Lexington
Electric System Distribution Plan

Nebraska Public Power District

Always there when you need us

June 28, 2008

Lexington Distribution Plan

- **Plan Objectives:**
  - Eliminate Identified Service Issues
    - Overloaded Equipment or Conductors
    - Low Voltage
  - Improve Reliability
    - Aging Assets
    - Physical Issues
    - Serve Customers During N-1 Conditions
  - Improve the ability to serve new load

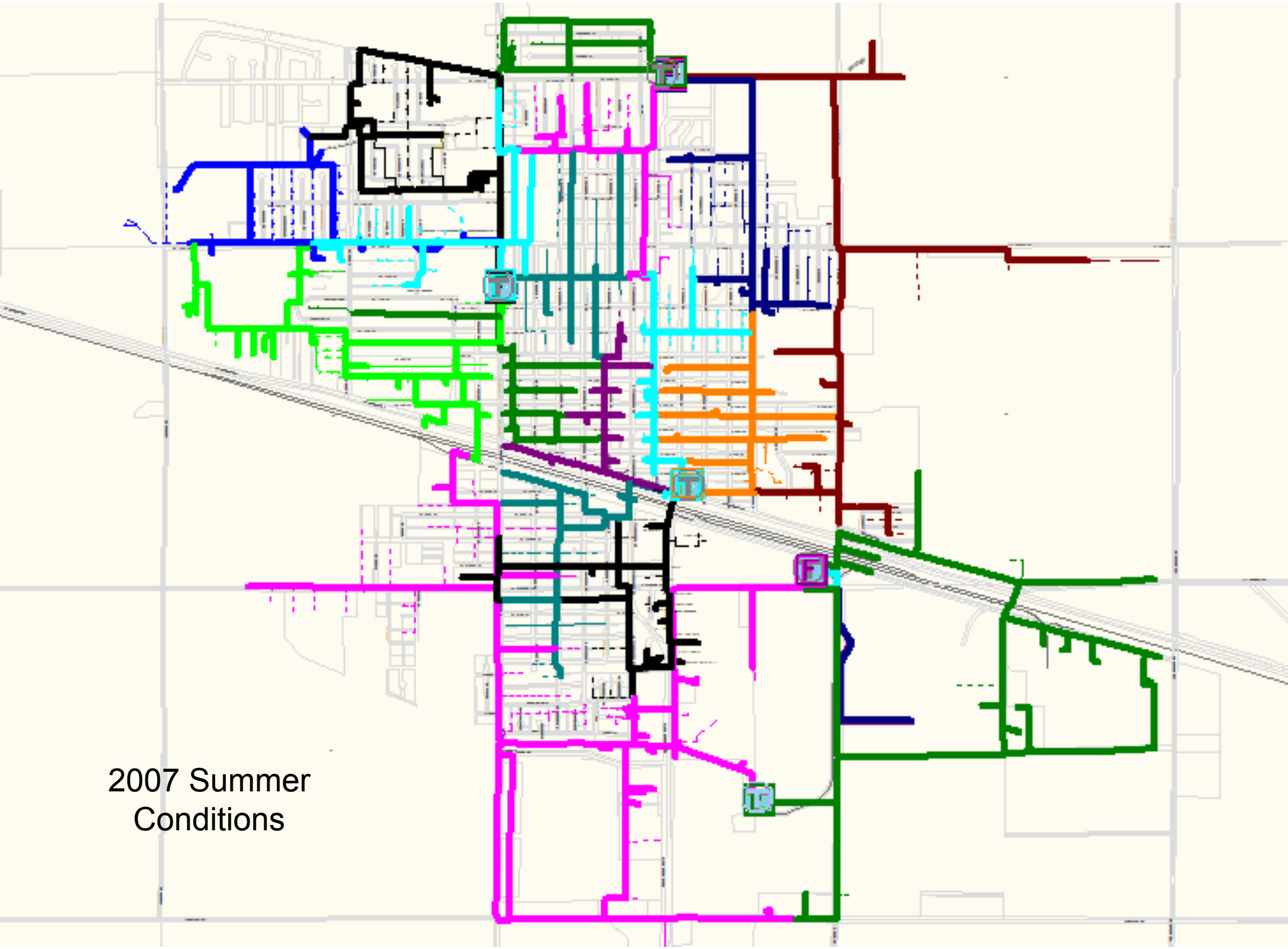
Lexington Distribution Plan

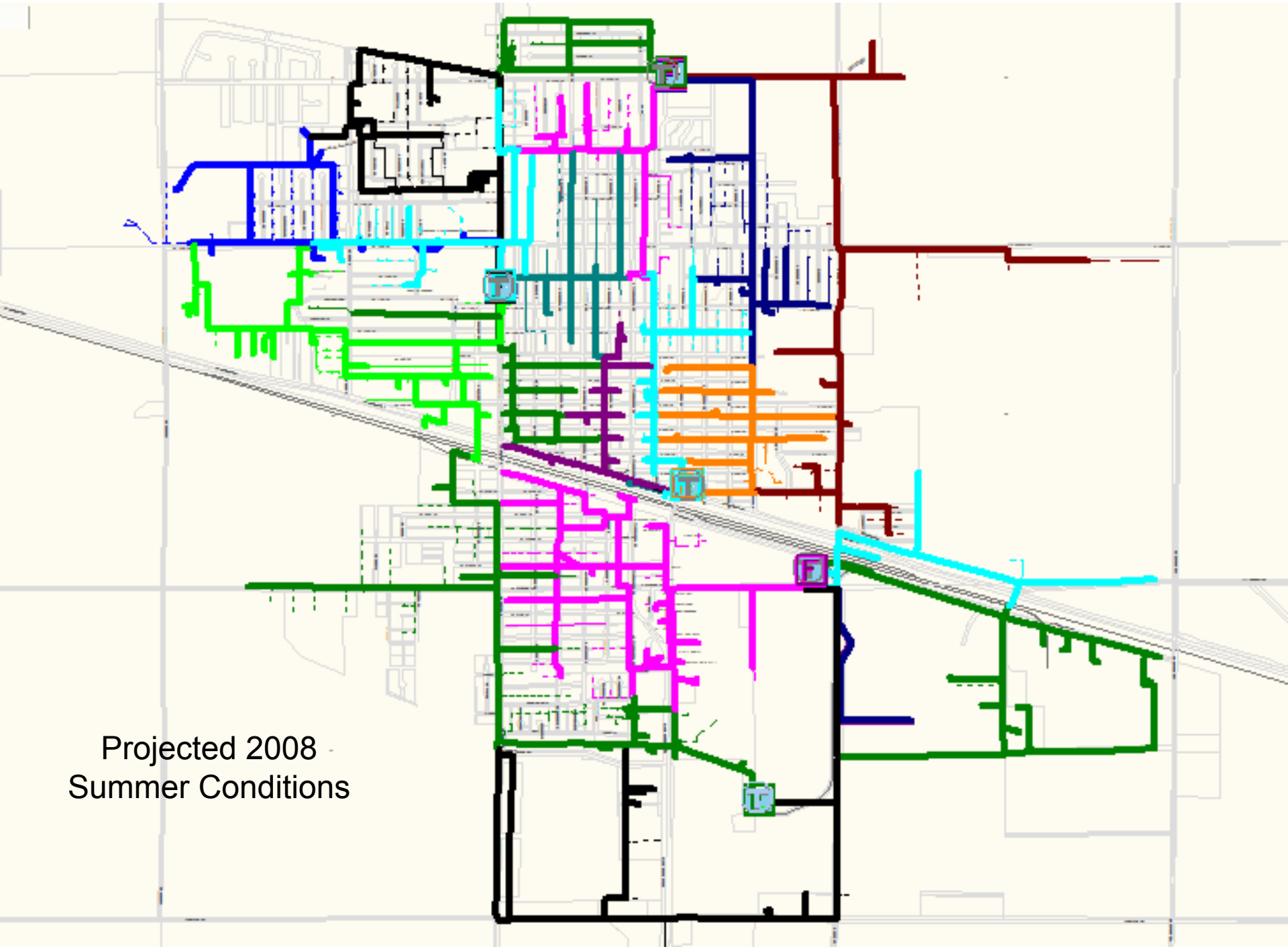
- **Plan Objectives** (cont.):
  - Compare Costs & Benefits of Options
    - Economic Analysis/Efficiency (kW losses)
  - Identify a sensible strategy for Lexington
    - Balance Cost Versus Efficiency and Reliability
    - Provide service and reliability consistent with customers expectations.
  - Develop a schedule for projects
    - Define and coordinate actions for NPPD & City of Lexington over the next 10 years

