## Section 1: Introduction

Barton County Electric Cooperative (BCEC) was established in 1937 to provide electric service to the rural areas of southwest Missouri. A Touchstone Energy Cooperative, BCEC is headquartered in Lamar, Missouri, and provides service to customers in Barton, Vernon, Jasper and Dade counties in Missouri. The cooperative is run by a board of nine directors which approve the company's mission and internally developed business policy:

> *"Barton County Electric Cooperative is dedicated to providing our members with a reliable, competitively-priced, high quality supply of electric energy, while adhering to cooperative principles and striving to improve the quality of life for all members through a highly trained, efficient staff."*

BCEC's service boundaries within the state of Missouri include Barton County in its entirety as well as the southern portion of Vernon County, the northern portion of Jasper County and the western portion of Dade. The cooperative owns 1,832 miles of distribution line within these counties. Figure 1 depicts the geographic boundaries of the cooperative in relation to USGS local quadrangles within the state of Missouri. *(Map sources: www.usgs.gov,*

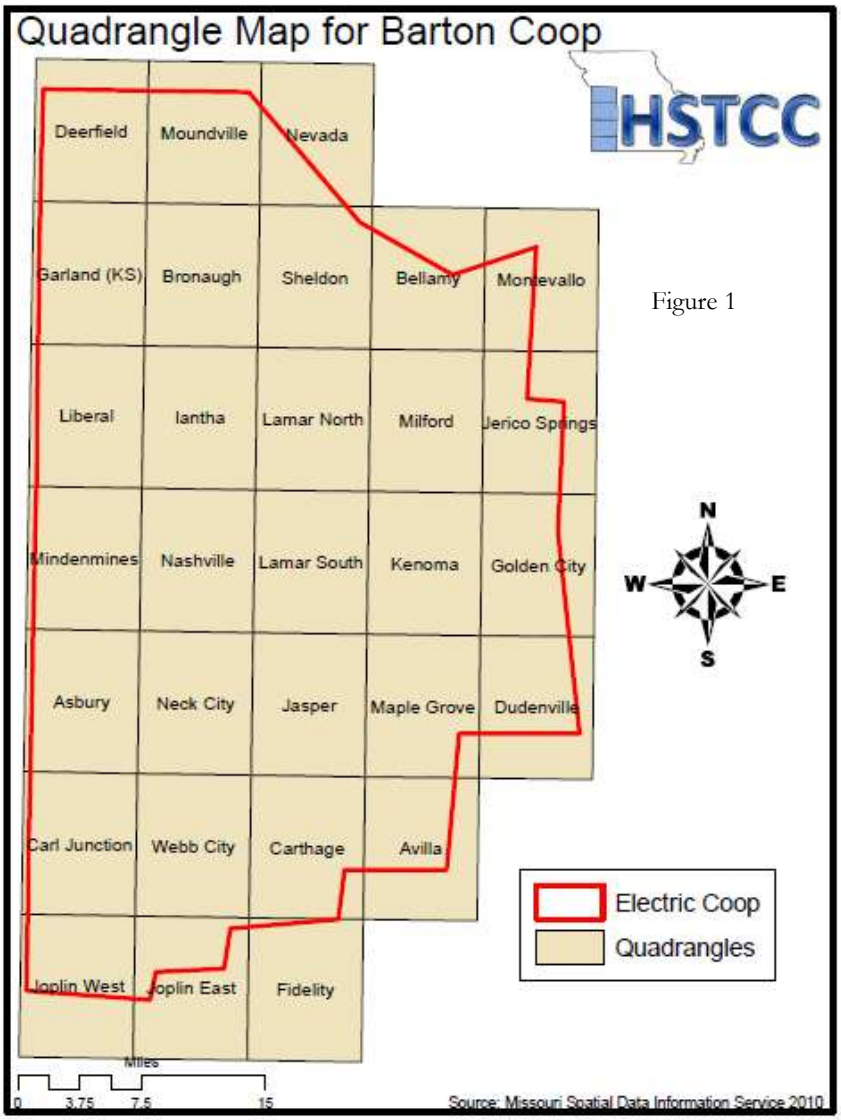



Figure 1

*Association of Missouri Electric Cooperatives, Barton County Electric Cooperative.)*

The customer base of BCEC is currently 6,466 members in the 4 counties of service. Residential customers account for 77.8% of memberships (5,033 members); while non-residential customers make up the remaining 22.2% (1,433 members). Table 1.1 provides the summary of metered customers by Missouri county.

| **Table 1.1** | **Meters by Missouri County** |
|---|---|
| **County** | **Number of meters** |
| Barton | 2,568 |
| Jasper | 1,811 |
| Vernon | 1,904 |
| Dade | 183 |
| Total | 6,466 |

The average daily customer usage for BCEC is 62 kilowatt-hours (kWh). Annual total usage of BCEC customers in 2010 was 146,293,394 kWh of service. Population density for the cooperative service area is depicted in Figure 2 (*Map source: MSDIS*).

