Electric Transmission Line Project

Presentation Outline

Main Points to Consider

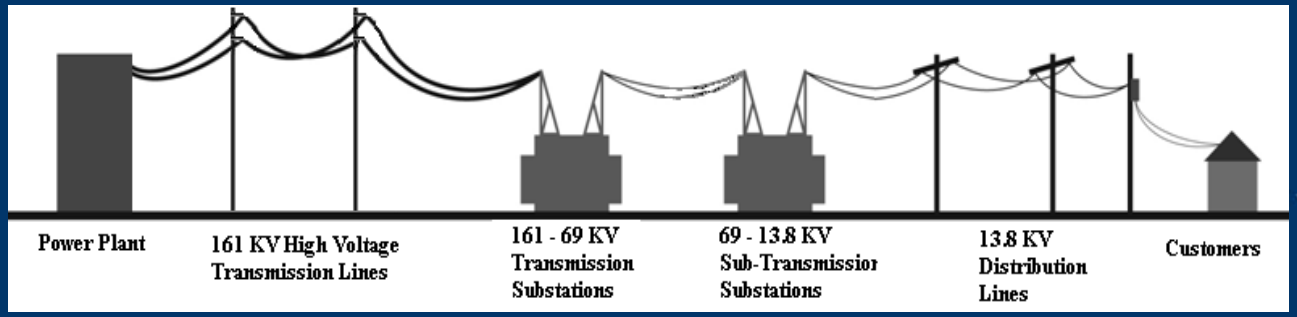
Historical Overview

Cost considerations

Routing Options: including reliability, real estate impact & costs of options

Non-transmission Alternatives

Summary



COLUMBIA WATER & LIGHT

Main Points to Consider

Reliability

- What risk is acceptable and how to meet our future needs?

Longevity

- How long should the solution solve the problem for?

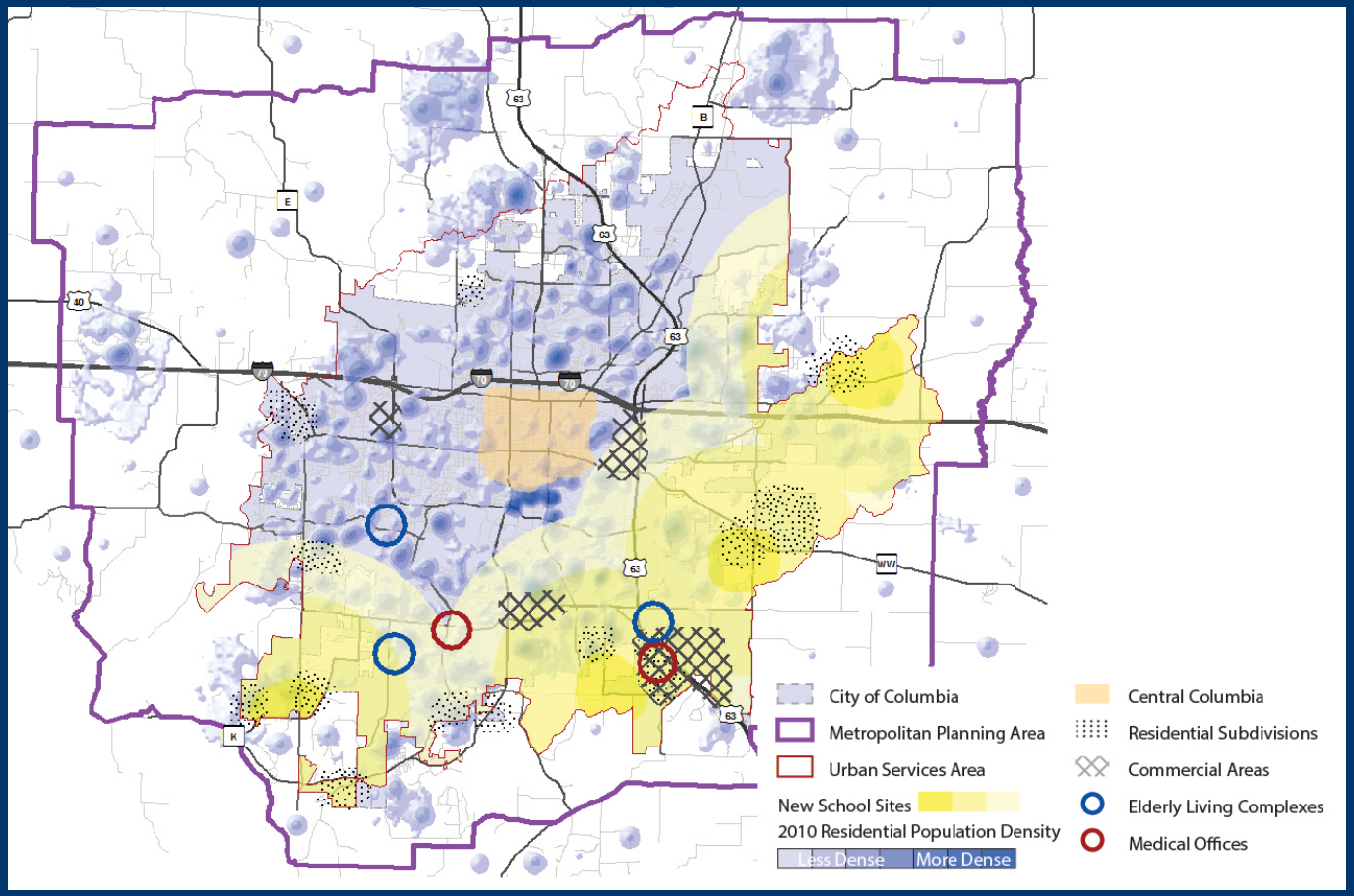
Location

- What is the appropriate community impact?

Impacts on Cost

- Going back & forth in process takes time and money

Historical Overview



Areas of Projected Growth

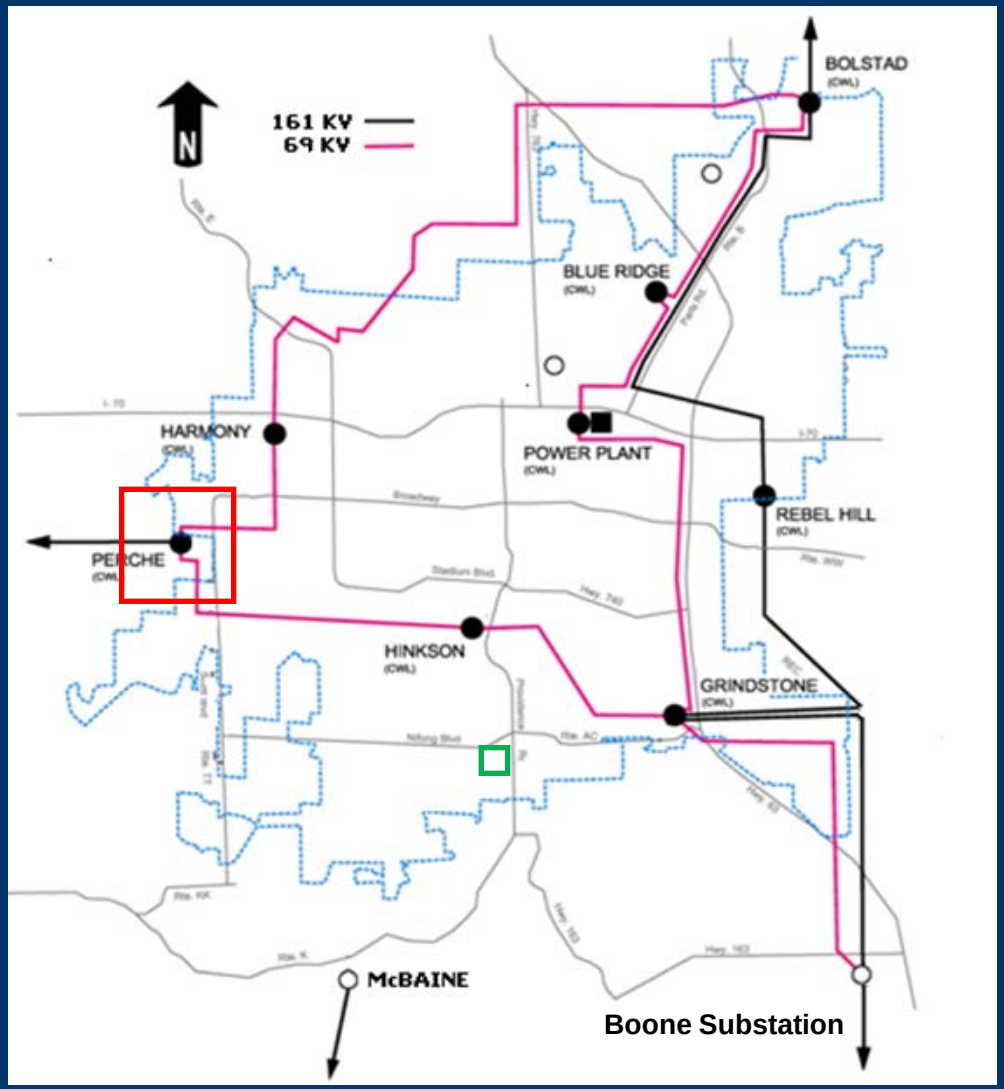
- Electric load growth is down from 2% to 1.25%
  - Recession & energy efficiency programs have lessened growth but it could move up again, especially during hot, humid summers
- Continued build out of subdivisions, new development plus redevelopment expected on south side of Columbia

Substation Loading

- Electric systems must have reserved capacity for time of high loads and/or problems with system
- Substation loading goal: two transformers at 50%, three transformers at 66.6%
  - Hinkson & Perche at or over capacity

