Rush Creek Task Force
Study Scope
March 29, 2017

I. Purpose

This scope of work lays out the plan for a coordinated and joint transmission study effort to analyze the costs and benefits of alternative proposals to potentially integrate the Rush Creek Wind Project 345 kV generation intertie as a network transmission facility. These studies will be performed through the Rush Creek Task Force (RCTF) of the Colorado Coordinated Planning Group (CCPG). Participation in the Task Force is open to all interested stakeholders.

II. Background

Public Service Company of Colorado (PSCo) has received approval to build, own, and operate a new 600 MW wind generation facility which will be located in Cheyenne, Elbert, Kit Carson, and Lincoln counties. The project will include two wind farm collector sites and nearly 90 miles of a radial 345 kV transmission line (Gen-Tie) to interconnect the facility to PSCo's transmission network at Missile Site Substation. The RCTF was created as a part of the Non-Unanimous Settlement Agreement for the Rush Creek Wind Project Public Utilities Commission of the State of Colorado (Commission) Proceeding No. 16A-0117E. Within the Settlement Agreement the Further Study section states:

> "The Company (PSCo) will take a leadership role in a Colorado Coordinated Planning Group ('CCPG') Task Force (or Sub-Group) to analyze the costs and benefits of alternative proposals to potentially integrate the Gen-Tie as a network transmission facility. The alternatives to be studied must be reviewed and determined to be a reasonable networking alternative to be evaluated by the CCPG Task Force. The Company commits that it will offer staff and computing resources from its Transmission Planning group, will use its best efforts to publish the CCPG report after stakeholder comment no later than 12 months after the settlement agreement is filed with the Commission."

III. Process

- Studies will be performed through the RCTF
- PSCo will facilitate the study effort
- Studies will expand upon PSCo's planned Rush Creek Wind Project and the Gen-Tie
- Materials will be posted at
  http://regplanning.westconnect.com/ccpg_rush_creek_tf.htm

IV. Models

Transmission study models will be developed from WECC and CCPG approved cases. The cases will include benchmarking and ten-year conditions, using the latest forecasted loads in the study footprint. Studies will include peak-summer conditions as well as off-peak light load conditions with higher wind generation.

A. Cases

1. Base Case (Benchmark)

The benchmark case will be the 2026 CCPG/WestConnect heavy summer case. This base case represents PSCo's summer peak loads per the September 2015 load forecast.

The renewable generation dispatch in the study area will be updated as shown in section C.

2. Light Load

The light load case will be the 2026 Light Spring CCPG/WestConnect case. The renewable generation dispatch in the study area will be updated as shown in section C.

B. Load Assumptions

1. Summer Peak – 100 % peak load

2. Light Load – Approximately 50% peak load

C. Generation Assumptions: Unit generation should be physically possible and economically reasonable. The following guidelines will be used for generation assumptions in the models:

1. General

a) Generation modeled as planned or expected for 2026

b) Model planned generation retirements, such as Craig 1 and Valmont

2. Summer Peak

a) Rush Creek Wind Project 100% rated capacity (600 MW)

b) Missile Site Area: 80% wind rated capacity (680 MW)

c) Pawnee Site Area: 40% wind rated capacity (230 MW), 90-100% conventional rated capacity (788 MW)

d) Burlington Area: wind 80% rated capacity (161 MW), 100% conventional rated capacity (100 MW)

e) Lincoln Area: 100% conventional rated capacity (129 MW)

The above a) – c) dispatch is consistent with recent Generator Interconnection Studies performed by PSCo in the Missile Site Area.

3. Light Load

a) Rush Creek Wind Project 100% rated capacity (600 MW)

b) Missile Site Area: 80% wind rated capacity (680 MW)

c) Pawnee Site Area: 80% wind rated capacity (460 MW), 66% conventional rated capacity (530 MW)

d) Burlington Area: wind 80% rated capacity (161 MW), 66% conventional rated capacity (66 MW)

e) Lincoln Area: 66% conventional rated capacity (85 MW)

D. Transmission Topology

The following significant transmission will be included in models:

a) Missile Site – Rush Creek 345 kV Gen-Tie
b) Pawnee – Daniels Park 345 kV Transmission Project
c) Lamar – Burlington 230 kV Transmission Project
d) Northern Greeley 230/115 kV Project
e) Poncha – San Luis Valley 230 kV Project

V. Studies

A. Benchmark

Benchmark studies will be performed to assess the 2026 system as modeled in the CCPG area

B. Alternatives

Transmission alternatives will be developed by the RCTF. The Task Force will review all alternatives and determine if it is a reasonable networking alternative to be evaluated. The RCTF agreed to evaluate the following alternatives.

1. New 345 kV line from Rush Creek II to Burlington Substation
2. New 345 kV line from Rush Creek I to Big Sandy Substation
3. New 345 kV line from Rush Creek II to Limon Wind Gen Substation
4. Second Missile Site to Rush Creek II 345 kV line, looping into Rush Creek I
5. New 345 kV lines from Rush Creek II to Burlington Substation and from Rush Creek I to Big Sandy Substation
6. New 345 kV lines from Rush Creek II to Burlington Substation and from Rush Creek I to Limon Gen Substation
7. New 345 kV lines from Rush Creek II to Burlington Substation and from Rush Creek II to Limon Wind Gen Substation
8. New 345 kV lines from Rush Creek I to Daniels Park 345 kV Substation and Rush Creek II to Burlington Substation
9. New 345 kV lines from Rush Creek I to Daniels Park 345 kV Substation and from Rush Creek I to Rush Creek II

The above alternatives are an initial proposed list based on Task Force participant feedback. Additional alternatives may be added to the list during the study process, including modifying alternatives to correct issues seen from initial power flow studies that can be resolved more easily such as the sag on poles, limiting substation equipment on transmission lines, or increased thermal ratings. One line diagrams of the benchmark and alternatives can be seen in the Appendix.