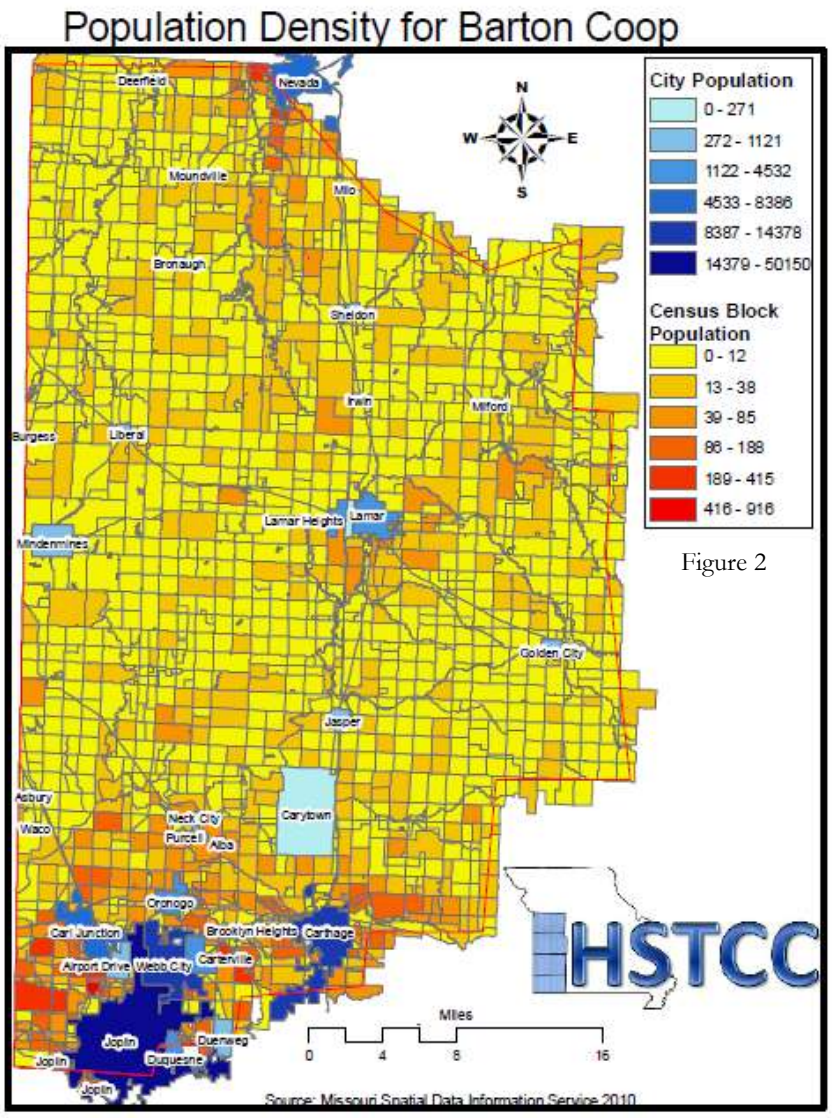



Figure 2

## Section 2: Planning process

Through a partnership between the Association of Missouri Electric Cooperatives and the Missouri Association of Councils of Government, the Harry S Truman Coordinating Council was contracted to facilitate a hazard mitigation planning process for BCEC. The initial meeting between the two entities was held on February 4, 2011 as part of a regional kick-off meeting for central Missouri. This informational meeting provided the basic responsibilities for each agency and allowed for initial discussion concerning the project timelines, data collection and other pertinent topics. Additional information was provided by Barton County staff via email, such as business structure, customer information, critical facilities information, and asset inventory by type and location.

One formal meeting was held at the BCEC offices in Lamar, Missouri on October 26, 2011. Table 1.2 summarizes the attendees and topics of each meeting. Meeting minutes are available in the chapter appendix.

| Table 1.2 | BCEC Planning Meeting Synopsis | |
|---|---|---|
| **Meeting Date** | **Attendees, Title, Organization** | **Topics of discussion** |
| Ongoing communication via email | Bobbi Anne Jeffries, CEO/General Manager<br>Rusty Endicott, Safety Coordinator<br>Gloria Bottom, HSTCC staff | BCEC business structure<br>Customer information<br>Critical facilities information<br>Asset inventory by type and location |
| October 26, 2011 | Chuck Wolfe, Line Superintendant<br>Shawna Phipps, Executive Assistant<br>Gloria Bottom, HSTCC staff | Data collection review<br>Current mitigation strategies<br>Establishment of goals, actions, and objectives<br>Method of prioritization<br>Prioritization of goals, actions, and objectives |

*Public Involvement*

As with all public hazard mitigation plans, public involvement was encouraged through a variety of methods. BCEC chapter was posted to the company's website and HSTCC website, inviting both cooperative members and the general public to provide comment. Print copies of the chapter were also made available upon request through their local offices. Comments from neighboring jurisdictions were also solicited using the standardized AMEC letter which was mailed to the appropriate contacts, including:

- Barton County Commission,
- Dade County Commission,
- Jasper County Commission,
- Vernon County Commission,
- local emergency management directors, and
- the local Red Cross chapter.

BCEC provides service to three large industrial centers, Murphy Family Ventures, Tamko Building Products, and Archer Daniels Midland. Additionally, BCEC's mitigation plan was included in the public comment period for the combined AMEC plan.

## Section 3: Asset inventory

Barton County Electric Cooperative has a wide variety of assets by type. Real estate owned by the company includes office buildings, warehouses, garages, and other outbuildings throughout the service area. Thirty-one vehicles provide access to customers and infrastructure. BCEC does not own any electric generation or

transmission infrastructure. 1871 miles of distribution lines are owned and maintained by BCEC. Table 1.3 provides information concerning total asset valuation.

**Table 1.3 Barton County Asset Inventory Valuation Summary**

| Asset | Total Replacement Cost | Cost breakdown |
|---|---|---|
| Total BCEC Assets | $39,038,367.35 | Buildings and vehicles - $4,615,963.00<br>Overhead assets - $30,656,328.21<br>Underground assets - $3,766,076.14 |
| Distribution Lines | $6,586,313.18 OH<br>$1,859,887.00 UG | OH Single-phase lines - $2,646,247.50<br>UG Single-phase lines - $632,413.00<br>OH Three-phase lines - $3,940,064.68<br>UG Three-phase lines - $1,227,474.00 |
| Supporting Infrastructure | $24,070,016.03 OH<br>$1,906,189.14 UG | OH Meters - $ 1,963,988.65<br>UG Meters - $ 115,740.30<br>Poles - $ 9,101,685.66<br>OH Transformers - $ 5,043,770.74<br>UG Transformers - $ 1,615,197.60<br>Guys/Anchors - $ 1,378,155.10<br>Cross-arms - $ 1,395,235.04<br>Regulators - $ 337,914.95<br>SP Oil-Circuit Reclosures - $ 786,255.33<br>3phase Oil-Circuit Reclosures - $ 411,741.90<br>Capacitors - $ 142,910.50<br>Security Lights - $534,532.74<br>OH Meter Loops - $2,973,825.42<br>UG Meter Loops - $175,251.24 |
| Buildings | $1,847,815 | Offices - $1,847,815 |
| Warehouses | $ 948,157 | |
| Vehicles | $ 1,819,991 | |

*Source: Internal Barton County Accounting and Insurance records, 2011*

Ensuring quality distribution to its customers, Barton County maintains not only distribution lines, but also the supporting infrastructure as well. Table 1.4 includes a list of asset types, emergency replacement cost per unit or mile, the asset inventory by service county, and total infrastructure numbers.

| Table 1.4 | Barton County Asset Inventory by service county | | | | | |
|---|---|---|---|---|---|---|
| **Asset** | **Emergency Replacement Cost per unit or mile** | **Number of units or miles: BARTON** | **Number of units or miles: DADE** | **Number of units or miles: JASPER** | **Total number of units or miles: VERNON** | **Total number of units or miles:** |
| Meter | $326.95/unit<br>$326.95/unit | 2,465 OH<br>130 UG | 202 OH | 1,575 OH<br>155 UG | 1,765 OH<br>69 UG | 60354 UG07 OH |
| Pole | $235.74/unit | 15,830 | 1,158 | 11,583 | 10,038 | 38,609 |
| SP*** distribution line | $1,867.50 /mile OH ($25,296.52 /mile UG) | 580 OH**<br>10 UG*** | 44 OH**<br>1 UG*** | 425 OH**<br>8 UG*** | 368 OH**<br>6 UG*** | 1417 OH<br>25 UG |
| TP**** distribution line | $9,889.66/ mile OH ($122,747.40 /mile UG) | 163 OH**<br>4 UG*** | 12 OH**<br>1 UG*** | 119 OH**<br>3 UG*** | 104 OH**<br>2 UG*** | 398 OH<br>10 UG |
| Transformers | $656.57 OH<br>$4,486.66 UG | 3,150 OH<br>126 UG | 230 OH | 2,305 OH<br>162 UG | 1,997 OH<br>72 UG | 7,682 OH<br>360 UG |
| Regulators | $3,975.47 | 33 | 0 | 32 | 20 | 85 |
| Oil Circuit Reclosures SP | $1,913.03 | 179 | 5 | 105 | 122 | 411 |
| OCR 3 Phase | $15,249.70 | 13 | 0 | 5 | 9 | 27 |
| Capacitors | $1,242.70 | 39 | 1 | 37 | 38 | 115 |
| Guys/Anchors | $70.70 | 7998 | 584 | 5845 | 5066 | 19,493 |
| Cross-Arms | $136.48 | 4191 | 307 | 3067 | 2658 | 10,223 |
| Meter Loops | $495.06 OH<br>$495.06 UG | 2,465 OH<br>130 UG | 202 OH<br>0 UG | 1,575 OH<br>155 UG | 1,765 OH<br>69 UG | 6,007 OH<br>3554 UG |
| Security Lights | 137.13 | 1,614 | 118 | 1,024 | 1,142 | 3,898 |
| Total Replacement Value by cnty | OH<br>UG | $12,602,117.31<br>$1,416,135.26 | $901,187.31<br>$148,043.92 | $8,932,941.43<br>1,424,864.83 | $8,220,082.16<br>$777,032.13 | $30,656,328.21<br>$3,766,076.14 |
| **OH = overhead ***UG = underground ***SP = Single phase ****TP – Three phase<br>*Source: Internal Barton County Accounting and Maintenance records* | | | | | | |