Lexington Distribution Plan

- Process
  - Inventory Electric System Assets
  - Computer Simulation Models
  - Capture Peak Load Values
  - Develop load growth rates
  - Analyze Future System Conditions
  - Document criterion exceptions
  - Test solutions to eliminate exceptions
  - Group solutions into several overall plans
  - Estimate cost of each plan project
  - Compare plans against each other
  - Quantify & document benefits of each plan
  - Select Plan considering benefits and costs

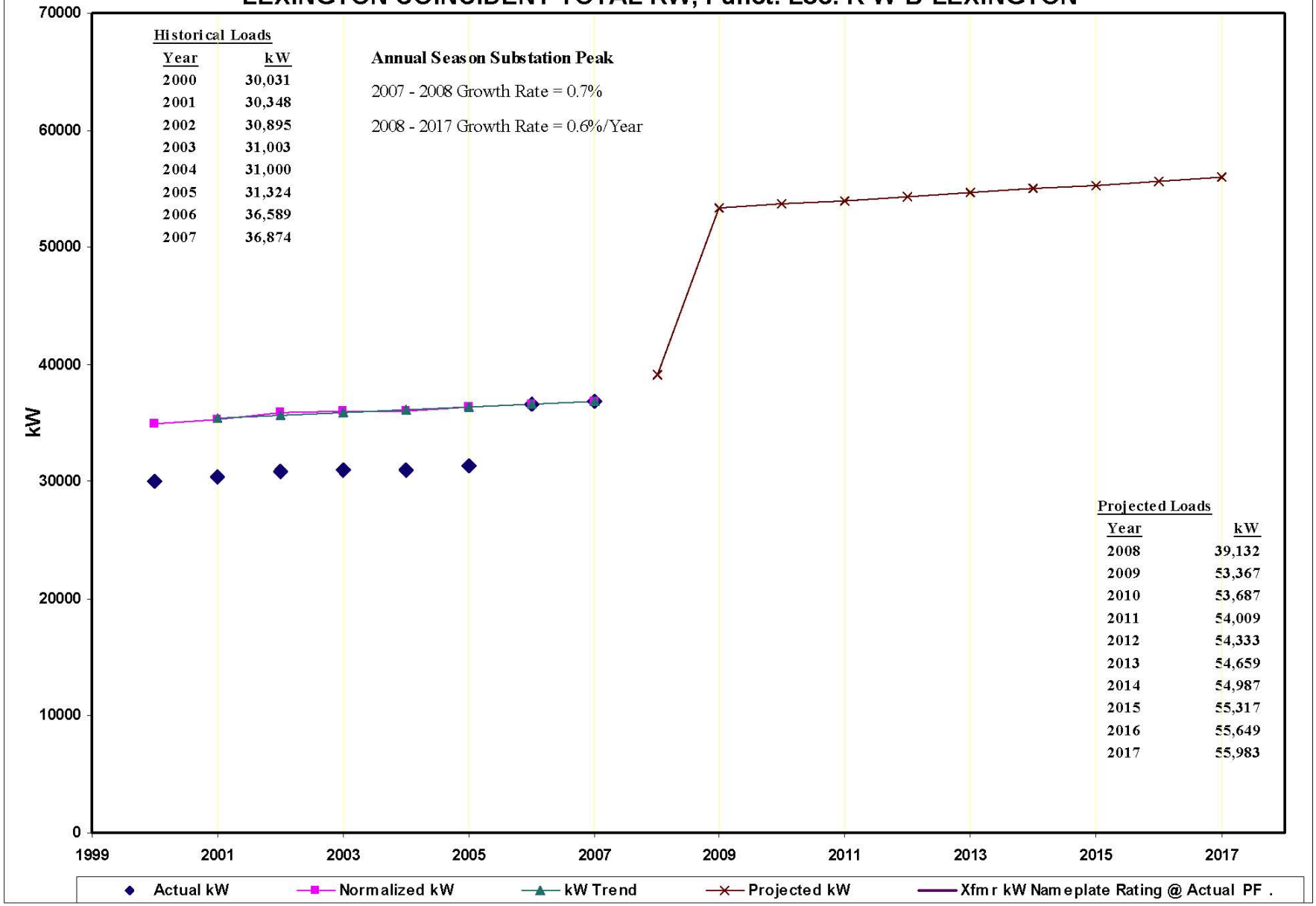
