CITY OF GARDNER, KANSAS
MASTER PLAN
EXECUTIVE SUMMARY

Meers Engineering, Inc. was contracted to perform an Electric Master Plan 2007 through 2020 by the City of Gardner, Kansas.

Meers Engineering, Inc. has made several trips to Gardner to gather data (one (1) prior to contract award) in addition with several emails, electronic transfer of data and maps to our office.

The original Scope was to develop a single Master Plan, however the staff has requested two (2) scenarios'.

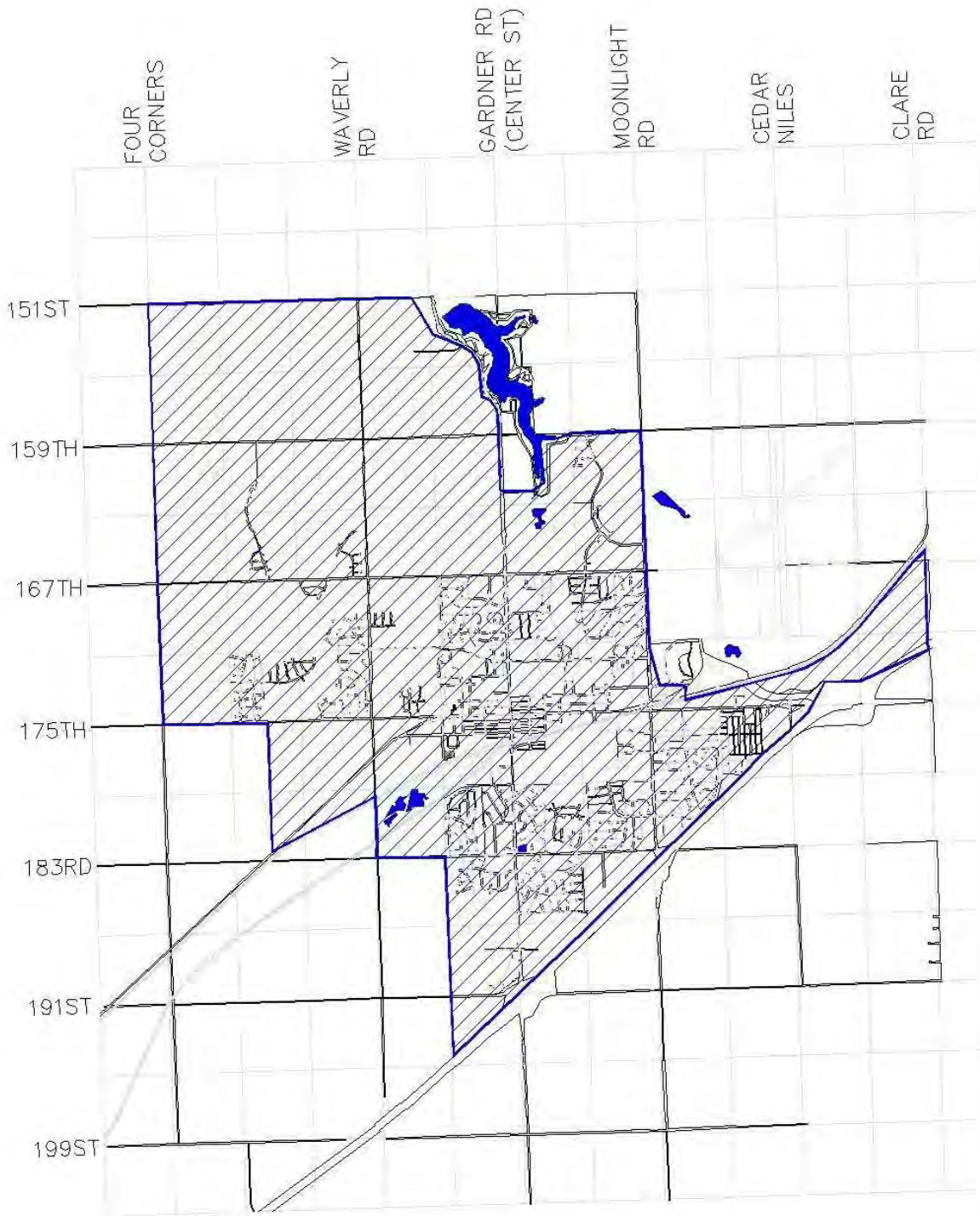
1. Minimum Service Area
2. Ultimate Service Area

The Minimum Service Area Scenario omitted BNSF and all electric service areas south of Interstate 35 and did not consider growth past current City Council accepted service boundaries. This was in accordance with City staff directives. The intent of this scenario was to establish the minimum required electric system.

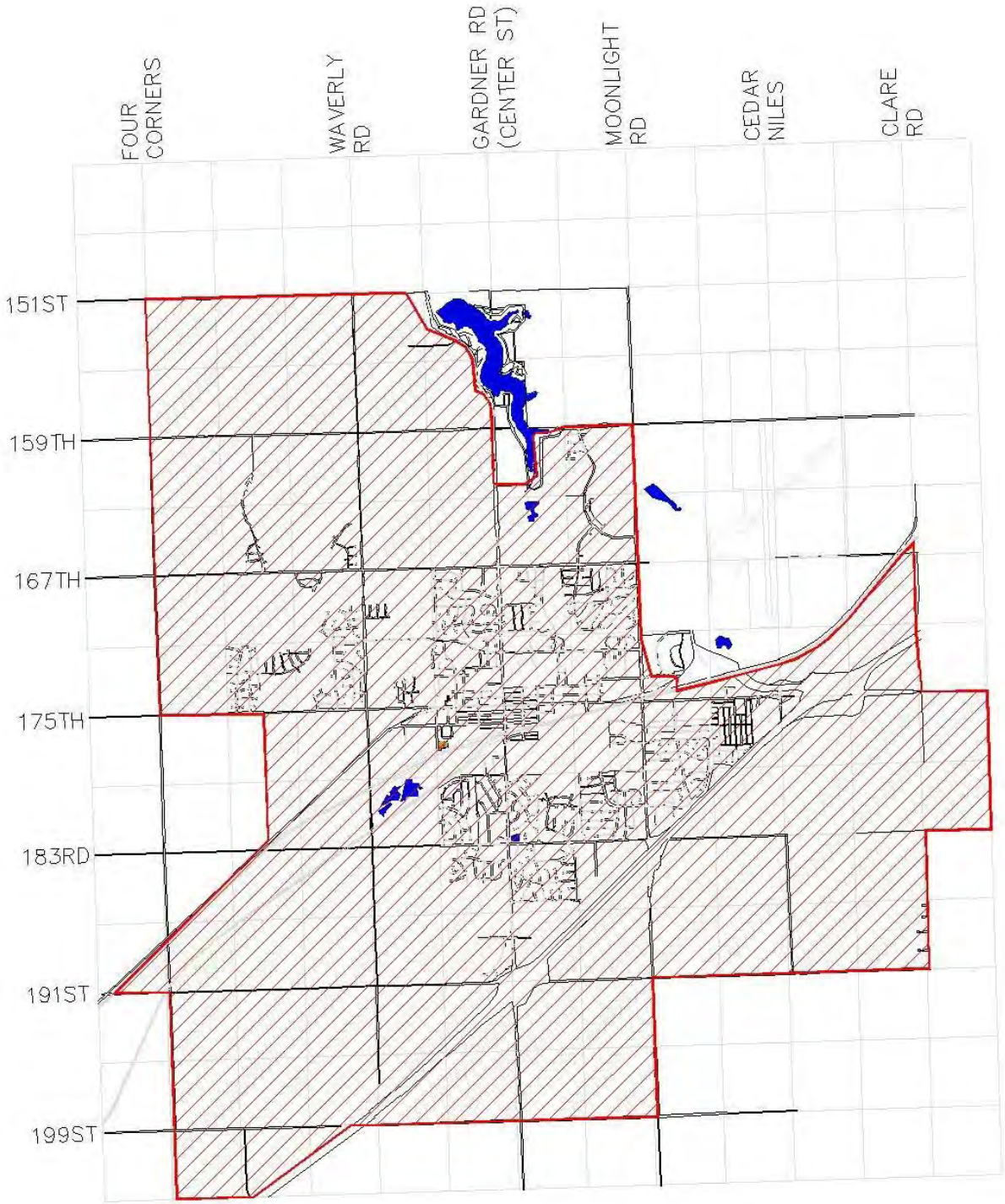
The Ultimate Service Area Scenario allowed all areas identified by Community Development to be populated including BNSF plus it takes into account the Sprawl factor of the Kansas City area of 3.2% per year to grow the service boundary.

Refer to the following graphs for boundaries of the service area

2020 MINIMUM SERVICE AREA



2020 ULTIMATE SERVICE AREA



SUMMARY OF FINDINGS

Substations

The two (2) scenarios are compared on a projected load versus system capacity basis. We established Action Threshold at 90% of system capacity, which demands action. We also established a Contingency Goal of 75% of system capacity. This is the margin, which we attempt to keep in the system capacity.

The projects required to maintain the system reliability are noted on the respective curves:

Minimum Scenario System Loading and Modifications Graph – MINGRAPH
Ultimate Scenario System Loading and Modifications Graph - ULTGRAPH

The projects are selected to specifically handle the areas, which are developing in any specific year. Regardless of the scenario selected, there is no difference in the system improvement recommendations until 2009.

The City electric load versus the capacity establishes the projects. The recommended system configuration with modification dates for each scenario are listed below and shown on the following one lines:

Minimum Scenario Transmission One Line – MINSYS-1
Ultimate Scenario Transmission One Line – ULTSYS-1

The **Minimum** Service Area Scenario based on the current population projections and the Community Development Plan Future Use Map without considering Sprawl, BNSF or additional load south of Interstate 35. The minimum number of substations required for 2020 are listed below with other pertinent information.

MINIMUM SERVICE AREA

Substation	Average Load	Peak Load	Number of Transformers	In Service Year
Energy Center	5.42	12.74	1	Existing/2011
Santa Fe	19.92	46.81	2	Existing/2008/2010
North Waverly	21.54	50.27	2	Existing/2012/2017
BNSF	-	-	-	Not considered
Cedar Niles	-	-	-	Not considered
South Waverly	5.92	12.95	1	2015
Total	**52.80**	**122.77**		

The **Ultimate** Substation Service Area Scenario for 2020 was established based on projected population and hence load. The load in turn established the number of substations. The ultimate number of substations required for 2020 are listed below with other pertinent information.

ULTIMATE SERVICE AREA

Substation	Average Load	Peak Load	Number of Transformers	In Service Year
Energy Center	5.42	12.74	1	Existing/2011
Santa Fe	21.50	50.52	2	Existing/2008/2010
North Waverly	21.54	50.27	2	Existing/2012/2017
BNSF	21.74	38.41	2	2009
Cedar Niles	8.90	20.92	1	2013
South Waverly	16.61	38.06	2	2015/2018
Total	**95.71**	**210.92**		

Transmissions

The substation must be interconnected with the transmission system. The recommended transmission projects with In Service dates are as listed below:

Transmission lines need to be constructed as set forth below:

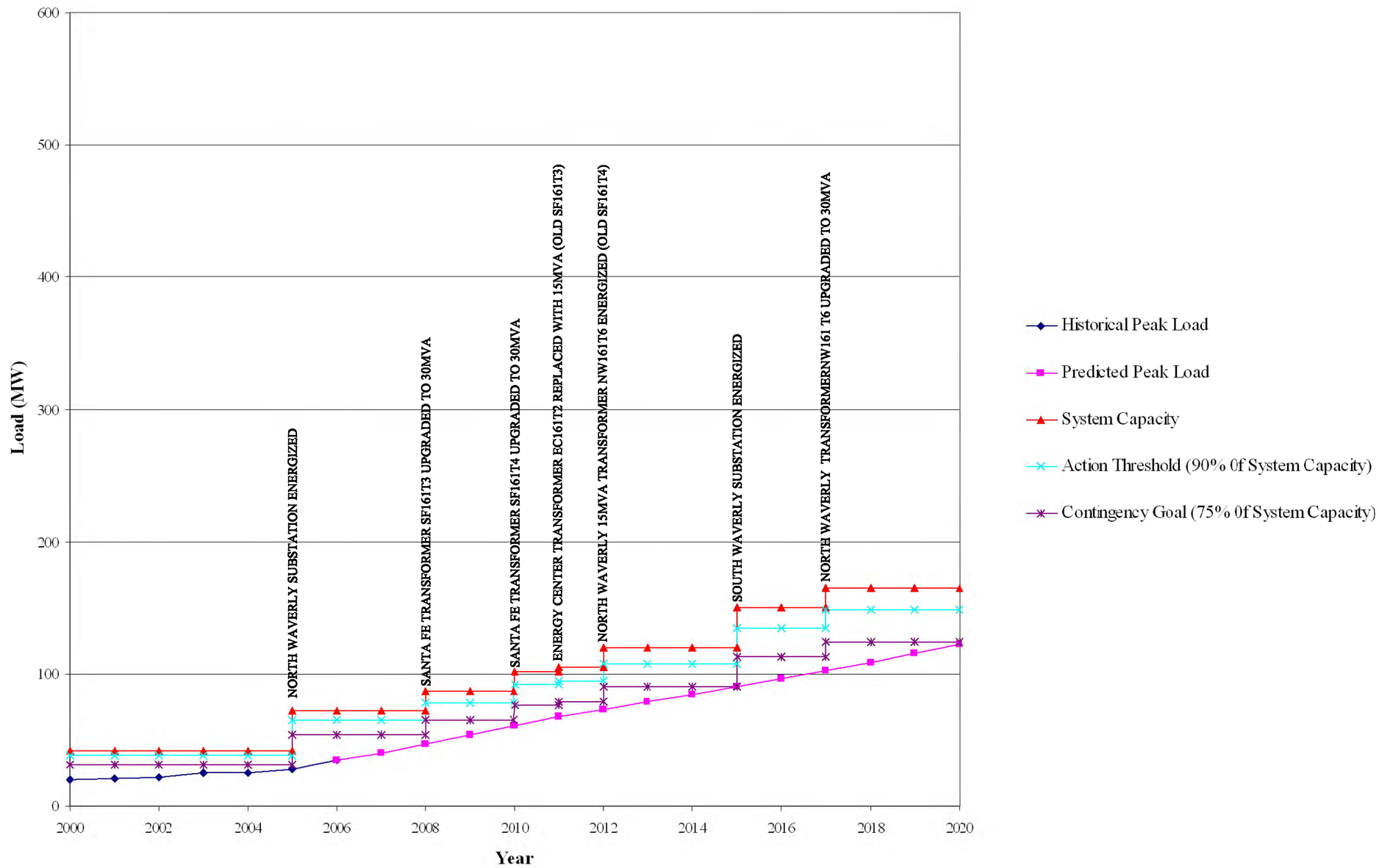
161 kV Transmission Line	Minimum	Ultimate	In Service Year
North Waverly – BNSF	Not required	5.25 Miles 161 kV	2009
South Waverly – Cedar Niles	Not required	3.25 Miles 161 kV	2013
Cedar Niles – Energy Center	Not required	1.75 Miles 161 kV	2013
North Waverly – South Waverly	6.0 Miles 161 kV	Included above	2015
South Waverly – Santa Fe	2.4 Miles 161 kV	2.4 Miles 161 kV	2015

Distribution Feeders

Additional 12.5 kV distribution feeders will need to be built from the substation to support the load growth in both scenarios. The Engineer understands the City's desire to have developers pay for the majority of the feeder expansion. The complete cost of each feeder is included in the CIP dollars since all negotiations on feeders are not final at this time.