## Section 4: Identified Hazards and Risk Assessment Methodology

Natural hazards in southwest Missouri vary dramatically with regard to intensity, frequency, and the scope of impact. Some hazards, like earthquakes, happen without warning and do not provide any opportunity to prepare for the threat. Other hazards, such as tornadoes, flooding, or severe winter storms, provide a period of warning which allows for public preparation prior to their occurrence. Regardless, hazard mitigation planning can lessen the negative of any natural disaster regardless of onset time. The following natural hazards have been identified as potential threats for the service region of the Barton County Electric Cooperative:

- Tornadoes
- Severe Thunderstorms, Hail, and High Winds
- Flood
- Severe Winter Weather
- Earthquakes
- Dam Failure
- Wildfire

Likewise, a number of hazards may be eliminated from consideration in their local plan due to the state's geographic location including tsunamis, hurricanes, coastal storms, volcanic activity, avalanche, and tropical storms. Additionally, a number of hazards may be eliminated specifically for BCEC because of asset types and geographic location in the state of Missouri. Those hazards eliminated for the BCEC service region include:

- Drought
- Heat Wave
- Severe land subsidence
- Landslides
- Levee Failure

Although drought can potentially impact southwest Missouri, water availability does not directly impact the delivery of electric service to BCEC customers. Similarly, heat wave has been eliminated. Though it may result in additional usage and potentially tax the system, heat waves do not usually cause infrastructure damage to cooperative assets. The results of a heat wave in the BCEC service area may be considered cascading events rather than damage caused directly by the hazard itself. Land subsidence and landslides have also been eliminated based upon local soil structure categorization by the USGS. Limestone, carbonate rock, salt beds, and other naturally dissolving rock which are most susceptible to the formation of sinkholes are in karst areas. Barton County has few assets in the Springfield Plateau sub-province of the Ozarks Plateau, which is a major karst area. Because nearly all of BCEC assets are in the non-karst area of the Cherokee Plains and no assets have been affected by sinkholes, sinkholes will not be addressed in this planning process.

For the purpose of this risk assessment, the identified hazards for the BCEC service area have been divided into two categories: **historical and non-historical hazards**.

> **Historical Hazards** are those hazards with a measurable previous impact upon the service area. Damage costs per event and a chronology of occurrences are available. The associated vulnerability assessments utilize the number of events and cost of each event to establish an average cost per incident. For BCEC, hazards with historical data include tornadoes, severe thunderstorms/high wind/hail, flood and levee failure, severe winter weather, and wildfire.
>
> **Non-historical Hazards** are hazards with no previous record of impact upon the local service area. As such, the associated vulnerability assessments for each of these hazards will have an occurrence probability of less than 1% in any given year, but the extent of damage will vary considerably. For BCEC, hazards without historical data include earthquakes and dam failure.

*Probability of Occurrence*

In determining the potential frequency of occurrences, a simple formula was used. For historical events, the number of recorded events for the service area was divided by the

number of years of record. This number was then multiplied by 100 to provide a percentage. This formula was used to determine future probability for each hazard. For events that have not occurred, a probability of less than 1% was automatically assigned as the hazard cannot be excluded from the possibility of occurrence. Likewise, when discussing the probable risk of each hazard based upon historical occurrences, the following scale was utilized:

- Less than 1% chance of an event occurrence in any given year.
- 1-10% chance of an event occurrence in any given year
- 10-99% chance of an event occurrence in any given year
- Near 100% chance of an event occurrence in any given year

The number of occurrences was further refined to focus on damage-causing events. Those occasions which had reported damages were divided by the total number of recorded events to obtain a percentage of total storms which result in infrastructure damage. (Formula: Number of damage-causing events / total number of events = Percentage of occurrences which cause damage.)

*Potential Extent of Damage*

Vulnerability Assessment matrices for each hazard are included on the following pages. These worksheets detail loss estimates for each hazard affecting the cooperative's service area. Loss estimates were calculated using the asset summary created by internal BCEC accounting records. Each hazard has a unique impact upon the service area, requiring each hazard to utilize a different valuation amount depending upon the level of impact. Non-historical hazards assume damage to all general assets. For Historical Hazards, assets were divided into two groups based upon historical impact which were utilized in the hazard damage analysis:

- Overhead infrastructure assets and buildings
    - Used for Tornado damage assessments
    - Valued at $32,504,143
- Overhead infrastructure assets only
    - Used for:
        - Severe Thunderstorm / High Wind / Hail
        - Flood
        - Severe Winter Weather
    - Valued at $30,656,328

In addition, historical hazards with recorded damages were used to identify an average cost per event. (Formula: Total cost of damages / total number of events = Average damage cost per event.) When discussing the extent of potential damages for all hazards, the following scale was utilized:

- Less than 10% potential damages to total cooperative infrastructure
- 10-25% potential damages to total cooperative infrastructure

- 25-50% potential damages to total cooperative infrastructure
- More than 50% potential damages to total cooperative infrastructure

Regardless of hazard categorization, the following matrix (Table 1.5) will be utilized to identify the potential damage extent and likelihood of occurrence for each natural hazard type.

| **Table 1.5**<br><br>**Sample Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: _____** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | Near 100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

In many instances, natural hazard events occur without causing significant damage to the cooperative's infrastructure. The more significant impact of natural hazard episodes comes in the form of reported customer outages. The infrastructure may not be significantly harmed by an ice storm, but may result in prolonged and widespread outages in the cooperative's service area. In considering the potential impact of a hazard, loss of function provides a more concise picture for comparison of events and geographic regions of the state. In addition to system damage, each hazard will be evaluated on the average number of reported or estimated outages per event occurrence. (Formula: Average number of outages reported / Total number of customers = Average percentage of outages reported per event)

