Section 1: Introduction

Atchison-Holt Electric Cooperative (AHEC) was established in 1938 to provide electric service to the rural areas of northwest Missouri. A Touchstone Energy Cooperative, AHEC is headquartered in Rock Port, Missouri, and provides service to customers in Atchison, Holt, and Nodaway counties in Missouri as well as three counties in Iowa and Nebraska. The cooperative is run by a board of nine directors which approve the company's mission and internally developed business policy:

> *"Atchison-Holt 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."*

AHEC's service boundaries within the state of Missouri include Atchison and Holt counties in their entirety as well as the western portion of Nodaway County. The cooperative owns 894 miles of service 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, Association of Missouri Electric Cooperatives, Atchison-Holt Electric Cooperative.)*

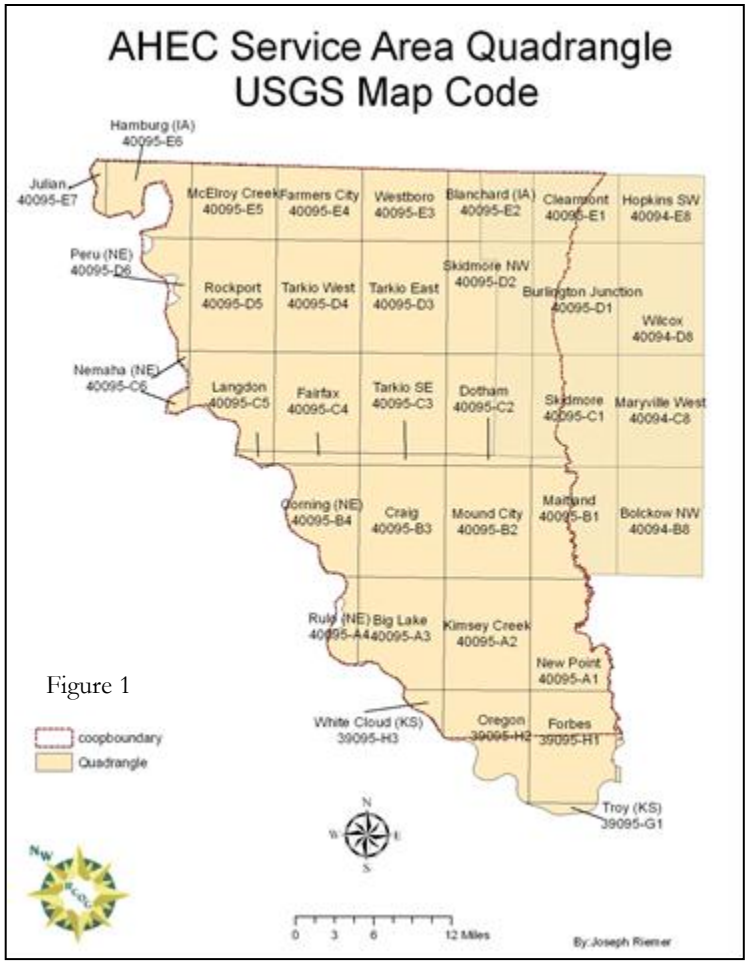


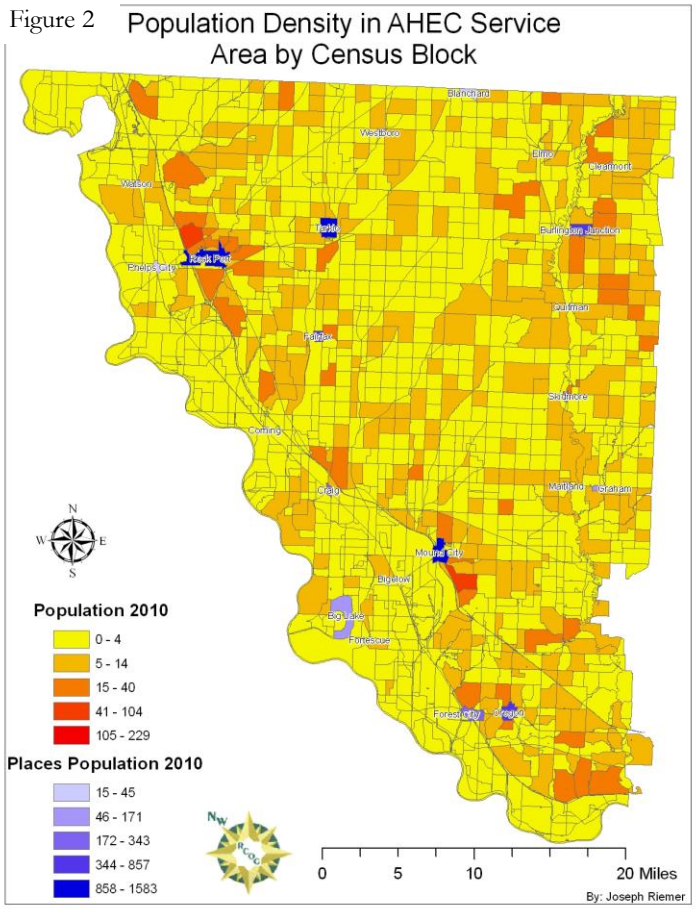
Figure 1

The customer base of AHEC currently exceeds 4,600 members in the three states of service. 2,638 of those members are located in the state of Missouri. Residential customers account for 89.3% of memberships (2,357 members) while non-residential customers make up the remaining 10.7% (281 members). Table 1.1 provides the summary of metered customers by Missouri county.

Table 1.1	Meters by Missouri County
County	**Number of meters**
Atchison	1,404
Holt	1,106
Nodaway	128

The average daily customer usage for AHEC is 66 kilowatt-hours (kWh). Annual total usage of AHEC customers in 2010 was 58,445,011 kWh of service. Population density for the cooperative service area is depicted in Figure 2 (*Map source: U.S. Census 2010*).

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 Northwest Missouri Regional Council of Governments was contracted to facilitate a hazard mitigation planning process for AHEC. The initial meeting between the two entities was held on January 26, 2011 as part of a regional kick-off meeting for northwest 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.

Three additional planning meetings were held at the AHEC offices in Rock Port, Missouri throughout the month of February. Table 1.2 summarizes the attendees and topics of each meeting. Meeting minutes are available in the chapter appendix.

Table 1.2	AHEC Planning Meeting Synopsis	
Meeting Date	**Attendees, Title, Organization**	**Topics of discussion**