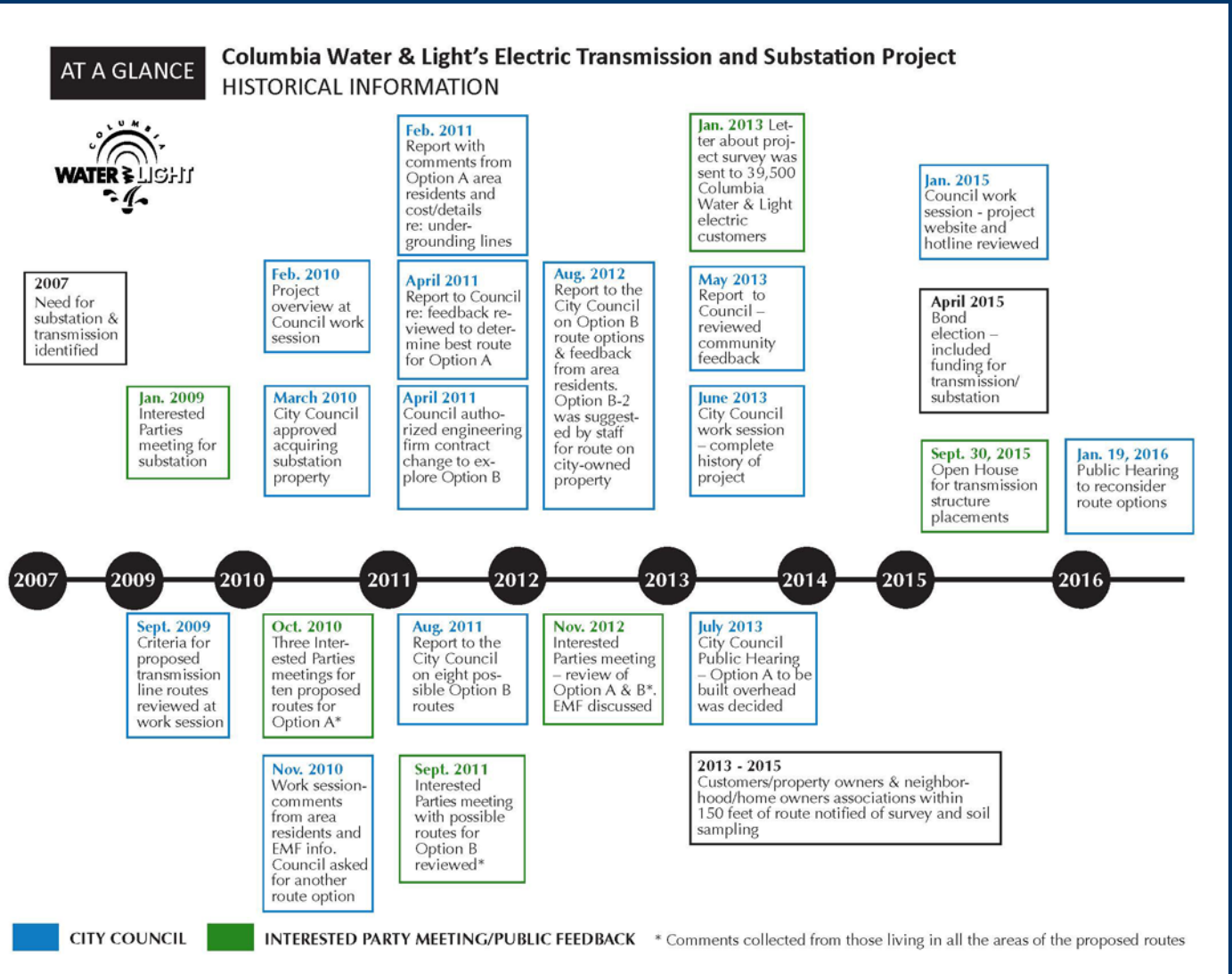
Year	Grindstone (3*)	Hinkson (3*)	Perche (2*)
2007	41.5%	67.6%	61.8%
2010	44.7%	68.6%	64.4%
2015	48.6%	64.2%	72.0%

*number of transformers



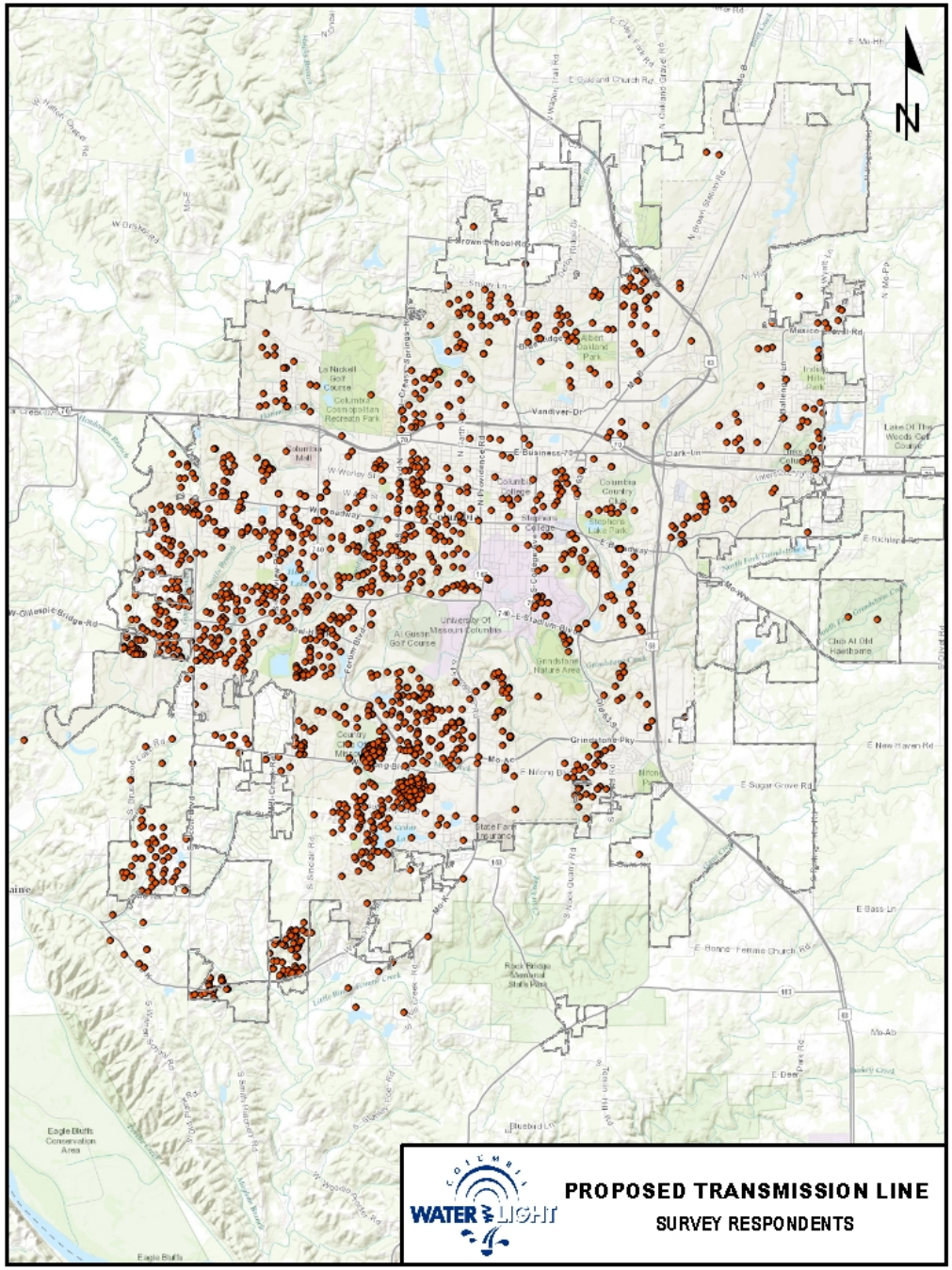
Improvements Needed:

1. Second 161 kV transmission line into Perche Creek for system redundancy (red)
2. Substation in southern part of electric service territory to reduce load at others (green)
3. Limit reliability exposure



Property owners near 18 suggested route options were invited, by mail, to FIVE public meetings to provide comment about route selection (including Boone Electric customers)

There was one meeting to gather feedback about pole structure types and locations (at 30% completion of design phase)



Survey Route Preference by Ward

	Option A	Option B	Option B-2
Ward 1	89%	10%	1%
Ward 2	77%	19%	4%
Ward 3	83%	13%	3%
Ward 4	85%	11%	4%
Ward 5	59%	27%	14%
Ward 6	87%	9%	4%
Outside City Limit	75%	17%	8%

Information from city-wide survey AFTER input from area property owners to select the least objectionable route for Option A & B

Cost Considerations

Planning Order

- **Substation:** Identify where substation will be located so possible transmission line routes can be determined
- **Route Selection:** Identify criteria and submit several options, gather feedback to determine least objectionable route
- **Line Design:** Survey, soil sampling, determine existing easements and plan for any road expansion to determine pole type & location
  - At 30% of this phase for Option A. Presented preliminary structure locations/types to collect feedback in September, stopped line design process in November 2015

Funding & Planning

- As of December 2015, $7.3 million encumbered, spent $3.5 million
- Abandoning Option A: $2 million in line design services lost (surveying, soil sampling, determining where pole structures can be located, etc.)
- Equipment for substation: building at 69 kV level would cause around $1 million to be lost

Funding & Planning

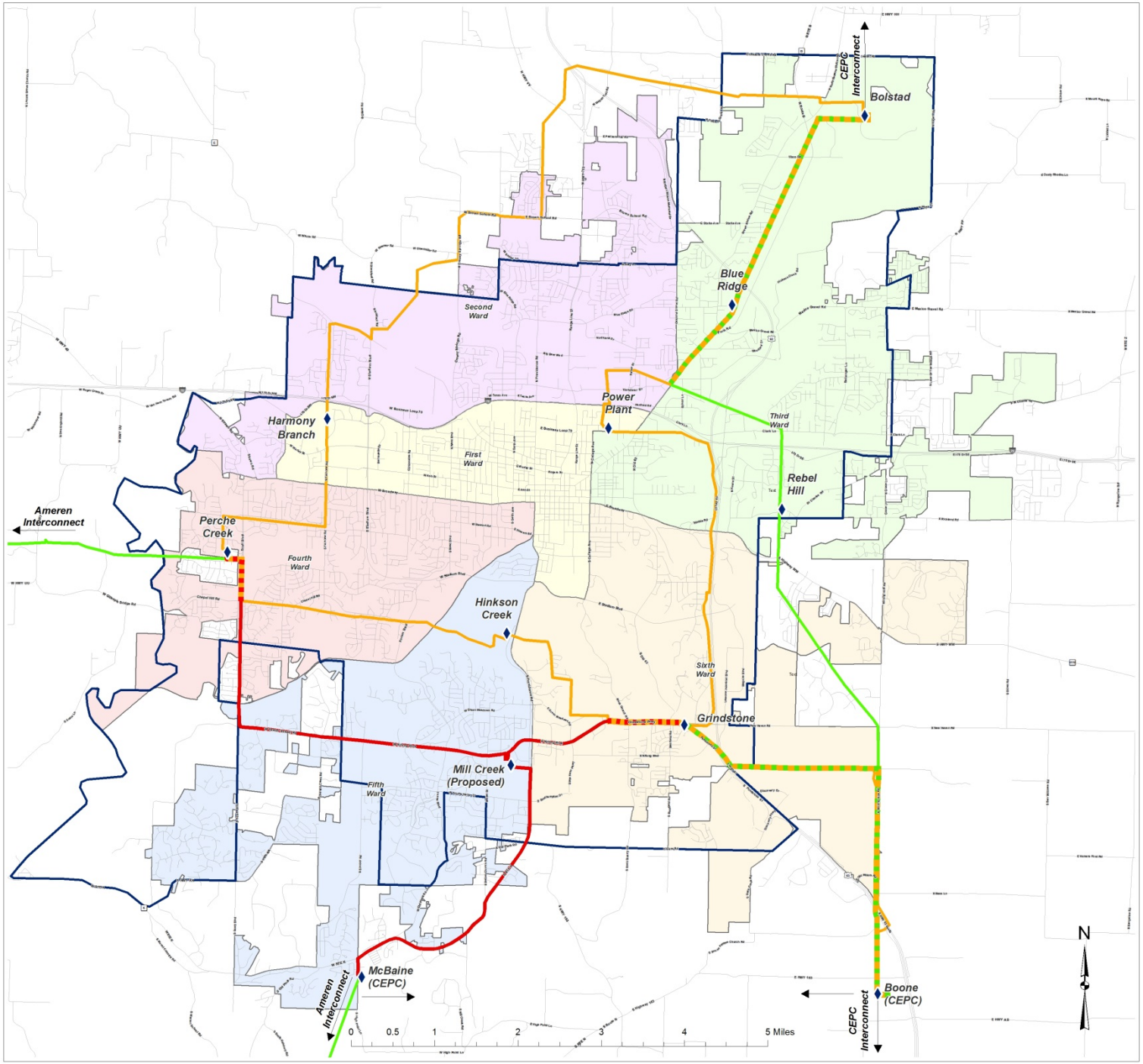
- Starting over would add, at a minimum, two to three years before improvements could be in place
- April 2015 bond language would allow changes to this project, but voters were presented information based on the Option A route
- Columbia electric customers' rates would be responsible for any money lost from changes to this project