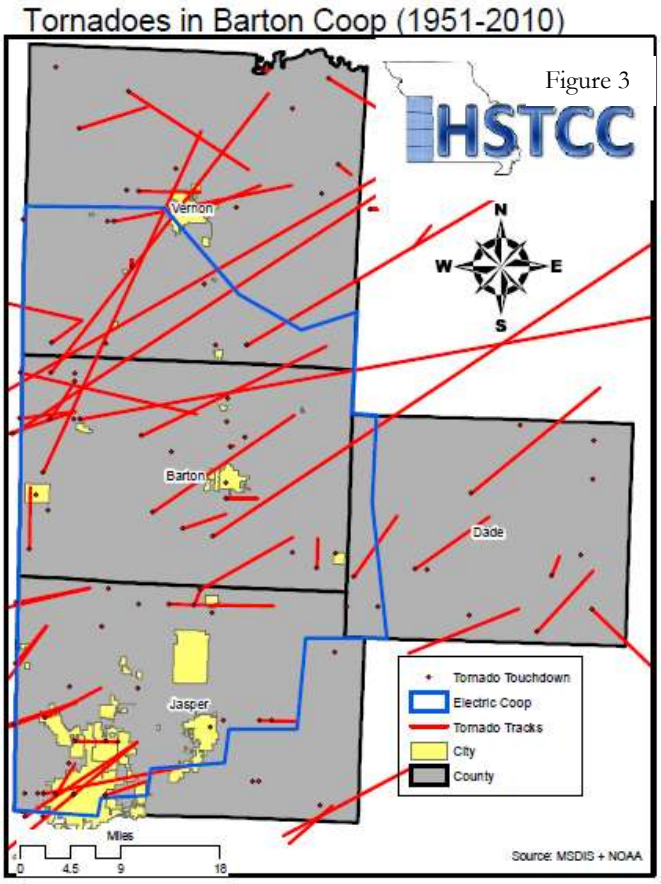
| **Table 1.6**<br><br>**Sample Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: _____** | | Probability of Damage-causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

## Section 5: Risk Assessment

### A) Historical Hazards:

*Tornadoes*

In the last 60 years, 58 tornadoes have been reported within the Barton County cooperative boundaries. Figure 3 provides a pictorial representation of all recorded tornado touchdown sites and recorded path. *(Data for map collected from NOAA and MSDIS.)*




A data insufficiency exists, however, between 1968 and 1998 in both historical hazard records and cooperative records concerning damage estimates. For the purpose of this assessment, the years for which records exist for both data sets have been used. From 1999-2010, Barton County's service area within the state of Missouri has experienced a total of 21 tornadic events. Using the previously described methodology, the probability of a tornadic event in the Barton County service area in any given year is near to 100% (21 events / 12 years = 175%). Estimated cooperative material damages associated with each of these events were compiled by BCEC staff. Three of the twenty-one occurrences caused damage to cooperative assets, resulting in a 14% probability that any given tornadic occurrence will produce damage (3/21 = 14%). Table 1.7 provides a summary of event dates, EF-scale ratings, damage cost estimates and outages reported. Only events with damages to the system are shown.

| Table 1.7 | Barton County Tornadic Event Summary | | |
|---|---|---|---|
| **Date of event** | **EF Scale rating** | **Damage estimates** | **Outages Reported** |
| 5/4/2003 | F3 | $130,791.03 | 8 |
| 5/4/2003 | F3 | $45,882.58 | 2 |
| 3/12/2006 | F1 | $30,687.11 | No outages |
| *Data provided based on internal BCEC records which reflect cost from the referenced event year.* | | | |

Based upon the last twelve years of historical event records, the average tornado to affect the cooperative will include an EF1-EF2 rating, causing an average damage cost of $69,120.24 per event ($207,360.72 / 3 events = $69,120.24). This averaged amount accounts for less than 1% of BCEC's total overhead assets and building valuation ($69,120.24 / $32,504,143 above ground assets= 0.21%). Table 1.8 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

| **Table 1.8**<br><br>**Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix**<br>**Hazard: Tornado** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | Near 100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

An average of 3 customers reported outages during recorded tornadoes since 1999. When compared with the total number of customers served by BCEC, it can be projected that less than 0.05% of all customers may report outages during any given tornadic event. Table 1.9 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

| **Table 1.9**<br><br>**Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix**<br>**Hazard: Tornado** | | Probability of Damage-causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

*Severe Thunderstorms, High Wind, and Hail*

From 1999-2010, Barton County's service area within the state of Missouri has experienced a total 261 hail events and 212 thunderstorm/high wind events. Therefore, the probability of a hail event in the Barton County service area in any given year is near to 100% (261 events / 12 years = 2175%) while the probability of a thunderstorm/high wind event in any given year is near to 100% (212 events / 12 years = 1767%). Estimated material damages associated with each of these events were compiled by BCEC staff. None of the two hundred and sixty-one occurrences caused damage to cooperative assets, resulting in a less than 1% probability that any given hail occurrence will produce damage. This leaves us to assume yearly damages then would be below 1% in damages. Barton County Electric does not consider hail a threat to the infrastructure.

Table 1.10 provides the information for thunderstorm/high wind events from 1999-2010. One of the 212 occurrences caused damages to cooperative assets, resulting in a less than 1% probability that any given thunderstorm/high wind occurrence will produce damage. (1 / 212 = .47%)

**Table 1.10 BCEC Thunderstorm/High Wind Event Summary**

| Event date | Damage estimates | Outages reported |
|---|---|---|
| 5/8/2009 | $166,016.30 | 135 |

*Data provided based on internal BCEC records which reflect cost from the referenced event year.*

Based upon historical records, the average thunderstorm/high wind event to affect the cooperative will cause an average damage cost of $166,016.30 ($166,016.30/ 1 event = $166,016.30). This averaged amount accounts for less than 1% of BCEC's overhead asset valuation ($166,016.30 / $30,656,328= .54%). Table 1.11 demonstrates the probability of occurrence in conjunction with the potential extent of damage for hail and thunderstorm events.

| **Table 1.11**<br><br>**Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: Hail/ Thunderstorm/High Wind** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | Near 100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

No customers reported outages related to hail events. An average of 135 customers reported outages during recorded thunderstorm and high wind events since 1999. When compared with the total number of customers served by BCEC, it can be projected that 2.09% of all customers may report outages during any given thunderstorm, or high wind event. Table 1.12 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

| **Table 1.12**<br><br>**Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix**<br>**Hazard: Hail / Thunderstorm/ High Wind** | | Probability of Damage-Causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

*Flood*

In the Barton County Electric Coop area, the FEMA digital shapefiles lack the Vernon County areas. Figure 4 below depicts the 100 year floodplain in relation to the cooperative's boundaries with the exception of Vernon County. *(Map sources: FEMA DFIRMS; MSDIS, and Association of Missouri Electric Cooperatives.)*