VI. Sensitivity Studies

In addition to the benchmark and alternative cases, some sensitivities may be performed to determine the impact of various parameter changes, such as generation dispatch, path flows, or transmission configuration. Potential sensitivities include:

A. Dispatch changes at locations such as Burlington, Lincoln, Lamar, Pawnee, and Missile Site.

B. For Alternatives 8 and 9, may consider Looping the Midway – Waterton 345 kV line into Daniels Park Substation

VII. Methodology

A. Methodology

To analyze the benefit of a given alternative, a maximum generation injection capability will be determined for each alternative as well as the benchmark scenario. The injection capability will be determined by increasing fictitious generation output along the Gen-Tie until a constraint is reached. The increasing generation will be initially dispatched to sink into the Denver Metro Area.

B. Contingencies

Studies will focus on North American Electric Reliability Corporation (NERC) Category P0 (system intact, N-0) and NERC Category P1 (single contingency, N-1) performance. Some selected NERC Category P2 through P7 disturbances may also be performed.

C. Monitoring

As a general rule, the following system parameters will be monitored during the study and tabulated in the report as needed:

1. All buses, lines, and transformers with base voltages equal to or greater than 44 kV in the Colorado powerflow areas 70 and 73 will be monitored in all study cases.
2. Post contingency element loadings will only be tabulated when an element rating is exceeded and the loading increase is at least 1% from the normal system loading. Specifically, if an element was overloaded in the normal condition and increased no more than 1% in the outage condition, the overload will not be reported.
3. Post contingency voltage violations will be tabulated only if the deviation is more than 0.08 p.u. from the normal system voltage or higher if allowed by local criteria. Base case and contingency low voltage violations will be determined, however contingency voltage violations will be ignored if voltage change is less than 0.08 p.u.
4. Transient and voltage stability criteria adhere to the WECC Criterion TPL-001-WECC-CRT-3.

D. Criteria

Studies shall adhere to the NERC, WECC, and utility standards and criteria.

1. Element Loading

a) All elements should remain within 100% of stated ratings.

b) All voltages within 0.95 and 1.05 under system normal conditions.

c) All voltages within 0.90 and 1.10 under contingency conditions.

d) Voltages must not vary by 8% or more under single contingency conditions.

VIII. Cost Estimates

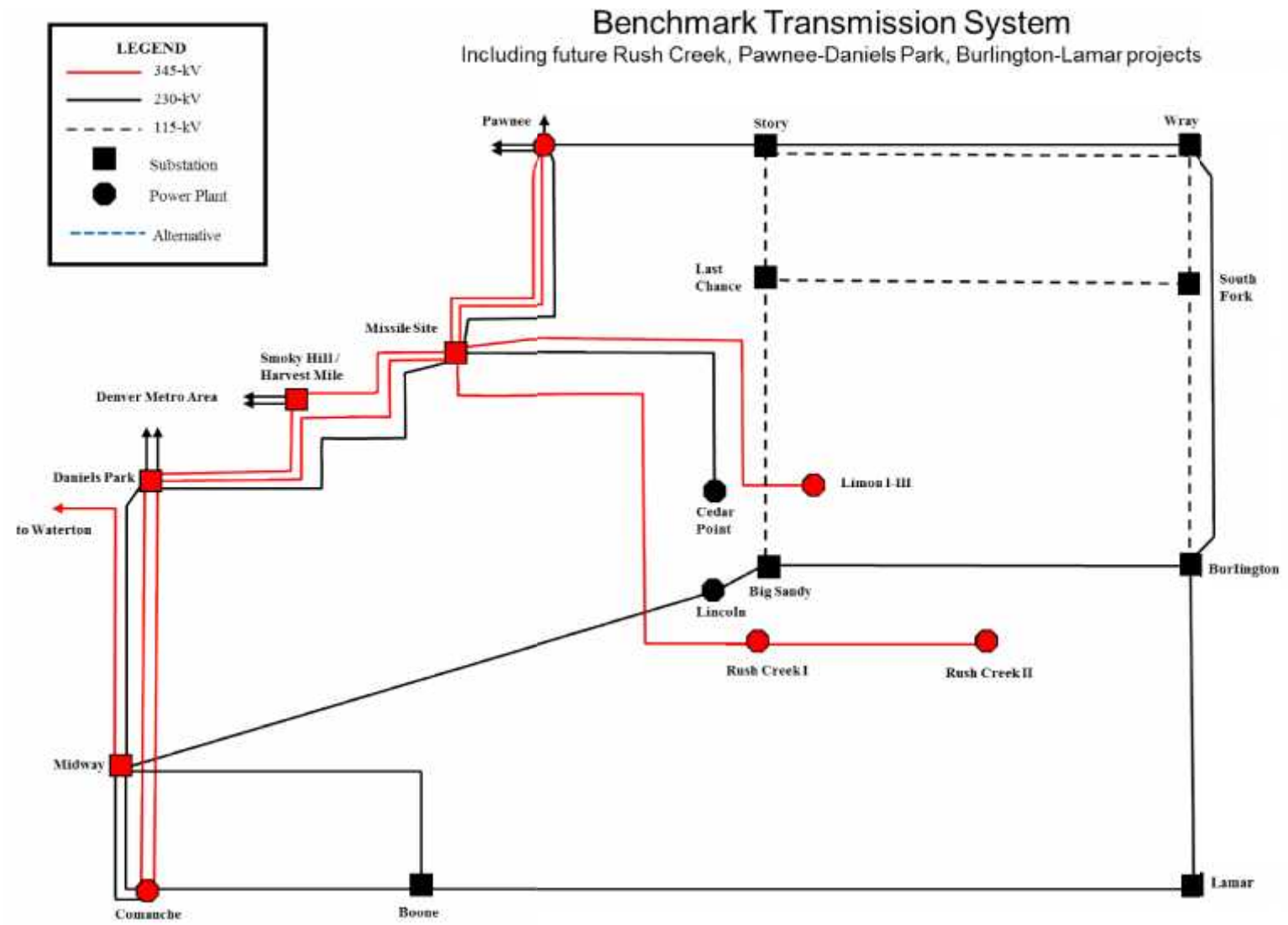
Indicative cost estimates will be provided for each alternative. The cost estimates will have no level of accuracy and will be based on 2017 dollars with escalation and contingency applied. Indicative estimates are based upon typical construction costs for previously performed similar projects. These