The 12.5 kV feeder trunk line, which need to be constructed as, set forth below:

In Service Year	Minimum Miles of 12.5 kV Trunk Line	Ultimate Miles of 12.5 kV Trunk Line
2007	7	12
2008	2	2
2009	1	4
2010	3	6
2011	1	3
2012	1	4
2013	1	4
2014	1	2
2015	4	4
2016	2	3
2017	2	7
2018	1	1
2019	4	5
2020	1	1



GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

REFERENCE DRAWINGS

REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	11/16/06	ISSUED FOR REVIEW	SAB	LJM
B	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 11/07/06 CODE
PLOTTED 11/22/06 CHECKED BY LJM
LAST UPDATE BY SAB

MINIMUM SCENARIO SYSTEM LOADING AND MODIFICATIONS GRAPH

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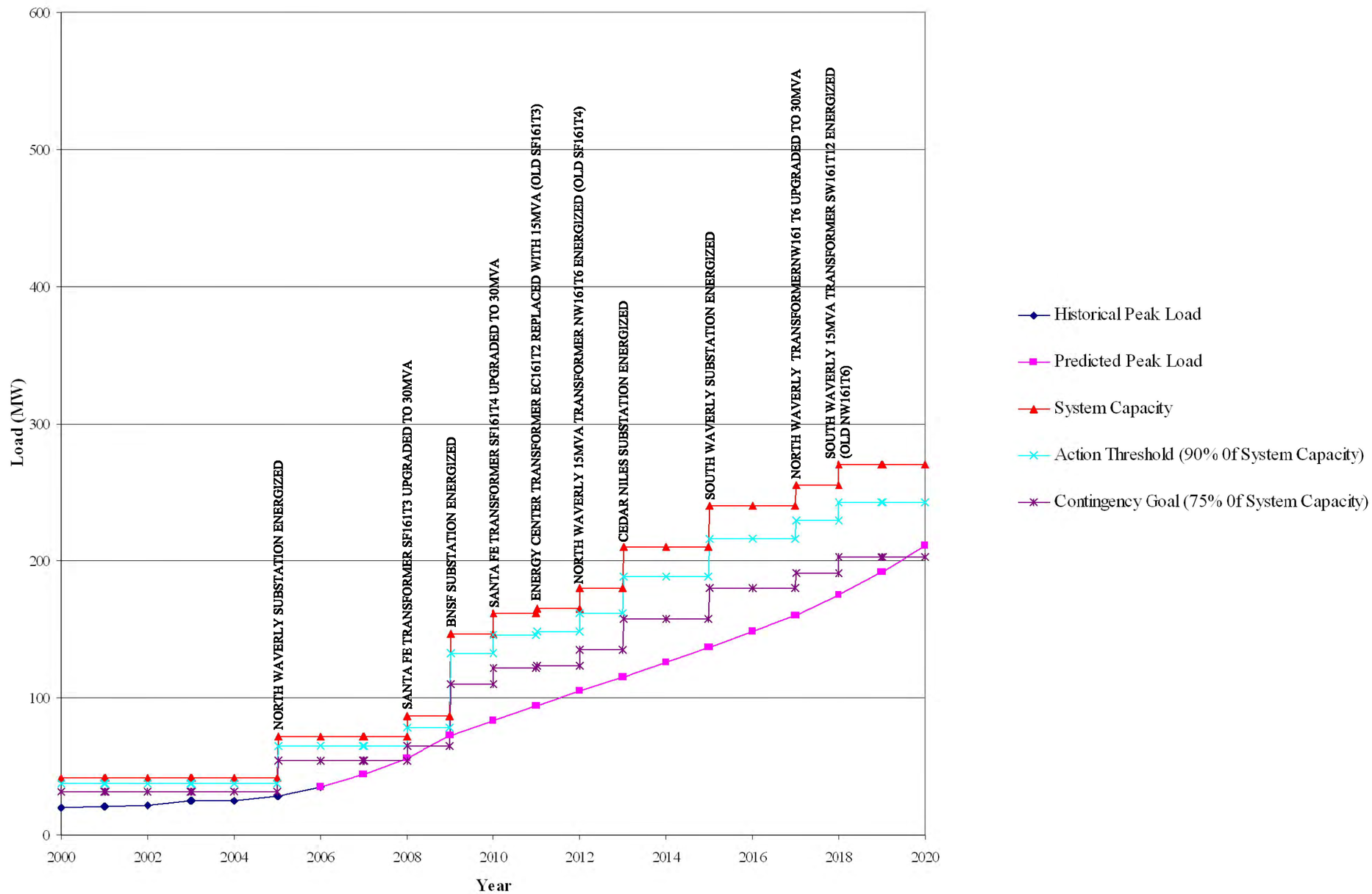
CHECKED: LJM DRAWING NO.: ISSUE:
APPROVED: LJM **MINGRAPH** **B**
FILENAME: MINGRAPH



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NOTES

LEGEND

REFERENCE DRAWINGS

REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	09/29/06	ISSUED FOR REVIEW	SAB	LJM
B	11/16/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 09/27/06 CODE
PLOTTED 11/16/06 CHECKED BY LJM
LAST UPDATE BY SAB

ULTIMATE SCENARIO SYSTEM LOADING AND MODIFICATIONS GRAPH

DRAWN: SAB SCALE: NONE
CHECKED: LJM DRAWING NO.: ISSUE:
APPROVED: LJM **ULTGRAPH** **B**
FILENAME: ULTGRAPH

SUMMARY OF IMPROVEMENTS

The system improvements do not change regardless of which scenario track the City chooses until 2009 which is when BNSF Substation and associated transmission lines are required to be in service in the Ultimate Service Area Scenario.

The second difference is not constructing the Cedar Niles Substation and its associated transmission lines in 2013 to also support the Ultimate Service Area Scenario.

The intent of the Minimum Service Area Scenario was to determine if South Waverly Substation could be delayed or omitted. The results show that assuming BNSF Intermodal facility is constructed regardless of the energy provider to the facility, the associated support businesses will be constructed in the City of Gardner Service Area. The Santa Fe Substation still loads up in a similar manner, thus the schedule for the first transformer in South Waverly Substation remains at 2015. The lack of expansion of service territory defers the second transformer in South Waverly Substation beyond the time frame of the Master Plan.

A review and comparison of the Ultimate Scenario System Loading and Modifications Graph versus the Minimum Scenario System Loading and Modifications Graph displays an interesting fact. The improvement schedule is much more critical in the Minimum Service Area Scenario since the load intersects the system capacity contingency goal of 75% every three to four years.

The CIP dollars appear reversed or in error in 2013, however, we have delayed construction of infrastructure to the longest possible time, thus the large dollar figure. Should the City decide to construct portions early this would ease the CIP dollars in that year.

The improvements are priced in 2006 dollars and listed below. The improvements are listed in the year they must be in service, not necessarily the year activity must begin or dollars committed to achieve the operational goal.

The detail for each category of CIP money is further shown in each specific year.

SUMMARY OF SYSTEM IMPROVEMENTS

A detailed breakdown is addressed in the Yearly Capital Improvement Budget in each year.

Year	Item	2006 Minimum Dollars	2006 Ultimate Dollars
2007	Substation Construction CIP Total	$0.00	$0.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction		
	A. New Feeder from North Waverly NW55 B. Extend North Waverly Feeder NW53 South C. Extend Santa Fe Feeder SF46 D. Extend North Waverly Feeder NW51 South E. Extend North Waverly Feeder NW55 South F. Extend Energy Center Feeder EC24 East		
	12.5 kV Distribution Feeder Construction CIP Total	$477,259.20	$1,554,194.40
	BNSF Substation Site Purchase	$0.00	$120,000.00
	CIP Total	**$477,259.20**	**$1,674,194.40**
2008	Substation Construction		
	1. Santa Fe upgrade SF161T3		
	Substation Construction CIP Total	$1,871,760.00	$1,871,760.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction		
	A. Extend Santa Fe Feeder SF44 East		
	12.5 kV Distribution Feeder Construction CIP Total	$29,000.00	$29,000.00
	CIP Total	**$1,889,078.40**	**$1,889,078.40**

Year	Item	2006 Minimum Dollars	2006 Ultimate Dollars
2009	Substation Construction 1. BNSF Substation new construction 2. North Waverly Substation upgrade		
	Substation Construction CIP Total	$0.00	$7,323,360.00
	161 kV Transmission Construction 1. North Waverly to BNSF (161TL4)		
	161 kV Transmission Construction CIP Total	$0.00	$3,110,184.00
	12.5 kV Distribution Feeder Construction A. New Feeder from BNSF BN84 West B. New Feeder from BNSF BN71 West C. New Feeder from BNSF BN82 Northeast D. New Feeder from BNSF BN75 Northeast E. New Feeder from BNSF BN86 East		
	12.5 kV Distribution Feeder Construction CIP Total	$0.00	$574,596.00
	CIP Total	**$0.00**	**$11,008,140.00**
2010	Substation Construction 1. Santa Fe upgrade SF161T4		
	Substation Construction CIP Total	$1,417,680.00	$1,417,680.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction A. Extend Santa Fe Feeder SF42 West B. New Feeder from Santa Fe SF46 Southwest C. New Feeder from BNSF BN77 East		
	12.5 kV Distribution Feeder Construction CIP Total	$233,956.80	$638,352.00
	CIP Total	**$1,651,636.80**	**$2,056,032.00**

Year	Item	2006 Minimum Dollars	2006 Ultimate Dollars
2011	Substation Construction 1. Energy Center Substation upgrade 2. Change out Transformer EC161T2		
	Substation Construction CIP Total	$3,329,040.00	$3,329,040.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction A. Extend North Waverly Feeder NW57 East		
	12.5 kV Distribution Feeder Construction CIP Total	$136,804.80	$136,804.80
	CIP Total	**$3,465,844.80**	**$3,465,844.80**
2012	Substation Construction 1. North Waverly Substation upgrade		
	Substation Construction CIP Total	$1,961,520.00	$1,561,560.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction A. New Feeder from BNFS BN88 South B. Extend Santa Fe Feeder SF46 South		
	12.5 kV Distribution Feeder Construction CIP Total	$0.00	$554,875.20
	Cedar Niles Substation Site Purchase	$0.00	$120,000.00
	CIP Total	**$1,961,520.00**	**$2,236,435.20**

Year	Item	2006 Minimum Dollars	2006 Ultimate Dollars
2013	Substation Construction 1. Cedar Niles Substation new construction 2. BNSF Substation upgrade for transmission addition 3. Energy Center Substation upgrade for transmission addition		
	Substation Construction CIP Total	$0.00	$4,782,360.00
	161 kV Transmission Construction 1. BNSF to South Waverly 161TL5 2. South Waverly to Cedar Niles 161TL6 3. Cedar Niles to Energy Center 161TL7		
	161 kV Transmission Construction CIP Total	$0.00	$4,087,670.40
	12.5 kV Distribution Feeder Construction A. Extend North Waverly Feeder NW64 West B. New Feeder from North Waverly NW66 North C. New Feeder from North Waverly NW55 South D. Extend BNSF Feeder BN86 East E. New Feeder from Cedar Niles CN91 North		
	12.5 kV Distribution Feeder Construction CIP Total	$333,722.40	$539,088.00
	CIP Total	**$333,722.40**	**$9,409,118.40**
2014	Substation Construction CIP Total	$0.00	$0.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction A. Extend North Waverly Feeder NW57 West B. Extend BNSF Feeder BN88 South C. Extend Santa Fe Feeder SF46 East		
	12.5 kV Distribution Feeder Construction CIP Total	$161,172.00	$265,214.40
	South Waverly Substation Site Purchase	$120,000.00	$120,000.00
	CIP Total	**$281,172.00**	**$385,214.40**

Year	Item	2006 Minimum Dollars	2006 Ultimate Dollars
2015	Substation Construction 1. South Waverly Substation new construction 2. North Waverly Substation upgrade – Minimum Scenario only 3. Santa Fe Substation upgrade for transmission addition		
	Substation Construction CIP Total	$5,356,560.00	$5,258,880.00
	161 kV Transmission Construction 1. North Waverly to South Waverly 161TL4 – Minimum Scenario 2. Santa Fe to South Waverly 161TL8		
	161 kV Transmission Construction CIP Total	$5,627,952.00	$1,421,798.40
	12.5 kV Distribution Feeder Construction A. New Feeder from North Waverly NW62 East B. Extend Feeder from Santa Fe SF44 South C. New Feeder from South Waverly SW115 South D. Extend Feeder from South Waverly SW113 South E. New Feeder from South Waverly SW117 South		
	12.5 kV Distribution Feeder Construction CIP Total	$528,660.00	$659,419.20
	CIP Total	**$11,513,172.00**	**$7,340,097.60**
2016	Substation Construction CIP Total	$0.00	$0.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction A. Extend Feeder from North Waverly NW55 West B. Extend Feeder from South Waverly SW117 East		
	12.5 kV Distribution Feeder Construction CIP Total	$67,425.60	$278,388.00
	CIP Total	**$67,425.60**	**$278,388.00**

Year	Item	2006 Minimum Dollars	2006 Ultimate Dollars
	Substation Construction		
2017	1. North Waverly Substation upgrade NW161T6		
	Substation Construction CIP Total	$1,417,680.00	$1,417,680.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction		
	A. Extend Feeder from North Waverly NW57 West B. Extend Feeder from North Waverly NW66 North C. New Feeder from Cedar Niles CN93 West D. New Feeder from Cedar Niles CN95 North E. New Feeder from Cedar Niles CN97 South		
	12.5 kV Distribution Feeder Construction CIP Total	$171,415.20	$937,780.80
	CIP Total	**$1,589,095.20**	**$2,355,460.80**
	Substation Construction		
2018	1. South Waverly Substation upgrade SW161T12		
	Substation Construction CIP Total	$0.00	$707,520.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction		
	A. Extend Feeder from Santa Fe SF42 North		
	12.5 kV Distribution Feeder Construction CIP Total	$133,900.80	$133,900.80
	CIP Total	**$133,900.80**	**$841,420.80**

Year	Item	2006 Minimum Dollars	2006 Ultimate Dollars
2019	Substation Construction CIP Total	$0.00	$0.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction		
	A. Extend Feeder from North Waverly NW57 North B. Extend Feeder from North Waverly NW66 North C. Extend Feeder from BNSF BN73 South D. New Feeder from South Waverly SW124 South		
	12.5 kV Distribution Feeder Construction CIP Total	$279,972.00	$389,743.20
	CIP Total	**$279,972.00**	**$389,743.20**
2020	Substation Construction CIP Total	$0.00	$0.00
	161 kV Transmission Construction CIP Total	$0.00	$0.00
	12.5 kV Distribution Feeder Construction		
	A. Extend Feeder from Energy Center EC22 North		
	12.5 kV Distribution Feeder Construction CIP Total	$80,282.40	$80,282.40
	CIP Total	**$80,282.40**	**$80,282.40**
	GRAND CIP TOTAL	**$23,724,081.60**	**$43,409,450.40**

MINIMUM SERVICE AREA SCENARIO

SUMMARY OF APPROACH

The approach utilized a complicated database and multiple comparisons. We are providing a summary of the approach here but it is detailed in the APPROACH section.

These system additions and modifications are noted on the MINGRAPH located in the Summary of Findings.

There is a definite relationship between population and electric customers. There is a definite relationship between electric customers to electric load. Mr. Wilson's 2004 System Capacity Addition Master Plan validated the relationship. Although some quantitive changes may occur over time the relationship remains fairly constant.

The population projected by the Community Development of 42,054 was matched with our projected ultimate load to determine population scale on the right hand side of both Load versus Population graphs.

A graphical comparison of population growth and load growth reveals some interesting facts.

The approach that we utilized to develop the Minimum Service Area Scenario under the Master Plan was as follows:

MINIMUM SERVICE AREA

The city limits were not expanded.

The Community Development Department has assigned predictive zonings for each area, plus estimated population growth of 42,054 to 2020. The same zoning intuitively leads to assigning various construction or electrical usage types, i.e. single residences, multi-family residences, strip shopping center, large commercial malls, industrial complexes for the entire defined city limits as defined identical to the Ultimate Plan was used in the areas included. The population growth was the major factor to define the percentage build out for each unique area.

Refer to Minimum Scenario Electric System Load Definition Map (MINESD-1) at the end of the Executive Summary.

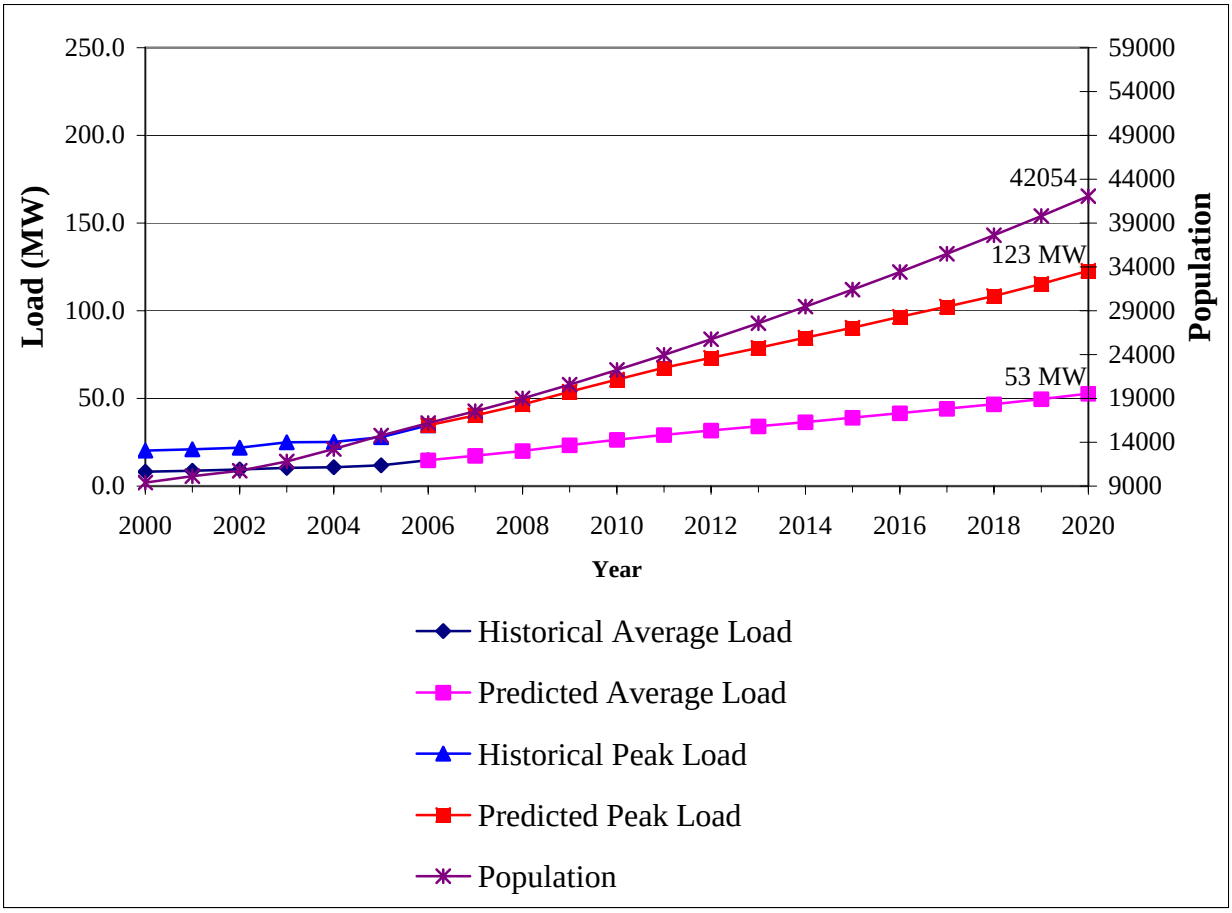
The electrical density in **megawatts per mile** for each particular electric usage type was calculated from reliable sources which are identified by category in the Approach.