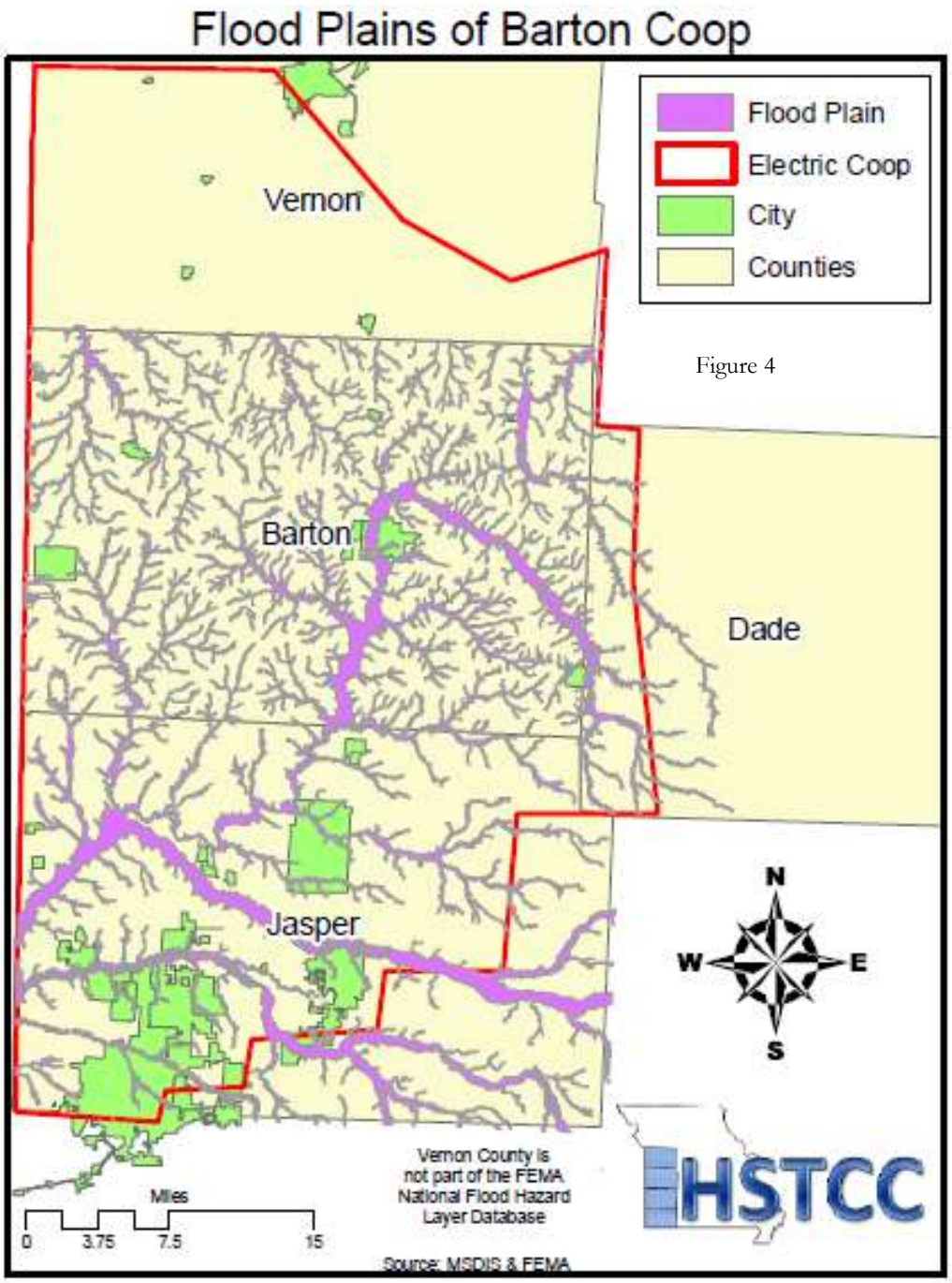



Figure 4

Flooding damages for BCEC historically do not exist. From 1999-2010, Barton County's service area has experienced 104 flooding events. Therefore, the probability of a flood event affecting the cooperative assets in any given year is near 100% (104 events / 12 years = 867%). None of the occurrences caused damage to cooperative assets, resulting in less than 1% probability that any given flood occurrence will produce damage.

Flood events vary widely based upon numerous factors including annual precipitation. Based upon historical records, the average flood event to affect the cooperative will cause

less than 1% of damages to the overhead assets. Table 1.13 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

| **Table 1.13**<br><br>**Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix**<br>**Hazard: Flood** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | ≥100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

No customers reported outages during recorded flooding events since 1999. It therefore, can be projected that less than 1% of all customers may report outages during any given flooding event. Table 1.14 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

| **Table 1.14**<br><br>**Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix**<br>**Hazard: Flood** | | Probability of Damage-Causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

*Severe Winter Weather*

From 1999-2010, Barton County's service area has experienced a total of 26 severe winter weather events, including significant snowfall and ice storms. Therefore, the probability of a severe winter weather event in the Barton County service area in any given year is near 100% (26 events / 12 years = 217%). Estimated material damages

associated with each of these events were compiled by BCEC staff. Table 1.15 provides a summary of event dates, types, associated damage estimates, and reported outages. Three of the twenty-six occurrences caused damage to cooperative assets, resulting in a 38% probability that any given severe winter weather occurrence will produce damage. (3 / 26 events = 11.5%)

| **Table 1.15** | **BCEC Severe Winter Weather Event Summary** | | |
|---|---|---|---|
| **Event date** | **Event type** | **Damage estimates** | **Outages reported** |
| 1/1/1999 | Winter Storm | 0 | 108 |
| 1/30/2002 | Ice Storm | $43,207.42 | 40 |
| 12/9/2007 | Ice Storm | $584,817.55 | 248 |
| *Data provided based on internal BCEC records which reflect cost from the referenced event year.* | | | |

Based upon these historical records, the average severe winter weather event to affect the cooperative will cause an average damage cost of $209,341.66 ($628,024.97 / 3 events = $209,341.66). This averaged amount accounts for less than 1% of BCEC's total overhead asset valuation ($209,341.66 / $30,656,328 = 0.683%). Table 1.16 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

| **Table 1.16**<br><br>**Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: Severe Winter Weather** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | Near 100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

An average of 132 customers reported outages during recorded severe winter weather events since 1999. When compared with the total number of customers served by BCEC, it can be projected that 2.04% of all customers may report outages during any given severe winter weather event. Table 1.17 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

| Table 1.17<br><br>**Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix**<br>**Hazard: Severe Winter Weather** | | Probability of Damage-Causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

*Wildfire*

The incidence of wildfire in the BCEC service area presents a unique risk assessment. Wildfire events have occurred in each of the four counties. According to the Missouri Department of Conservation, Jasper, Vernon, Barton and Dade counties have experienced wildfires between 2004 and 2008. Table 1.18 summarizes the incidences of wildfire within the three counties. Therefore, the probability of a wildfire event in the Barton County service area in any given year is near 100% (441 events / 4 years = 11,025%). Therefore, for the purposes of this assessment, wildfire and its associated impacts cannot be eliminated from the realm of possibility.