Routing Options

including reliability, real estate impact & costs of options

Proposed Mill Creek Transmission Project

Option A - Original



- Substations
- Multiple Transmission Lines-69Kv/Proposed 161Kv
- Proposed 161Kv Transmission Lines
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory
- First Ward
- Second Ward
- Third Ward
- Fourth Ward
- Fifth Ward
- Sixth Ward

COLUMBIA WATER & LIGHT

May 2016

Sources:
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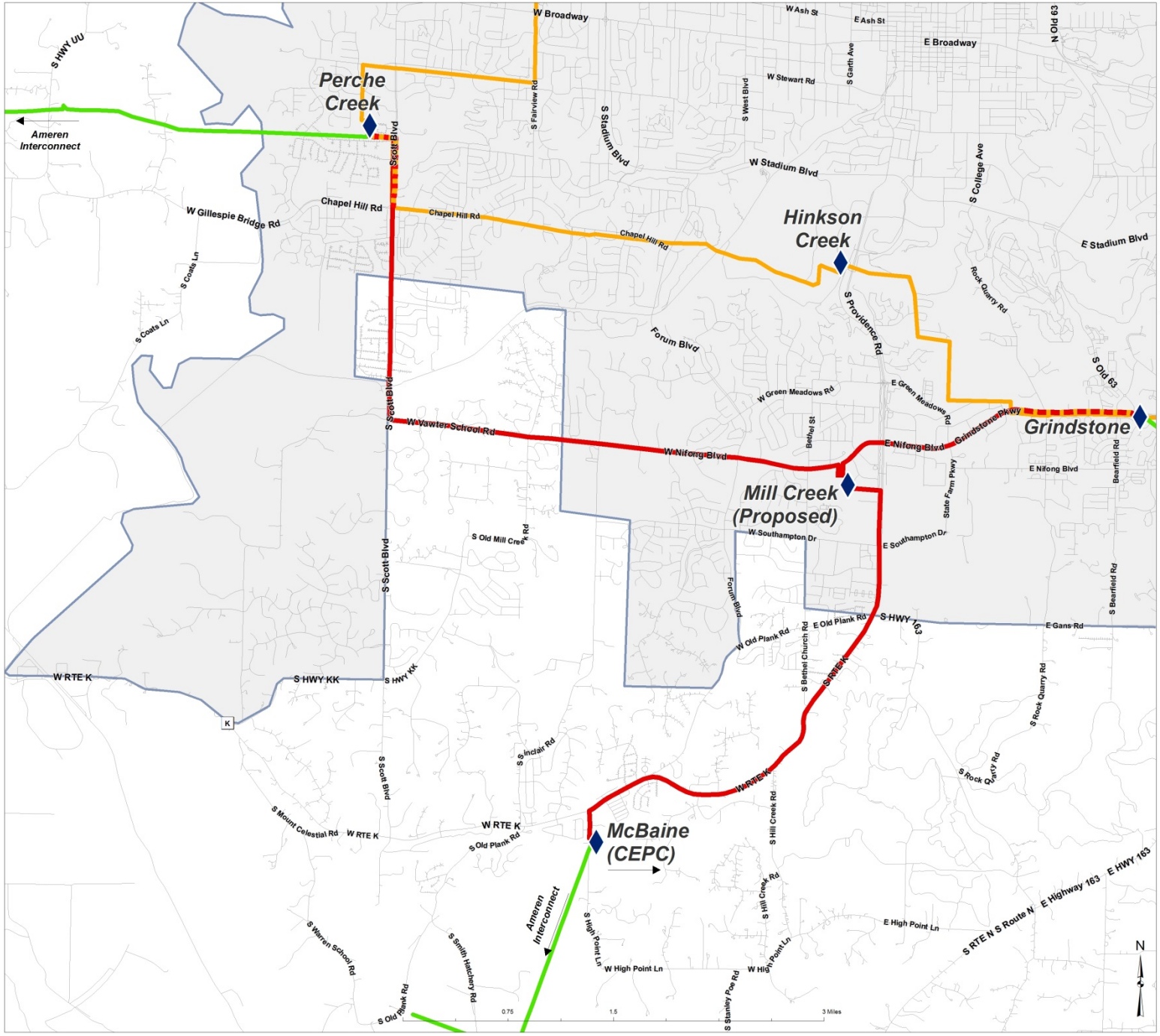
Transmission Lines-City of Columbia Water & Light Department
Wards-City of Columbia Geospatial Information Services Office



Proposed Mill Creek Transmission Project

Option A - Original

- Substations
- Multiple Transmission Lines-69Kv/Proposed 161Kv
- Proposed 161Kv Transmission Lines
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory

COLUMBIA WATER & LIGHT

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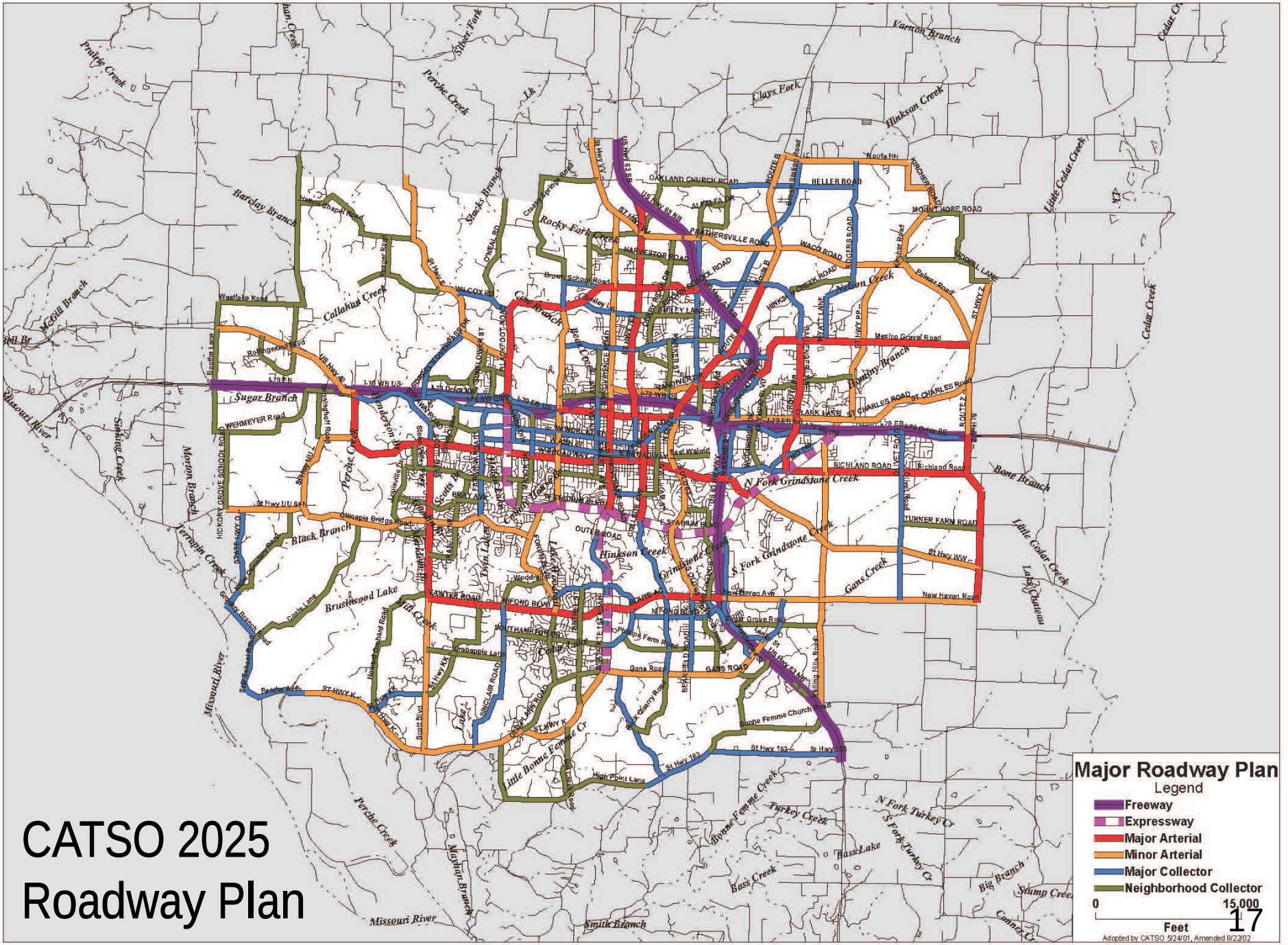


CATSO 2025 Roadway Plan

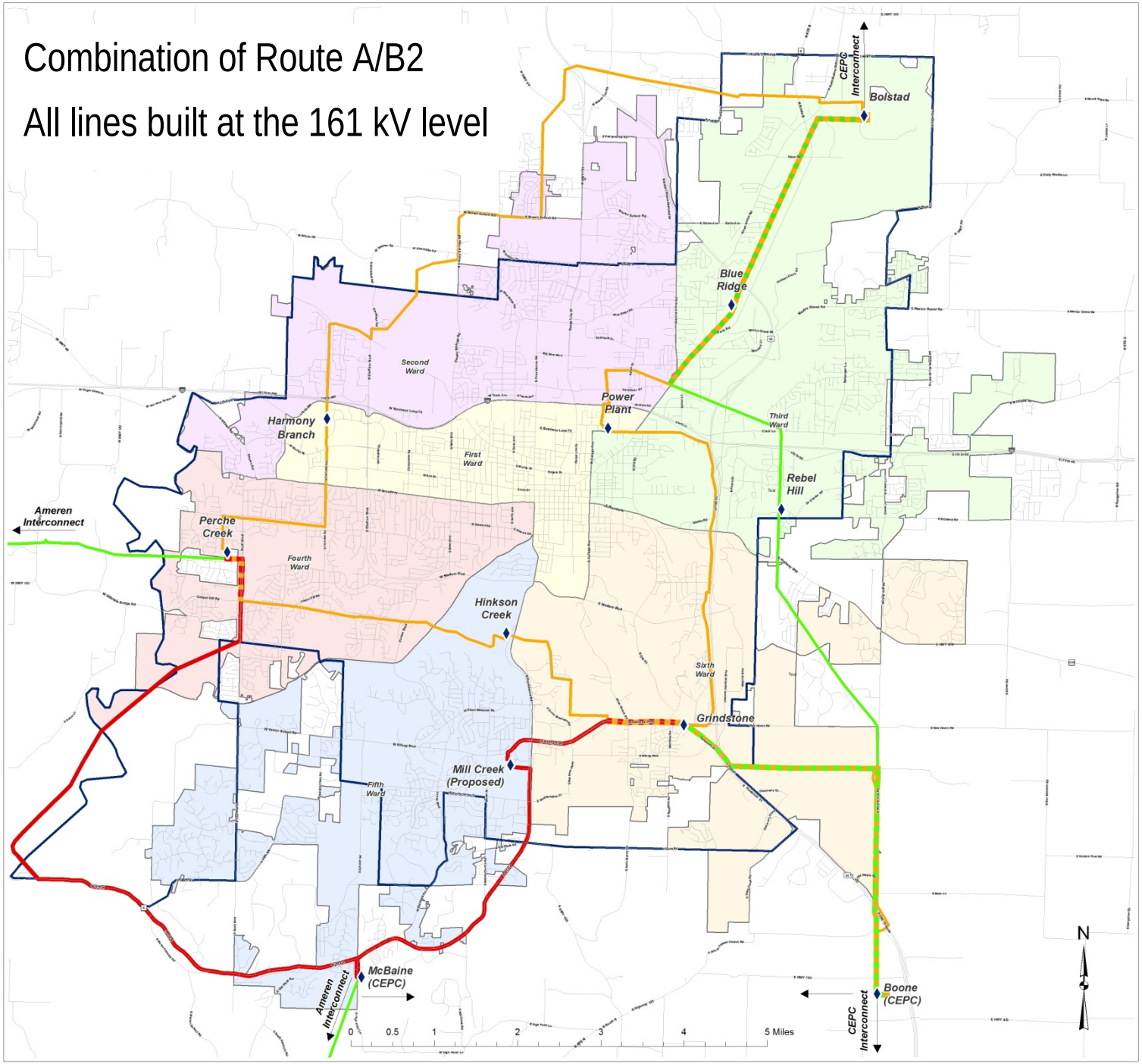
Existing Electric Distribution System at Nifong & Bethel Intersection