Lexington Electric Distribution System

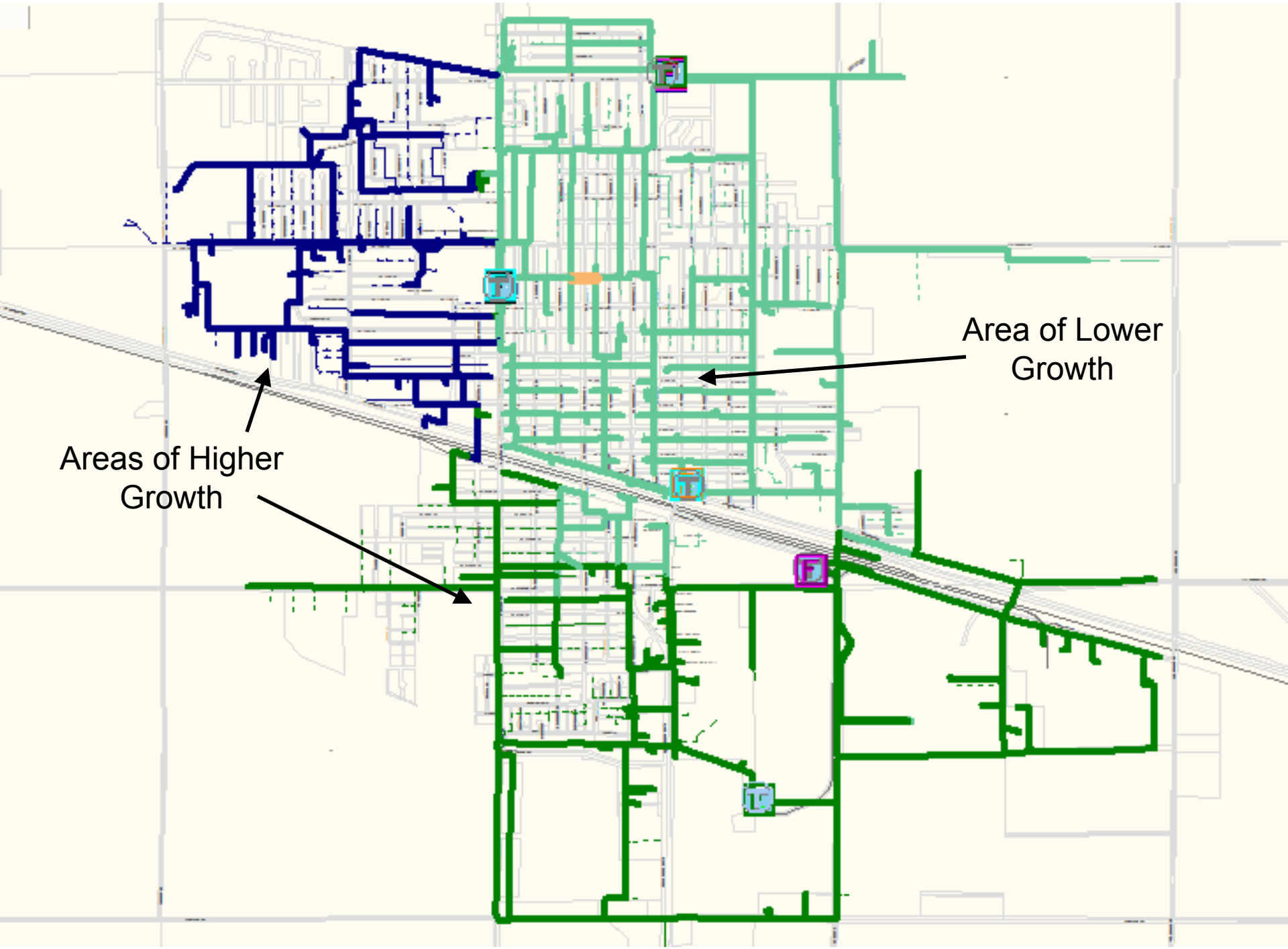

2007 Summer
Conditions


Projected 2008
Summer Conditions

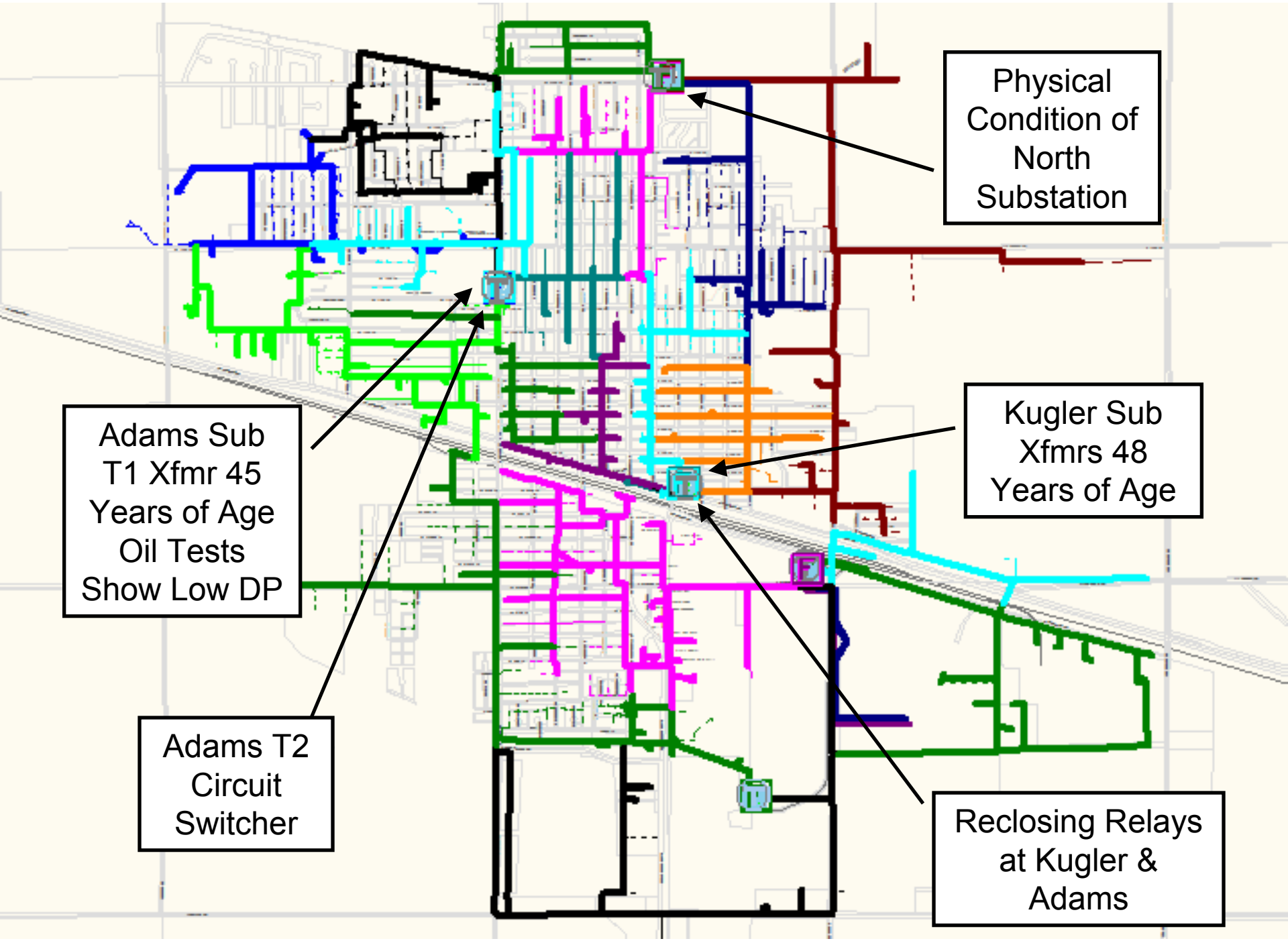
Future Load

LEXINGTON COINCIDENT TOTAL KW, Funct. Loc. R-W-B-LEXINGTON




Area of Lower Growth
Areas of Higher Growth

Physical Issues


Physical Condition of North Substation
Kugler Sub Xfmrs 48 Years of Age
Adams Sub T1 Xfmr 45 Years of Age Oil Tests Show Low DP
Adams T2 Circuit Switcher
Reclosing Relays at Kugler & Adams