February 8, 2011	Kevin Clark, CFO, AHEC Jill Lager, Accountant, AHEC Steve Shineman, Purchasing Superintendent, AHEC Jerry Clemens, Operations Superintendent, AHEC Jerry Stanfill, Regional Planner, NWMORCOG Dana Ternus, Regional Planner, NWMORCOG	AHEC business structure Customer information Critical facilities information Asset inventory by type and location Data collection assignments
February 17, 2011	Kevin Clark, CFO, AHEC Jill Lager, Accountant, AHEC Steve Shineman, Purchasing Superintendent, AHEC Jerry Clemens, Operations Superintendent, AHEC Jerry Stanfill, Regional Planner, NWMORCOG Dana Ternus, Regional Planner, NWMORCOG	Data collection review Current mitigation strategies Establishment of goals, actions, and objectives
February 28, 2011	Kevin Clark, CFO, AHEC Jill Lager, Accountant, AHEC Steve Shineman, Purchasing Superintendent, AHEC Jerry Clemens, Operations Superintendent, AHEC Jerry Stanfill, Regional Planner, NWMORCOG Dana Ternus, Regional Planner, NWMORCOG	Method of prioritization Prioritization of goals, actions, and objectives

Public Involvement

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

- Atchison County Commission,
- Holt County Commission,
- Nodaway County Commission,
- local emergency management directors, and
- the local Red Cross chapter.

AHEC does not provide service to any critical facilities (hospitals, emergency services, etc.), higher education institutions, or large industrial centers. Additionally, AHEC's mitigation plan was included in the public comment period for the combined AMEC plan.

Section 3: Asset inventory

Atchison-Holt 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. Twelve vehicles provide access to customers and infrastructure. AHEC does not own any electric generation or transmission infrastructure. 902 miles of distribution lines are owned and maintained by AHEC. Table 1.3 provides information concerning total asset valuation.

Table 1.3	**Atchison-Holt Asset Inventory Valuation Summary**	
Asset	**Total Replacement Cost**	**Cost breakdown**
Total AHEC Assets	$44,475,535	Buildings and vehicles - $5,000,000 Overhead assets - $35,020,175 Underground assets - $4,455,360
Distribution Lines	$21,838,080 OH $1,383,360 UG	OH Single-phase lines - $14,446,080 UG Single-phase lines - $1,298,880 OH Three-phase lines - $7,392,000 UG Three-phase lines - $84,480
Supporting Infrastructure	$12,743,045 OH $3,072,000 UG	Meters - $303,370 Poles - $7,990,000 OH Transformers - $2,121,000 UG Transformers - $3,072,000 Guys/Anchors - $1,022,175 Cross-arms - $487,500 Regulators - $283,500 SP Oil-Circuit Reclosures - $301,500 3phase Oil-Circuit Reclosures - $171,000 Capacitors - $63,000
Office Buildings	$2,000,000	
Warehouses	$1,000,000	
Vehicles	$2,000,000	
Source: Internal Atchison-Holt Accounting and Insurance records, 2011		