Example: With buried distribution & new transmission lines with roadway expansion

NOTE: roadway expansion design not completed but road engineers have suggested pole locations for transmission lines

Alternative Routing Considerations

- Council requested a 69 kV option inside the city limits but it is not a viable long-term option due to electric demands
- Since January public hearing, different routing options have been reviewed by staff members but not formally vetted
- New alternatives include building the Mill Creek substation at the 161 kV level



Proposed Mill Creek Transmission Project

Option C

- Substations
- Multiple Transmission Lines - 69Kv/Proposed 161Kv
- Multiple Transmission Lines - 69Kv/Existing 161Kv
- Proposed 161Kv Transmission Lines
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory
- First Ward
- Second Ward
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COLUMBIA WATER & LIGHT

May 2016

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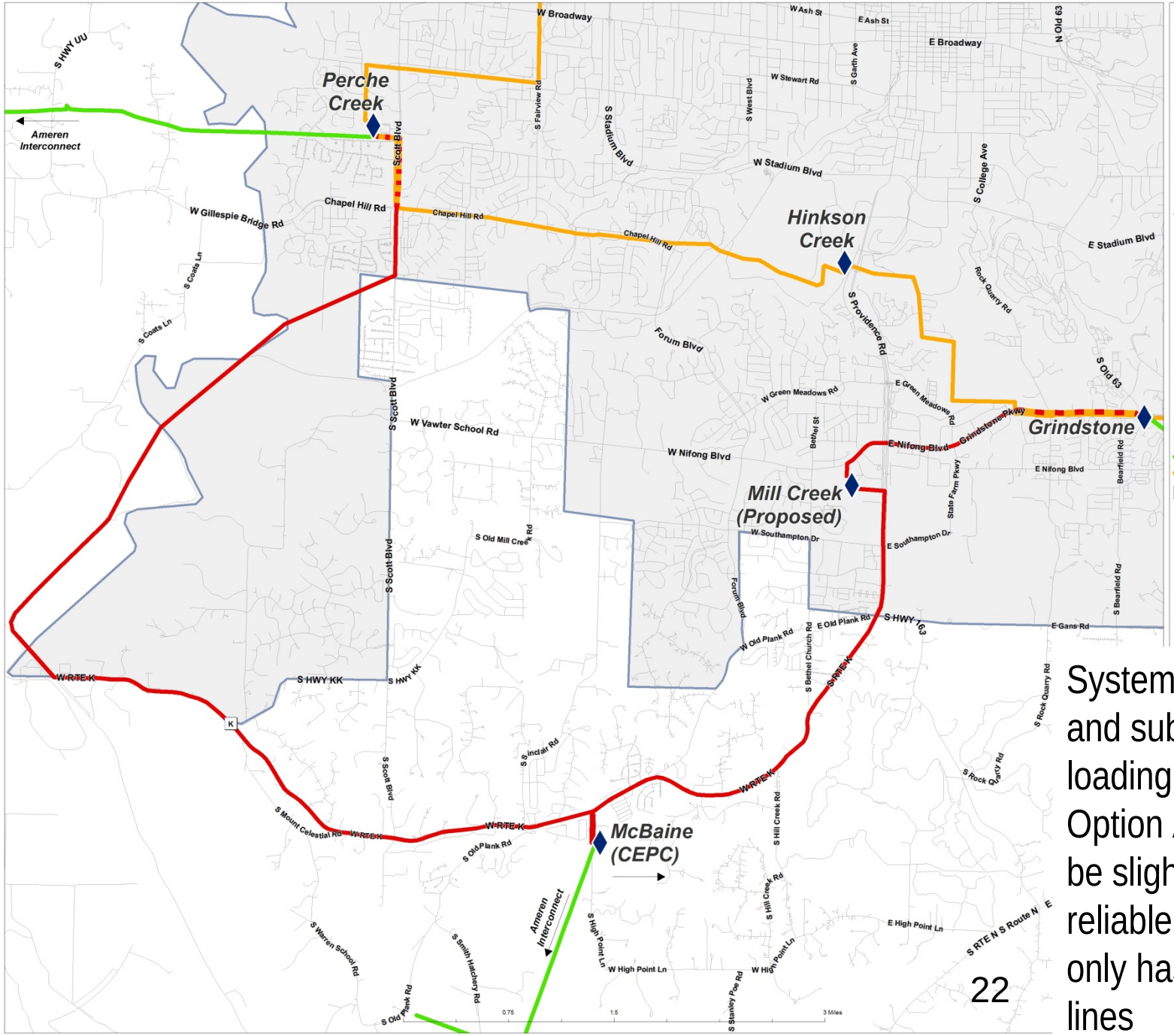
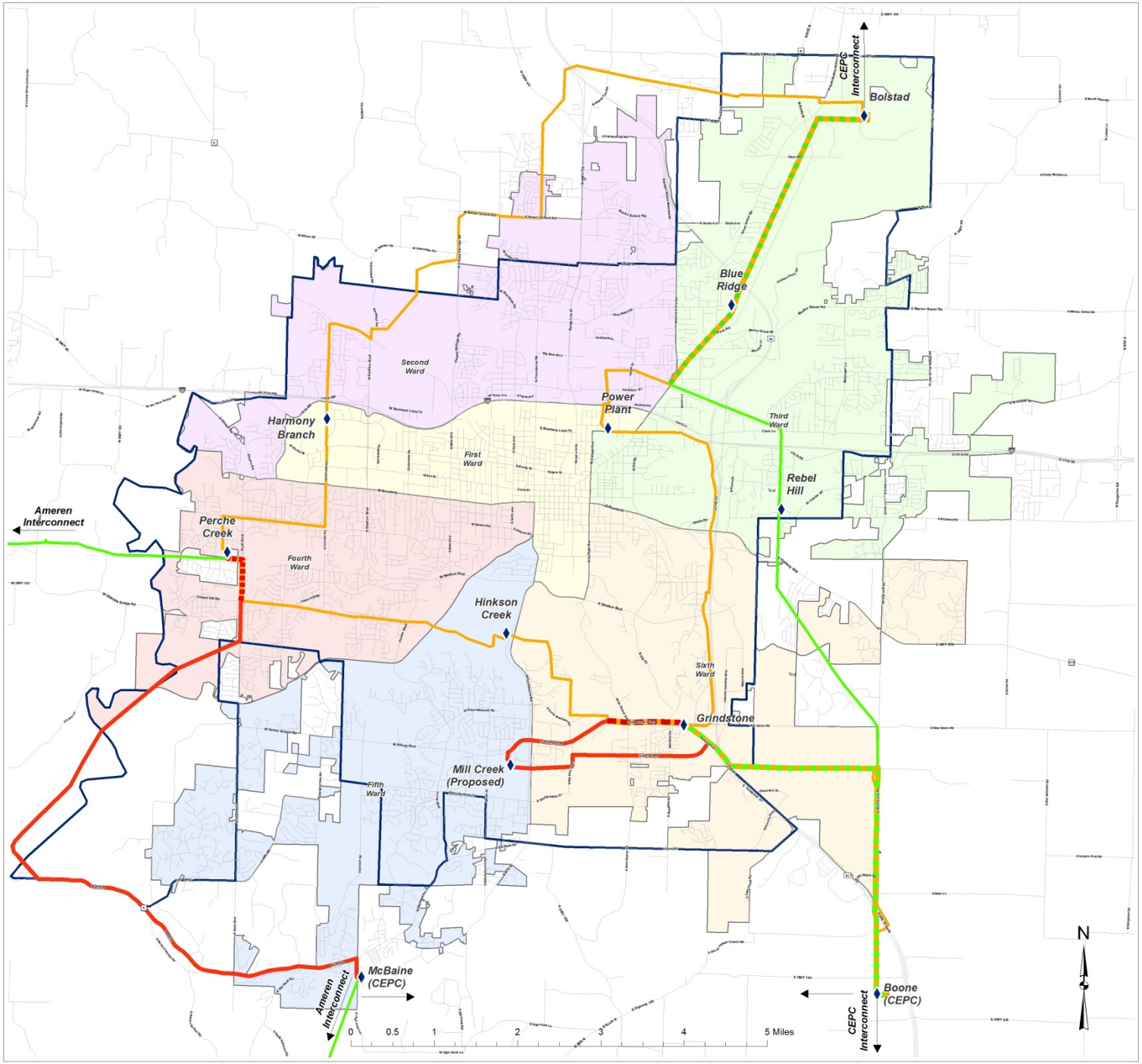


Proposed Mill Creek Transmission Project

Option C

- Substations
- Multiple Transmission Lines - 69Kv/Proposed 161Kv
- Proposed 161Kv Transmission Lines
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory

System redundancy and substation loading similar to Option A but would be slightly less reliable because it only has two 161 kV lines



Proposed Mill Creek Transmission Project

Option D

- Substations
- Multiple Transmission Lines - 69Kv/Existing 161Kv
- Proposed Transmission Lines
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory
- First Ward
- Second Ward
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COLUMBIA WATER & LIGHT