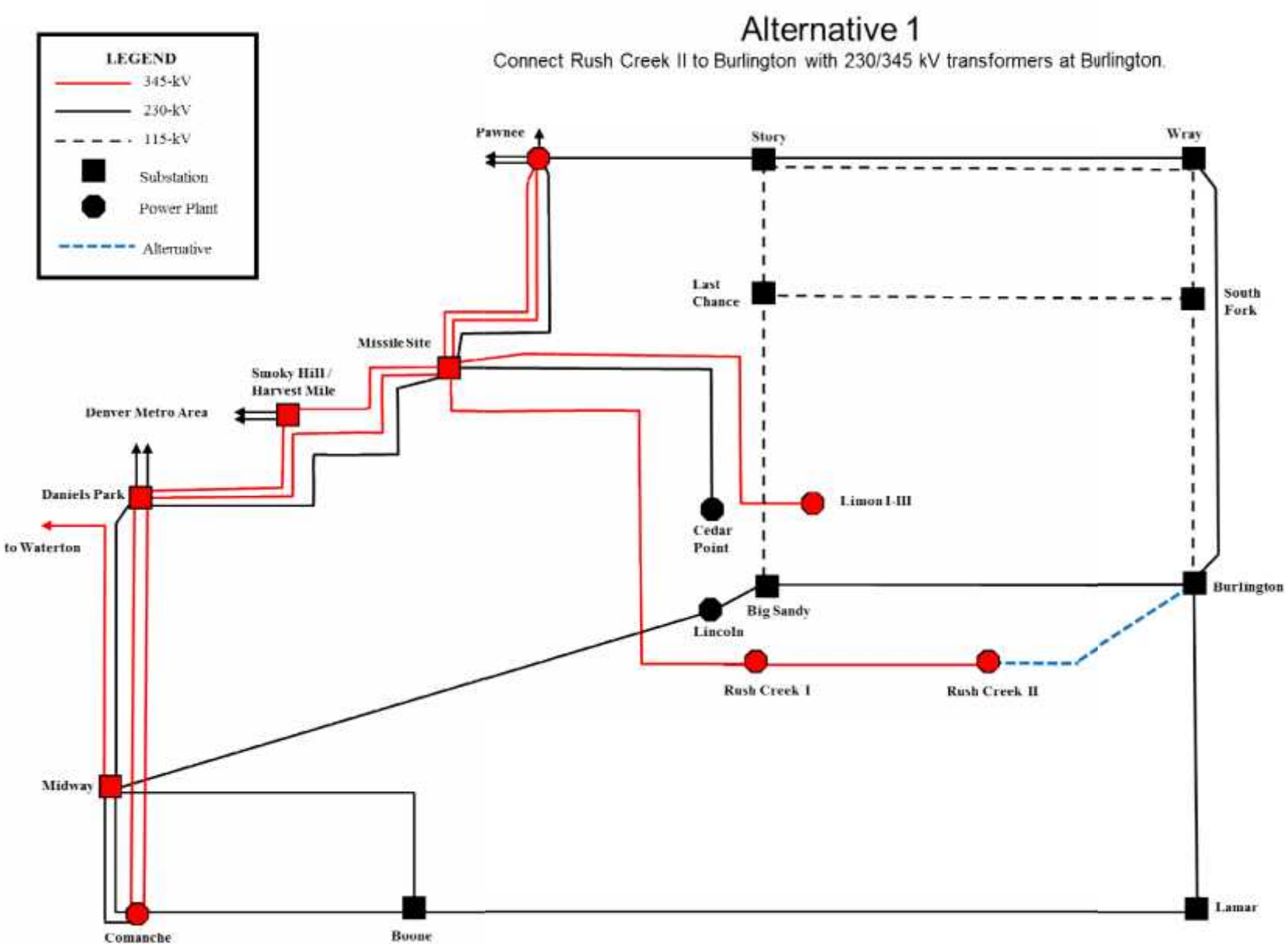
estimated costs include all applicable labor and overheads associated with the siting support, engineering, design, and construction of these new PSCo facilities.