Ensuring quality distribution to its customers, Atchison-Holt 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	Atchison-Holt Asset Inventory by service county				
Asset	**Emergency Replacement Cost per unit or mile**	**Number of units or miles: ATCHISON**	**Number of units or miles: HOLT**	**Number of units or miles: NODAWAY**	**Total number of units or miles:**
Meter	$115/unit	1,404	1,106	128	2,638
Pole	$400/unit	11,150	8,750	750	20,650
SP*** distribution line	$21,120/mile OH ($4/foot OH) $31,680/mile UG ($6/foot UG)	432 OH** 18 UG***	218 OH 18 UG	34 OH 5 UG	684 OH 41 UG
TP**** distribution line	$42,240/mile ($8/foot UG/OH)	106 OH	63 OH 2 UG	6 OH	175 OH 2 UG
Transformers	$1,050 OH $12,000 UG	1,091 OH 108 UG	848 OH 148 UG	81 OH	2,020 OH 261 UG
Guys/anchors	$99/unit	5,550	4,600	175	10,325
Cross-arms	$100	2,625	2,000	250	4,875
Regulators	$8,100	19	16	0	35
Oil Circuit Reclosures	$1,500 SP $19,000 TP	98 SP 6 TP	93 SP 2 TP	10 SP 1 TP	201 SP 9 TP
Capacitors	$1,750/unit	12	18	6	36
Total Replacement Value by county		$20,616,690 OH $563,760 UG	$12,776,870 OH $2,430,720 UG	$1,626,615 OH $158,400 UG	$35,020,175 OH $4,455,360 UG

**OH = overhead ***UG = underground ***SP = Single phase ****TP – Three phase

Source: Internal Atchison-Holt Accounting and Maintenance records

Section 4: Identified Hazards and Risk Assessment Methodology

Natural hazards in northwest 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 Atchison-Holt Electric Cooperative:

- Tornadoes
- Severe Thunderstorms, Hail, and High Winds
- Flood and Levee Failure
- 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 AHEC because of asset types and geographic location in the state of Missouri. Those hazards eliminated for the AHEC service region include:

- Drought
- Heat Wave
- Severe land subsidence
- Landslides

Although drought can potentially impact northwest Missouri, water availability does not directly impact the delivery of electric service to AHEC 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 AHEC 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 do not form the basis of soil in the AHEC service region.

For the purpose of this risk assessment, the identified hazards for the AHEC 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 AHEC, 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 AHEC, 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 AHEC 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 $38,020,175
- Overhead infrastructure assets only
    - Used for:
        - Severe Thunderstorm / High Wind / Hail
        - Flood
        - Severe Winter Weather
    - Valued at $35,020,175

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 **Sample Atchison-Holt 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 **Sample Atchison-Holt 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, 36 tornadoes have been reported within the Atchison-Holt cooperative boundaries. Figure 3 provides a pictorial representation of all recorded tornado touchdown sites and recorded path. *(Data for map collected from NOAA.)*

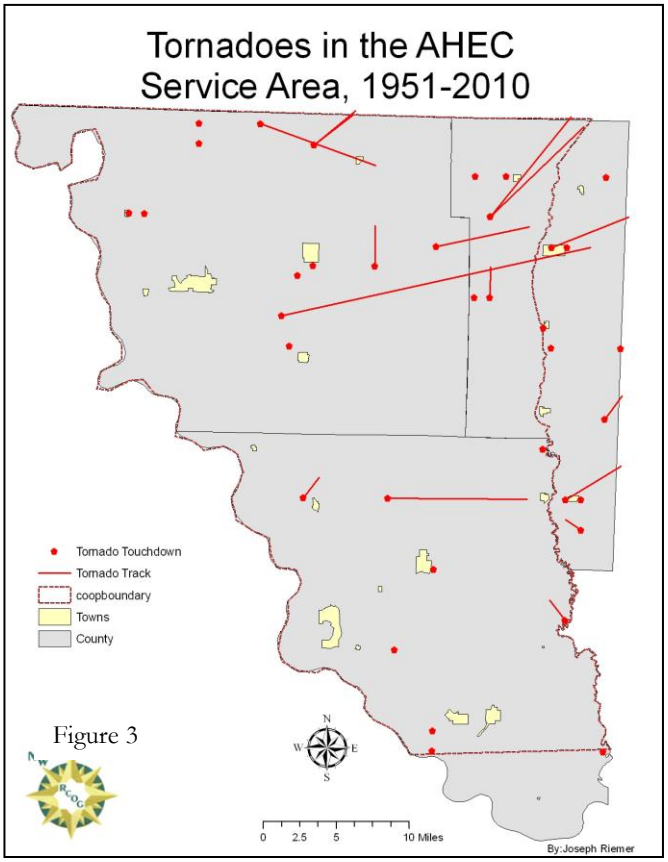


Figure 3

A data insufficiency exists, however, between 1968 and 1990 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 1990-2010, Atchison-Holt's service area within the state of Missouri has experienced a total of five tornadic events. Using the previously described methodology, the probability of a tornadic event in the Atchison-Holt service area in any given year is 25% (5 events / 20 years = 25%). Estimated cooperative material damages associated with each of these events were compiled by AHEC staff. Four of the five occurrences caused damage to cooperative assets, resulting in an 80% probability that any given tornadic occurrence will produce damage. Table 1.7 provides a summary of event dates, EF-scale ratings, damage cost estimates and outages reported.