Lexington Distribution Plan

- Adams T1
  - 45 years of age
    - NPPD oldest LTC SubT xfmr is 43 years of age
  - Oil testing shows the Winding Insulation Degree of Polymerization = 500 or ½ strength
  - New insulation DP = 1000
  - GE type U Bushings, Testing shows concern

Lexington Distribution Plan

- Kugler T1
  - 48 years of age
  - Oil Leak between LTC and Main Tank
    - Can cause contamination of main tank oil and an associated reduction in insulating strength of oil which can lead to xfmr failure.
  - Degree of Polymerization = 605

Lexington Distribution Plan

- Kugler T2
  - 48 years of age
  - Oil leak from LTC compartment to Control Cabinet.
  - Degree of Polymerization = 659

Contingency Issues

Lexington Distribution Plan

- Contingency Condition Analysis
- 2008 through 2017
- Normal – 1 (N-1) Conditions
- Utilize Overload Capacities
- Utilize Contingency Criteria for Voltage

Lexington Distribution Plan

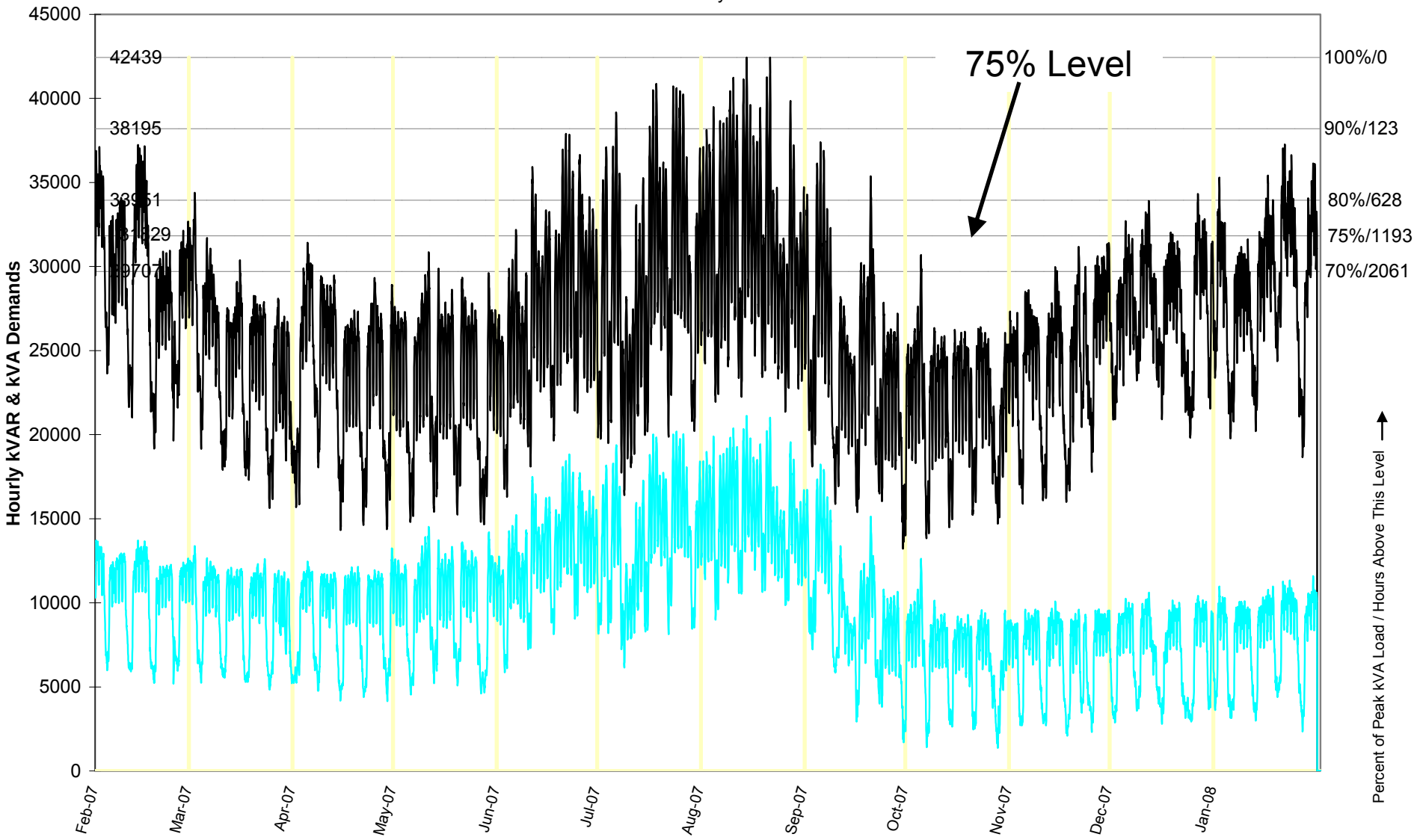
- North T1 Contingency
  - Conductor Overloads
  - 75% or less load levels
  - Above 75% - Some Customers will be out

Data prepared by NPPD CS&D
Asset Management - Subtransmission & Distribution Planning

