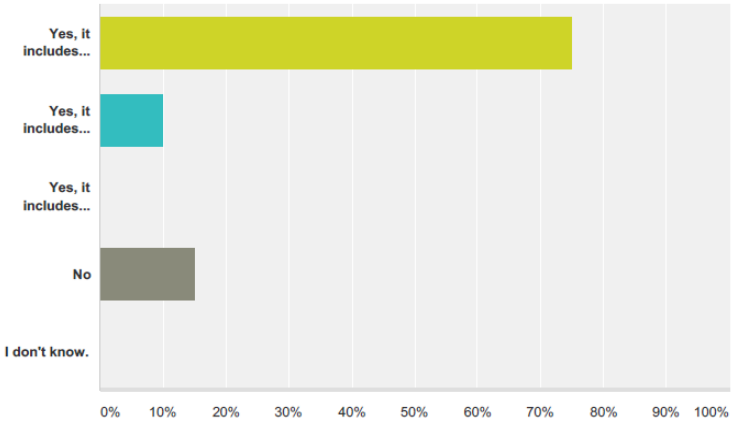
Answered: 20 Skipped: 0



Answer Choices	Responses	
Yes	50.00%	10
No	10.00%	2
I already have a COOP.	40.00%	8
Total		20

Q6 Does your business have an Emergency Plan?

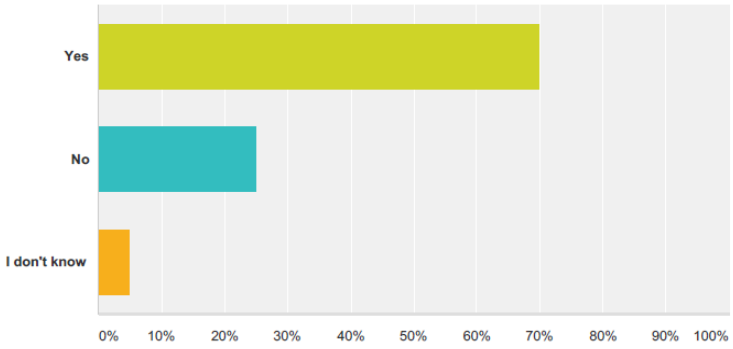
Answered: 20 Skipped: 0



Answer Choices	Responses	
Yes, it includes evacuation and shelter-in-place directions	75.00%	15
Yes, it includes evacuation directions	10.00%	2
Yes, it includes shelter-in-place directions	0.00%	0
No	15.00%	3
I don't know.	0.00%	0
Total		20

Q7 Have you taken any actions to make your business more resistant to hazards? (i.e. - floodproofing, relocating inventory/vital records, etc.)

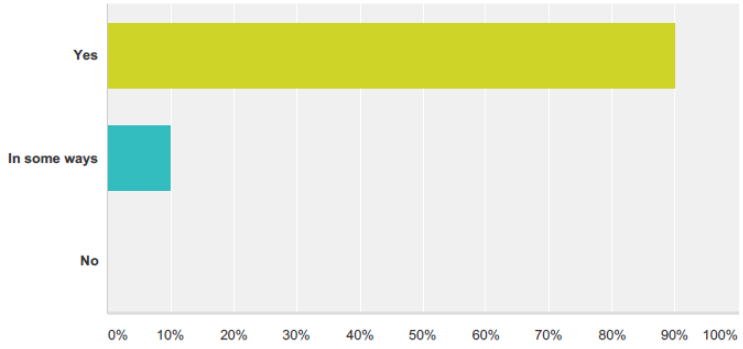
Answered: 20 Skipped: 0



Answer Choices	Responses	
Yes	70.00%	14
No	25.00%	5
I don't know	5.00%	1
Total		20

Q8 Is your business prepared to assist customers during a disaster event, both those potentially on-site or those off-site? (i.e. - extended service hours, mobile services, etc.)