Table 1.7	**AHEC Tornadic Event Summary**		
Date of event	**EF Scale rating**	**Damage estimates**	**Outages Reported**
5/8/96	F1	$1,200	0
4/24/04	F0	$0	0
5/24/04	F1	$2,500	0
8/8/07	F0	$2,500	0
6/5/08	F0/F1	$2,500	0
Data provided based on internal AHEC records which reflect cost from the referenced event year.			

Based upon the last twenty years of historical event records, the average tornado to affect the cooperative will include an EF0-EF1 rating, causing an average damage cost of

$1,740 per event ($8,700/5 events = $1,740). This averaged amount accounts for less than 1% of AHEC's total overhead assets and building valuation ($1,740 /$ 38,020,175 = 0.0000457). Table 1.8 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

Table 1.8 **Atchison-Holt Electric Cooperative Infrastructure Vulnerability Assessment Matrix** **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				

None of AHEC's customers reported outages during recorded tornadoes since 1996. When compared with the total number of customers served by AHEC, it can be projected that less than 1% of all customers may report outages during any given tornadic event. Table 1.9 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Table 1.9 **Atchison-Holt Electric Cooperative Service Interruption Vulnerability Assessment Matrix** **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 1990-2010, Atchison-Holt's service area within the state of Missouri has experienced a total 82 hail events and 47 thunderstorm/high wind events. Therefore, the probability of a hail event in the Atchison-Holt service area in any given year is near to 100% (82 events / 20 years = 410%) while the probability of a thunderstorm/high wind event in any given year is near to 100% (47 events / 20 years = 235%). Estimated material damages associated with each of these events were compiled by AHEC staff. Table 1.10 provides a summary of those hail events which caused damage to cooperative infrastructure by date, cost estimate of damage, and reported outages. Thirty-five of the eighty-two occurrences caused damage to cooperative assets, resulting in a 43% probability that any given hail occurrence will produce damage. (35 / 82=42.6%)

Table 1.10 AHEC Hail Event Damage Summary

Event date	Damage estimates	Outages reported	Event date	Damage estimates	Outages reported
5/14/96	$500	0	4/15/03	$50	0
5/20/96	$1,000	0	5/24/04	$2,500	0
8/19/96	$500	0	6/12/04	$500	0
7/23/97	$2,000	0	8/25/04	$3,000	0
5/19/98	$300	0	8/26/04	$1,000	0
6/13/98	$800	0	6/4/05	$200	0
5/26/00	$100	0	3/21/07	$50	0
6/13/00	$800	0	5/6/07	$500	0
6/23/00	$200	0	8/8/07	$2,500	0
7/26/00	$1,000	0	4/25/08	$500	0
4/5/01	$50	0	5/24/08	$1,500	0
5/10/01	$300	0	6/4/08	$50	0
7/3/01	$100	0	6/5/08	$2,000	0
9/7/01	$800	0	3/23/09	$180	0
4/18/02	$800	0	6/1/09	$50	0
4/24/02	$1,000	0	6/7/09	$50	0
5/6/02	$900	0	8/19/09	$1,000	0
7/26/02	$250	0			0

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

Based upon historical records, the average hail event to affect the cooperative will cause an average damage cost of $772 ($27,030 / 35 events = $772). This averaged amount accounts for less than 1% of AHEC's total overhead asset valuation ($772 / $35,020,175 = 0.0022%).

Table 1.9 provides the same information for thunderstorm/high wind events. Thirty-three of the forty-seven occurrences caused damage to cooperative assets, resulting in a 70% probability that any given thunderstorm/high wind occurrence will produce damage. (33 / 47 = 70%)