LOAD PROFILE for LEXINGTON CITY COINCIDENT TOTAL,

Meter Location or Summary ID = B286

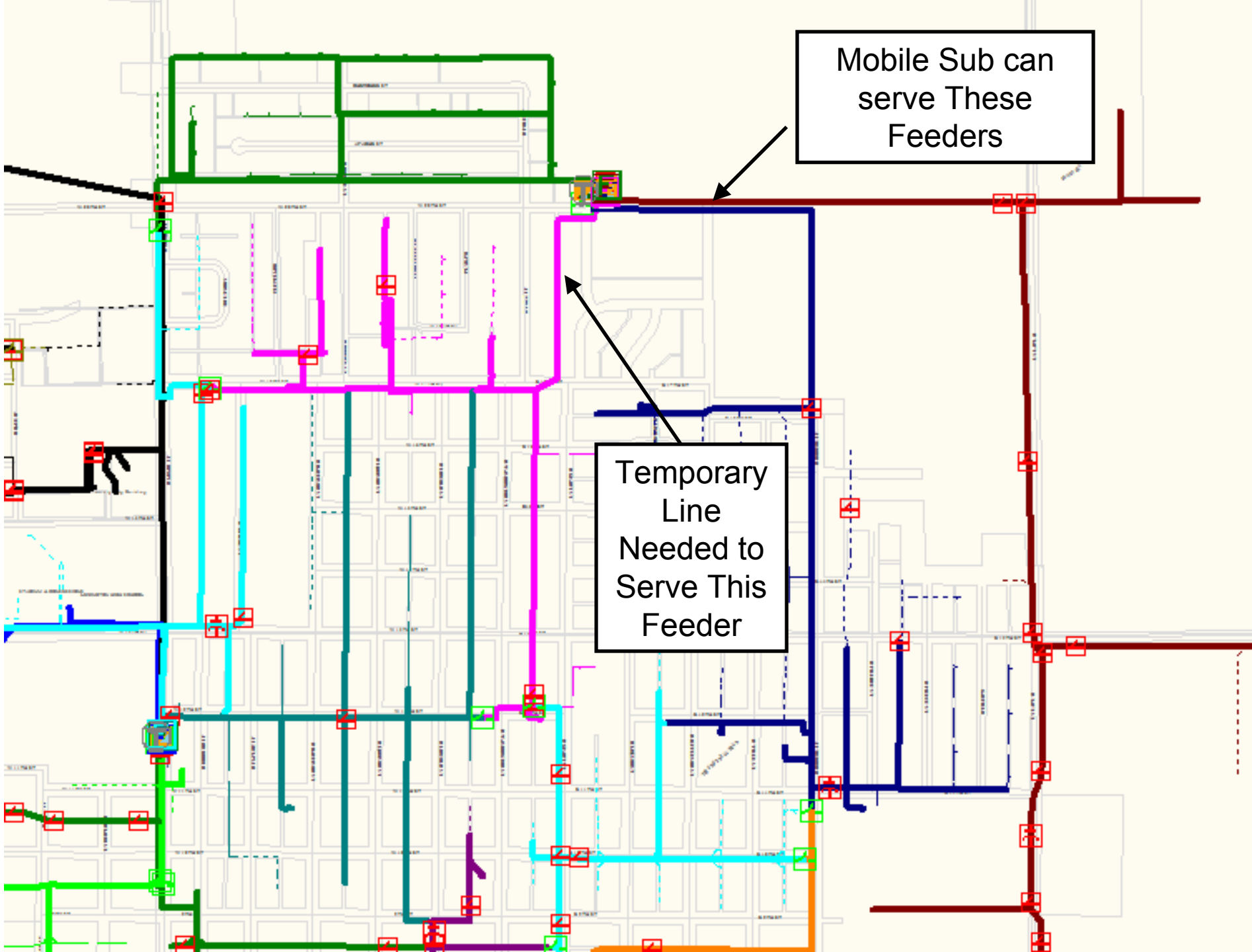
2/1/08 15:13
MDRS MV-90 Data



Highest kVA = 42,439 kVA 36,873 kW 21,010 kVAR 86.9% pf and occured on 08/21/2007 hour ending 17:00
Highest kW = 36,874 kW 42,439 kVA 21,010 kVAR 86.9% pf and occured on 08/21/2007 hour ending 17:00
Approximate Energy = 210,433,200 kWH Load Factor based on 8760 hours kW > 0 = 65.1% Load Factor based on 8760 hours = 65.1%
The data above is based on actual kW loads. Load shifts can cause unusual peak or minimum loads.

Lexington Distribution Plan

- North Contingency
  - Mobile Sub installation 1 to 2 days
    - ≈ $15,000 install costs
    - $300 / day
    - Subject to Availability, NPPD mobile subs are frequently in use for maintenance activities and failures and may not be available.
    - Can only serve 2 of 4 feeders without building a temporary line


Mobile Sub can serve These Feeders
Temporary Line Needed to Serve This Feeder

Lexington Distribution Plan

- Larger UG conductors out of the substation at Adams and Kugler
- Larger overhead main feeder conductor on Kugler feeder
- Substation xfmr capacity is near its limits
- Various levels of 4.16 to 13.8kV Conversion

Lexington Distribution Plan

- Adams T1 Contingency (4.16kV)
  - Conductor Overloads
  - 75% of or less load levels
  - Above 75% - Some Customers will be Out
  - Mobile Sub installation 1 to 2 days subject to availability
    - Should be able to serve 100% load

Lexington Distribution Plan

- Adams T1 Contingency (4.16kV)
  - Larger UG conductors out of the North Substation
  - New North Sub
  - Various levels of 4.16 to 13.8kV Conversion

Lexington Distribution Plan

- Kugler T1 Contingency
  - Conductor Overload
  - 70% or less load levels
  - Above 70% - Some Customers will be Out
  - Switchgear outage – DeBruce Grain Out
  - Mobile Sub installation 1 to 2 days subject to availability
    - Should be able to serve 100% load except for DeBruce Grain

Lexington Distribution Plan

- Kugler T1 Contingency
  - Larger UG conductors out of the North Substation
  - New North Sub
  - Various levels of 4.16 to 13.8kV Conversion

Lexington Distribution Plan

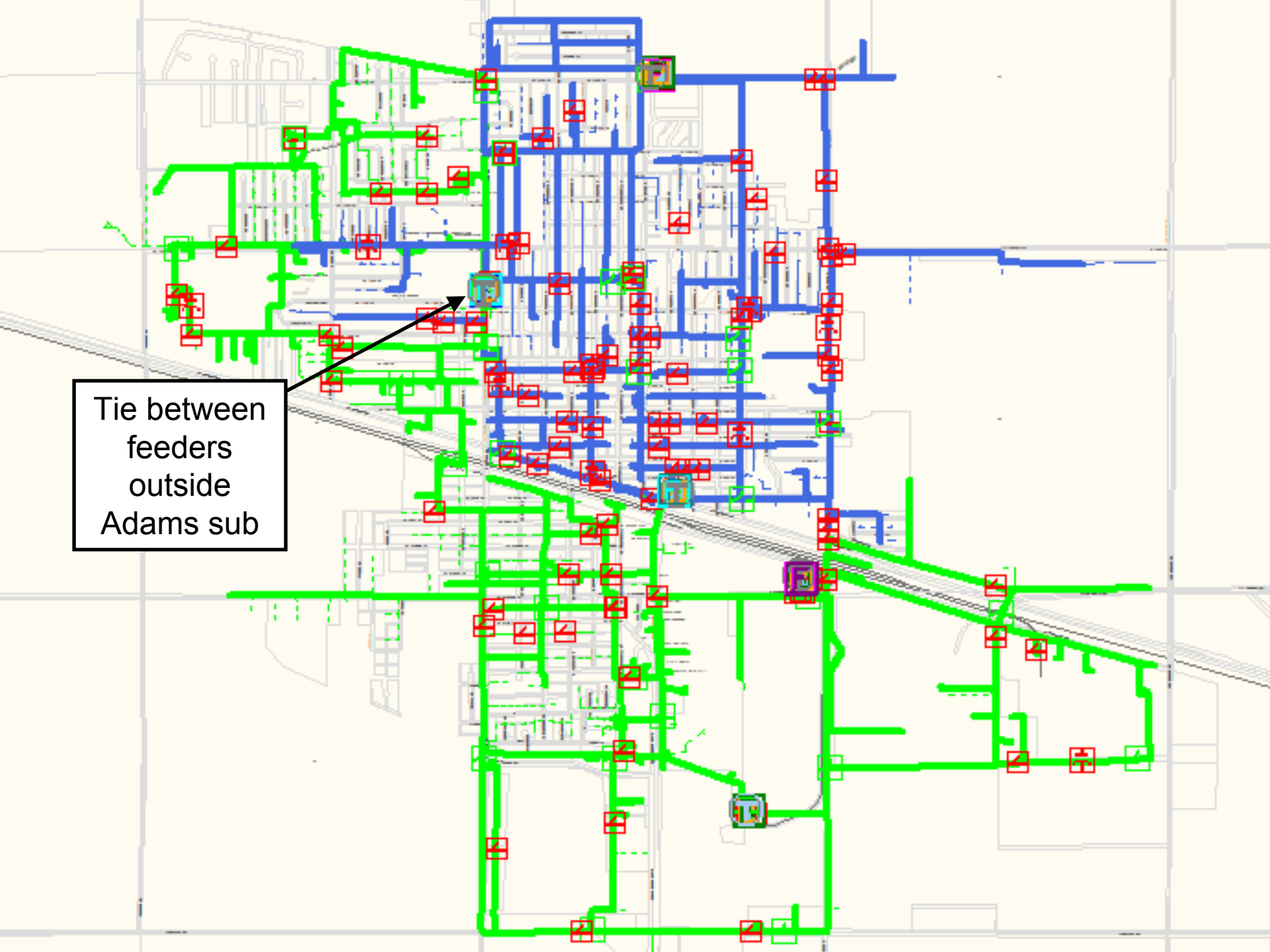
- Kugler T2 Contingency
  - Conductor Overloads
  - 75% or less load levels
  - Above 75% - Some Customers will be Out
  - Mobile Sub installation 1 to 2 days subject to availability
    - Should be able to serve 100% load