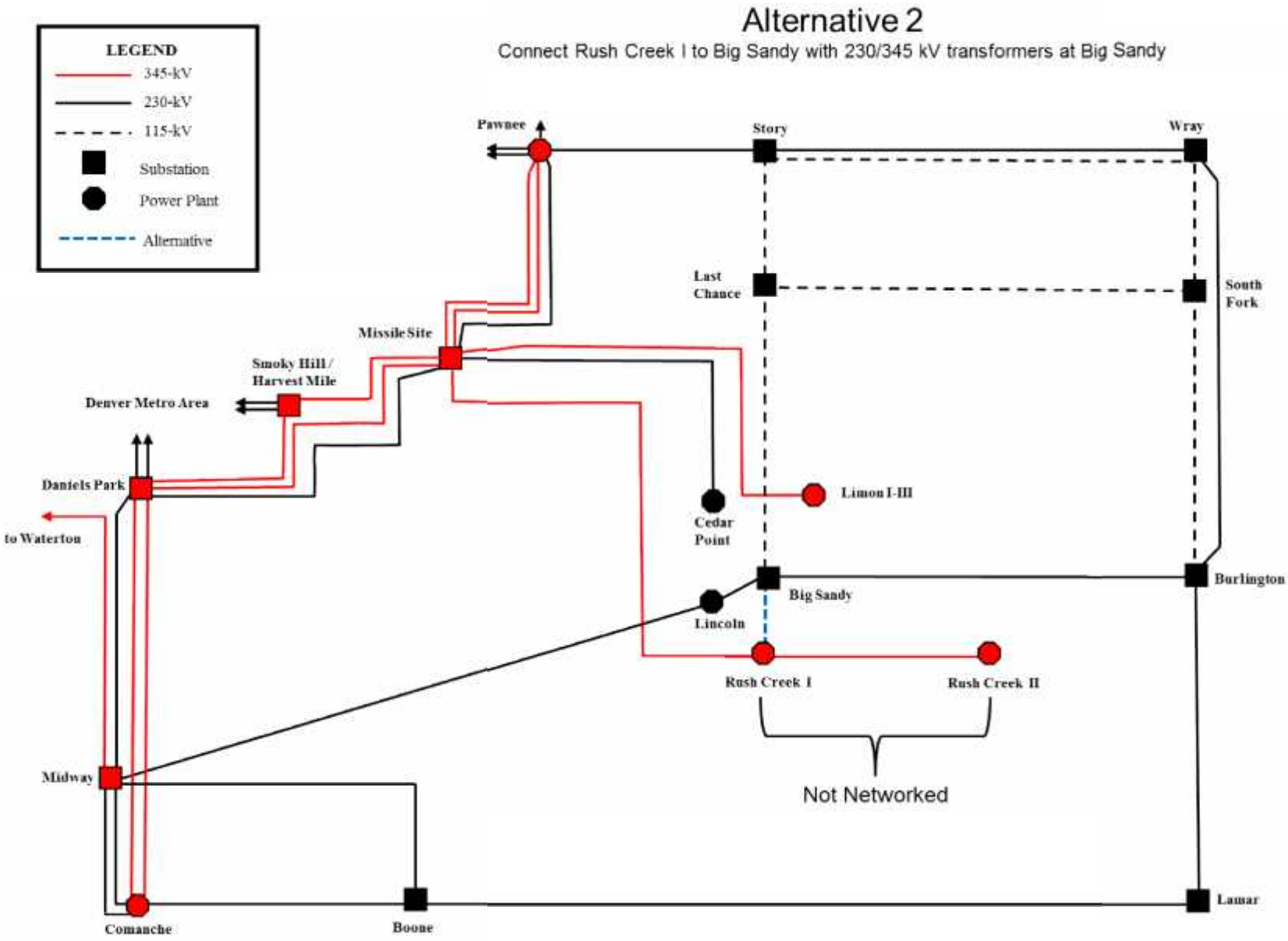
IX. Schedule

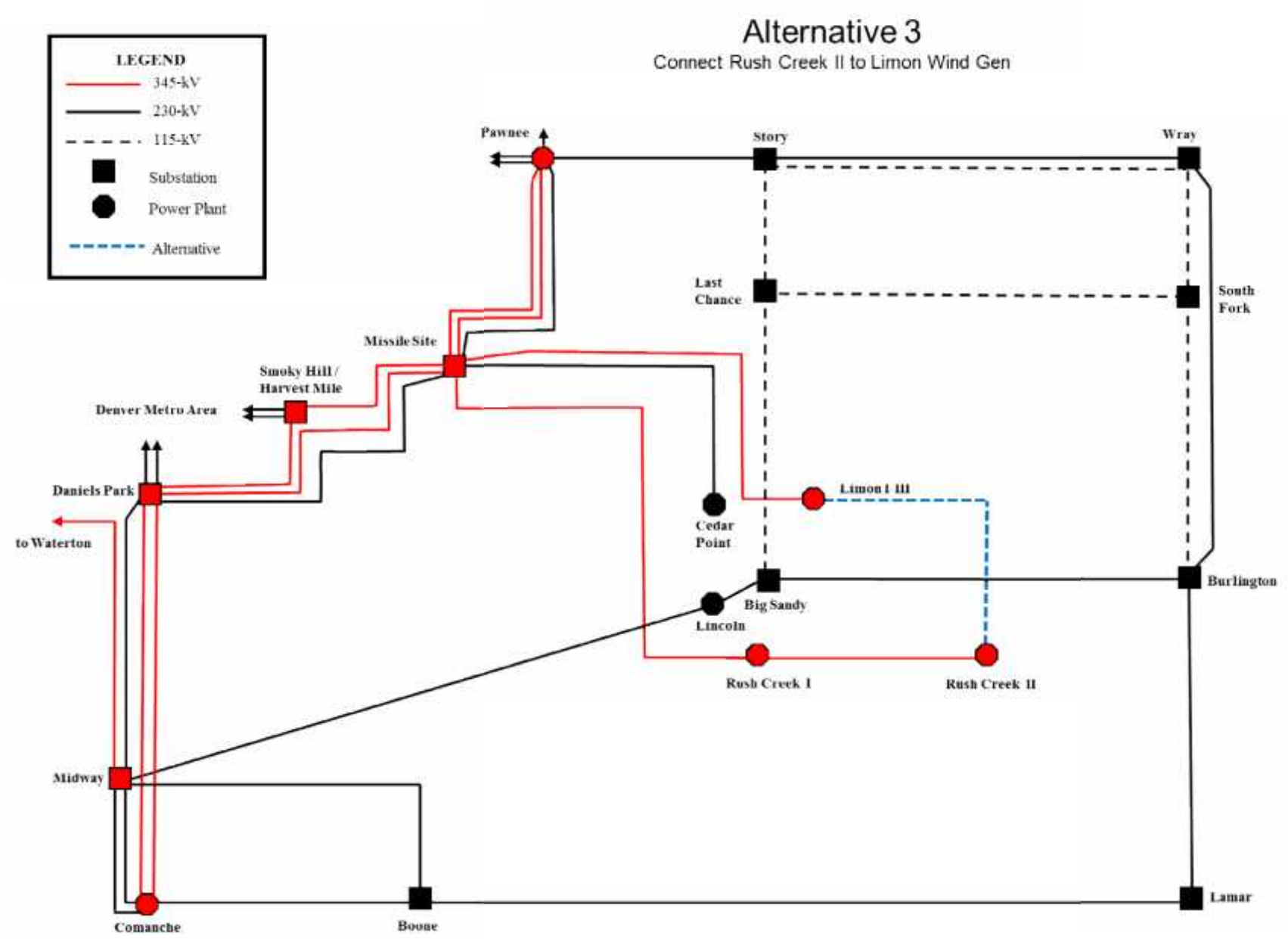
Tentative Schedule:
Study Scope and Alternatives Approval: March 2017
Studies Completed: July 2017
Draft Study Report: August 2017
Final Study Report: September 2017