Table 1.11 AHEC Thunderstorm/High Wind Event Summary					
Event date	**Damage estimates**	**Outages reported**	**Event date**	**Damage estimates**	**Outages reported**
7/19/96	$1,000	0	8/17/02	$500	117
6/21/97	$1,500	0	4/15/03	$50	0
7/23/97	$2,000	0	8/19/03	$50	72
4/14/98	$1,000	60	5/22/04	$300	116
5/15/98	$400	495	6/12/04	$500	43
5/20/98	$1,500	5	8/25/04	$1,500	10
4/5/99	$1,200	237	8/26/04	$1,000	121
4/8/99	$2,000	1,810	6/28/05	$50	31
6/27/99	$1,000	37	3/30/06	$1,200	467
7/30/99	$2,500	338	8/8/07	$500	840
6/13/00	$800	289	4/25/08	$500	48
6/23/00	$200	46	6/5/08	$2,000	2,369
8/19/00	$700	12	6/1/09	$50	4
4/7/01	$0	312	8/4/09	$500	515
4/11/01	$1,500	96	8/9/09	$50	174
5/10/01	$300	1	7/18/10	$500	81
7/18/01	$300	386	8/31/10	$1,200	71
Data provided based on internal AHEC 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 $880.88 ($29,950 / 34 events = $880.88). This averaged amount accounts for less than 1% of AHEC's overhead asset valuation ($880.88 / $23,221,440 = 0.0038%). Table 1.12 demonstrates the probability of occurrence in conjunction with the potential extent of damage for both hail and thunderstorm/high wind events.

Table 1.12 **Atchison-Holt Electric Cooperative Infrastructure Vulnerability Assessment Matrix Hazard: Thunderstorm/High Wind/Hail**		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 271 customers reported outages during recorded thunderstorm and high wind events since 1996. No customers reported outages during hail events according to cooperative records. When compared with the total number of customers served by

AHEC, it can be projected that 10.27% of all customers may report outages during any given hail, thunderstorm, or high wind event. Table 1.13 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Table 1.13 **Atchison-Holt Electric Cooperative Service Interruption Vulnerability Assessment Matrix** **Hazard: Thunderstorm/High Wind/Hail**		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			Hail	
	10-25% of customers report outages			Thunderstorm / Wind	
	26-50% of customers report outages				
	More than 50% of customers report outages				

Flood and Levee Failure

Flood and levee failure carry, perhaps, the greatest ongoing potential threat to the existing infrastructure of the Atchison-Holt Electric Cooperative. In Atchison County, approximately 15% of the cooperative service area in is located directly within the 100 year floodplain. 40% of the Holt County service area and 10% of the Nodaway county service area also lie in the floodplain. Figure 4 below depicts the 100 year floodplain in relation to the cooperative's boundaries. *(Map sources: FEMA HAZUS-MH; DFIRMS; Missouri Office of Administration, and Association of Missouri Electric Cooperatives.)* Currently, inundation data for levee failure is lacking due to issues surrounding mapping, appropriate models, and its close association with flooding events. Figure 5 below provides the location of known state and federal levees within the cooperative's boundaries. *(Map sources: Atchison County Emergency Management Agency, Holt County Commission, USDA.)*

From 1993-2010, Atchison-Holt's service area has experienced 34 flooding events. Currently, no data concerning levee failure damage can be separated from flood damage data. Therefore, the probability of a flood/levee failure event affecting the cooperative assets in any given year is near 100% (34 events / 18 years = 189%). Estimated material damages associated with each

Table 1.14	**AHEC Flood Event Summary**	
Event date	**Damage estimates**	**Outages reported**
1993	$94,900	0
May 2007	$102,050	0
June 2010	$137,500	0
Data provided based on internal AHEC records which reflect cost from the referenced event year.		

of these events were compiled by AHEC staff. Table 1.14 summarizes flood event dates by month, damage cost estimates, and reported outages. Three of the thirty-four occurrences caused damage to cooperative assets, resulting in a 9% probability that any given flood occurrence will produce damage. (3 / 34 = 8.8%)

Flood and levee failure events vary widely based upon numerous factors including, but not limited to, annual precipitation and extent of levee damage. Not all events, however, are extensive as evidenced in Table 1.14. Based upon historical records, the average flood/levee failure event to affect the cooperative will cause an average damage cost of $111,483 ($334,450 / 3 events = $111,483). This averaged amount accounts for less than 1% of AHEC's overhead asset valuation ($111,483 / $35,020,175 = 0.0032). Table 1.15 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

Table 1.15 **Atchison-Holt Electric Cooperative Infrastructure Vulnerability Assessment Matrix 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 AHEC customers reported outages during recorded flooding events since 1995. When compared with the total number of customers served by AHEC, it can be projected that less than 1% of all customers may report outages during any given flooding event. Table 1.16 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Table 1.16 **Atchison-Holt Electric Cooperative Service Interruption Vulnerability Assessment Matrix** **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				