Meers Engineering, Inc. understands that even though an area was included in the city limits by 2020 that every area would not be necessarily 100% built out. Therefore, we have assigned a percentage number based on our understanding of growth area, population growth and type of construction. This percentage number when less than 100% was used to modify the total electric load in each specific area.

This data resides in an Access database which can be easily updated. The database will become the property of the City of Gardner.

This procedure established the normal load estimate for 2020.

MINIMUM ELECTRIC LOAD vs. POPULATION COMPARISON



The graphical analysis reveals the following conclusion.

The population growth rate exceeds electric growth rate.

The Minimum Service Area scenario implies the population growth will exceed the electric load projection.

Either another entity such as KCPL will serve the load as it increases or the system will experience unplanned actions to accommodate the unanticipated.

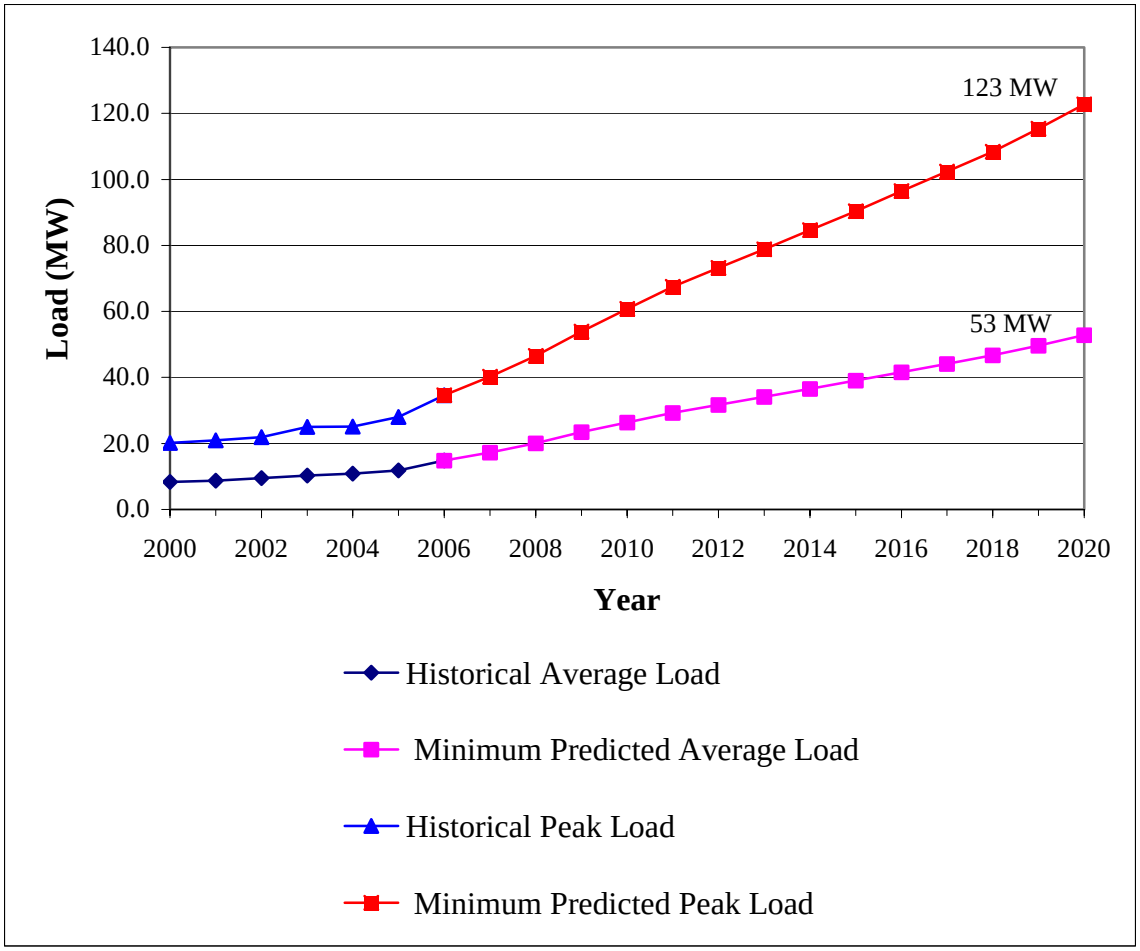
The energy consumption required by the population sets the capital improvements.

The maximum peak sets the system capacity requirements while the normal load will more closely establish the revenue since the peak conditions are fairly short lived events.

The purpose of this Minimum Scenario in the Master Plan is to establish the proper electric system to serve the load in a given year, therefore, we will concentrate on the peak conditions.

The projected system peak and normal loading is shown on the following graph:

MINIMUM SYSTEM PREDICTED LOADING



MINLDP DRAWINGS

The electric service area currently approved by the City Council was left unchanged. The load growth which will ultimately occur outside of this are is not considered as part of the Gardner Electric System.

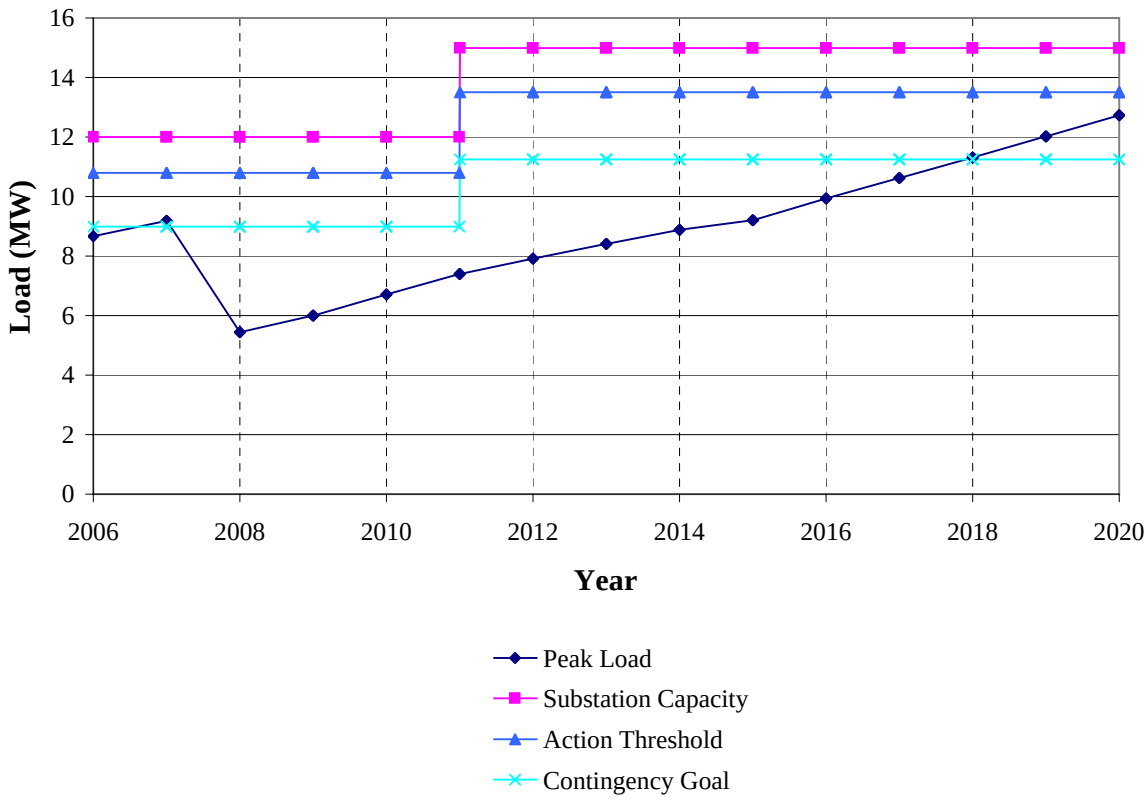
The City requested an analysis based on this area building out completely. The results are

Substation Capacity	Peak Load
165 MW	158 MW

This violates our 90% Action Threshold and implies additional projects would be necessary based on the Community Development population projections. The Engineer believes this will occur after the 2020 time frame of the study.

MINIMUM SCENARIO
ENERGY CENTER SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	8.67	12.00	
2007	9.19	12.00	
2008	5.44	12.00	Load moved to Feeder 302
2009	6.01	12.00	
2010	6.71	12.00	
2011	7.40	15.00	Moved SF161T3 from Santa Fe to Energy Center
2012	7.91	15.00	
2013	8.42	15.00	
2014	8.88	15.00	
2015	9.21	15.00	
2016	9.93	15.00	
2017	10.63	15.00	
2018	11.32	15.00	
2019	12.02	15.00	
2020	12.74	15.00	



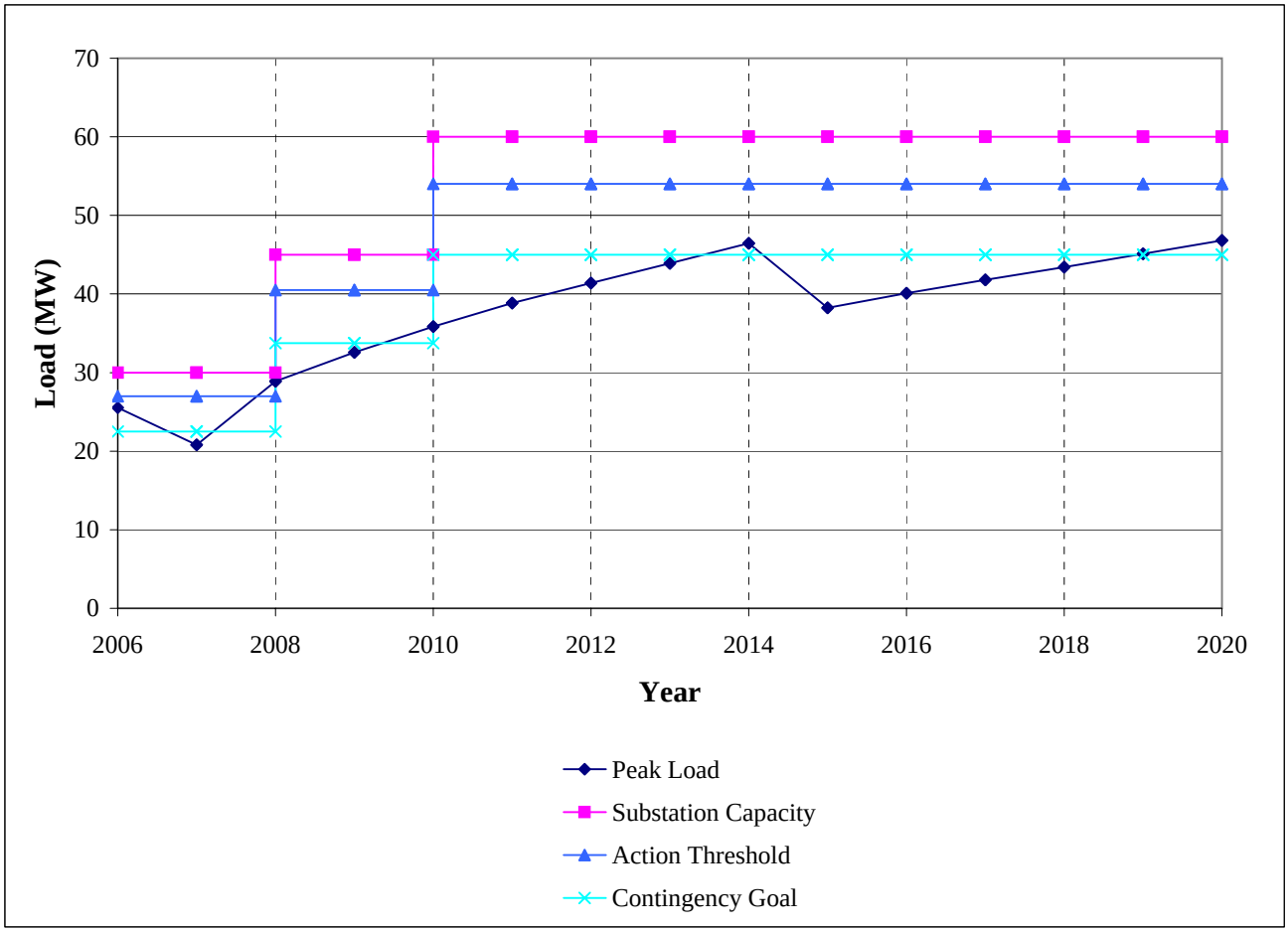
MINIMUM SCENARIO
ENERGY CENTER SUBSTATION
TRANSFORMER LOADING

TRANSFORMER EC161T2

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	8.67	9.00	10.80	12
2007	9.19	9.00	10.80	12
2008	5.44	9.00	10.80	12
2009	6.01	9.00	10.80	12
2010	6.71	9.00	10.80	12
2011	7.40	11.25	13.50	15
2012	7.91	11.25	13.50	15
2013	8.42	11.25	13.50	15
2014	8.88	11.25	13.50	15
2015	9.21	11.25	13.50	15
2016	9.93	11.25	13.50	15
2017	10.63	11.25	13.50	15
2018	11.32	11.25	13.50	15
2019	12.02	11.25	13.50	15
2020	12.74	11.25	13.50	15

MINIMUM SCENARIO
SANTA FE SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	25.51	30.00	
2007	20.81	30.00	Load moved to NW161T5 located at North Waverly
2008	28.89	45.00	Changed out SF161T3 with a 30 MVA
2009	32.56	45.00	
2010	35.84	60.00	Changed out SF161T4 with a 30 MVA
2011	38.86	60.00	Energy Center transformer changed out
2012	41.41	60.00	
2013	43.89	60.00	
2014	46.44	60.00	
2015	38.23	60.00	South Waverly Substation comes on line with a 30 MVA
2016	40.09	60.00	transformer; load moved
2017	41.81	60.00	
2018	43.43	60.00	
2019	45.10	60.00	
2020	46.81	60.00	



MINIMUM SCENARIO
SANTA FE SUBSTATION
TRANSFORMER LOADING

TRANSFORMER SF161T3

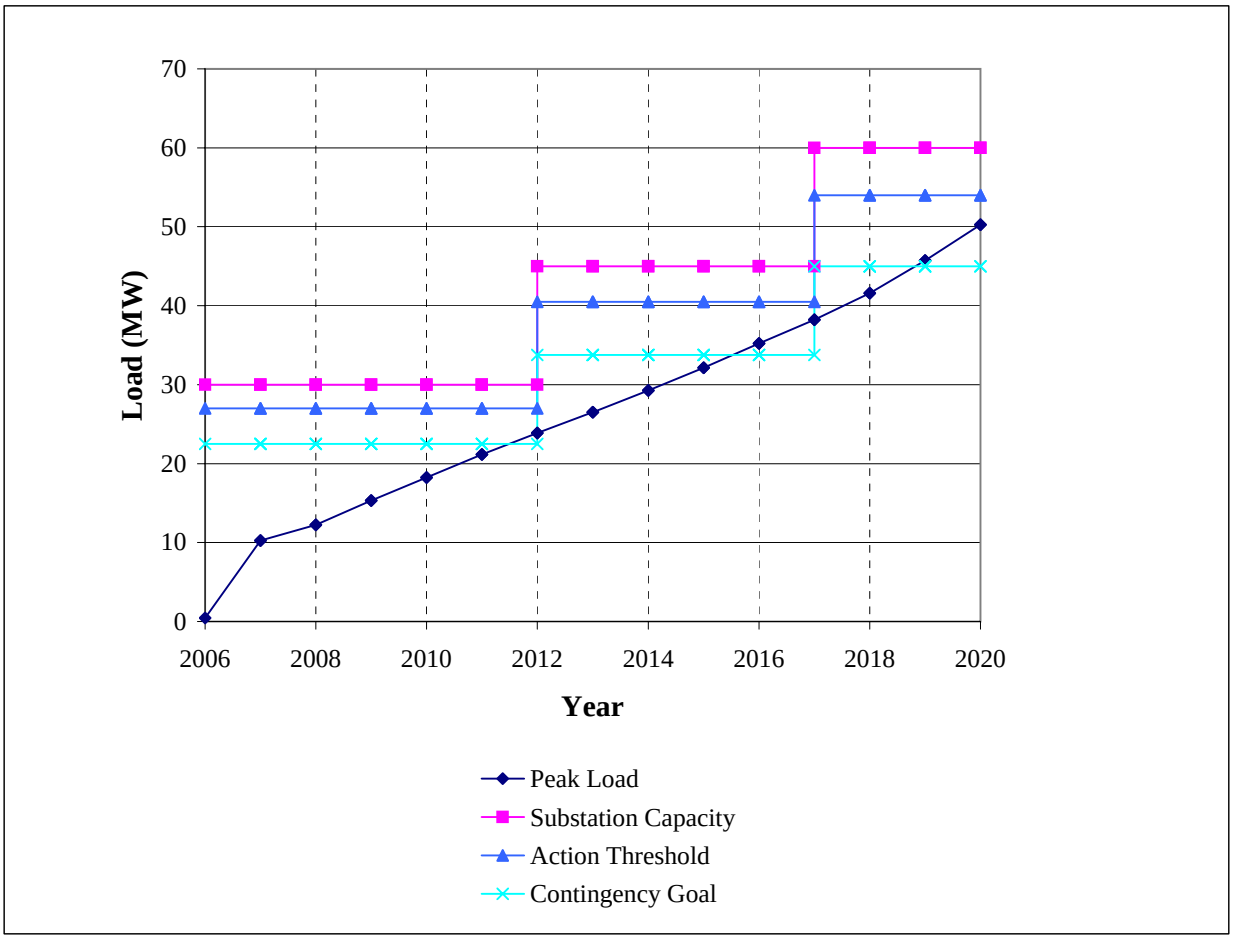
YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	13.72	11.25	13.50	15
2007	11.19	11.25	13.50	15
2008	17.64	22.50	27.00	30
2009	20.26	22.50	27.00	30
2010	18.40	22.50	27.00	30
2011	19.48	22.50	27.00	30
2012	19.90	22.50	27.00	30
2013	20.55	22.50	27.00	30
2014	21.17	22.50	27.00	30
2015	21.72	22.50	27.00	30
2016	22.26	22.50	27.00	30
2017	22.77	22.50	27.00	30
2018	23.21	22.50	27.00	30
2019	23.64	22.50	27.00	30
2020	24.08	22.50	27.00	30