May 2016

Sources:
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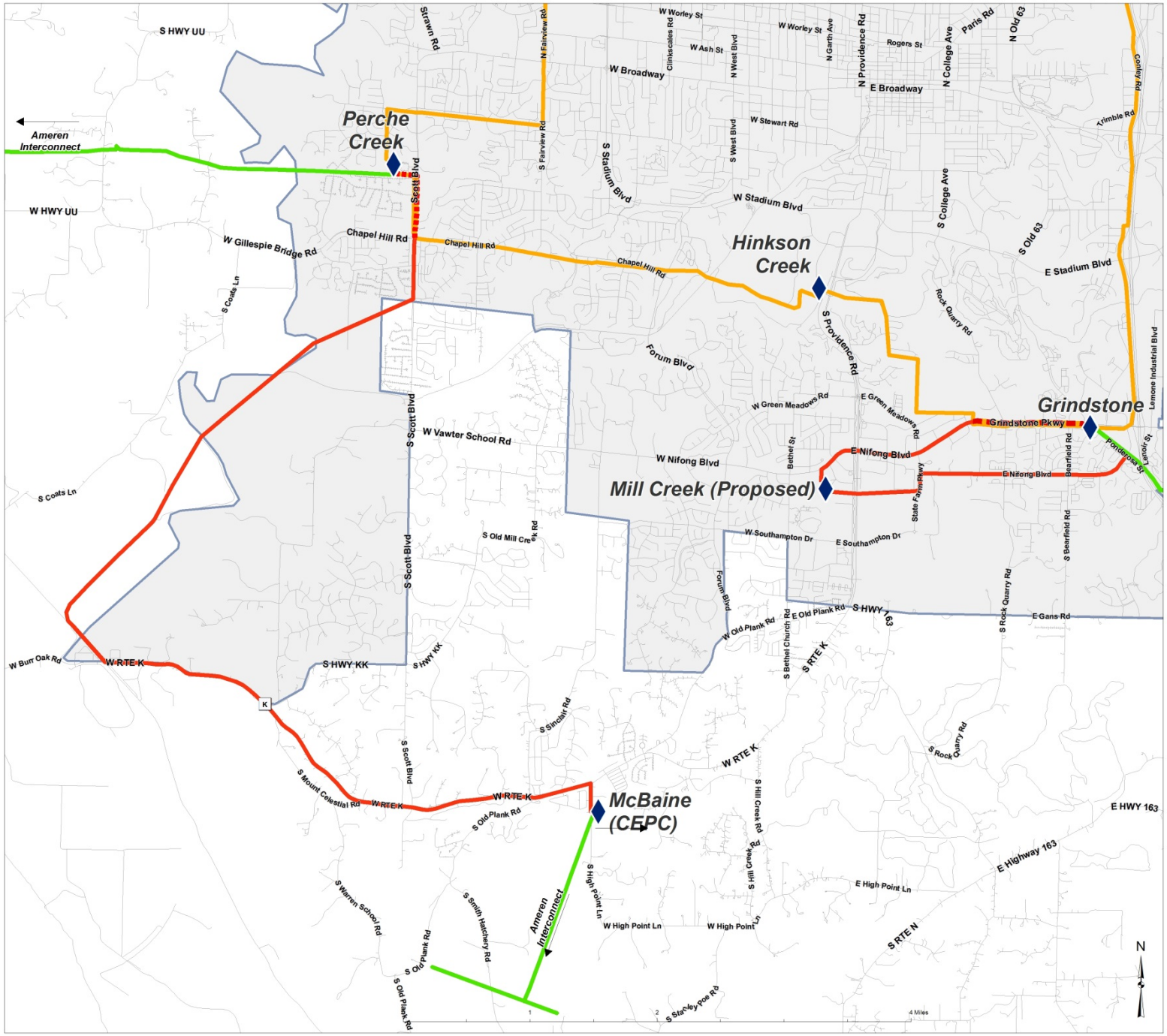

Proposed Mill Creek Transmission Project

Option D

COLUMBIA WATER & LIGHT

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Reliability Exposure

	Option A	Option C	Option D
2nd 161 kV feed to Perche substation	Yes	Yes	Yes
Reduce substation loading	Yes. Supports 75 MW planned distribution capacity.	Yes. Supports 75 MW planned distribution capacity.	Yes. Supports 75 MW planned distribution capacity.
Reliability considerations	Most reliable of these 3 options. Least amount of new double circuited lines. All 161 kV lines follow diverse paths.	In between the other two options. It has one fewer section of 161 kV lines but follows diverse paths.	Least reliable of these 3 options. Most amount of new lines within close proximity of each other. Has one fewer section of 161 kV lines with the least diverse path.

Real Estate Impact

Values in linear miles that include property within 150 feet of both sides of the route

	Option A*	Option C	Option D
Residential	11.1 miles 474 parcels	9 miles 409 parcels	6.75 miles 311 parcels
Commercial	5.8 miles 113 parcels	4.9 miles 88 parcels	4.8 miles 71 parcels
Agricultural	5.5 miles 56 parcels	17.2 miles 131 parcels	17.3 miles 117 parcels
TOTAL	22.4 miles 643 parcels	31.1 miles 628 parcels	28.85 miles 505 parcels
Schools	Mill Creek Rockbridge (elementary & high school)	Rockbridge (elementary & high school)	None

*includes Mill Creek to McBaine portion

Cost Comparisons

	Option A Phase I	Option A Phase II	Option C	Option D
161 kV	$15,600,123	$8,103,960	$33,200,000 to $36,500,000	$27,500,000 to $31,600,000
69 kV	$0	$0	$0	$0
Easement	$610,000	$1,503,610	$4,500,000 to $4,900,000	$3,215,900 to $3,248,300
Undergrounding Distribution Lines (CWL)	$3,463,400	$250,000	$1,500,000 to $1,650,000	$2,669,000 to $3,070,000
Undergrounding Distribution Lines (Boone Electric)	$1,536,600	$2,790,000	$6,500,000 to $7,200,000	$2,790,600 to $3,208,000
Subtotal	$21,210,123	$12,648,170		
Total	$33,858,293		$45,700,000 to $50,300,000	$36,175,500 to $41,126,300
Load Serving Capacity	270 MW		Requires further study	Requires further study

NOTE: Costs do not include required substation interconnections or upgrades to connect the new lines with existing substations.

Non-transmission Alternatives (NTA)

Energy & Demand

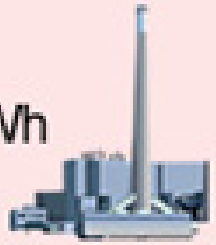
Power x Time = Energy Consumption

100 Watt

x

10 Hours

= 1,000 Watt-hours or 1 kWh



10 x 100 Watts

1,000 Watts

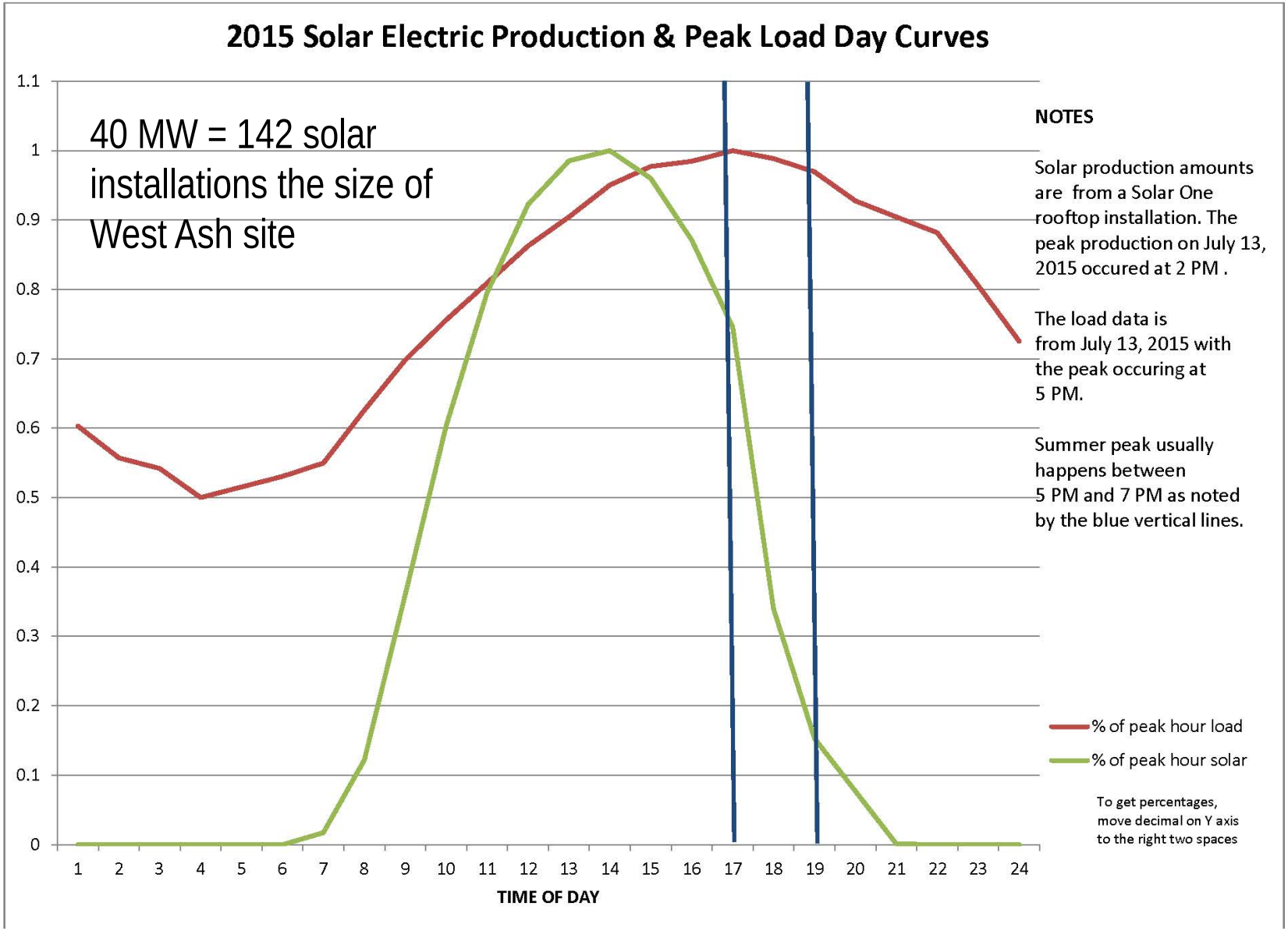
x

1 Hour

= 1,000 Watt-hours or 1 kWh

10 Times More Demand

NTA: Add Generation



Local solar: Midcontinent Independent System Operator credits solar at zero for capacity requirements

Storage

Lithium Ion batteries examples

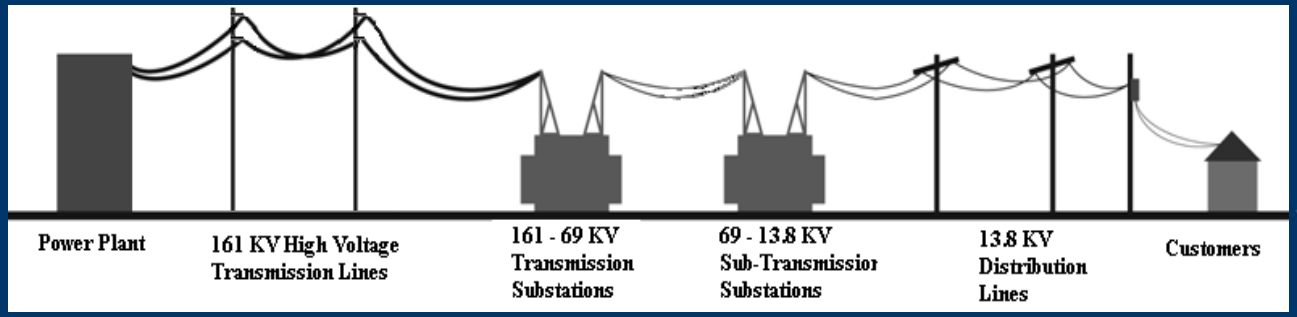
- Cost prohibitive at utility scale
  - Portland, Oregon: 5 megawatts (1.2 megawatt hours) for $23 million
    - This would last 14.5 minutes if you are using all 5 MW
    - 15 of these 5 MW batteries would equal 75 MW of capacity
  - Boothbay, Maine: Summer air conditioning load minimal, population ½ of Columbia's and cost was $6 million
- Very sensitive to hot temperatures

Storage

Fuel Cells

- According to Missouri University of Science & Technology solar demo manager, donated fuel cells have not performed well and he would not purchase any at this time

Future storage options: can’t be determined when the technology and cost will make it an acceptable option



COLUMBIA WATER & LIGHT

Main Points to Consider

Reliability

- What risk is acceptable and how to meet our future needs?

Longevity

- How long should the solution solve the problem for?

Location

- What is the appropriate community impact?