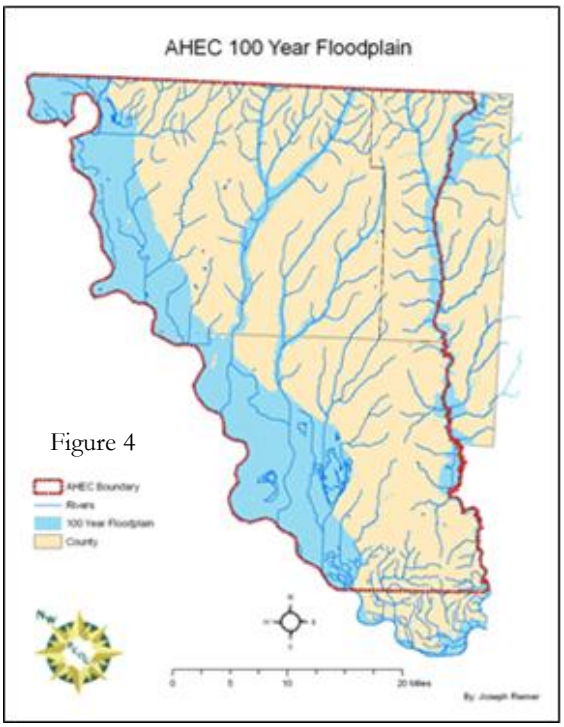


Figure 4

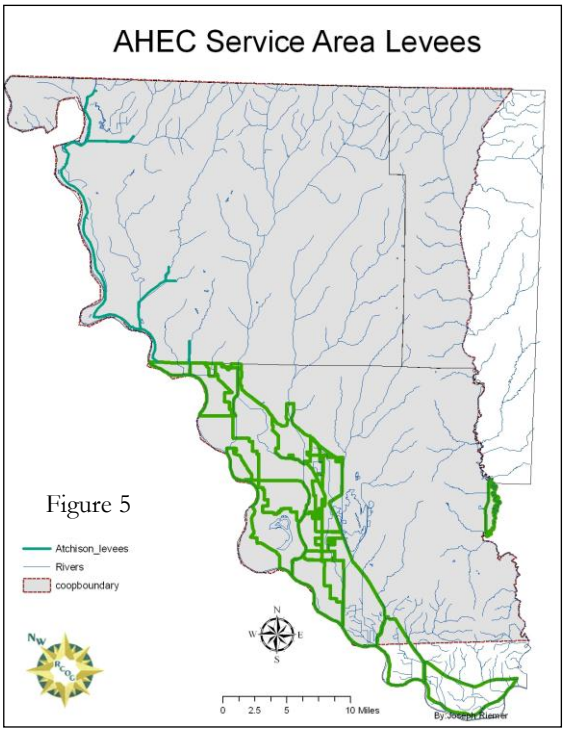


Figure 5

Severe Winter Weather

From 1994-2010, Atchison-Holt's service area has experienced a total of thirty severe winter weather events, including significant snowfall and ice storms. Therefore, the probability of a severe winter weather event in the Atchison-Holt service area in any given year is near 100% (30 events / 17 years = 176%). Estimated material damages associated with each of these events were compiled by AHEC staff, but damage estimates are available from 2001-2010 only. Table 1.17 provides a summary of event dates, types, associated damage estimates, and reported outages. Seven of the thirty occurrences caused damage to cooperative assets, resulting in a 26.7% probability that any given severe winter weather occurrence will produce damage. (8 / 30 = 26.7%)

Table 1.17	**AHEC Severe Winter Weather Event Summary**		
Event date	**Event type**	**Damage estimates**	**Outages reported**
2/9/01	Snow	$13,490	2,203
3/15/01	Snow	$1,200	395
1/3/05	Winter storm	$100	133
2/12/07	Snow	$1,500	0
12/1/07	Ice storm	$300	0
12/10/07	Ice storm	$335,695	1,500
11/16/09	Snow	$0	1,094
1/16/10	Winter storm	$2,500	237
Data provided based on internal AHEC 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 $44,348 ($354,785 / 8 events = $44,348). This averaged amount accounts for less than 1% of AHEC's total overhead asset valuation ($44348 / $35,020,175 = 0.127%). Table 1.18 demonstrates the probability of occurrence in conjunction with the potential extent of damage.

Table 1.18 **Atchison-Holt 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 695 customers reported outages during recorded severe winter weather events since 2000. When compared with the total number of customers served by AHEC, it can be projected that 26% of all customers may report outages during any given severe winter weather event. Table 1.19 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Table 1.19 **Atchison-Holt Electric Cooperative Service Interruption Vulnerability Assessment Matrix** **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 AHEC service area presents a unique risk assessment. Wildfire events have occurred in each of the three counties. According to the Missouri Department of Conservation, Atchison, Holt, and Nodaway counties have experienced wildfires between 2004 and 2008. Table 1.20 summarizes the incidences of wildfire within the three counties. Therefore, the probability of a wildfire event in the Atchison-Holt service area in any given year is near 100% (351 events / 5 years = 7,020%). However, for the purposes of this assessment, wildfire and its associated impacts cannot be eliminated from the realm of possibility.