TRANSFORMER SF161T4

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	11.79	11.25	13.50	15
2007	9.62	11.25	13.50	15
2008	11.25	11.25	13.50	15
2009	12.31	11.25	13.50	15
2010	17.44	22.50	27.00	30
2011	19.38	22.50	27.00	30
2012	21.51	22.50	27.00	30
2013	23.34	22.50	27.00	30
2014	25.27	22.50	27.00	30
2015	16.51	22.50	27.00	30
2016	17.83	22.50	27.00	30
2017	19.03	22.50	27.00	30
2018	20.22	22.50	27.00	30
2019	21.46	22.50	27.00	30
2020	22.73	22.50	27.00	30

MINIMUM SCENARIO
NORTH WAVERLY SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	0.45	30.00	
2007	10.27	30.00	Load added from SF161T3 and SF161T4 located at Santa Fe
2008	12.25	30.00	
2009	15.32	30.00	
2010	18.22	30.00	
2011	21.18	30.00	
2012	23.86	45.00	Relocated 15 MVA SF161T4 from Santa Fe as NW161T6
2013	26.51	45.00	
2014	29.28	45.00	
2015	32.13	45.00	
2016	35.22	45.00	
2017	38.24	60.00	Install new 30 MVA, replace existing NW161T6
2018	41.59	60.00	
2019	45.71	60.00	
2020	50.27	60.00	



MINIMUM SCENARIO
NORTH WAVERLY SUBSTATION
TRANSFORMER LOADING

TRANSFORMER NW161T5

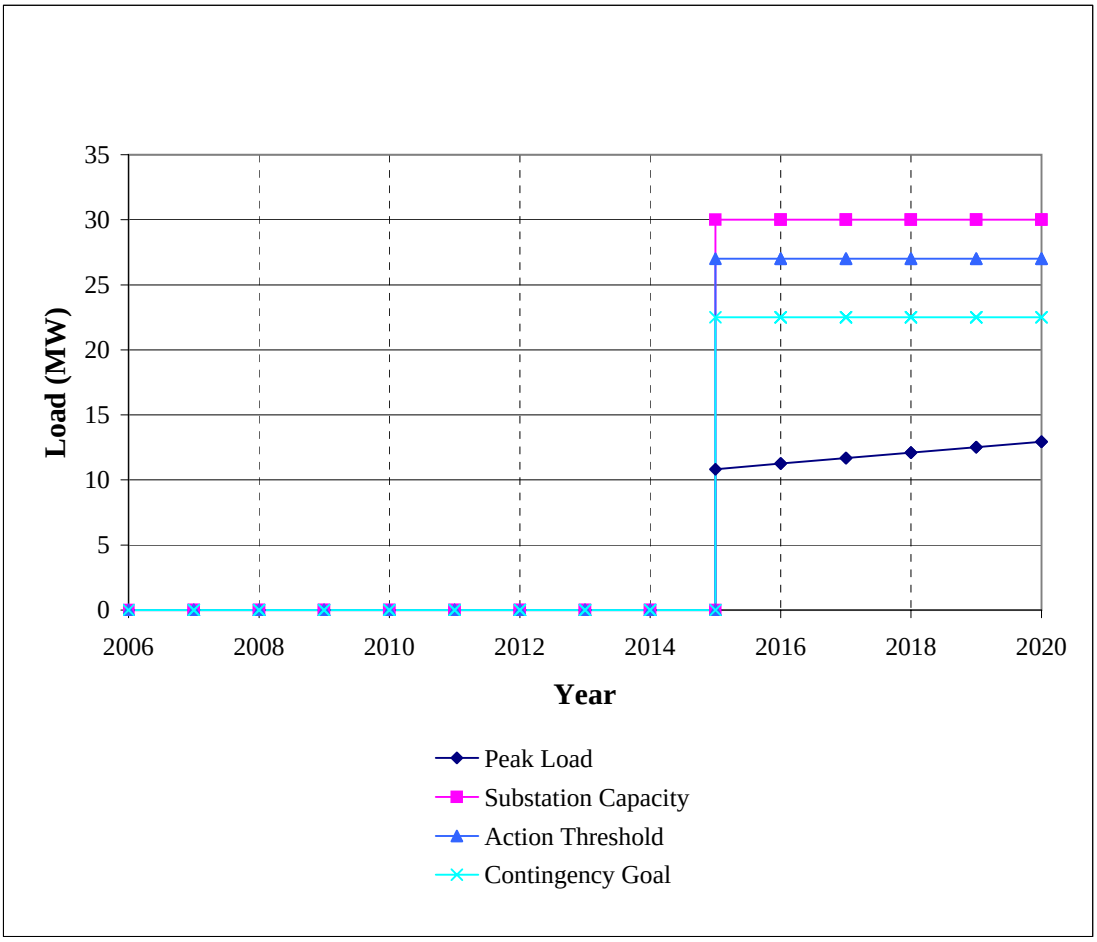
YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.45	22.50	27.00	30
2007	10.27	22.50	27.00	30
2008	12.25	22.50	27.00	30
2009	15.32	22.50	27.00	30
2010	18.22	22.50	27.00	30
2011	21.18	22.50	27.00	30
2012	23.86	22.50	27.00	30
2013	19.24	22.50	27.00	30
2014	20.85	22.50	27.00	30
2015	20.30	22.50	27.00	30
2016	21.65	22.50	27.00	30
2017	22.94	22.50	27.00	30
2018	24.31	22.50	27.00	30
2019	25.85	22.50	27.00	30
2020	27.49	22.50	27.00	30

TRANSFORMER NW161T6

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	11.25	13.50	15
2013	7.26	11.25	13.50	15
2014	8.43	11.25	13.50	15
2015	11.83	11.25	13.50	15
2016	13.58	11.25	13.50	15
2017	15.30	22.50	27.00	30
2018	17.28	22.50	27.00	30
2019	19.86	22.50	27.00	30
2020	22.78	22.50	27.00	30

MINIMUM SCENARIO
SOUTH WAVERLY SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	0.00	0.00	
2007	0.00	0.00	
2008	0.00	0.00	
2009	0.00	0.00	
2010	0.00	0.00	
2011	0.00	0.00	
2012	0.00	0.00	
2013	0.00	0.00	
2014	0.00	0.00	
2015	10.83	30.00	One new 30 MVA transformer
2016	11.27	30.00	
2017	11.68	30.00	
2018	12.09	30.00	
2019	12.52	30.00	
2020	12.95	30.00	



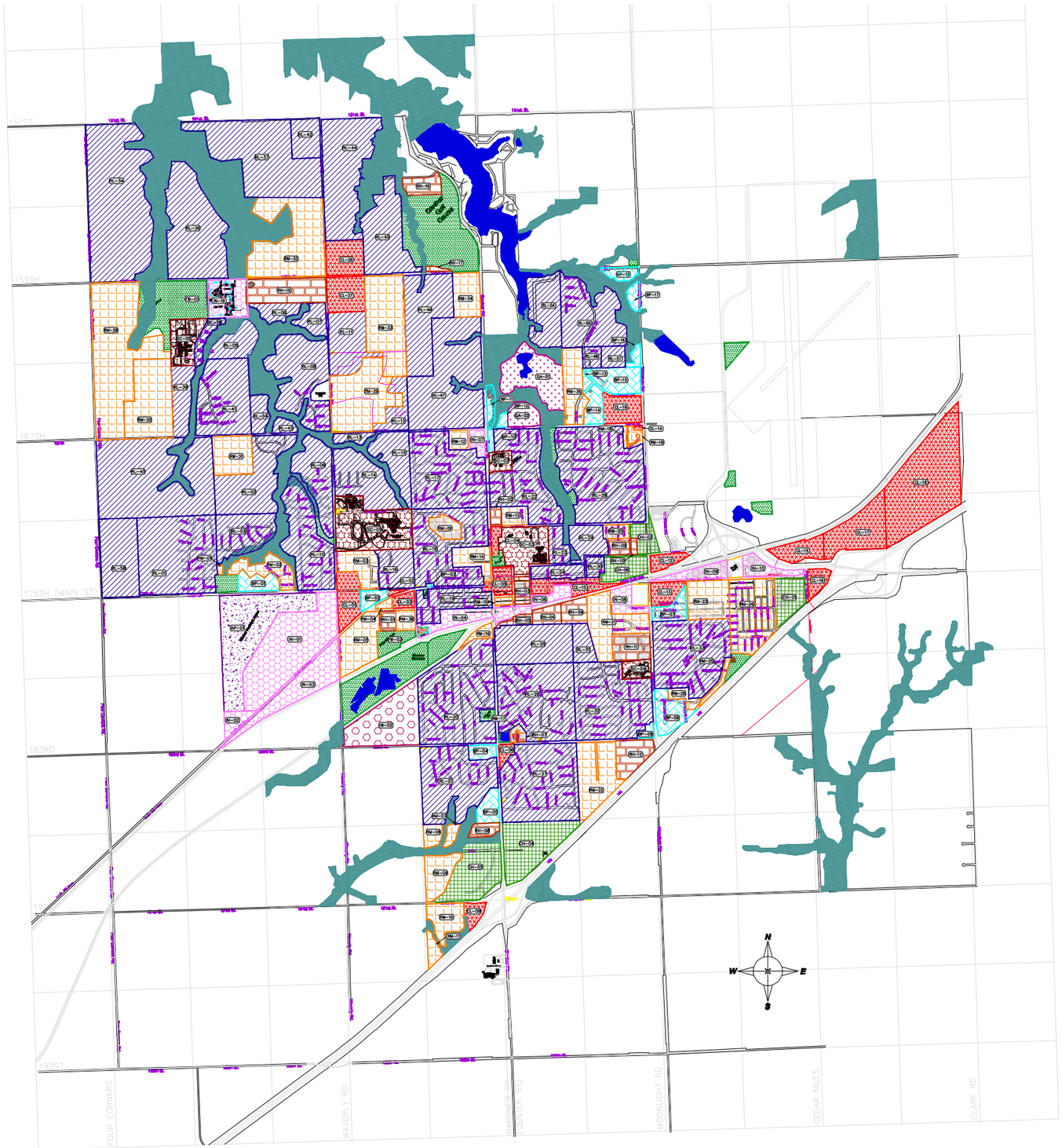
MINIMUM SCENARIO
SOUTH WAVERLY SUBSTATION
TRANSFORMER LOADING

TRANSFORMER SW161T11

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	0.00	0.00	0
2013	0.00	0.00	0.00	0
2014	0.00	0.00	0.00	0
2015	10.83	22.50	27.00	30
2016	11.27	22.50	27.00	30
2017	11.68	22.50	27.00	30
2018	12.09	22.50	27.00	30
2019	12.52	22.50	27.00	30
2020	12.95	22.50	27.00	30

TRANSFORMER SW161T12

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	0.00	0.00	0
2013	0.00	0.00	0.00	0
2014	0.00	0.00	0.00	0
2015	0.00	0.00	0.00	0
2016	0.00	0.00	0.00	0
2017	0.00	0.00	0.00	0
2018	0.00	0.00	0.00	0
2019	0.00	0.00	0.00	0
2020	0.00	0.00	0.00	0



LOW DENSITY RESIDENTIAL

MEDIUM DENSITY RESIDENTIAL

HIGH DENSITY RESIDENTIAL

LIGHT COMMERCIAL

HEAVY COMMERCIAL

BUSINESS/OFFICE PARK

INDUSTRIAL/MANUFACTURING

INTERMODAL TRANSPORT HUB (BNSF LOGISTIC PARK)

INDUSTRIAL WAREHOUSE

AIRPORT

QUARRY

SCHOOL

PARK/RECREATION

RIPARIAN CORRIDOR

LAKE

GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.
209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

REFERENCE DRAWINGS

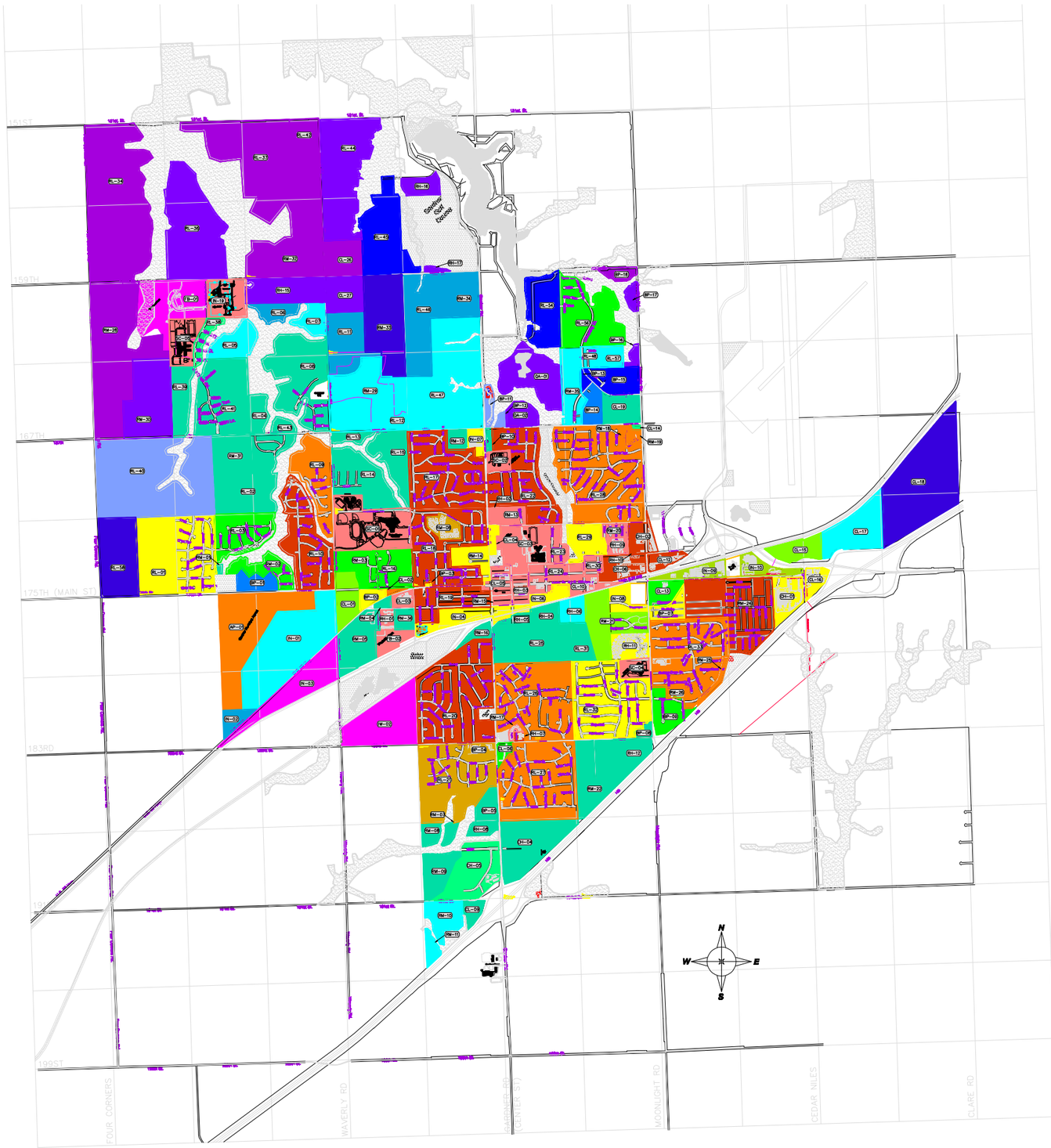
REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	11/16/06	ISSUED FOR REVIEW	SAB	LJM
B	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 7/10/06 CODE
PLOTTED 11/22/06 CHECKED BY LJM
LAST UPDATE BY SAB

MINIMUM SCENARIO ELECTRIC SYSTEM LOAD DEFINITION MAP

DRAWN: SAB SCALE: 1"=2000'
CHECKED: LJM
APPROVED: LJM
FILENAME: MINESD-1
DRAWING NO.: MINESD-1
ISSUE: B



- VERY LOW DEVELOPMENT POTENTIAL DURING STUDY. LESS THEN 10% BY 2020
- NEW DEVELOPMENT. 20% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 30% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 40% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 50% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 60% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 70% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 80% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 90% DEVELOPMENT BY 2020
- NEW FAST TRACK DEVELOPMENT. 90% DEVELOPMENT BY 2015
- NEW FAST TRACK DEVELOPMENT. 90% DEVELOPMENT BY 2011
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2017
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2016
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2014
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2013
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2011
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2010
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2009
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2008
- MATURE DEVELOPMENT. 90% DEVELOPMENT BY 2006

GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

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NOTES

LEGEND

REFERENCE DRAWINGS

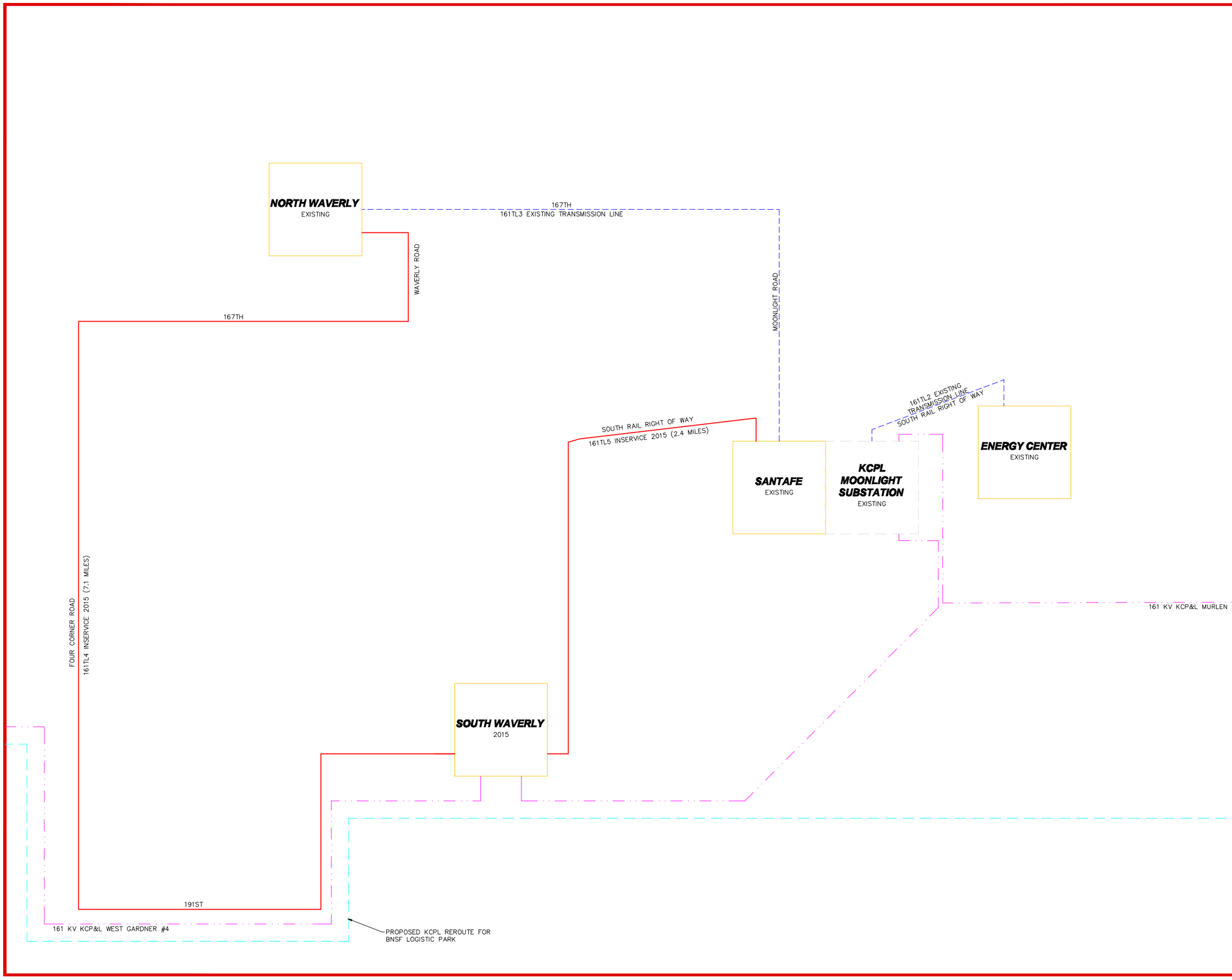
REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	11/16/06	ISSUED FOR REVIEW	SAB	LJM
B	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 9/06/06 CODE
PLOTTED 11/22/06 CHECKED BY LJM
LAST UPDATE BY SAB

MINIMUM SCENARIO ELECTRIC SYSTEM DEVELOPMENT MAP

DRAWN: SAB SCALE: 1"=2000'
CHECKED: LJM DRAWING NO.: ISSUE:
APPROVED: LJM **MINLDP-1** **B**
FILENAME: MINLDP-1



GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

- NEW TRANSMISSION LINE
- EXISTING TRANSMISSION LINE
- KCPL 161KV LINE
- KCPL 345KV LINE

161TL2
- LINE IDENTIFICTION NUMBER
- TRANSMISSION LINE
- VOLTAGE

REFERENCE DRAWINGS

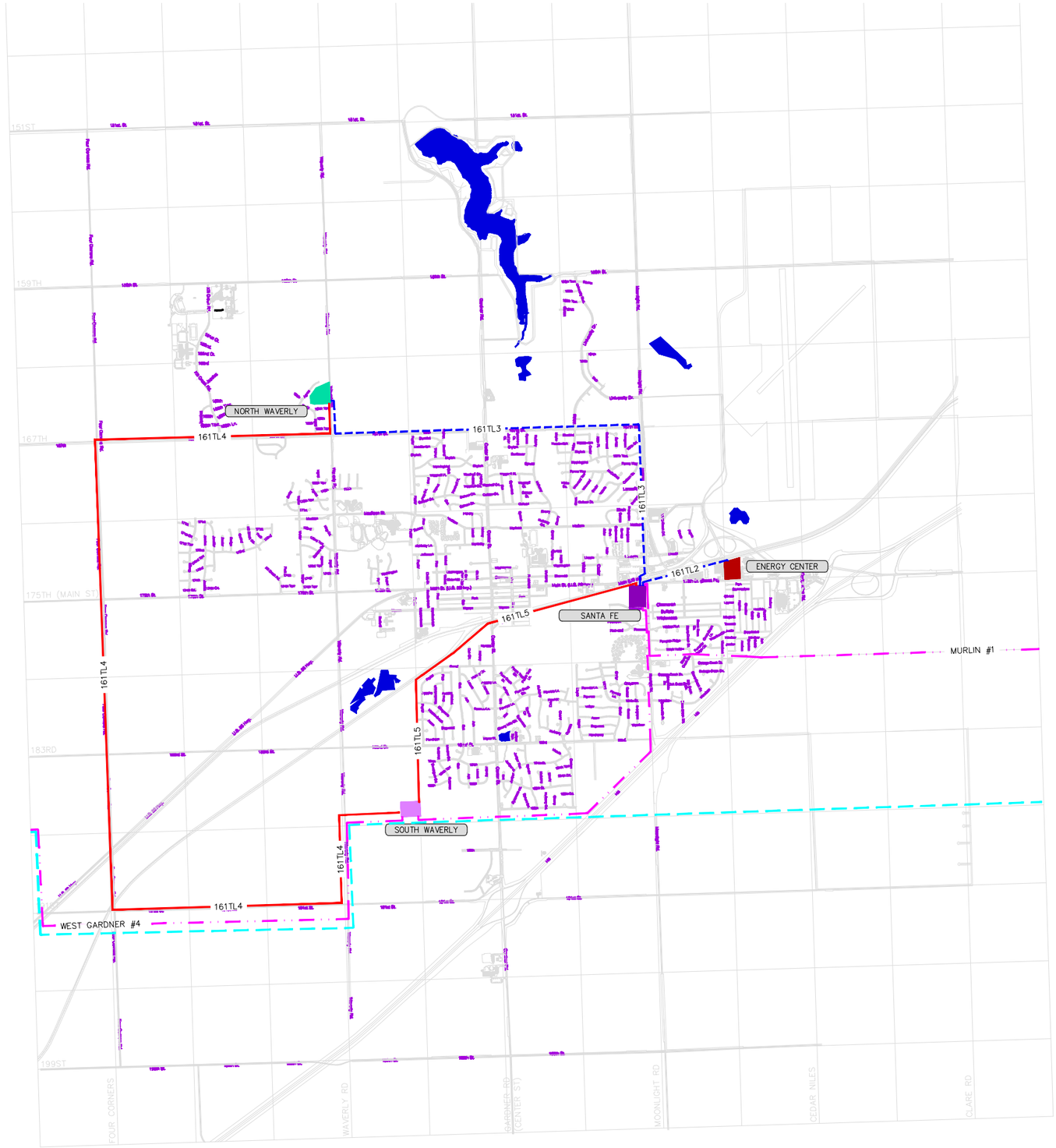
REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	11/16/06	ISSUED FOR REVIEW	SAB	LJM
B	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 11/01/06 CODE
PLOTTED 11/22/06 CHECKED BY LJM
LAST UPDATE BY SDB

MINIMUM SCENARIO TRANSMISSION ONE LINE

DRAWN: SAB SCALE: NONE
CHECKED: LJM DRAWING NO.: ISSUE:
APPROVED: LJM MINSYS-1 B
FILENAME: MINSYS-1



GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

NEW TRANSMISSION LINE

EXISTING TRANSMISSION LINE

KCPL 161KV LINE

KCPL 345KV LINE

161TL2
- LINE IDENTIFICTION NUMBER
- TRANSMISSION LINE
- VOLTAGE

REFERENCE DRAWINGS

REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	11/16/06	ISSUED FOR REVIEW	SAB	LJM
B	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB

CREATED 11/07/06 CODE

PLOTTED 11/22/06 CHECKED BY LJM

LAST UPDATE BY SAB

TRANSMISSION LINE ROUTING MAP MINIMUM SCENARIO

DRAWN: SAB SCALE: 1"=2000'

CHECKED: LJM

APPROVED: LJM

FILENAME: MINTRM-1

DRAWING NO.: MINTRM-1

ISSUE: B

ULTIMATE SERVICE AREA SCENARIO

SUMMARY OF APPROACH

The approach utilized a complicated database and multiple comparisons. We are providing a summary of the Approach here but it is detailed out in the APPROACH section.

These system additions and modifications are noted on the ULTGRAPH located in the Summary of Findings.

There is a definite relationship between population and electric customers. There is a definite relationship between electric customers to electric load. Mr. Wilson's 2004 System Capacity Addition Master Plan validated the relationship. Although some quantitive changes may occur over time the relationship remains fairly constant.

The population projected by the Community Development of 42,054 was matched with our projected ultimate load to determine population scale on the right hand side of both Load versus Population graphs.

A graphical comparison of population growth and load growth reveals some interesting facts.

The approach that we utilized to develop the Ultimate Service Area Scenario under the Master Plan was as follows:

ULTIMATE SERVICE AREA

The city limits were expanded utilizing the Community Development Plan in conjunction with the Kansas City Sprawl factor (refer to Approach; Sprawl Rate).

The Community Development Department has assigned predictive zonings for each area, plus estimated population growth of 42,054 to 2020. This information was used extensively.

This predictive zoning intuitively leads to assigning various construction or electrical usage types, i.e. single residences, multi-family residences, strip shopping center, large commercial malls, industrial complexes for the entire defined city limits. Refer to Ultimate Scenario Electric System Load Definition Map (ULTESD-1) at the end of the Executive Summary.

The electrical density in **megawatts per mile** for each particular electric usage type was calculated from reliable sources which are identified by load type in the Approach; Load Density.

Meers Engineering, Inc. understands that even though an area was included in the city limits by 2020 that every area would not be necessarily 100% built out. Therefore, we have assigned a percentage number based on our understanding of growth area, population growth and type of construction. This percentage number when less than 100% was used to modify the total electric load in each specific area.

This data resides in an Access database which can be easily updated. The database will become the property of the City of Gardner.

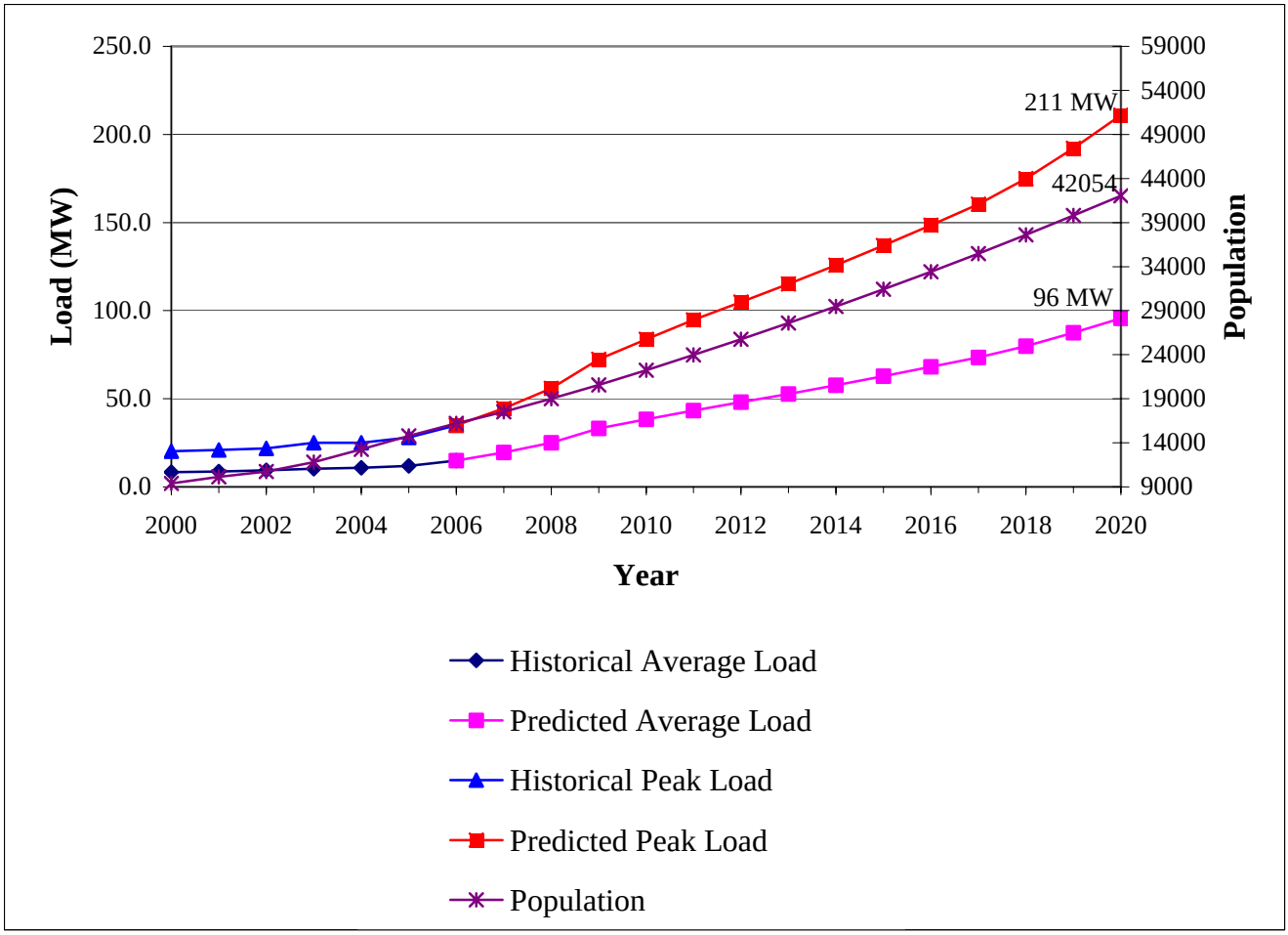
This procedure established the normal load estimate for 2020.

The value established as the nominal value for 2020 was 95.71 MW and a peak value of 210.92.

Mr. Greg Wilson provided historical data for average energy usage and peak demand. Mr. Wilson's nominal and peak values agreed very close to ours, considering Mr. Wilson did not have the industrial load which now needs to be considered, thus our forecast electrical load was higher than Mr. Wilson's.

Mr. Wilson's data was used to establish the ratio between the average load and the peak demand for residential loads. The ratio of peak to average is 2.35 for residential loads.