**Table 1.18 Wildfire summary by county**

| County | # of Wildfires, 2004-08 | Average Annual # of Wildfires | Likelihood (1-5) | Acres Burned | Average Annual Acres Burned | Total Buildings Damaged | Vulnerability |
|---|---|---|---|---|---|---|---|
| Jasper | 211 | 42.2 | 2 | 1207 | 241 | 1 | Medium |
| Vernon | 56 | 11.2 | 1 | 2386.6 | 477 | 4 | Medium |
| Barton | 9 | 1.8 | 1 | 343.5 | 69 | 0 | Low |
| Dade | 165 | 33 | 2 | 1617.8 | 324 | 3 | Medium |
| Totals | 441 | 88.2 | 1-2 | 5554.9 | 12.60 | 8 | Medium |

*Source: Missouri State Hazard Mitigation Plan, 2010*

The potential extent of damage caused by wildfire is difficult to determine. Like earthquakes and dam failure, wildfires have had no measurable impact upon the BCEC service area. To date, 441 fires have burned a total of 5,554.9 acres, for an average of 12.6 acres affected per event. BCEC sustained no damage related to wildfires in its service area during this time period. Cooperative assets are located throughout the service area rather than being located at a single central site. With an average of 13 acres per fire in the service area, it is unlikely that infrastructure damage would exceed 5% based upon asset location and unlikeliness of an uncontrollable wildfire. This initial assessment assumes a limited impact upon electric distribution infrastructure of less than

10% (Table 1.19). Further study will be required to create a model for damage assessments related to wildfire.

| **Table 1.19**<br><br>**Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: Wildfire** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | Near 100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

No customers have reported outages during recorded wildfires between 2004 and 2008. Therefore, it can be projected that less than 10% of all customers may report outages during any given wildfire event. Table 1.20 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

| **Table 1.20**<br><br>**Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix Hazard: Wildfire** | | Probability of Damage-causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

## B. Non-historical Hazards

*Earthquakes*

There are 2 earthquake zones near the BCEC area. One is NeMaha fault and the other is the well known New Madrid. Both are some distance away but due pose a risk to resources. The NeMaha Fault, which runs roughly from Oklahoma City, Oklahoma north to Lincoln, Nebraska is west of BCEC. In 1993, the NeMaha fault produced a discernable earthquake that was felt in the region, rating a 2.9 on the Richter Scale of

Earthquake Intensity. Additional quakes took place February 11, 1995 (3.1 rating); July 16, 2004 (3.5 rating); March 23, 2003 (3.1 rating). More recently, an earthquake rating 3.6 was recorded on December 17, 2009. Although a relatively quiet fault system, the NeMaha fault has the potential to produce a damaging earthquake but because of the distance the damages should be minor.

The region is also subject to effects of the New Madrid Fault located in extreme southeast Missouri, which has, according to many experts, the potential to produce the largest earthquakes in North America. Undoubtedly, this fault has the potential to affect the BCEC service area in its entirety.

While the NeMaha fault is geographically slightly closer and geologically active, C.E.R.I. records demonstrate the limited impact of said earthquakes, with no quakes to date exceeding a 5.5 on the Modified Mercalli Scale. Its cascading effects have been largely restricted to more localized regions, but even then the damage caused has been minimal. By contrast, the New Madrid fault has the potential to cause damage throughout the state of Missouri, including the BCEC service area. Scientists from the U.S. Geological Survey (USGS) and the Center for Earthquake Research and Information (CERI) at the University of Memphis have estimated the probability of a magnitude 6.0 or greater earthquake from the New Madrid Fault is 25-40 percent through the year 2053. The probability of an earthquake increases with each passing day.

The projected earthquake intensity ratings for the cooperative region changes based upon the Modified Mercalli Scale. Given a New Madrid earthquake with a 6.7 rating, the region would experience Level V intensity characteristics. In the event of an earthquake with a 7.6 rating, the region would experiences Level VI intensity characteristic while an earthquake with an 8.6 rating would most likely cause Level VII intensity characteristics.

In the event of an earthquake with a 7.6 rating, the BCEC service area would most likely experience minor building damage as well as damage to the electrical distribution system. This damage, however, would most likely be relatively minimal and localized when compared with the southeast corner of the state. Distribution lines overhead and underground could become disconnected or severed, and transformers could be damaged. The HAZUS-MH loss estimation per the State Hazard Plan 2010, gives a 2% chance of exceedance in the next 50 years. Counties within BCEC have a loss ratio of 1 to 2 percent. Though the probability of occurrence is very small, the potential extent of damage could impact both the cooperative and its customers as demonstrated in Table 1.21.

| **Table 1.21**<br><br>**Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix**<br>**Hazard: Earthquake** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | Near 100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

Based upon information outages related to damages from other events, it may be estimated that less than 10% customers could report outages related to an earthquake event. Table 1.22 demonstrates the probability of occurrence in conjunction with the potential extent of impact upon local customers.

| **Table 1.22**<br><br>**Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix**<br>**Hazard: Earthquake** | | Probability of Damage-causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

*Dam Failure*

Like earthquakes, dam failures have had no measurable impact upon the BCEC service area to date. According to Missouri DNR's Dam Safety Division, 72 dams currently exist within the cooperative boundaries: 41 in Barton County, 12 in Vernon County, 14 in Jasper and 5 in Dade County. Of these dams, one in Barton County and 1 in Vernon are regulated by the state due to the fact that they are non-agricultural, non-federal dams which exceed 35 feet in height. Figure 5 shows the locations of all known dams located within Barton County's service area. *(Map sources: www.msdis.missouri.edu; www.dnr.mo.gov/env/wrc.)*