Lexington Distribution Plan

- Kugler T2 Contingency
  - Larger UG conductors out of the North Substation
  - New North Sub
  - Various levels of 4.16 to 13.8kV Conversion

Lexington Distribution Plan

- Adams T2 (13.8kV) Contingency
  - 97% or less load levels for bus outage
  - 100% for transformer outage
  - How can we improve 97% to 100%
    - Develop tie between feeders, outside the sub
    - Conversion of North Feeders to 13.8kV


Tie between feeders outside Adams sub

Lexington Distribution Plan

- IBP T1 or T2 Contingency
  - 100% load levels
  - Tyson Foods must be able to transfer all their load onto remaining xfmr.
  - Tyson Warehouse Feeder on T2 would be out or may be able to serve from a portable generator.

Lexington Distribution Plan

- East Walnut T1 or T2 Contingency
  - 100% load levels
  - CEL must be able to transfer all their load onto remaining xfmr. Once their new feeder is installed to serve their expansion, they will be able to transfer all their load.

Lexington Distribution Plan

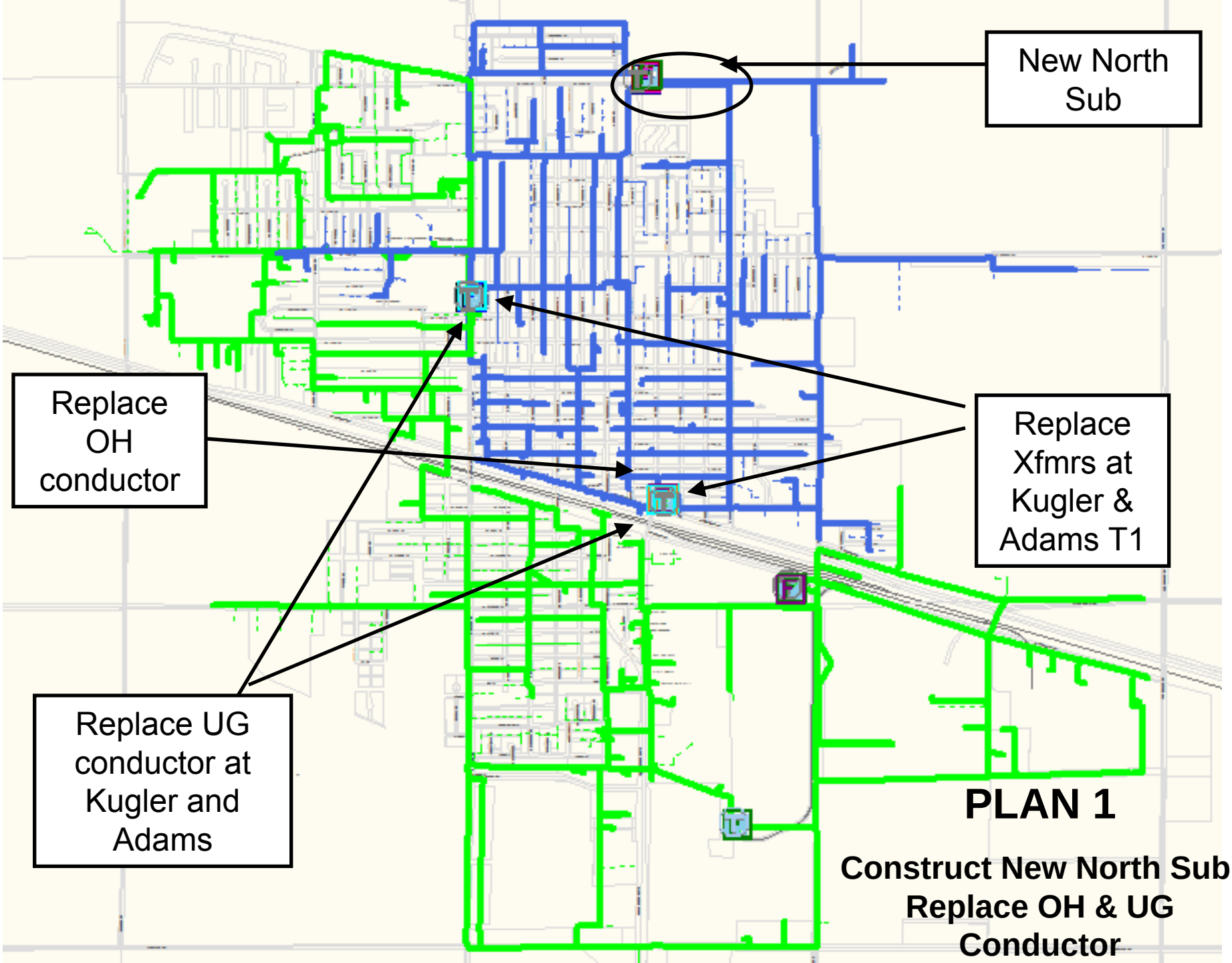
- Summary
  - Normal Conditions Look Good, Only 1 Conductor Loading Issue
  - Physical Conditions
    - North Substation
    - Aging Transformers at Kugler & Adams
    - Adams T2 Circuit Switcher
    - Reclose Relays at Adams and Kugler
  - Contingency Conditions
    - 4.16kV System is Weak
    - 13.8kV System is Good