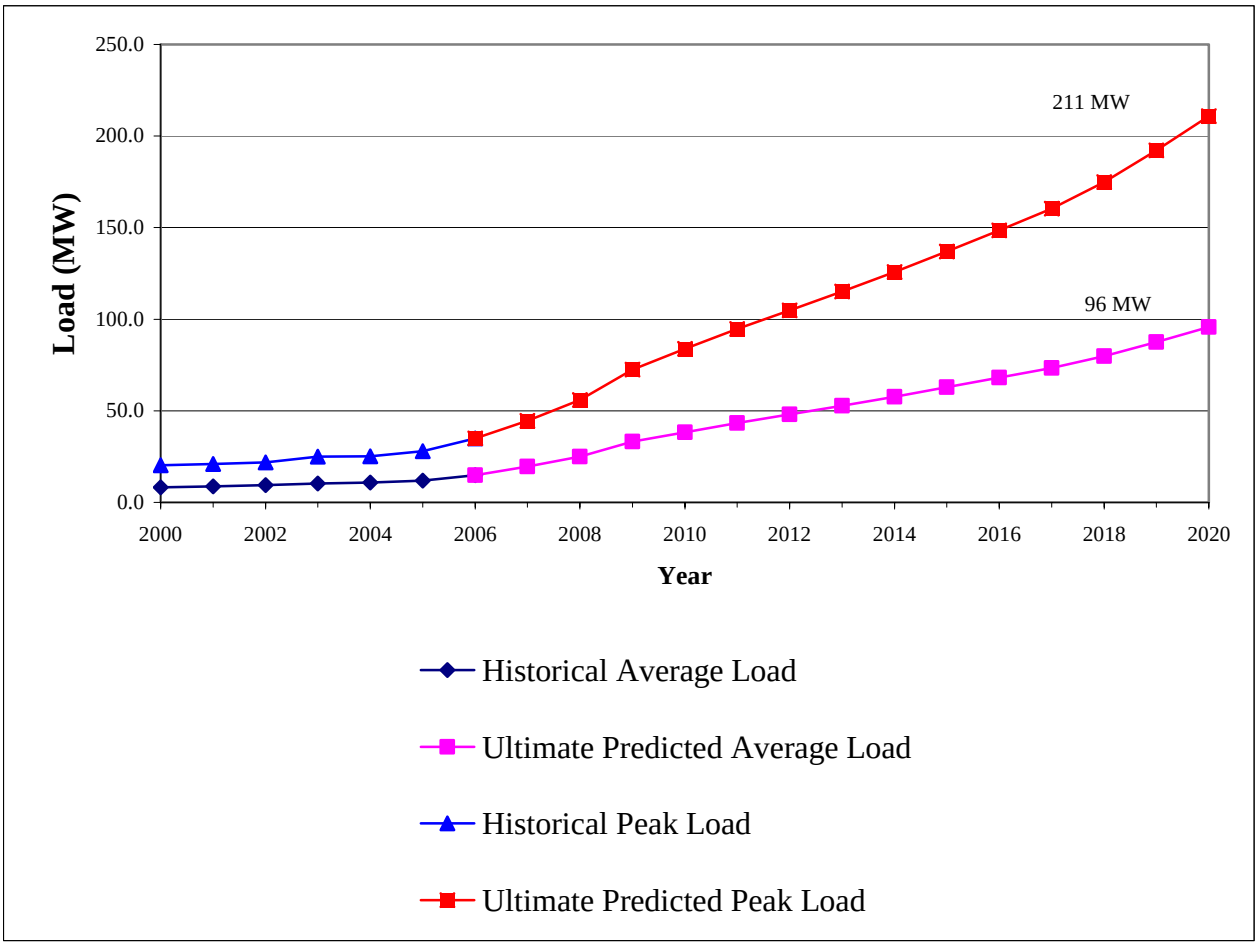
ULTIMATE SERVICE AREA vs. POPULATION COMPARISON



The graphical analysis reveals the following conclusion on a general system basis.

Population growth is very consistent with slope of curves for normal and peak load. The final numbers may vary from our predicted value but the trend is very representative.

ULTIMATE SYSTEM PREDICTED LOADING

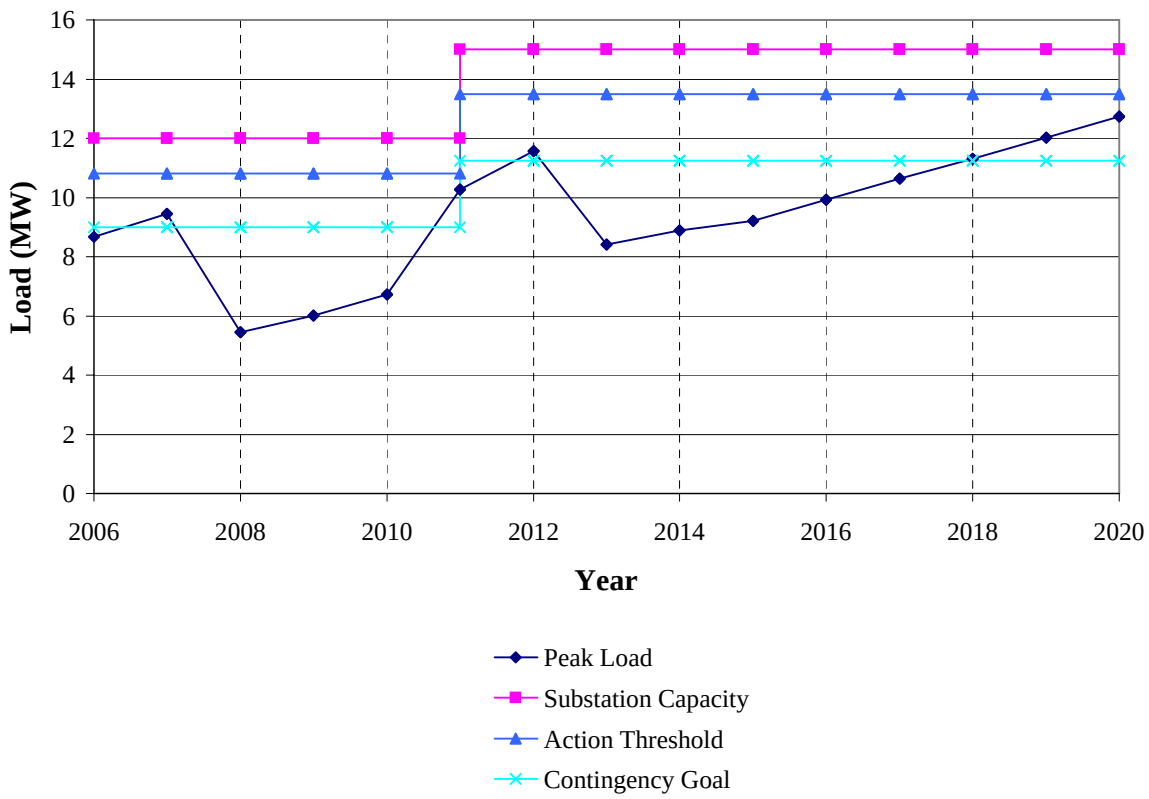


ULTLDP DRAWINGS

The electric service area is expanded per the Kansas City Area Sprawl factor. The boundaries are allowed to grow maintaining some degree of reasonableness.

ULTIMATE SCENARIO
ENERGY CENTER SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	8.67	12.00	
2007	9.46	12.00	
2008	5.44	12.00	Load moved to Feeder 302
2009	6.01	12.00	
2010	6.71	12.00	
2011	10.27	15.00	Moved SF161T3 from Santa Fe to Energy Center
2012	11.58	15.00	
2013	8.42	15.00	Cedar Niles Substation in service, moved load
2014	8.88	15.00	
2015	9.21	15.00	
2016	9.93	15.00	
2017	10.63	15.00	
2018	11.32	15.00	
2019	12.02	15.00	
2020	12.74	15.00	



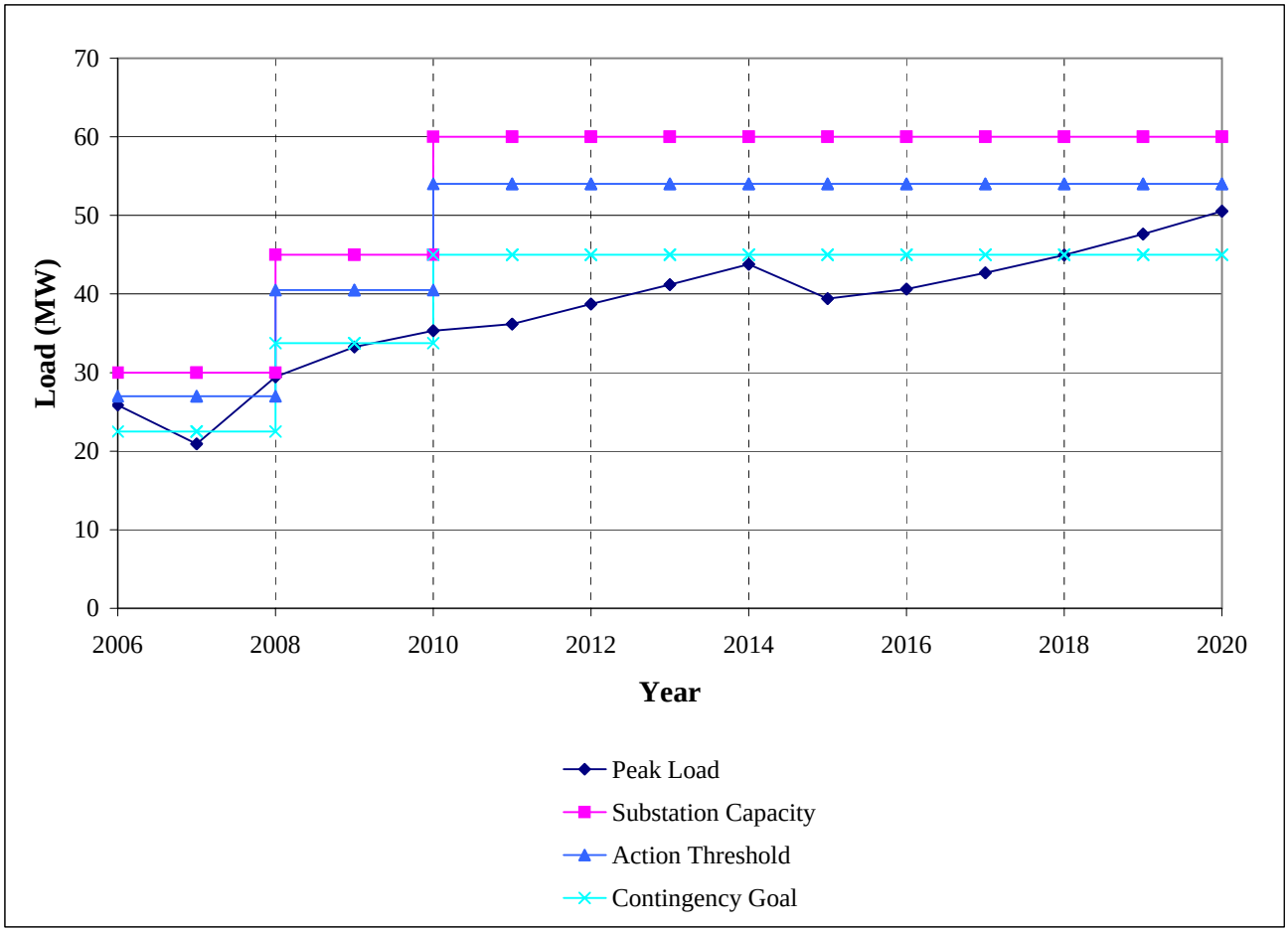
ULTIMATE SCENARIO
ENERGY CENTER SUBSTATION
TRANSFORMER LOADING

TRANSFORMER EC161T2

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	8.67	9.00	10.80	12
2007	9.46	9.00	10.80	12
2008	5.44	9.00	10.80	12
2009	6.01	9.00	10.80	12
2010	6.71	9.00	10.80	12
2011	10.27	11.25	13.50	15
2012	11.58	11.25	13.50	15
2013	8.42	11.25	13.50	15
2014	8.88	11.25	13.50	15
2015	9.21	11.25	13.50	15
2016	9.93	11.25	13.50	15
2017	10.63	11.25	13.50	15
2018	11.32	11.25	13.50	15
2019	12.02	11.25	13.50	15
2020	12.74	11.25	13.50	15

ULTIMATE SCENARIO
SANTA FE SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	25.86	30.00	
2007	20.92	30.00	Load moved to NW161T5 located at North Waverly
2008	29.46	45.00	Changed out SF161T3 with a 30 MVA
2009	33.28	45.00	
2010	35.34	60.00	Changed out SF161T4 with a 30 MVA
2011	36.16	60.00	Energy Center transformer changed out
2012	38.71	60.00	
2013	41.18	60.00	
2014	43.79	60.00	
2015	39.39	60.00	South Waverly Substation comes on line with a 30 MVA
2016	40.63	60.00	transformer; load moved
2017	42.70	60.00	
2018	44.97	60.00	
2019	47.63	60.00	
2020	50.52	60.00	



ULTIMATE SCENARIO
SANTA FE SUBSTATION
TRANSFORMER LOADING

TRANSFORMER SF161T3

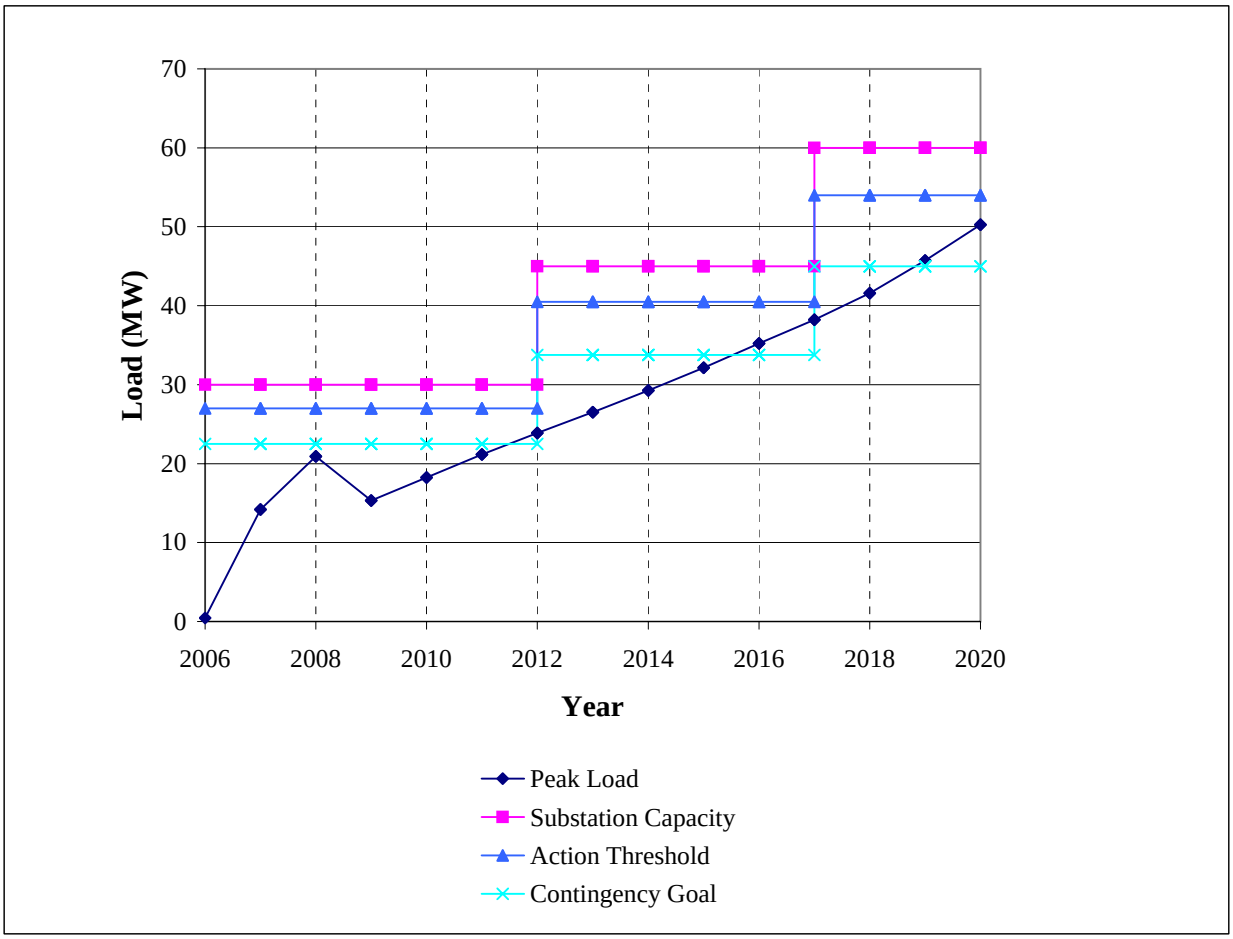
YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	13.72	11.25	13.50	15
2007	11.19	11.25	13.50	15
2008	19.02	22.50	27.00	30
2009	22.31	22.50	27.00	30
2010	20.79	22.50	27.00	30
2011	19.76	22.50	27.00	30
2012	20.50	22.50	27.00	30
2013	21.23	22.50	27.00	30
2014	21.94	22.50	27.00	30
2015	22.58	22.50	27.00	30
2016	22.26	22.50	27.00	30
2017	22.77	22.50	27.00	30
2018	23.21	22.50	27.00	30
2019	23.64	22.50	27.00	30
2020	24.08	22.50	27.00	30

TRANSFORMER SF161T4

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	12.13	11.25	13.50	15
2007	9.73	11.25	13.50	15
2008	10.43	11.25	13.50	15
2009	10.96	11.25	13.50	15
2010	14.55	22.50	27.00	30
2011	16.40	22.50	27.00	30
2012	18.21	22.50	27.00	30
2013	19.95	22.50	27.00	30
2014	21.86	22.50	27.00	30
2015	16.81	22.50	27.00	30
2016	18.37	22.50	27.00	30
2017	19.93	22.50	27.00	30
2018	21.76	22.50	27.00	30
2019	23.98	22.50	27.00	30
2020	26.44	22.50	27.00	30

ULTIMATE SCENARIO
NORTH WAVERLY SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	0.45	30.00	
2007	14.18	30.00	Load added from SF161T3 and SF161T4 located at Santa Fe
2008	20.93	30.00	
2009	15.32	30.00	BNSF Energized Remove Load South of BNSF RR
2010	18.22	30.00	
2011	21.18	30.00	
2012	23.86	45.00	Relocated 15 MVA SF161T4 from Santa Fe as NW161T6
2013	26.51	45.00	
2014	29.28	45.00	
2015	32.13	45.00	
2016	35.22	45.00	
2017	38.24	60.00	Install new 30 MVA, replace existing NW161T6
2018	41.59	60.00	
2019	45.71	60.00	
2020	50.27	60.00	