Impacts on Cost

- Going back & forth in process takes time and money

Discussion

Appendix

Includes previous options & additional information provided/requested

Citizen Proposal

Melinda Jenne, Carolyn Hawks, Detelina Marinova & Kim Fallis

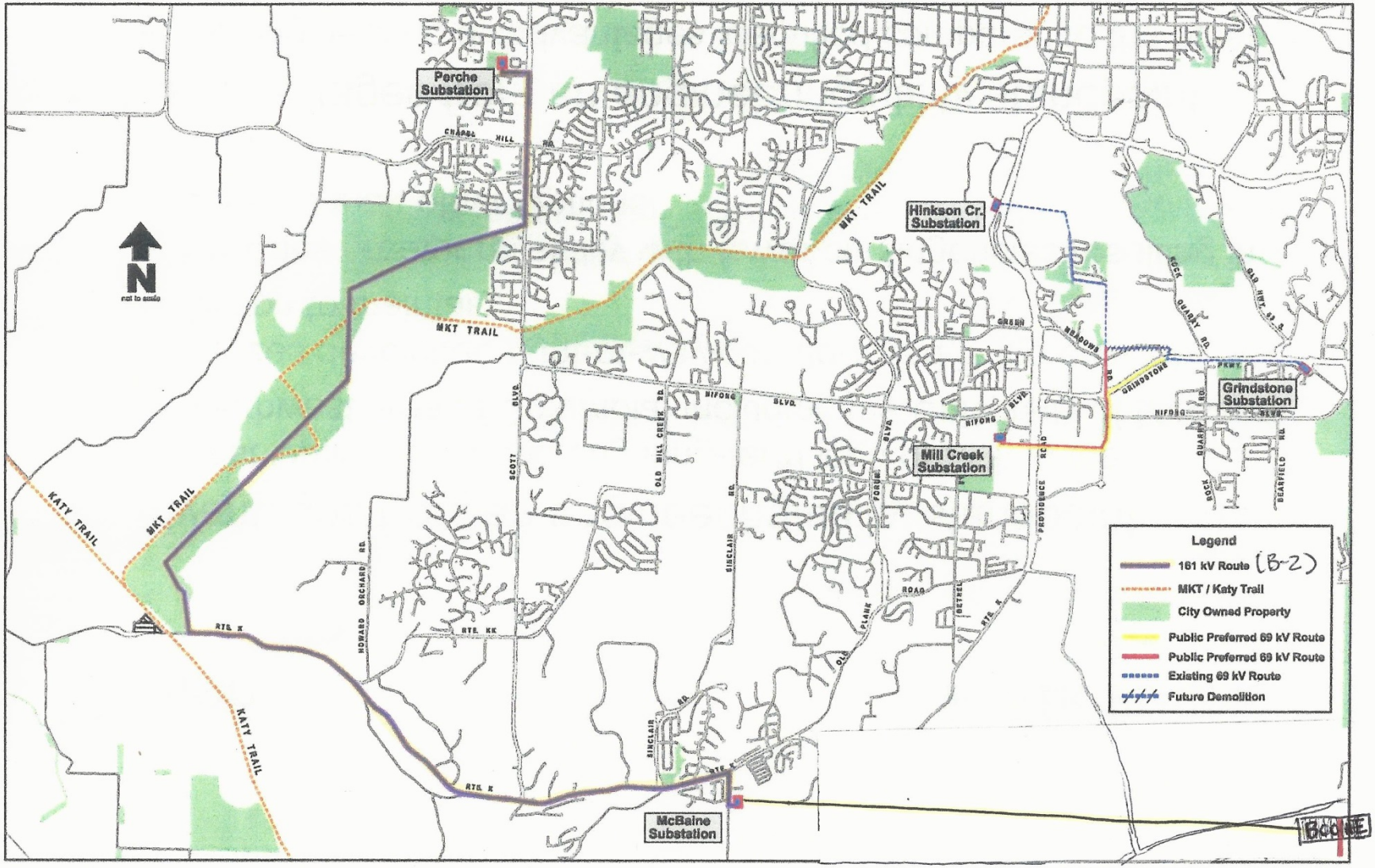
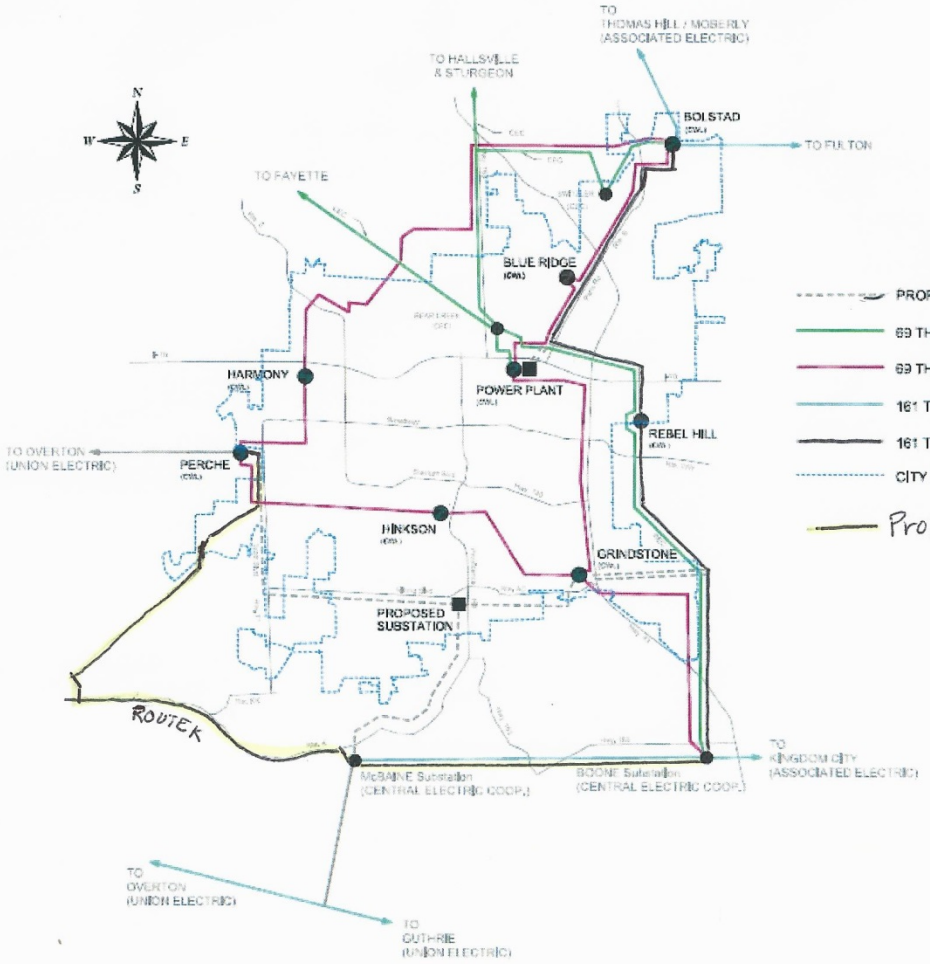


Figure 2-2: CWL Transmission System



Citizen Proposal

Melinda Jenne, Carolyn Hawks, Detelina Marinova & Kim Fallis

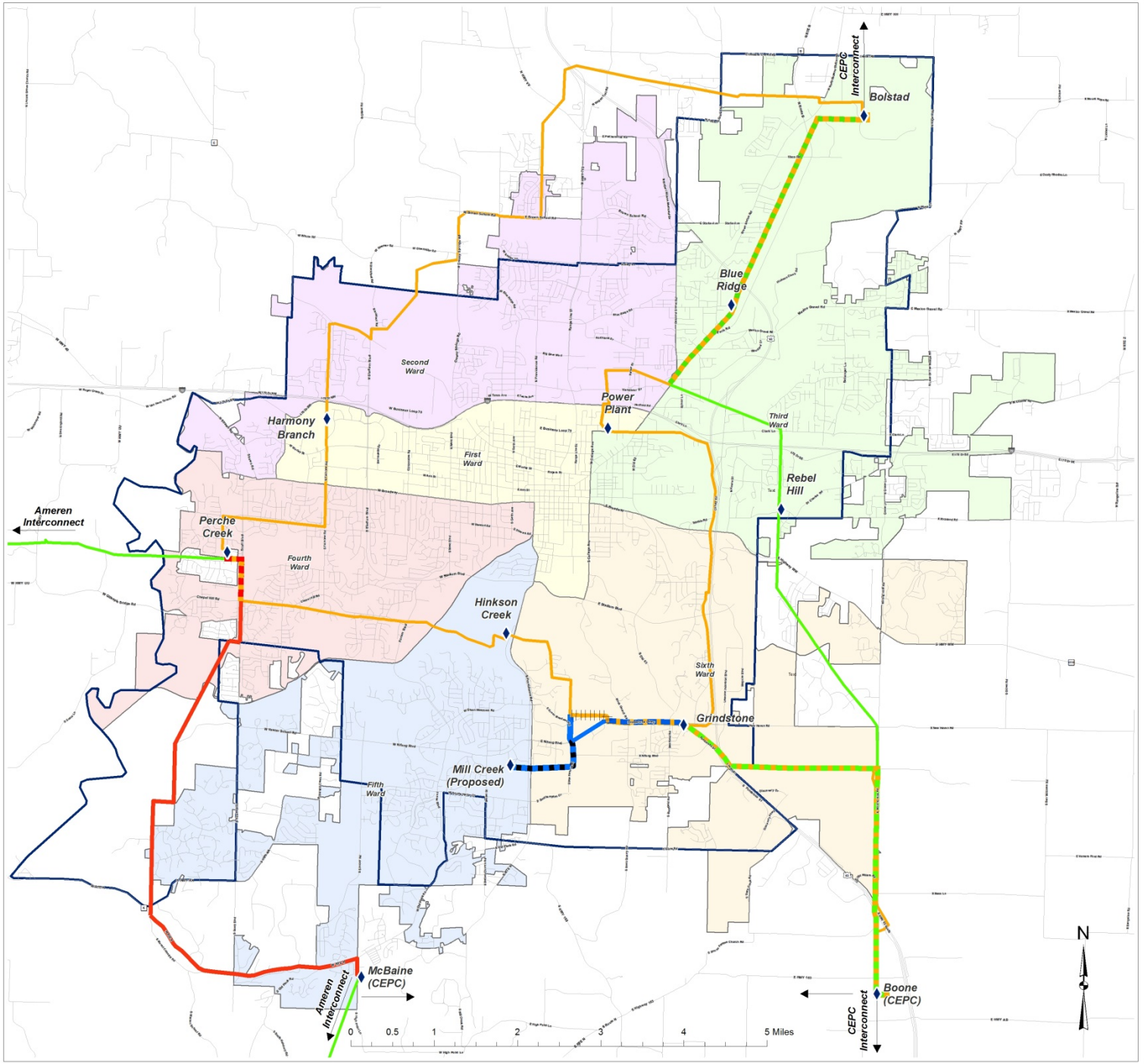
WATER & LIGHT

Columbia Water & Light

Transmission Lines and Interconnections

Proposed Mill Creek Transmission Project

Option B



- Substations
- Proposed 69Kv Transmission Lines
- Existing 69Kv Transmission Lines Removed
- Multiple Transmission Line-Proposed 69Kv/Proposed 69Kv
- Multiple Transmission Lines-69Kv/Proposed 69Kv
- Proposed 161 Kv Transmission Lines
- Multiple Transmission Lines - 69Kv/161Kv
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory
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COLUMBIA WATER & LIGHT