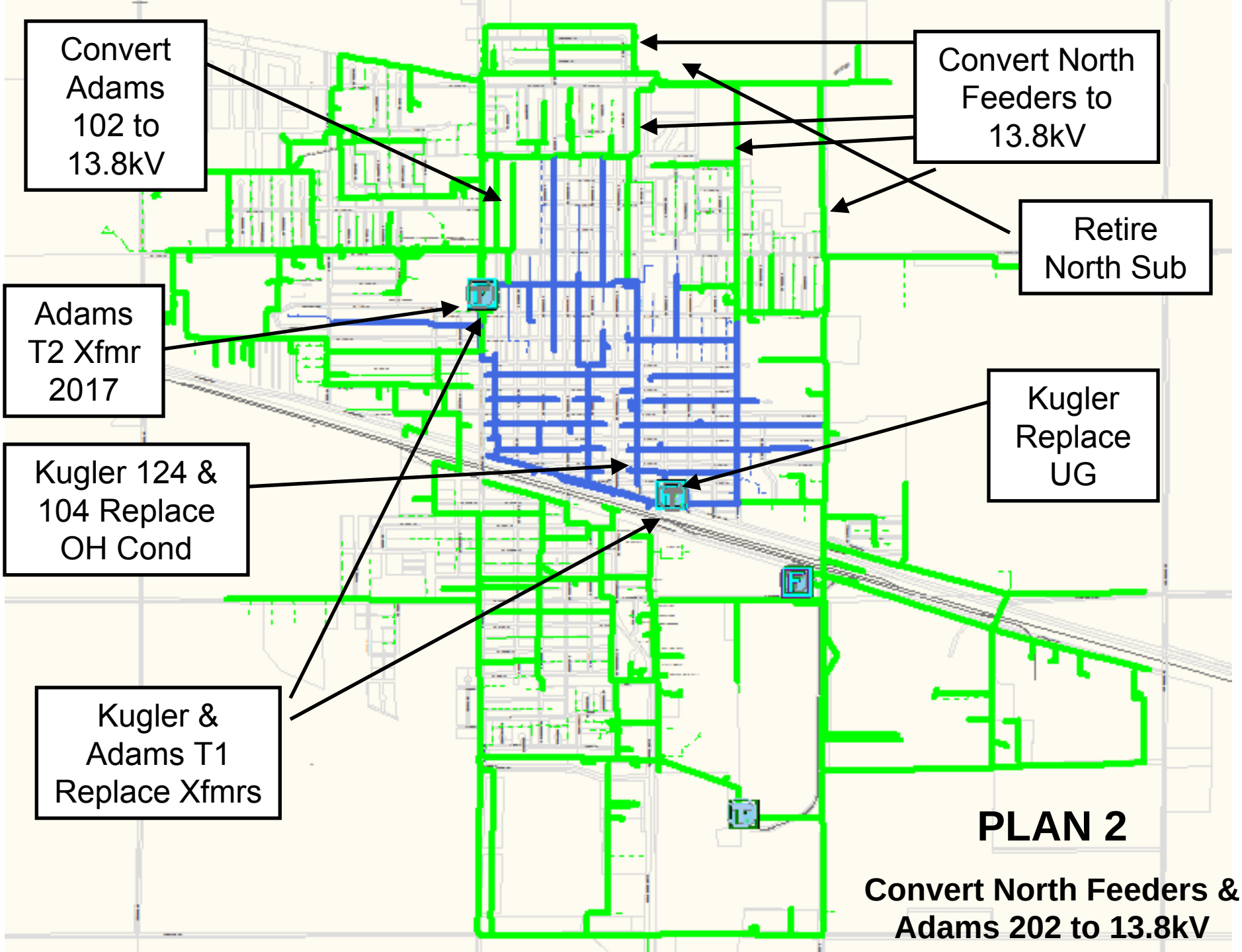
Lexington Distribution Plan

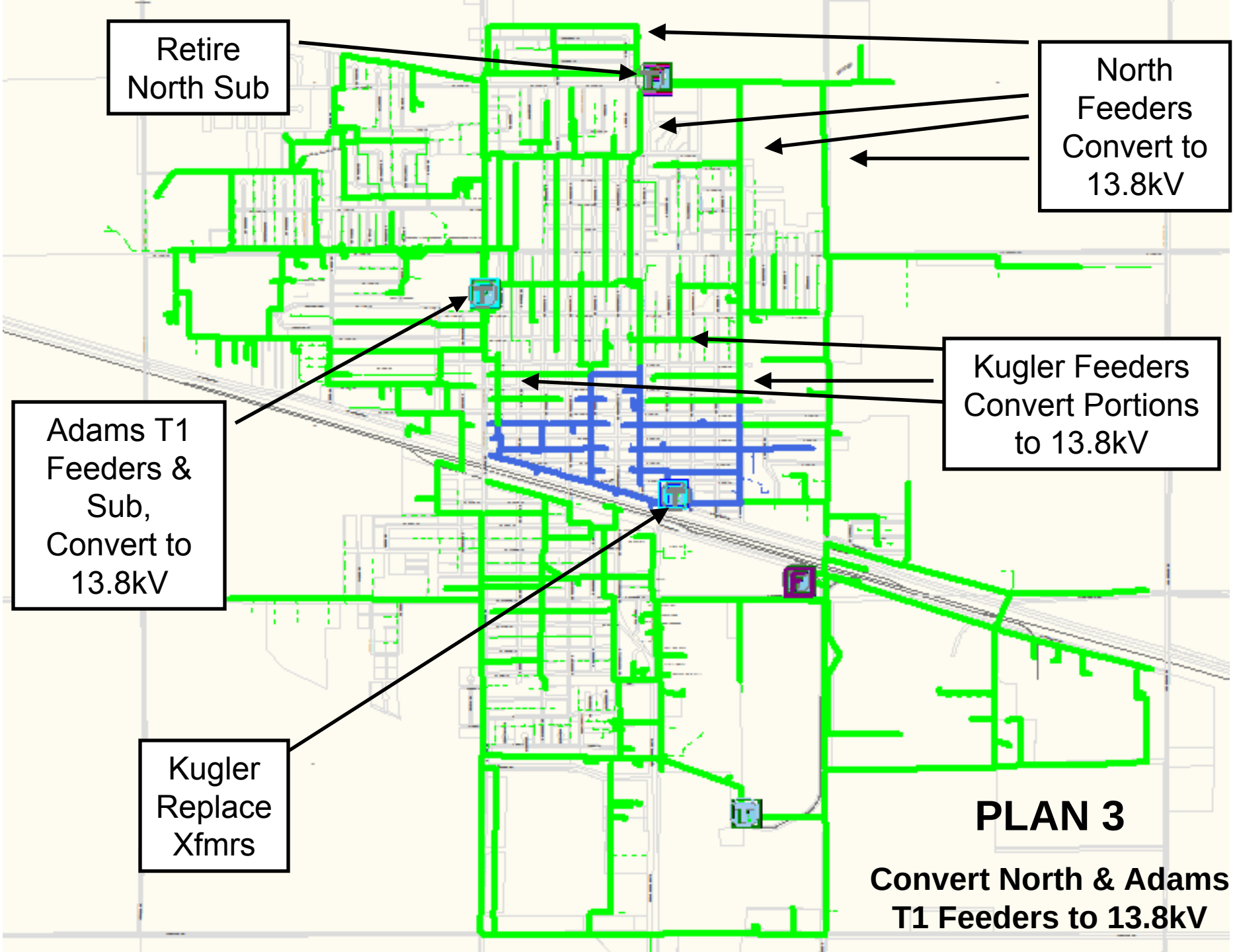
- Many solutions were considered to resolve these issues.
- 4 Overall Plans were Developed