ULTIMATE SCENARIO
NORTH WAVERLY SUBSTATION
TRANSFORMER LOADING

TRANSFORMER NW161T5

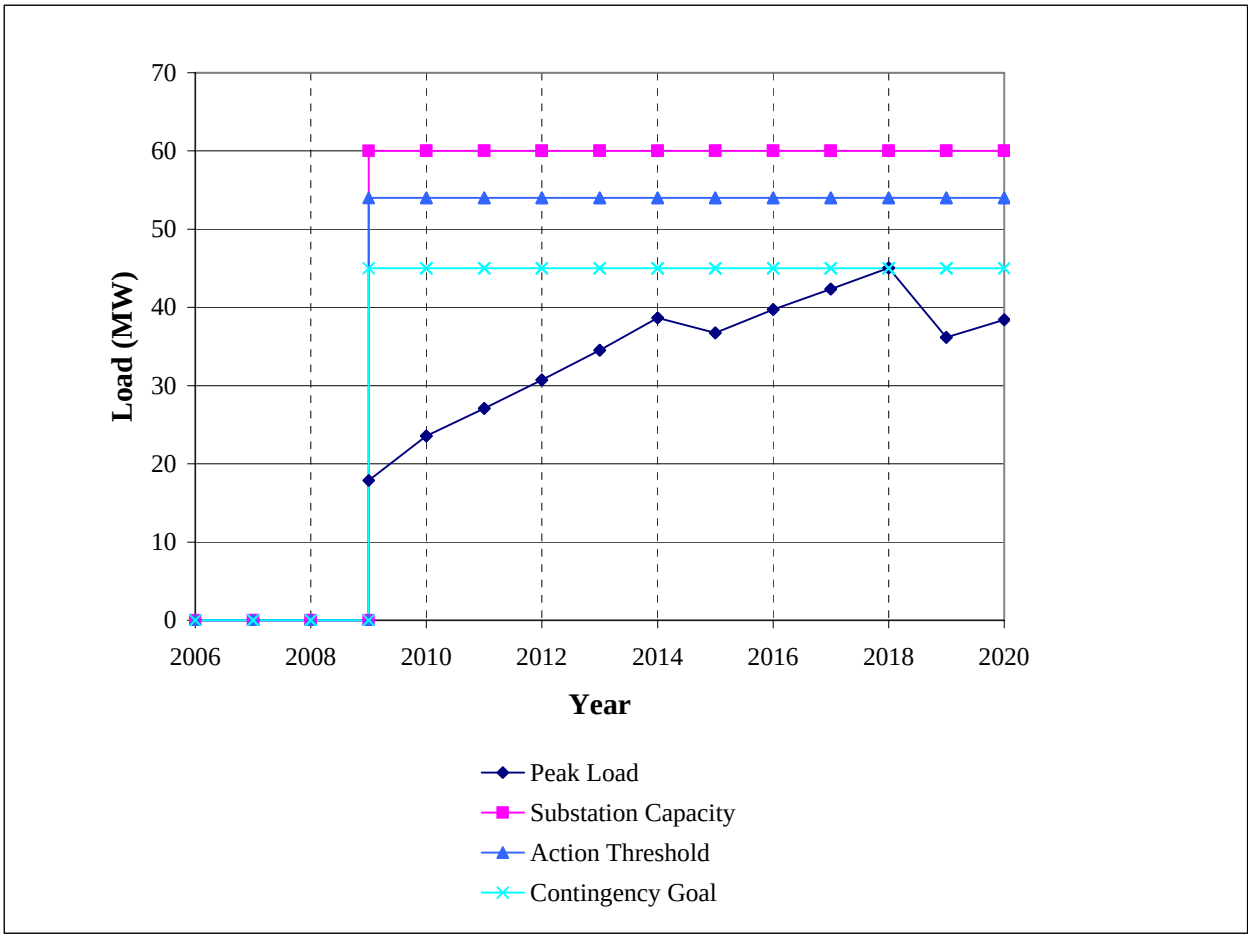
YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.45	22.50	27.00	30
2007	14.18	22.50	27.00	30
2008	20.93	22.50	27.00	30
2009	15.32	22.50	27.00	30
2010	18.22	22.50	27.00	30
2011	21.18	22.50	27.00	30
2012	23.86	22.50	27.00	30
2013	19.24	22.50	27.00	30
2014	20.85	22.50	27.00	30
2015	20.30	22.50	27.00	30
2016	21.65	22.50	27.00	30
2017	22.94	22.50	27.00	30
2018	24.31	22.50	27.00	30
2019	25.85	22.50	27.00	30
2020	27.49	22.50	27.00	30

TRANSFORMER NW161T6

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	11.25	13.50	15
2013	7.26	11.25	13.50	15
2014	8.43	11.25	13.50	15
2015	11.83	11.25	13.50	15
2016	13.58	11.25	13.50	15
2017	15.30	22.50	27.00	30
2018	17.28	22.50	27.00	30
2019	19.86	22.50	27.00	30
2020	22.78	22.50	27.00	30

ULTIMATE SCENARIO
BNSF SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	0.00	0.00	
2007	0.00	0.00	
2008	0.00	0.00	
2009	17.87	60.00	Two new 30 MVA transformers
2010	23.56	60.00	
2011	27.09	60.00	
2012	30.74	60.00	
2013	34.55	60.00	
2014	38.65	60.00	
2015	36.74	60.00	South Waverly Substation comes on line with a 30 MVA transformer; load moved
2016	39.72	60.00	
2017	42.36	60.00	
2018	45.03	60.00	
2019	36.18	60.00	South Waverly Substation 15 MVA transformer comes online; load moved
2020	38.41	60.00	



ULTIMATE SCENARIO
BNSF SUBSTATION
TRANSFORMER LOADING

TRANSFORMER BN161T7

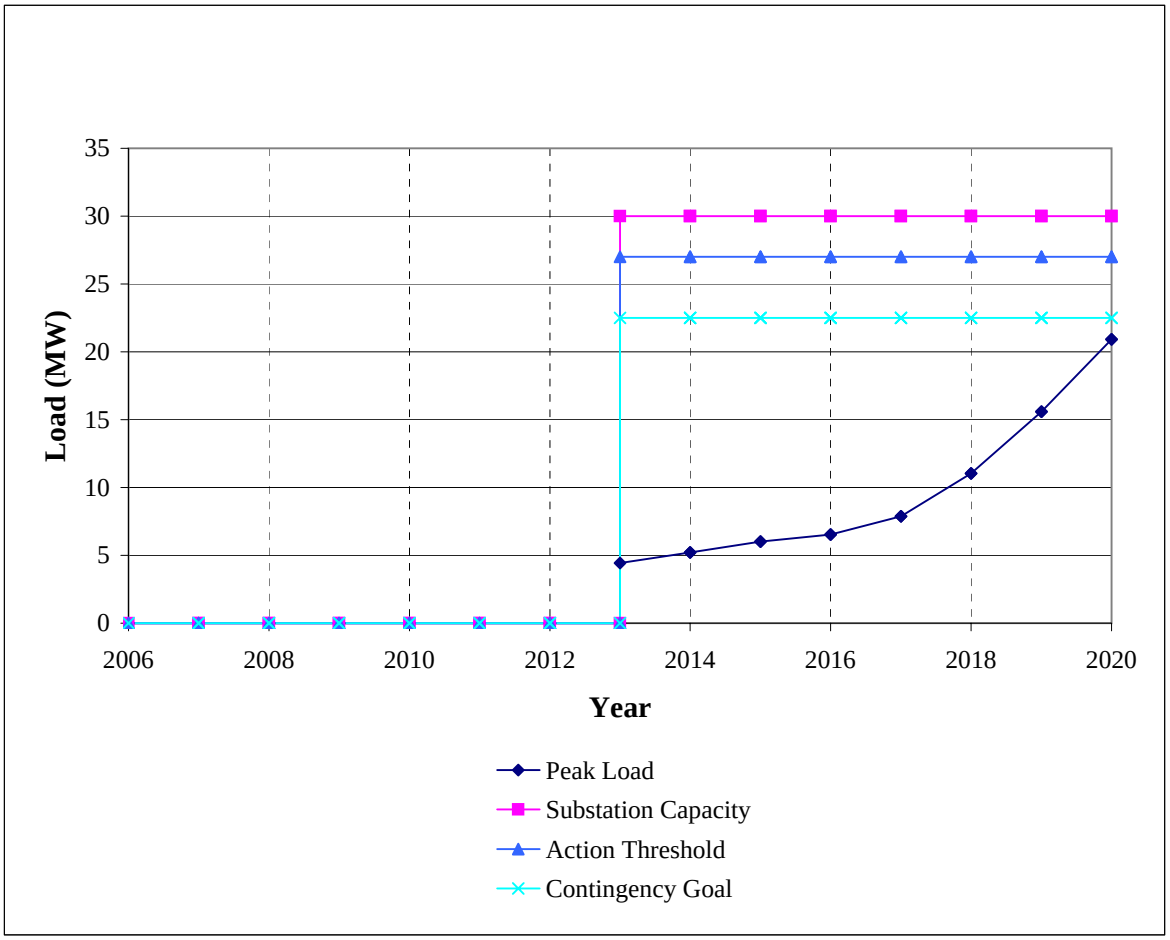
YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	10.83	22.50	27.00	30
2010	15.04	22.50	27.00	30
2011	17.19	22.50	27.00	30
2012	19.05	22.50	27.00	30
2013	20.75	22.50	27.00	30
2014	22.46	22.50	27.00	30
2015	21.03	22.50	27.00	30
2016	22.16	22.50	27.00	30
2017	23.15	22.50	27.00	30
2018	24.15	22.50	27.00	30
2019	16.45	22.50	27.00	30
2020	17.26	22.50	27.00	30

TRANSFORMER BN161T8

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	7.04	22.50	27.00	30
2010	8.52	22.50	27.00	30
2011	9.90	22.50	27.00	30
2012	11.69	22.50	27.00	30
2013	13.80	22.50	27.00	30
2014	16.19	22.50	27.00	30
2015	15.71	22.50	27.00	30
2016	17.56	22.50	27.00	30
2017	19.21	22.50	27.00	30
2018	20.88	22.50	27.00	30
2019	19.73	22.50	27.00	30
2020	21.15	22.50	27.00	30

ULTIMATE SCENARIO
CEDAR NILES SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	0.00	0.00	
2007	0.00	0.00	
2008	0.00	0.00	
2009	0.00	0.00	
2010	0.00	0.00	
2011	0.00	0.00	
2012	0.00	0.00	
2013	4.43	30.00	One new 30 MVA transformer
2014	5.21	30.00	
2015	6.02	30.00	
2016	6.54	30.00	
2017	7.88	30.00	
2018	11.04	30.00	
2019	15.59	30.00	
2020	20.92	30.00	



ULTIMATE SCENARIO
CEDAR NILES SUBSTATION
TRANSFORMER LOADING

TRANSFORMER CN161T9

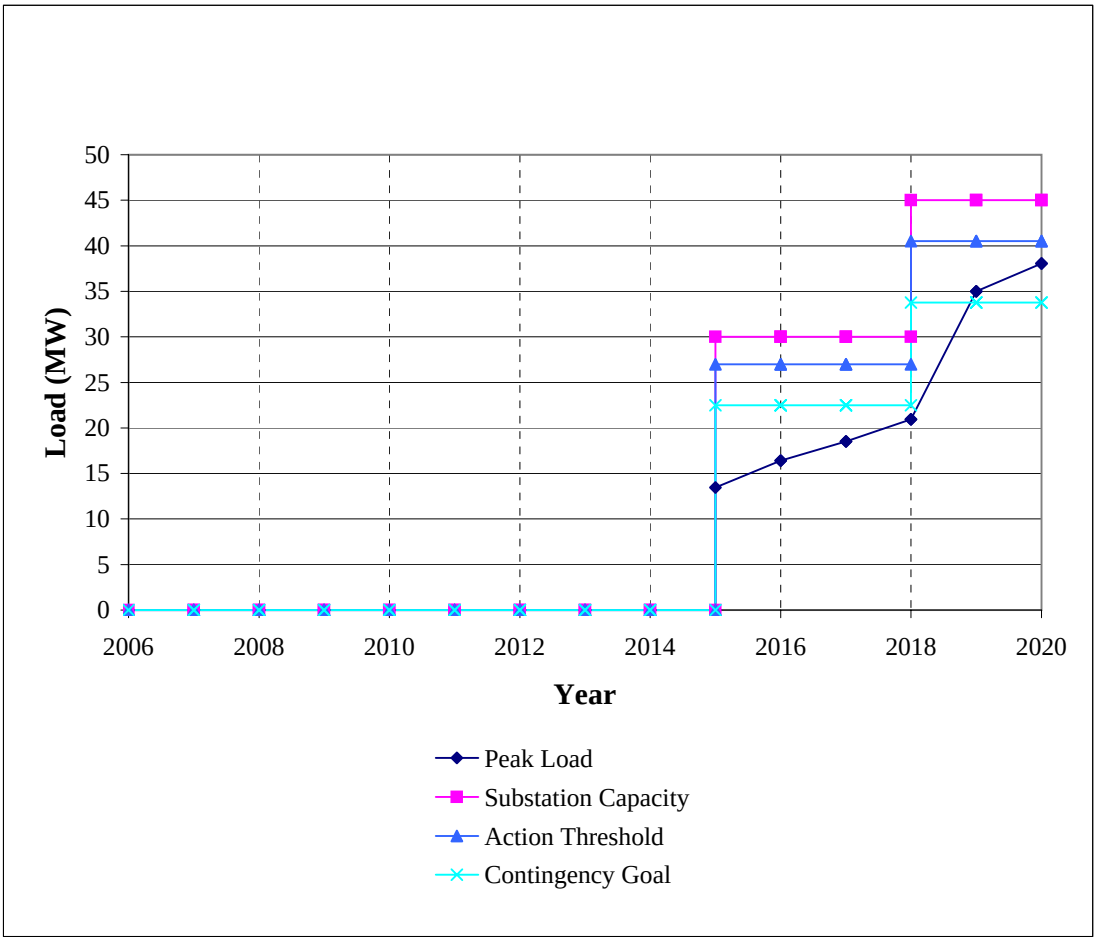
YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	0.00	0.00	0
2013	4.43	22.50	27.00	30
2014	5.21	22.50	27.00	30
2015	6.02	22.50	27.00	30
2016	6.54	22.50	27.00	30
2017	7.88	22.50	27.00	30
2018	11.04	22.50	27.00	30
2019	15.59	22.50	27.00	30
2020	20.92	22.50	27.00	30

TRANSFORMER CN161T10

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	0.00	0.00	0
2013	0.00	0.00	0.00	0
2014	0.00	0.00	0.00	0
2015	0.00	0.00	0.00	0
2016	0.00	0.00	0.00	0
2017	0.00	0.00	0.00	0
2018	0.00	0.00	0.00	0
2019	0.00	0.00	0.00	0
2020	0.00	0.00	0.00	0

ULTIMATE SCENARIO
SOUTH WAVERLY SUBSTATION
LOAD GROWTH AND MODIFICATIONS

YEAR	PEAK LOADING MVA	CAPACITY MVA	SYSTEM SEQUENCE OF EVENTS
2006	0.00	0.00	
2007	0.00	0.00	
2008	0.00	0.00	
2009	0.00	0.00	
2010	0.00	0.00	
2011	0.00	0.00	
2012	0.00	0.00	
2013	0.00	0.00	
2014	0.00	0.00	
2015	13.45	30.00	One new 30 MVA transformer
2016	16.43	30.00	
2017	18.52	30.00	
2018	20.95	45.00	Relocated 15 MVA NW161T6 from North
2019	35.00	45.00	Waverly as SW161T12
2020	38.06	45.00	



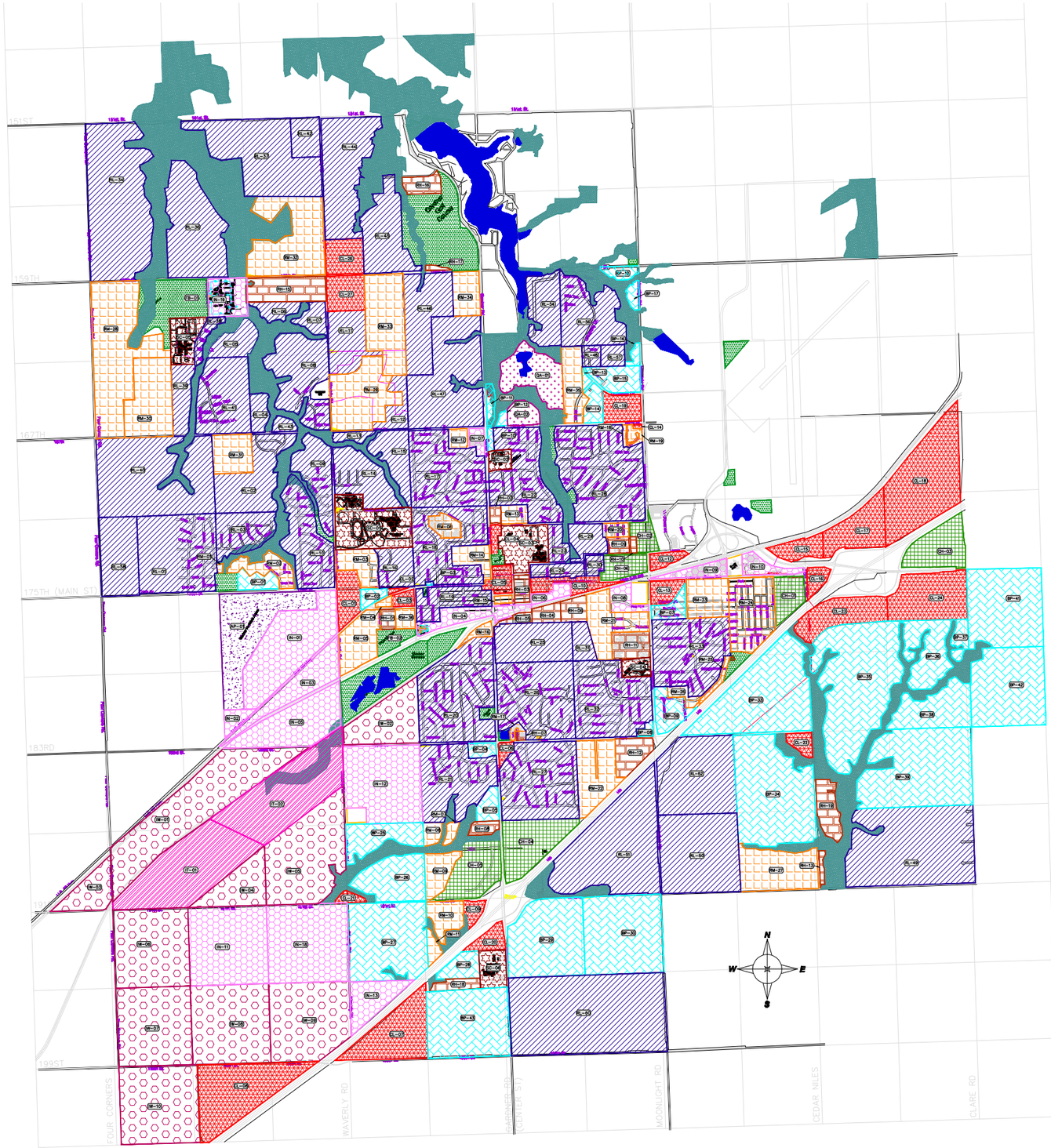
ULTIMATE SCENARIO
SOUTH WAVERLY SUBSTATION
TRANSFORMER LOADING

TRANSFORMER SW161T11

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	0.00	0.00	0
2013	0.00	0.00	0.00	0
2014	0.00	0.00	0.00	0
2015	13.45	22.50	27.00	30
2016	16.43	22.50	27.00	30
2017	18.52	22.50	27.00	30
2018	20.95	22.50	27.00	30
2019	23.46	22.50	27.00	30
2020	26.02	22.50	27.00	30