Table 1.20 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
Atchison	107	21.4	1	953.8	191	2	Medium-low
Holt	66	13.2	1	543.5	109	0	Medium-low
Nodaway	181	36.2	2	2374.96	475	7	Medium
Totals	354	70.8	1-2	3,872.26	775	9	Medium-low

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 AHEC

service area. To date, 354 fires have burned a total of 3,872.26 acres, for an average of 10.9 acres affected per event. AHEC 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 10 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 1.21). Further study will be required to create a model for damage assessments related to wildfire.

Table 1.21 **Atchison-Holt 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. When compared with the total number of customers served by AHEC, it can be projected that less than 1% of all customers may report outages during any given wildfire event. Table 1.22 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Table 1.22 **Atchison-Holt 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

The closest source of earthquake risk in northwest Missouri is the NeMaha Fault, which runs roughly from Oklahoma City, Oklahoma north to Lincoln, Nebraska. 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, profoundly impacting the Atchison-Holt Electric Cooperative.

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 AHEC service area in its entirety. In addition, there have been several small, virtually undetectable earth movements in the region in recent history, which may or may not be attributed to the aforementioned fault lines or other, very small faults located nearby.

While the NeMaha fault is geographically 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 AHEC 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 AHEC 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. Though the probability of occurrence is very small, the potential extent of damage could significantly impact both the cooperative and its customers as demonstrated in Table 1.23.

Table 1.23 **Atchison-Holt Electric Cooperative Infrastructure Vulnerability Assessment Matrix 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 from CERI, FEMA, and SEMA, it may be estimated that 650 customers could report outages related to an earthquake event. When compared with the total number of customers served by AHEC, it can be projected that 25% of all customers may report outages during any given seismic event. Table 1.24 demonstrates the probability of occurrence in conjunction with the potent extent of impact upon local customers.

Table 1.24 **Atchison-Holt Electric Cooperative Service Interruption Vulnerability Assessment Matrix 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 AHEC service area to date. According to Missouri DNR's Dam Safety Division, 64 dams currently exist within the cooperative boundaries: 15 in Atchison County, 27 in Holt County, and 22 in Nodaway County. Of these dams, five in Atchison County and six in Nodaway County are regulated by the state due to the fact that they are non-agricultural, non-federal dams which exceed 35 feet in height. Figure 6 shows the locations of all known dams located within Atchison-Holt's service area. *(Map sources: www.msdis.missouri.edu; www.dnr.mo.gov/env/wrc.)*

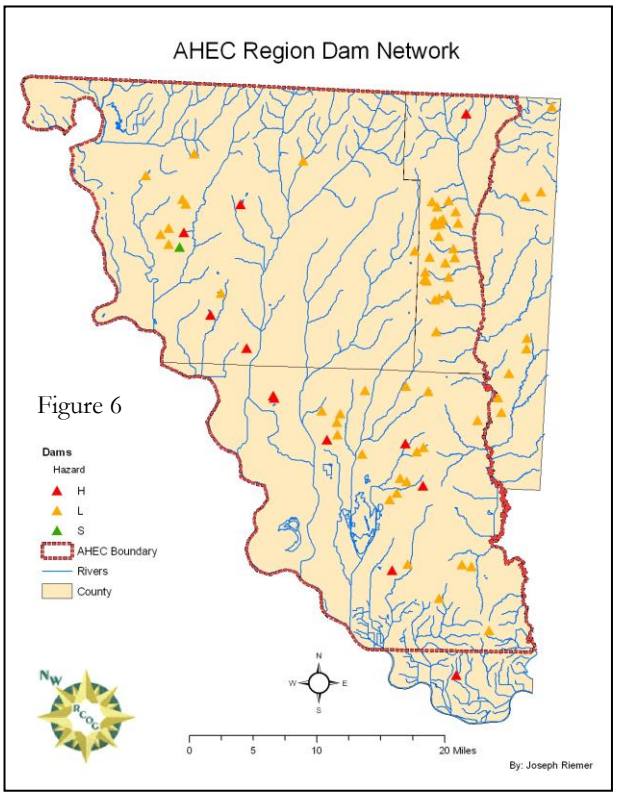


Figure 6

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%.

Table 1.25 **Atchison-Holt Electric Cooperative Infrastructure Vulnerability Assessment Matrix** **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 Damage	Less than 10% of damage to system				
	10-25% damage of system				
	26-50% damage of system				
	More than 50% damage of system				

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 1.25 and 1.26).

Table 1.26 **Atchison-Holt Electric Cooperative Service Interruption Vulnerability Assessment Matrix 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 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 6: Mitigation strategies

Previous efforts at mitigation

For organizations like AHEC, 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. Atchison-Holt 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 AHEC 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, AHEC 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 AHEC mitigation planning committee, with assistance from NWMORCOG 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 1.27 provides a simple synopsis of the goals and objectives before prioritization.