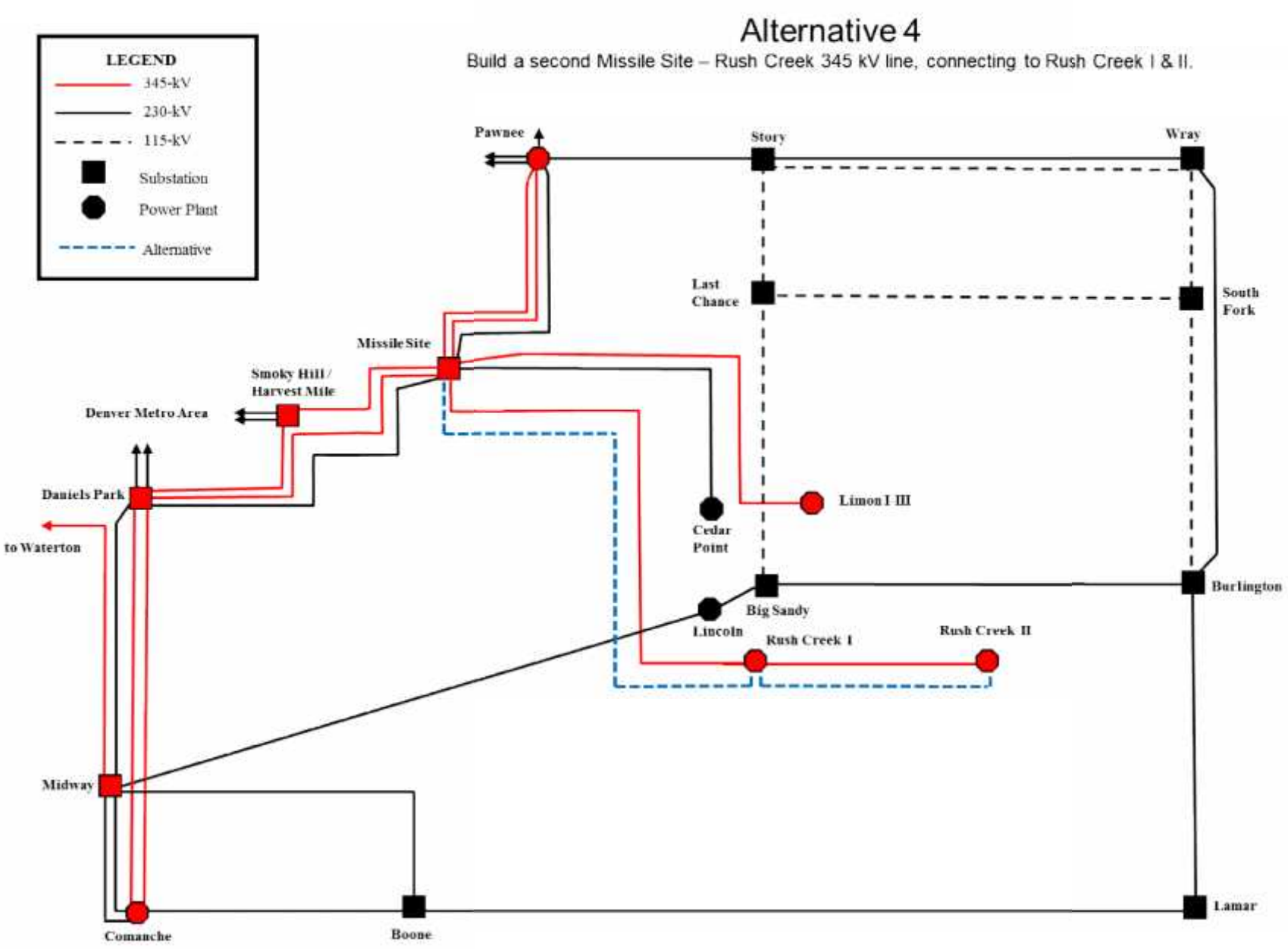
Appendix – One-Line Drawings of Benchmark and Potential Alternatives Configuration
Drawings are simplified and not to scale.