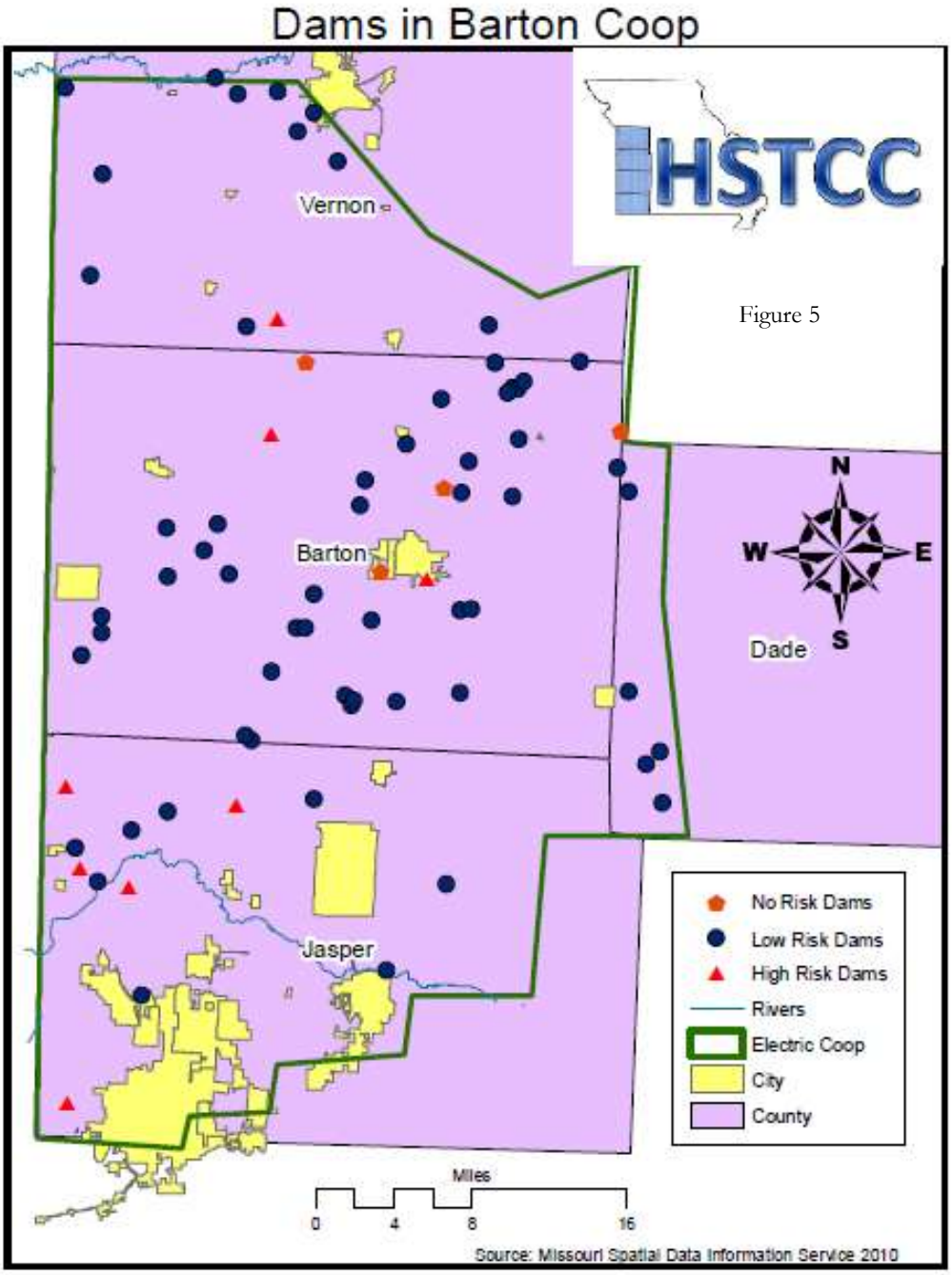



Figure 5

26 dam failures have occurred within the state of Missouri over the past 100 years. However, no such event has occurred within or near the cooperative's boundaries. However, for the purposes of this assessment, dam failure and its associated impacts cannot be eliminated from the realm of possibility. In order to allow for a risk assessment, the probability of this event has been included as less than 1%.

Determining the potential extent of dam failure is currently impossible due to a lack of data concerning inundation zones. Further study concerning existing dams and their impact is required to make a more comprehensive assessment of potential damages. This initial assessment assumes a limited impact upon downstream electric distribution infrastructure of less than 10% for both infrastructure damage and service interruption. (Tables 1.23 and 1.24).

| **Table 1.23**<br><br>**Barton County Electric Cooperative Service Interruption Vulnerability Assessment Matrix**<br>**Hazard: Dam Failure** | | Probability of Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | > Near 100% probability in any given year |
| Potential Extent of Impact | Less than 10% of customers report outages | | | | |
| | 10-25% of customers report outages | | | | |
| | 26-50% of customers report outages | | | | |
| | More than 50% of customers report outages | | | | |

| **Table 1.24**<br><br>**Barton County Electric Cooperative Infrastructure Vulnerability Assessment Matrix**<br>**Hazard: Dam Failure** | | Probability of Damage-causing Hazard Occurrence | | | |
|---|---|---|---|---|---|
| | | Less than 1% in any given year | 1-10% chance in any given year | 10- 99% chance in any given year | Near 100% probability in any given year |
| Potential Extent of Damage | Less than 10% of damage to system | | | | |
| | 10-25% damage of system | | | | |
| | 26-50% damage of system | | | | |
| | More than 50% damage of system | | | | |

## Section 6: Mitigation strategies

*Previous efforts at mitigation*

For organizations like BCEC, mitigation is considered to be part of prudent business operations. In order to ensure the delivery of a quality product and minimize service interruptions, a number of mitigation strategies are continually utilized. Routine maintenance and upgrades to existing equipment are completed as part of daily tasks. Vegetation management is utilized to limit the cascading effects of natural hazards.

Safety and reporting information are disseminated to the public through various types of media. Mutual aid agreements and partnerships create relationships which provide for future support in the event of a natural disaster.

Additionally, mitigation is considered prior to any expansion of service into special hazard areas. Before any service is build, it is first "staked out" in coordination with local builders and property owners. This process, completed by the Line Superintendent and contracted engineers, identifies and addresses foreseeable hazards and safety issues before any new service lines area constructed. USDA-RUS specifications regarding operation and safety are utilized in every step of the process. Steps are taken to practically minimize the exposure of equipment to loss due to foreseeable hazards, particularly flooding. Customers who reside in the floodplain are not charged for repairs or losses associated with flooding unless they purposefully destroy or restrict the cooperative from protecting their distribution system assets.

*Existing and potential resources*

As stated above, mitigation is a key component of good business practices. Barton County Electric Cooperative includes mitigation strategies as part of regular work activities to ensure service with minimal interruptions. Funding for these activities is provided through the cooperative's normal budgetary process for maintenance.

In order to expand mitigation efforts beyond normal maintenance, it is likely that BCEC will need to seek outside funding sources. These may include private, state, or federal programs which provide grant and loan funding. Upon passage of this plan, BCEC will be eligible for funding through FEMA in the following categories:

- Hazard Mitigation Grant Program
- Flood Mitigation Assistance Program
- Pre-Disaster Mitigation Program
- 406 Stafford Act

*Development of goals, objectives, and actions*

Establishing mitigation goals, objectives, and actions for a business entity requires a slightly different approach than public agencies. Certainly, a number of similarities exist; both entities must consider which hazards most commonly occur and have the greatest potential for causing disruption to members or residents. They must also consider which types of actions will maximize benefits and minimize costs, how mitigation strategies will be implemented, who will enforce implementation, and how the overall plan will be maintained and updated.

The BCEC mitigation planning committee, with assistance from HSTCC staff, worked to identify goals, actions, and objectives which addressed hazard mitigation issues. The committee first identified ongoing mitigation strategies as well as potential strategies which seek to improve service and limit disruptions resulting from natural hazards.

Action items were then analyzed for common characteristics and summarized to create nine objectives. Likewise, these nine objectives were grouped into similar categories and used as the basis for the four overarching goals. Table 1.25 provides a simple synopsis of the goals and objectives before prioritization.

| Table 1.25 | BCEC goals and objectives |
|---|---|
| **Identified Goals** | **Identified Objectives** |
| **Goal 1:** Protect the health and safety of the community. | **Objective 1:** Prevent injury, loss of life, and damage to property. |
| | **Objective 2:** Reduce outage time to critical facilities. |
| **Goal 2:** Reduce future losses due to natural hazard events. | **Objective 1**: Protect and maintain existing infrastructure. |
| | **Objective 2:** Research and develop plans for future infrastructure improvements, seeking implementation where feasible. |
| | **Objective 3:** Research and develop plans for future communication and data collection improvements where feasible. |
| **Goal 3**: Improve emergency management capabilities and enhance local partnerships. | **Objective 1:** Improve assessment of outages and reduce response time. |
| | **Objective 2:** Create or maintain partnerships with outside agencies. |
| **Goal 4**: Continue to promote public awareness and education. | **Objective 1:** Utilize media resources to promote public education. |
| | **Objective 2**: Continue interaction with local schools and civic groups. |

Traditionally, the STAPLEE (Social, Technical, Administrative, Political, Legal, Environmental, and Economic) method is used to prioritize mitigation actions. These categories, however, do not align with the private sector in the same way they are applicable to governmental agencies. A number of action items could be included with multiple goals and objectives, for example. As a result, the committee chose to use a different method to prioritize their mitigation strategy.

After identifying ongoing and potential action items, the committee created three priority tiers:

- **First tier** actions focus on physical infrastructure protection and improvements which ensure continued, quality service and seek to reduce power outages. These types of actions are the highest priority of BCEC.
- **Second tier** actions create and maintain working relationships to reduce and prevent the impact of power outages. These include improvements to safety and reporting information, mutual aid agreements, and other efforts which seek to expand and improve both customer service and disaster planning.
- **Third tier** actions identify potential projects for other system improvements. These include mapping efforts, technological improvements, and research related to the expansion of mitigation efforts.