Traditionally, the STAPLEE (Social, Technical, Administrative, Political, Legal, Environmental, and Economic) method is used to prioritize mitigation actions. These categories, however, do not necessarily 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.

Table 1.27	AHEC 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.

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 AHEC.
- **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 1.28, 1.29, and 1.30 provide lists of action items by tier as well as the goals and objectives identified with each.

Table 1.28 Prioritized Mitigation Actions for Atchison-Holt 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: • Addition of lightning arresters, electronic reclosures, conductors, guidewires. • Replacement or repair on poles, cross-arms, lines. • Raising padmount transformers in flood prone areas.	Goal 1 / Objective 1 Goal 2 / Objective 1	Ongoing effort	Low cost High benefit Score: 9
Upgrade to concrete or steel poles where possible.	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 1 Goal 2 / Objective 2	Dependent upon additional funding.	High cost High benefit Score: 7
Use vegetation management to prevent interference with delivery of power.	Goal 1 / Objective 1 Goal 2 / Objective 1	Ongoing effort	Low cost Medium benefit Score: 6
Complete annual inspections of lines and poles.	Goal 1 / Objective 1 Goal 2 / Objective 1	Completed annually.	Low cost Medium benefit Score: 6
Add alternate source wiring to eliminate or reduce time of outages.	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 2	Ongoing effort; Completed as funding allows.	Medium cost High benefit Score: 4
Convert overhead lines to underground lines or vice versa in troubled areas based on vulnerability.	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 1 Goal 2 / Objective 2	Ongoing effort; Dependent upon funding.	Medium cost High benefit Score: 4

Table 1.29 Prioritized Mitigation Actions for Atchison-Holt 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: • Company website • Social media sites • Local newspapers • Presentations • Publications	Goal 1 / Objective 1 Goal 4 / Objective 1	Ongoing effort	Low cost Medium benefit Score: 6
Increase number of generators owned for use in critical asset outages	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 2 / Objective 2	Dependent upon additional funding.	Medium cost High benefit Score: 4
Maintain mutual aid agreements with other rural electric cooperatives.	Goal 3 / Objective 2	Ongoing effort.	Low cost Low benefit Score: 3
Partner with county emergency management agencies to ensure power for local shelters, fuel stations, and public safety.	Goal 1 / Objective 1 Goal 1 / Objective 2 Goal 3 / Objective 2	Ongoing effort.	Low cost High benefit Score: 1
Cooperate with local law enforcement and government officials to reduce the impact of power outages.	Goal 1 / Objective 1 Goal 3 / Objective 2	Ongoing effort.	Low cost High benefit Score: 1

Table 1.30 Prioritized Mitigation Actions for Atchison-Holt Electric Cooperative – Tier 3			
Tier 3			
Action item:	*Goal/Objective*	*Timeframe for completion*	*Cost-benefit*
Research methods for waterproofing meters in flood-prone areas.	Goal 2 / Objective 2	Ongoing effort.	Low cost High benefit Score: 9
Collect GPS data for all existing infrastructure.	Goal 2 / Objective 1 Goal 2 / Objective 3 Goal 3 / Objective 1	Dependent upon additional funding.	High cost High benefit Score: 7
Utilize GIS technology to reduce site identification and response time.	Goal 2 / Objective 2 Goal 2 / Objective 3 Goal 3 / Objective 1	Dependent upon additional funding.	Medium cost Medium benefit Score: 5
Consider implementation of automated voice response systems to improve outage reporting.	Goal 1 / Objective 2 Goal 3 / Objective 1	Dependent upon additional funding.	High cost Medium benefit Score: 4
Monitor developments in data availability concerning the impact of dam failure and wildfire upon the AHEC service area through local, state, and federal agencies.	Goal 1 / Objective 1 Goal 2 / Objective 1	Ongoing effort.	Low cost Low benefit Score: 3

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 AHEC employment level as the organization strives to ensure quality service to their customers.

Other Local Planning Mechanisms

Beyond the AHEC plan, few planning mechanisms exist at the local level. The Missouri counties of Atchison, Holt, and Nodaway each have a FEMA-approved Natural Hazard Mitigation Plan in place. County emergency management directors have Local Emergency Operations Plans which seek to mitigate the same hazards for residents. These same counties are also included in the Regional Transportation Plan (RTP) as well as a Comprehensive Economic Development Strategy (CEDS). AHEC's plan can be easily incorporated into these local plans and allow for coordination across agencies in the event of an emergency.

AHEC is located within the rural portions of third-class counties which are prohibited from enforcing building codes and zoning by the state of Missouri. They do not provide service to any municipality within these counties. Comprehensive plans and Capital Improvement plans do not exist inside of the AHEC service areas.

Plan Maintenance

Atchison-Holt 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

Atchison-Holt 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 AHEC.