May 2016

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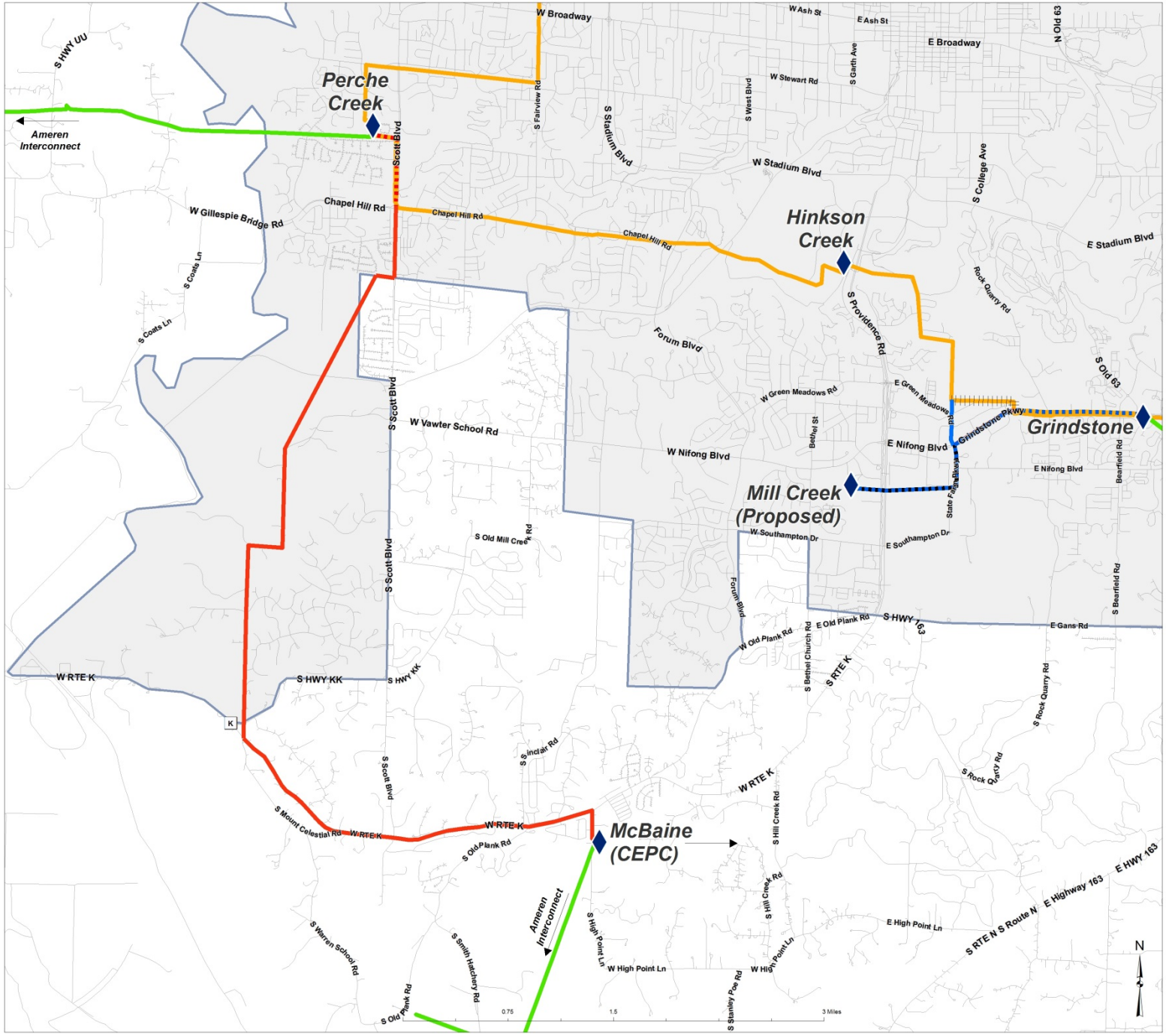

Proposed Mill Creek Transmission Project

Option B

- Substations
- Existing 69Kv Transmission Lines Removed
- Multiple Transmission Lines-68Kv/Proposed 161Kv
- Multiple Transmission Lines-69Kv/Proposed 69Kv
- Multiple Transmission Lines-Proposed 69Kv/Proposed 69Kv
- Proposed 69Kv Transmission Lines
- Proposed 161Kv Transmission Lines
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory

COLUMBIA WATER & LIGHT

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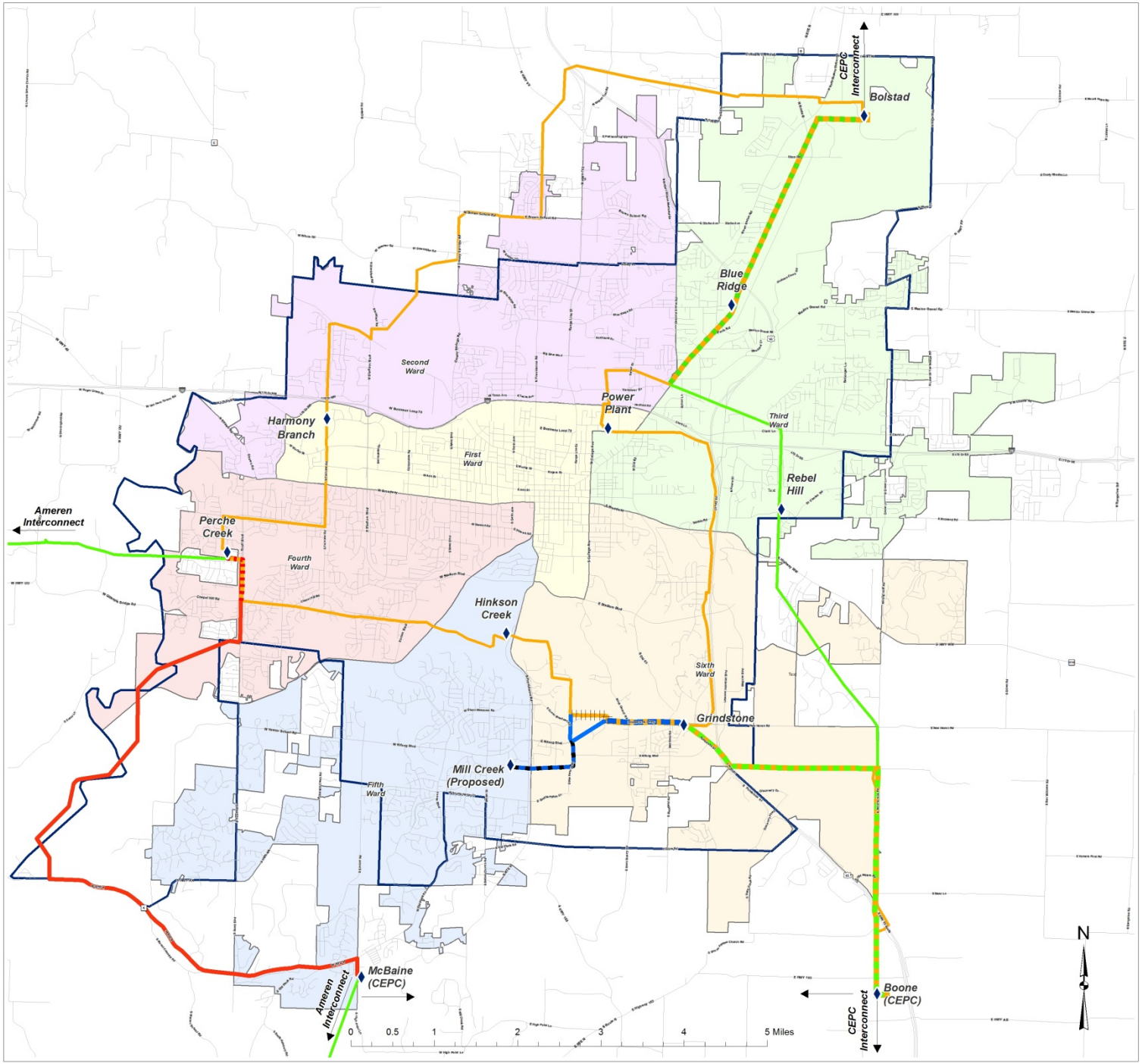

Proposed Mill Creek Transmission Project

Option B2

- Substations
- Multiple Transmission Line-Proposed 69Kv/Proposed 69Kv
- Multiple Transmission Lines-69Kv/161Kv
- Multiple Transmission Lines-69Kv/Proposed 69Kv
- Existing 161Kv Transmission Lines Removed
- Proposed 69Kv Transmission Lines
- Proposed 161Kv Transmission Lines
- 161Kv Existing Transmission Line
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COLUMBIA WATER & LIGHT

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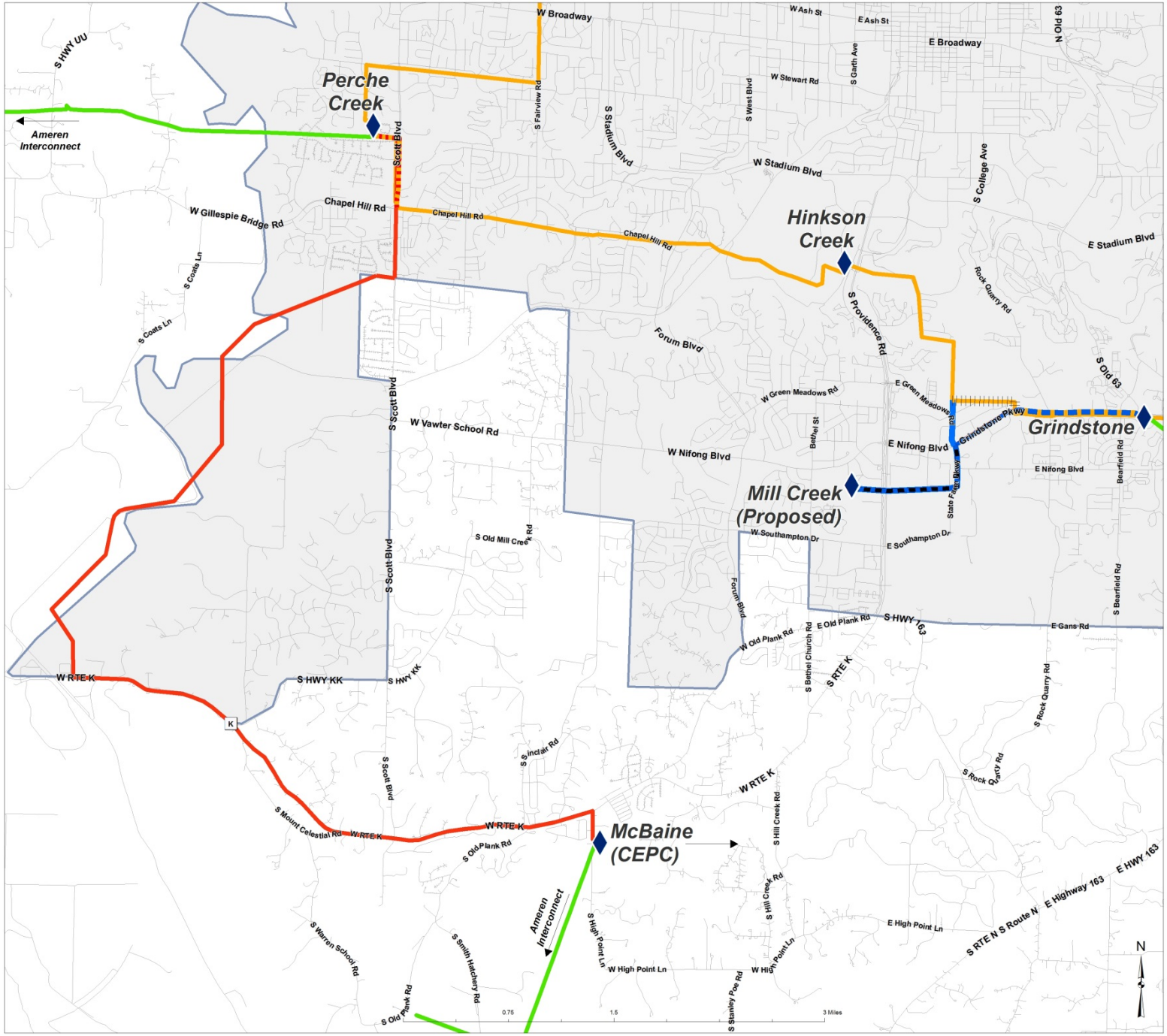