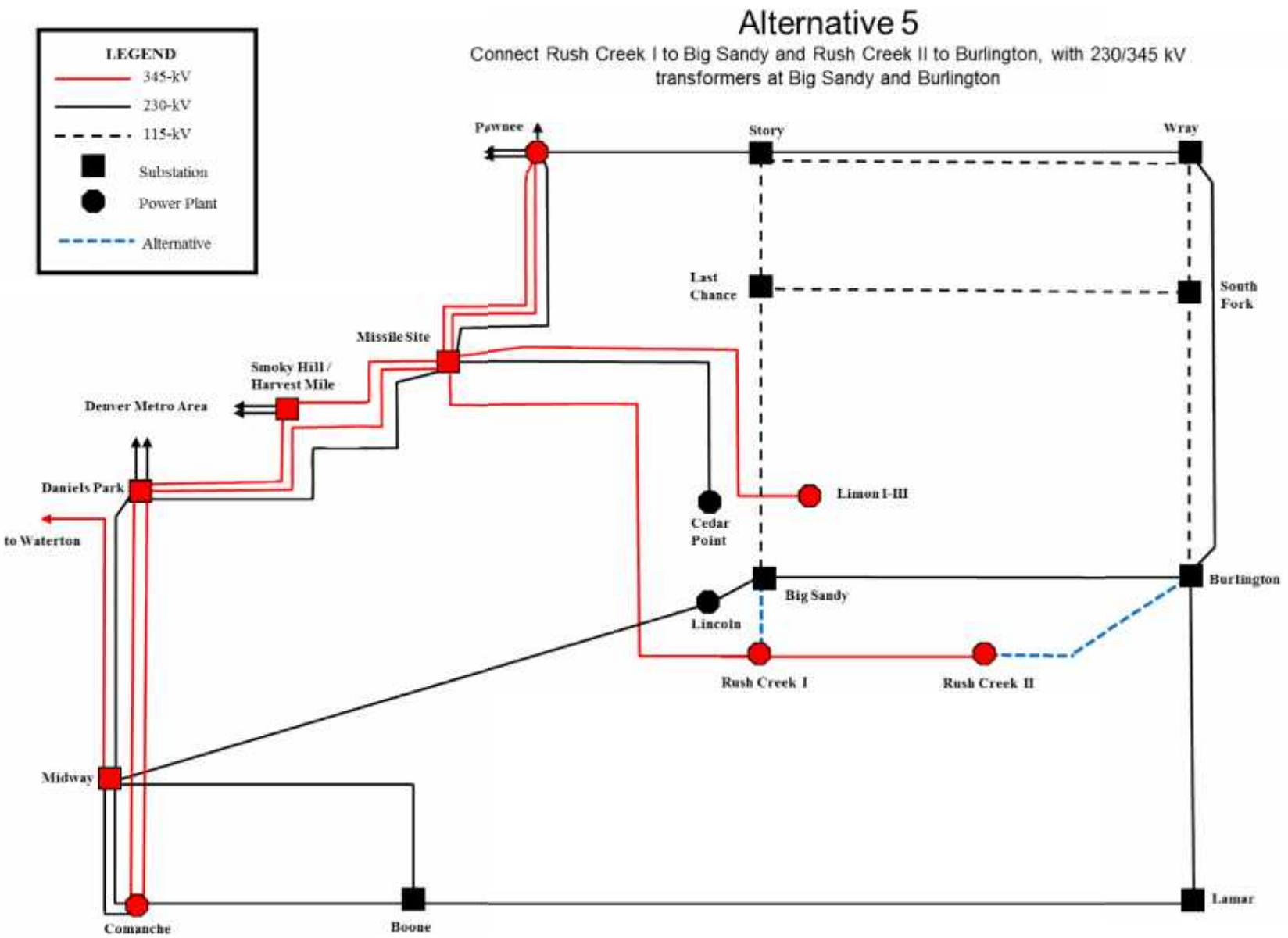


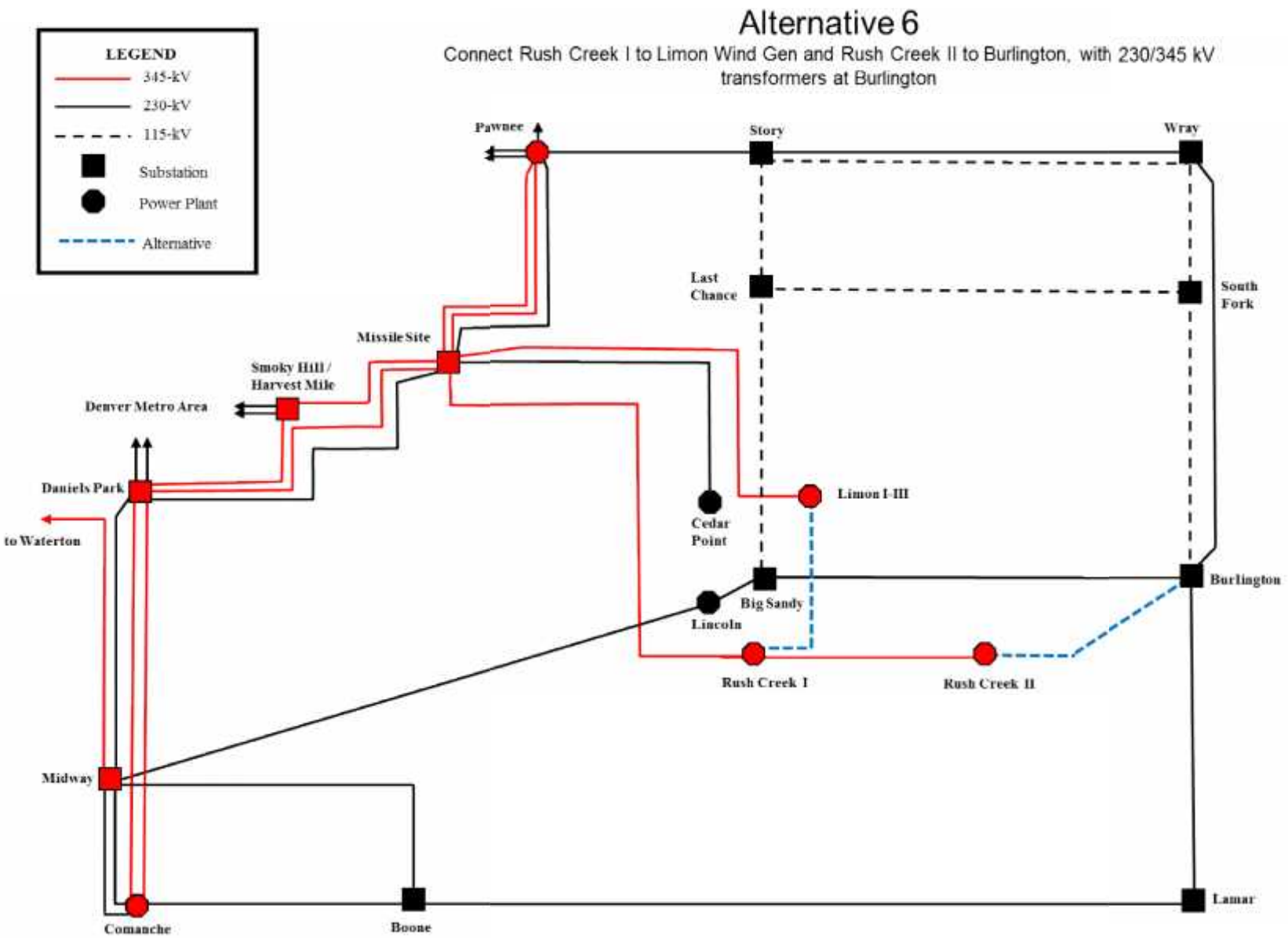

Alternative 1
Connect Rush Creek II to Burlington with 230/345 kV transformers at Burlington.
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Cedar Point
Limon I-III
Burlington
Big Sandy
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar

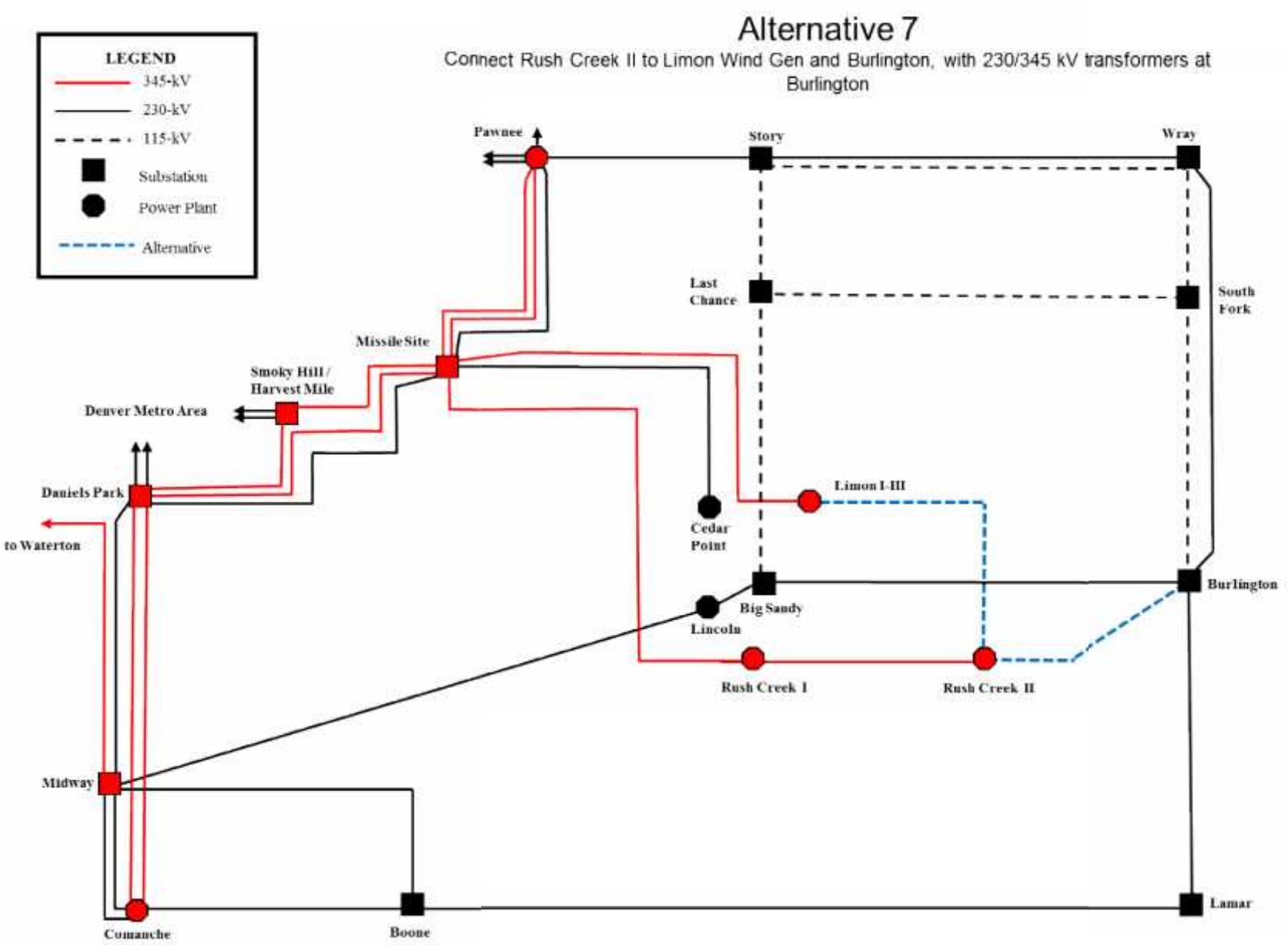

Alternative 2
Connect Rush Creek I to Big Sandy with 230/345 kV transformers at Big Sandy
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Limon I-III
Cedar Point
Big Sandy
Burlington
Lincoln
Rush Creek I
Rush Creek II
Not Networked
Midway
Comanche
Boone
Lamar

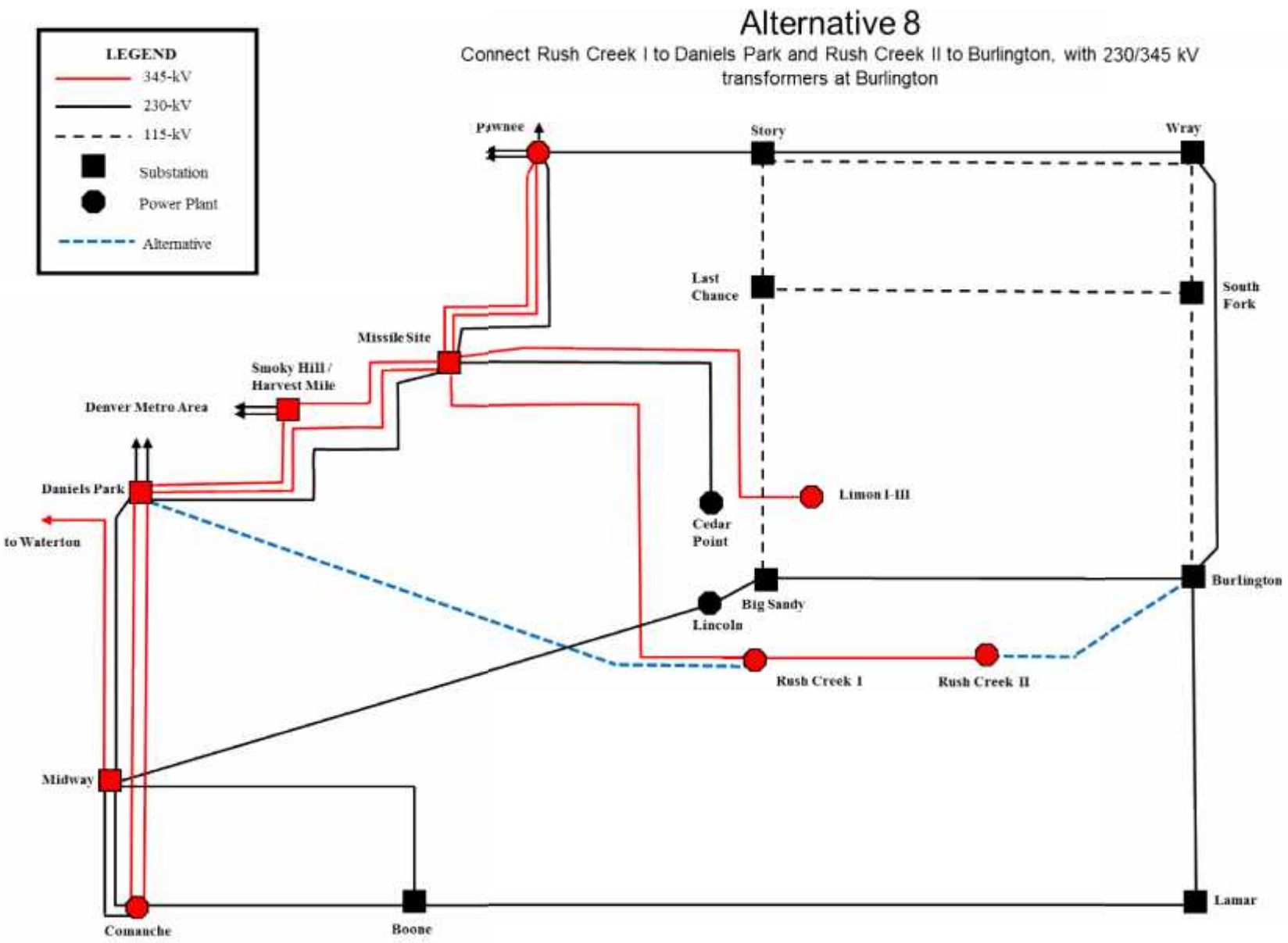

Alternative 3
Connect Rush Creek II to Limon Wind Gen
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Limon I III
Cedar Point
Burlington
Big Sandy
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar

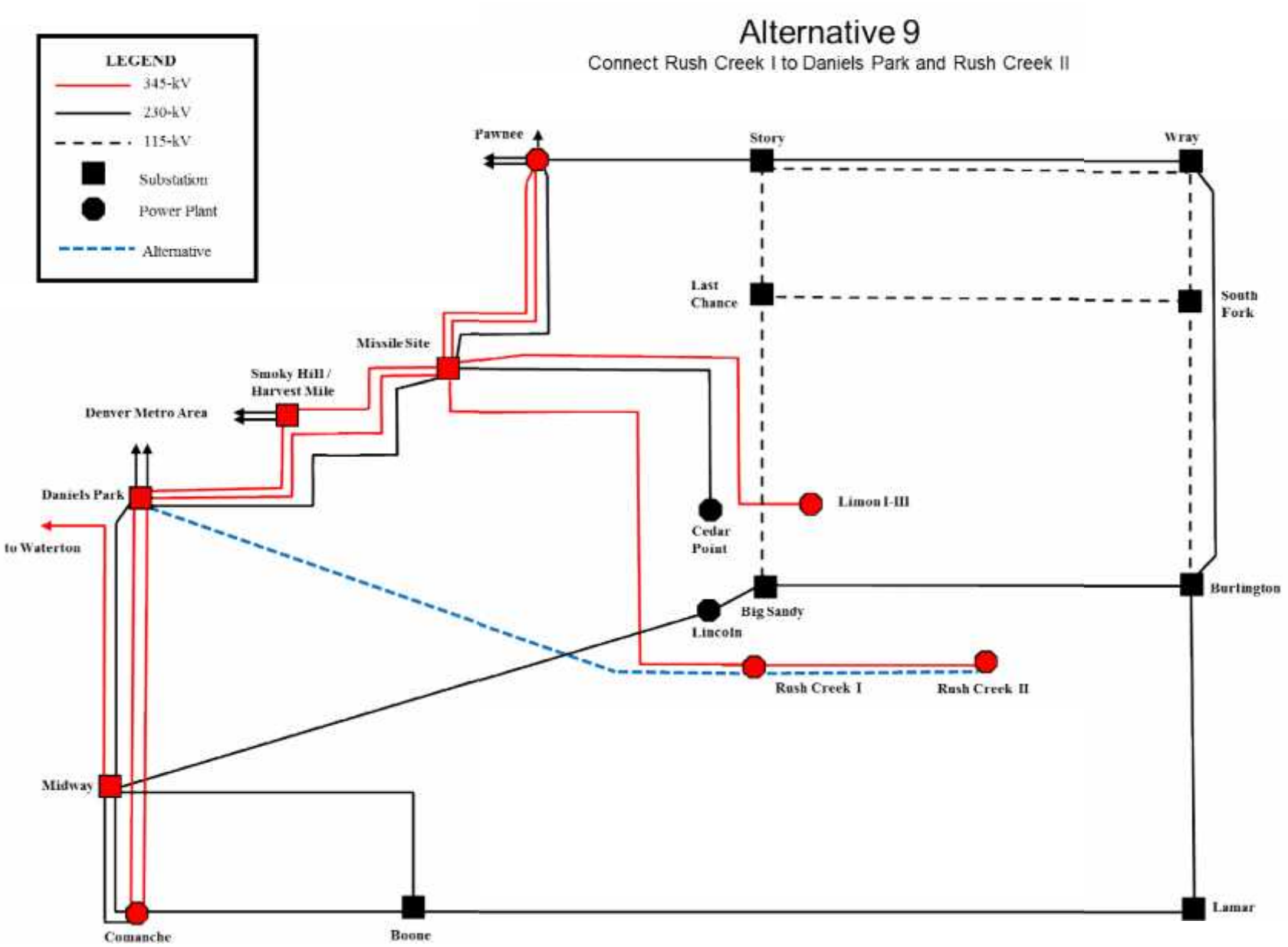

Alternative 4
Build a second Missile Site – Rush Creek 345 kV line, connecting to Rush Creek I & II.
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Cedar Point
Limon I III
Burlington
Big Sandy
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar


Alternative 5
Connect Rush Creek I to Big Sandy and Rush Creek II to Burlington, with 230/345 kV transformers at Big Sandy and Burlington
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Cedar Point
Limon I-III
Big Sandy
Burlington
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar


Alternative 6
Connect Rush Creek I to Limon Wind Gen and Rush Creek II to Burlington, with 230/345 kV transformers at Burlington
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Cedar Point
Limon I-III
Burlington
Big Sandy
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar


Alternative 7
Connect Rush Creek II to Limon Wind Gen and Burlington, with 230/345 kV transformers at Burlington
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Limon I-III
Cedar Point
Burlington
Big Sandy
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar


Alternative 8
Connect Rush Creek I to Daniels Park and Rush Creek II to Burlington, with 230/345 kV transformers at Burlington
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Cedar Point
Limon I-III
Burlington
Big Sandy
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar


Alternative 9
Connect Rush Creek I to Daniels Park and Rush Creek II
LEGEND
345-kV
230-kV
115-kV
Substation
Power Plant
Alternative
Pawnee
Story
Wray
Last Chance
South Fork
Missile Site
Smoky Hill / Harvest Mile
Denver Metro Area
Daniels Park
to Waterton
Cedar Point
Limon I-III
Burlington
Big Sandy
Lincoln
Rush Creek I
Rush Creek II
Midway
Comanche
Boone
Lamar