Actions within each tier may be funded through regular budgetary methods or identified outside sources. Tables 1.26, 1.27, and 1.28 provide lists of action items by tier as well as the goals and objectives identified with each.

**Table 1.26 Prioritized Mitigation Actions for Barton County Electric Cooperative – Tier 1**

| Tier 1 | | | |
|---|---|---|---|
| *Action item:* | *Goal/Objective* | *Timeframe for completion* | *Cost-benefit score* |
| Perform routine maintenance and utilize upgraded equipment where possible to ensure quality of system. Tasks may include part replacement and/or upgrades. Identified work includes, but is not limited to:<br>• Addition of lightning arresters, electronic reclosures, conductors, guidewires.<br>• Replacement or repair on poles, cross-arms, lines. | Goal 1 / Objective 1<br>Goal 2 / Objective 1 | Ongoing effort | Low cost<br>High benefit<br>Score: 9 |
| Upgrade to concrete or steel poles where possible. | Goal 1 / Objective 1<br>Goal 1 / Objective 2<br>Goal 2 / Objective 1<br>Goal 2 / Objective 2 | Dependent upon additional funding. | High cost<br>High benefit<br>Score: 7 |
| Use vegetation management to prevent interference with delivery of power. | Goal 1 / Objective 1<br>Goal 2 / Objective 1 | Ongoing effort | Low cost<br>Medium benefit<br>Score: 6 |
| Complete annual inspections of lines and poles. | Goal 1 / Objective 1<br>Goal 2 / Objective 1 | Completed annually. | Low cost<br>Medium benefit<br>Score: 6 |
| Add alternate source wiring to eliminate or reduce time of outages. | Goal 1 / Objective 1<br>Goal 1 / Objective 2<br>Goal 2 / Objective 2 | Dependent upon additional funding. | Medium cost<br>High benefit<br>Score: 8 |
| Convert overhead lines to underground lines in troubled areas based on vulnerability. | Goal 1 / Objective 1<br>Goal 1 / Objective 2<br>Goal 2 / Objective 1<br>Goal 2 / Objective 2 | Dependent upon additional funding. | Medium cost<br>High benefit<br>Score: 4 |
| Upgrade critical Road Crossings | Goal 1 / Objective 2<br>Goal 2 / Objective 1 | Dependent upon additional funding. | High cost<br>Medium benefit<br>Score: 4 |
| Add poles etc. to create shorter spans | Goal 1 / Objective 1<br>Goal 1 / Objective 2<br>Goal 2 / Objective 1<br>Goal 2 / Objective 2 | Dependent upon additional funding. | High cost<br>High benefit<br>Score: 7 |

| Table 1.27 Prioritized Mitigation Actions for Barton County Electric Cooperative – Tier 2 | | | |
|---|---|---|---|
| **Tier 2** | | | |
| *Action item:* | *Goal/Objective* | *Timeframe for completion* | *Cost-benefit Score* |
| Provide safety and reporting information to the general public through varying methods:<br>• Company website<br>• Social media sites<br>• Local newspapers<br>• Presentations<br>• Publications | Goal 1 / Objective 1<br>Goal 4 / Objective 1 | Ongoing effort | Low cost<br>Medium benefit<br>Score: 6 |
| Maintain mutual aid agreements with other rural electric cooperatives. | Goal 3 / Objective 2 | Ongoing effort. | Low cost<br>Medium benefit<br>Score: 6 |
| Partner with county emergency management agencies to ensure power for local shelters, fuel stations, and public safety. | Goal 1 / Objective 1<br>Goal 1 / Objective 2<br>Goal 3 / Objective 2 | Ongoing effort. | Low cost<br>Low benefit<br>Score: 3 |
| Cooperate with local law enforcement and government officials to reduce the impact of power outages. | Goal 1 / Objective 1<br>Goal 3 / Objective 2 | Ongoing effort. | Low cost<br>Medium benefit<br>Score: 6 |

| Table 1.28 Prioritized Mitigation Actions for Barton County Electric Cooperative – Tier 3 | | | |
|---|---|---|---|
| **Tier 3** | | | |
| *Action item:* | *Goal/Objective* | *Timeframe for completion* | *Cost-benefit* |
| Apply for funding to build a saferoom at the cooperative office for the protection of employees. | Goal 1 / Objective 1 | Dependent upon additional funding. | High cost<br>High benefit<br>Score7 |
| Collect GPS data for all existing infrastructure. | Goal 2 / Objective 1<br>Goal 2 / Objective 3<br>Goal 3 / Objective 1 | Dependent upon additional funding. | High cost<br>High benefit<br>Score: 7 |
| Utilize GIS technology to reduce site identification and response time. | Goal 2 / Objective 2<br>Goal 2 / Objective 3<br>Goal 3 / Objective 1 | Dependent upon additional funding. | High cost<br>High benefit<br>Score: 7 |
| Consider implementation of automated voice response systems to improve outage reporting. | Goal 1 / Objective 2<br>Goal 3 / Objective 1 | Dependent upon additional funding. | High cost<br>Medium benefit<br>Score: 4 |
| Install Raptor protectors on outside plant | Goal 1 / Objective 1<br>Goal 1 / Objective 2<br>Goal 3 / Objective 2 | Dependent upon additional funding. | High cost<br>High benefit<br>Score: 7 |

## Section 7 – Plan Implementation and Maintenance

*Plan incorporation*

The goals, objectives, and actions of the previous section identify both ongoing efforts at mitigation and potential methods for expanding efforts. The plan has been reviewed and adopted by the Board of Directors as part of the company's operations policy. This mitigation plan necessitates involvement from every BCEC employment level as the organization strives to ensure quality service to their customers.

*Other Local Planning Mechanisms*

Beyond the BCEC plan, few planning mechanisms exist at the local level. The Missouri counties of Jasper and Barton each have a FEMA-approved Natural Hazard Mitigation Plan in place. Dade County has contracted to have its first plan written and Vernon County is in the process of an update. County emergency management directors have Local Emergency Operations Plans which seek to mitigate the same hazards for residents. Barton and Jasper Counties are also included in the Regional Transportation Plan (RTP) as well as a Comprehensive Economic Development Strategy (CEDS). BCEC's plan can be easily incorporated into these local plans and allow for coordination across agencies in the event of an emergency.

BCEC is located within the rural portions of third-class counties which are prohibited from enforcing building codes and zoning by the state of Missouri, with the exception of the service area in Jasper County but does not have a comprehensive plan approved by voters to enforce building codes. They do not provide service to any municipality within these counties. Comprehensive plans and Capital Improvement plans do not exist inside of the BCEC service areas.

*Plan Maintenance*

Barton County will conform to the requirements established by the Association of Missouri Electric Cooperatives (AMEC) for monitoring, evaluating, and updating the plan.

*Continued Public Involvement Opportunities*

Barton County will conform to the requirements established by the Association of Missouri Electric Cooperatives (AMEC) for continued public involvement. Opportunities for public comment will continue to be offered through various media outlets, the cooperative's website, and the physical office of BCEC.