Proposed Mill Creek Transmission Project

Option B2

- Substations
- Existing 69Kv Transmission Lines Removed
- Multiple Transmission Lines-Proposed 69 Kv/Proposed 69Kv
- Multiple Transmission Lines-69Kv/Proposed 161Kv
- Multiple Transmission Lines-69Kv/Proposed 69Kv
- Proposed 69Kv Transmission Lines
- Proposed 161Kv Transmission Lines
- 161Kv Existing Transmission Line
- 69Kv Existing Transmission Line
- Water & Light Electric Territory

COLUMBIA WATER & LIGHT

May 2016

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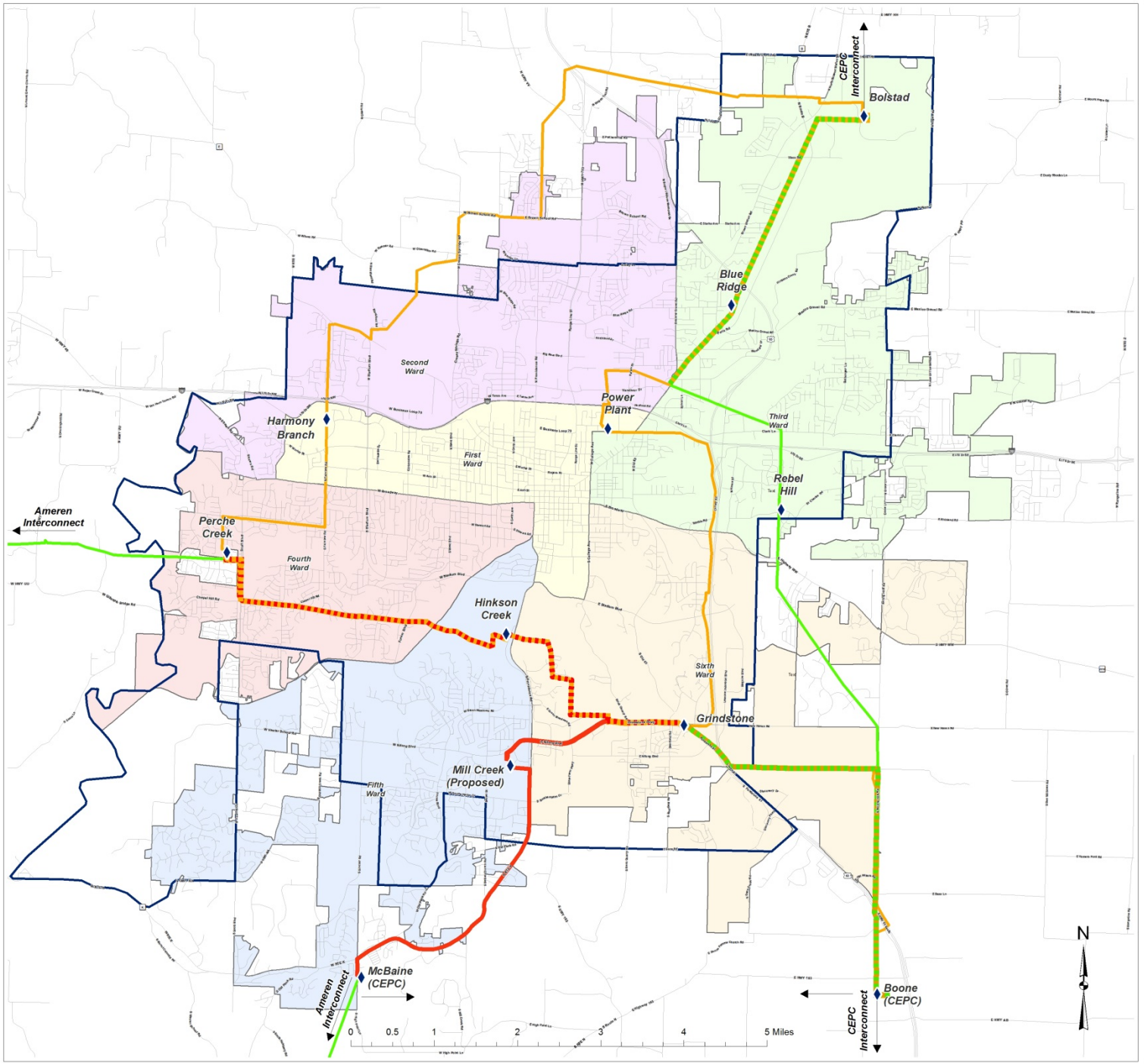
Proposed Mill Creek Transmission Project

Option A - North



- Substations
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COLUMBIA WATER & LIGHT

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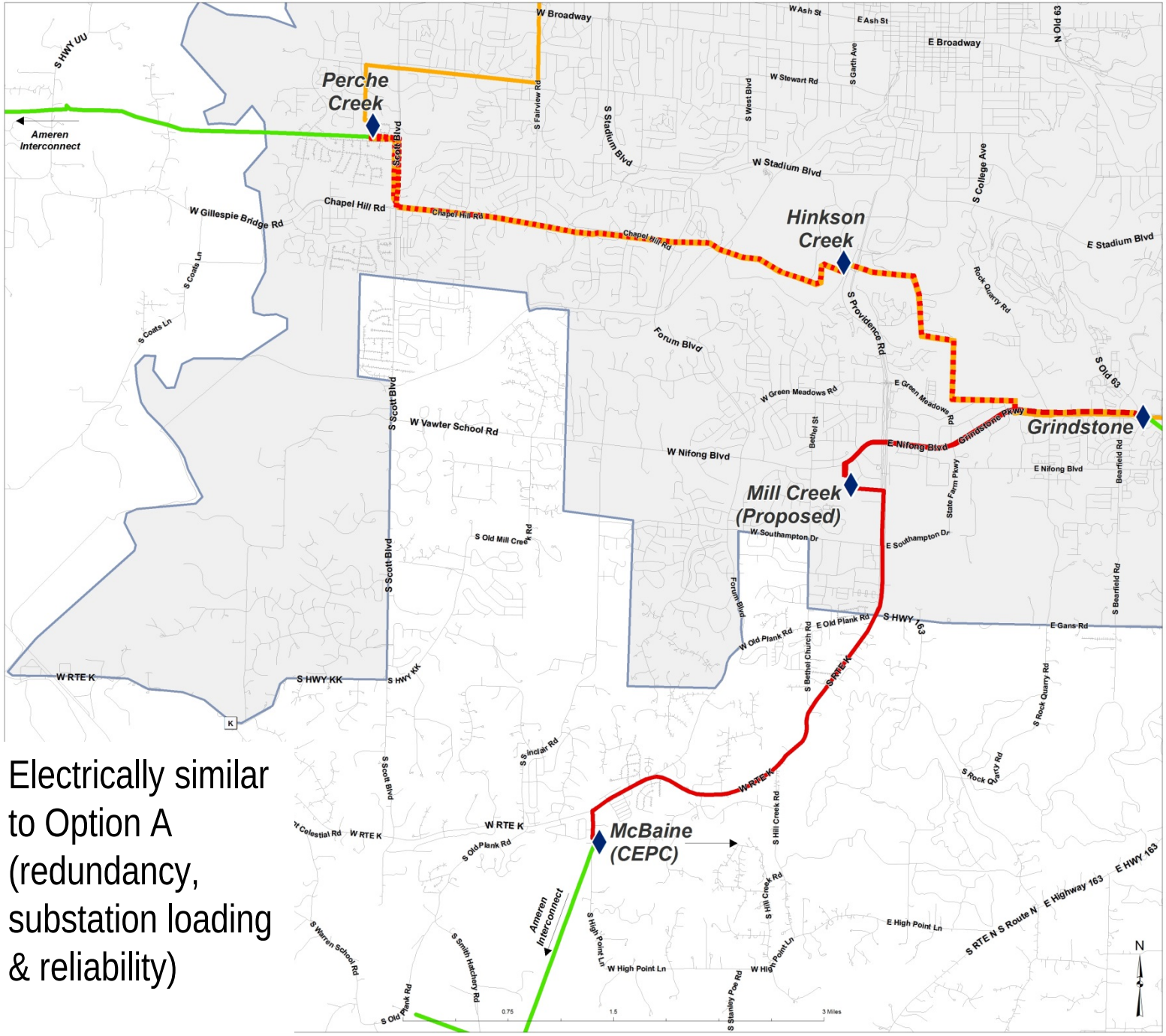
Proposed Mill Creek Transmission Project

Option A - North



Electrically similar to Option A (redundancy, substation loading & reliability)

May 2016

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Real Estate Impact

Values in linear miles that include property within 150 feet of both sides of the route

	Option A*	Option B**	Option B2**	Option C	Option D
Residential	11.1 miles 474 parcels	6.15 miles 291 parcels	5.1 miles 264 parcels	9 miles 409 parcels	6.75 miles 311 parcels
Commercial	5.8 miles 113 parcels	4.5 miles 72 parcels	4.4 miles 72 parcels	4.9 miles 88 parcels	4.8 miles 71 parcels
Agricultural	5.5 miles 56 parcels	11.6 miles 94 parcels	16.2 miles 98 parcels	17.2 miles 131 parcels	17.3 miles 117 parcels
TOTAL	22.4 miles 643 parcels	22.25 miles 457 parcels	25.7 miles 434 parcels	31.1 miles 628 parcels	28.85 miles 505 parcels
Schools	Mill Creek Rockbridge (elementary & high school)	None	None	Rockbridge (elementary & high school)	None

*includes Mill Creek to McBaine portion
**includes 69 kV portion

Cost Comparisons

	Option A Phase I	Option A Phase II	Option B	Option B2	Option C	Option D
161 kV	$15,600,123	$8,103,960	$16,410,519	$20,057,301	$33.2 M to $36.5 M	$27.5 M to $31.6 M
69 kV	$0	$0	$2,425,500	$2,425,500	$0	$0
Easement	$610,000	$1,503,610	$3,055,080	$3,072,285	$4.5 M to $4.9 M	$3,215,900 to $3,248,300
Undergrounding Distribution Lines (CWL)	$3,463,400	$250,000	$1,229,200	$1,229,200	$1.5 M to $1.65 M	$2.669 M to $3.07 M
Undergrounding Distribution Lines (Boone Electric)	$1,536,600	$2,790,000	$4,327,200	$3,762,400	$6,500,000 to $7,200,000	$2.791 M to $3.208 M
Subtotal	$21,210,123	$12,648,170				
Total	$33,858,293		$27,447,499	$30,546,686	$45,700,000 to $50,300,000	$36.176 M to $41.126 M
Load Serving Capacity	270 MW		27 MW	27 MW	Requires further study	Requires further study

NOTE: Costs do not include the McBaine switch station.

Impact of raising transit fee study

Taken from summer 2013 report

- Review of the literature and input from key informants and community members strongly suggests that what may seem like an insignificant amount to some – $2-4 monthly – could further harm the most vulnerable Columbia residents.
- For low- and fixed-income families, money for food, health care, households items, car payments and maintenance, etc., is already limited so that any extra expenses threaten the residents' health and well-being.