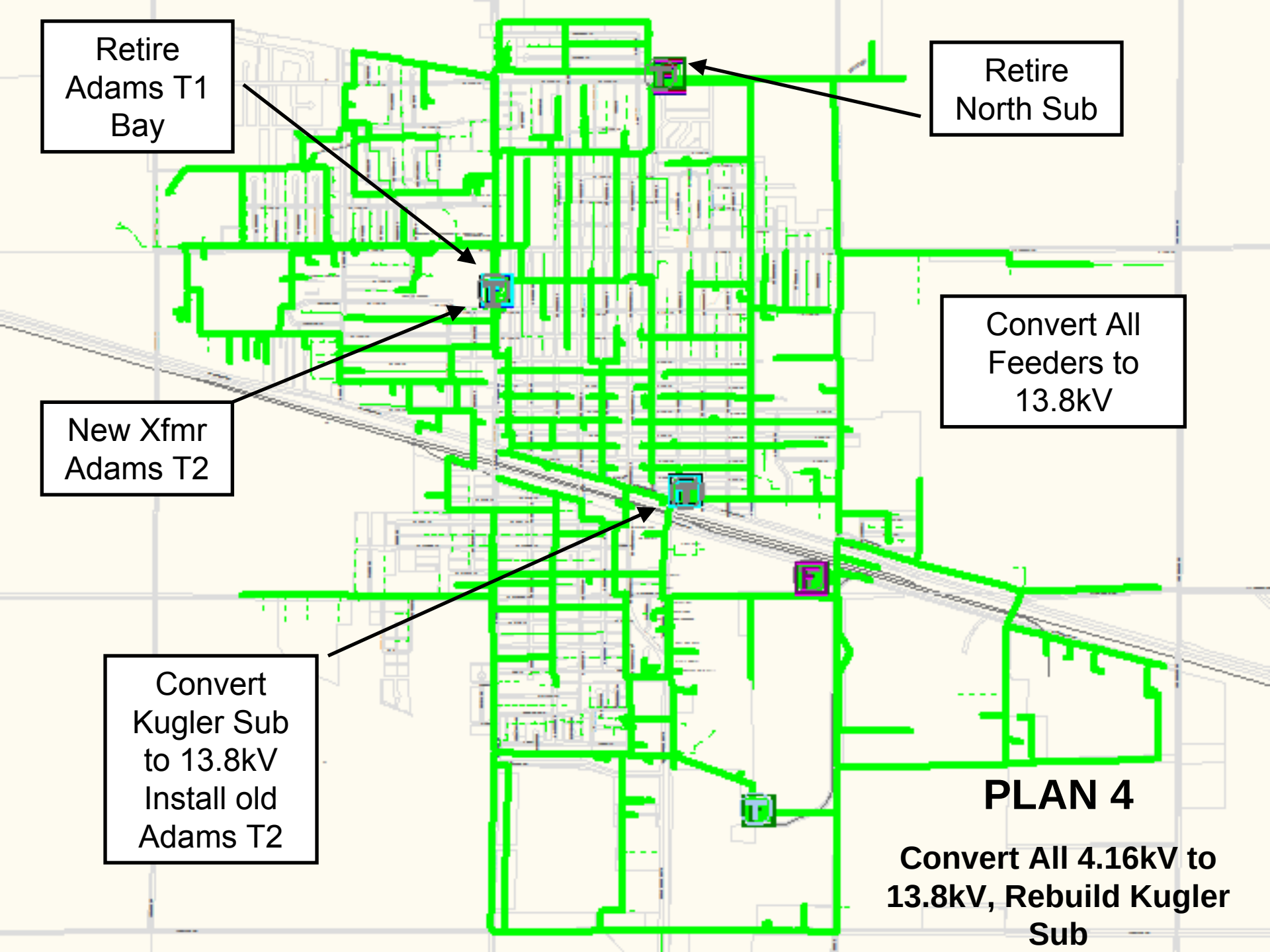
Lexington Distribution Plan

- Projects in all 4 plans
  - 2008 – Kugler 106 and 108 feeders, convert to 13.8kV
  - 2009 – Adams T2 Circuit Switcher Repair or Replace


New North Sub
Replace OH conductor
Replace Xfmrs at Kugler & Adams T1
Replace UG conductor at Kugler and Adams
PLAN 1
Construct New North Sub, Replace OH & UG Conductor


Convert Adams 102 to 13.8kV
Convert North Feeders to 13.8kV
Retire North Sub
Adams T2 Xfmr 2017
Kugler Replace UG
Kugler 124 & 104 Replace OH Cond
Kugler & Adams T1 Replace Xfmrs
PLAN 2
Convert North Feeders & Adams 202 to 13.8kV


Retire North Sub
North Feeders Convert to 13.8kV
Kugler Feeders Convert Portions to 13.8kV
Adams T1 Feeders & Sub, Convert to 13.8kV
Kugler Replace Xfmrs
PLAN 3
Convert North & Adams T1 Feeders to 13.8kV


Retire Adams T1 Bay
Retire North Sub
Convert All Feeders to 13.8kV
New Xfmr Adams T2
Convert Kugler Sub to 13.8kV Install old Adams T2
PLAN 4
Convert All 4.16kV to 13.8kV, Rebuild Kugler Sub

Distribution
and Substation

City of Lexington Distribution System
NPPD - Distribution Asset Planning
Net Present Value Analysis

SDA
02/15/08
12:12

Plan #4 - Convert All 4.16kV to 13.8kV, Rebuild Kugler Sub

	Estimated Cost
2008 - Kugler 106 & 108 feeders - Convert to 13.8kV	$445,445
2009 - North 104 & 108 feeder, convert to 13.8kV	$445,060
2009 - Adams T2 Replace Circuit Switcher	$160,000
2010 - North 102 & 106 feeders convert to 13.8kV	$380,765
2010 - Retire existing North substation	$97,700
2011 - Adams 102 feeder convert to 13.8kV	$280,588
2011 - Purchase a new 13.8kV xfmr for Adams T2	$825,000
2011 - Install new 13.8kV xfmr at Adams T2	$38,200
2012 - Adams 104 & 106 feeders convert to 13.8kV	$494,186
2012 - Retire Adams T1 bay	$60,300
2013 - Kugler 104 feeders convert to 13.8kV	$410,333
2014 - Kugler 124 feeder convert to 13.8kV	$281,589
2015 - Kugler 122 feeder convert to 13.8kV	$358,820
2015 - Kugler Substation convert to 13.8kV operation and install the old Adams T2	$458,700

Lexington Distribution Plan

- Plan 4 Pros and Cons
  - Costs are higher than plan 1 & 2 and lower than Plan 3
  - Eliminates all older 5kV switchgear
  - Places 13.8kV capacity where its needed.
  - Most operational flexibility
  - Provides the strongest system to serve large new loads
  - All $ spent on 13.8kV
  - Substation O & M costs lowest of 4 Plans