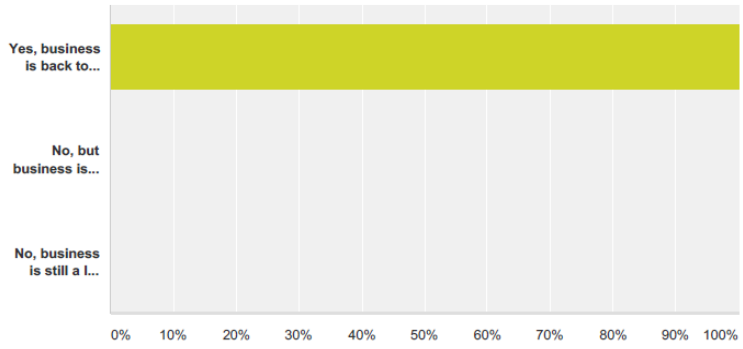
Answered: 20 Skipped: 0



Answer Choices	Responses	
Yes	90.00%	18
In some ways	10.00%	2
No	0.00%	0
Total		20

Q9 If your business was impacted by the 2013 flooding, do you feel you are now fully recovered?

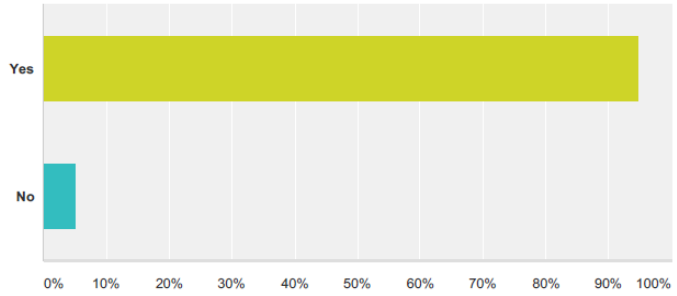
Answered: 19 Skipped: 1



Answer Choices	Responses	
Yes, business is back to normal.	100.00%	19
No, but business is getting close to normal.	0.00%	0
No, business is still a long way to full recovery.	0.00%	0
Total		19

Q10 Does your business feel current communications from the City in times of disaster are adequate?

Answered: 19 Skipped: 1



Answer Choices	Responses	
Yes	94.74%	18
No	5.26%	1
Total		19

Business Hazard Preparedness & Recovery Survey

Q11 Do you have any recommendations for how the City could help businesses better prepare for and recover from disasters?

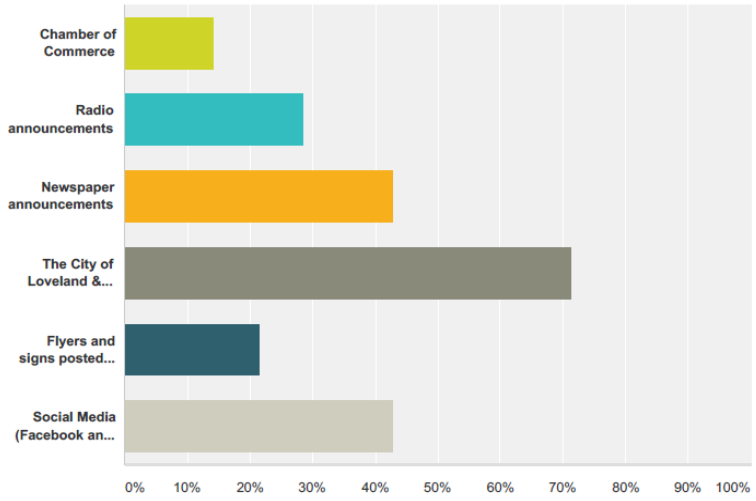
Answered: 3 Skipped: 17

Responses:

- No
- Make training seminars available for local businesses
- Keep up the great work!

Q12 What is the best way for your local emergency manager to contact your business about future planning activities, emergency preparedness, disaster recovery, and announcements? Please select any options that would work well for you.

Answered: 14 Skipped: 6



Answer Choices	Responses	
Chamber of Commerce	14.29%	2
Radio announcements	28.57%	4
Newspaper announcements	42.86%	6
The City of Loveland & Larimer County Websites	71.43%	10
Flyers and signs posted in public places	21.43%	3
Social Media (Facebook and Twitter)	42.86%	6
Total Respondents: 14		

The password to the public access wireless network (colguest...