TRANSFORMER SW161T12

YEAR	PEAK LOADING MVA	CONTINGENCY GOAL MVA	ACTION THRESHOLD MVA	CAPACITY MVA
2006	0.00	0.00	0.00	0
2007	0.00	0.00	0.00	0
2008	0.00	0.00	0.00	0
2009	0.00	0.00	0.00	0
2010	0.00	0.00	0.00	0
2011	0.00	0.00	0.00	0
2012	0.00	0.00	0.00	0
2013	0.00	0.00	0.00	0
2014	0.00	0.00	0.00	0
2015	0.00	0.00	0.00	0
2016	0.00	0.00	0.00	0
2017	0.00	0.00	0.00	0
2018	0.00	11.25	13.50	15
2019	11.54	11.25	13.50	15
2020	12.04	11.25	13.50	15



LOW DENSITY RESIDENTIAL

MEDIUM DENSITY RESIDENTIAL

HIGH DENSITY RESIDENTIAL

LIGHT COMMERCIAL

HEAVY COMMERCIAL

BUSINESS/OFFICE PARK

INDUSTRIAL/MANUFACTURING

INTERMODAL TRANSPORT HUB (BNSF LOGISTIC PARK)

INDUSTRIAL WAREHOUSE

AIRPORT

QUARRY

SCHOOL

PARK/RECREATION

RIPARIAN CORRIDOR

LAKE

GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.
209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

REFERENCE DRAWINGS

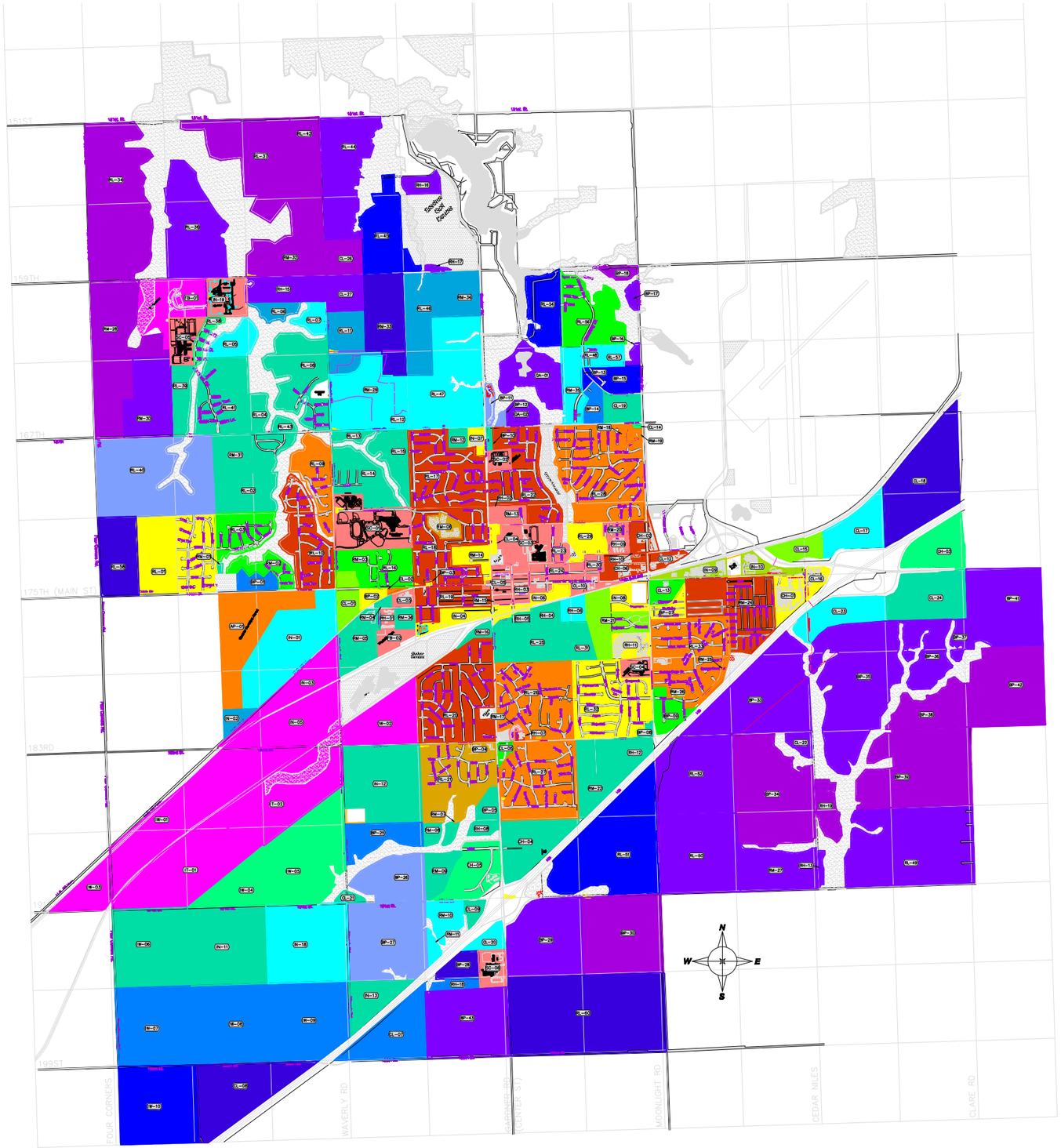
REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	11/16/06	ISSUED FOR REVIEW	SAB	LJM
B	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 11/07/06 CODE
PLOTTED 11/22/06 CHECKED BY LJM
LAST UPDATE BY SAB

ULTIMATE SCENARIO ELECTRIC SYSTEM LOAD DEFINITION MAP

DRAWN: SAB SCALE: 1"=2000'
CHECKED: LJM
APPROVED: LJM
FILENAME: ULTESD-1
DRAWING NO.: ULTESD-1
ISSUE: B



- VERY LOW DEVELOPMENT POTENTIAL DURING STUDY. LESS THEN 10% BY 2020
- NEW DEVELOPMENT. 20% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 30% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 40% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 50% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 60% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 70% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 80% DEVELOPMENT BY 2020
- NEW DEVELOPMENT. 90% DEVELOPMENT BY 2020
- NEW FAST TRACK DEVELOPMENT. 90% DEVELOPMENT BY 2015
- NEW FAST TRACK DEVELOPMENT. 90% DEVELOPMENT BY 2011
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2017
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2016
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2014
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2013
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2011
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2010
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2009
- CURRENT DEVELOPMENT. 90% DEVELOPMENT BY 2008
- MATURE DEVELOPMENT. 90% DEVELOPMENT BY 2006

GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.
209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

REFERENCE DRAWINGS

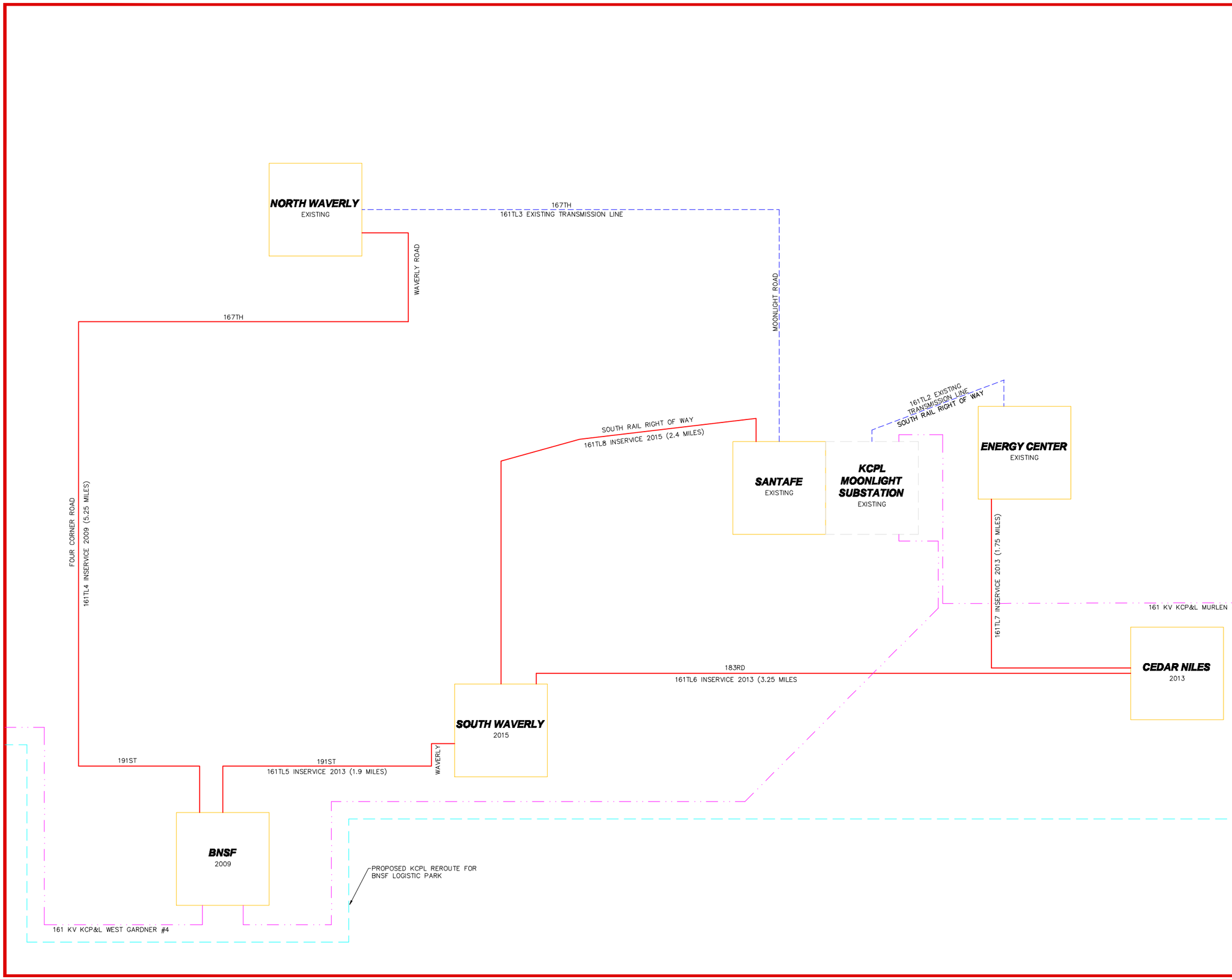
REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	09/25/06	ISSUED FOR REVIEW	SAB	LJM
B	11/16/06	ISSUED FOR REVIEW	SAB	LJM
C	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 9/06/06 CODE
PLOTTED 11/22/06 CHECKED BY LJM
LAST UPDATE BY SAB

ULTIMATE SCENARIO ELECTRIC SYSTEM DEVELOPMENT MAP

DRAWN: SAB SCALE: 1"=2000'
CHECKED: LJM DRAWING NO.: ISSUE:
APPROVED: LJM ULTLDP-1 C
FILENAME: ULTLDP-1



GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

- NEW TRANSMISSION LINE
- EXISTING TRANSMISSION LINE
- KCPL 161KV LINE
- KCPL 345KV LINE

161TL2
- LINE IDENTIFICTION NUMBER
- TRANSMISSION LINE
- VOLTAGE

REFERENCE DRAWINGS

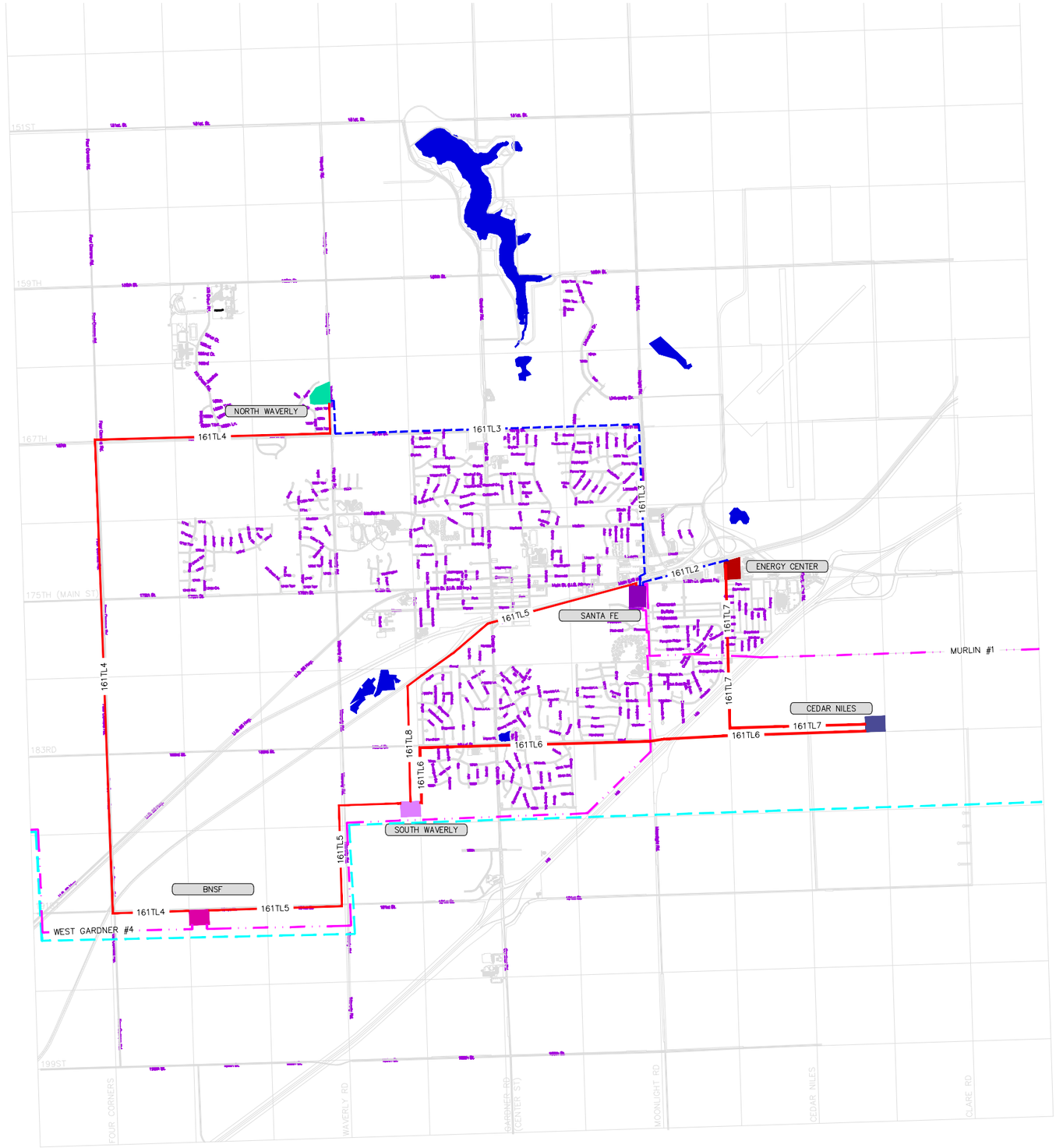
REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	08/10/06	ISSUED FOR REVIEW	SAB	LJM
B	09/29/06	ISSUED FOR REVIEW	SDB	LJM
C	11/16/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB
CREATED 8/02/06 CODE
PLOTTED 11/16/06 CHECKED BY LJM
LAST UPDATE BY SAB

ULTIMATE SCENARIO TRANSMISSION ONE LINE

DRAWN: SAB SCALE: NONE
CHECKED: LJM
APPROVED: LJM
FILENAME: ULTSYS-1
DRAWING NO.: ULTSYS-1
ISSUE: C



GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

NEW TRANSMISSION LINE

EXISTING TRANSMISSION LINE

KCPL 161KV LINE

KCPL 231KV LINE

161TL2
- LINE IDENTIFICTION NUMBER
- TRANSMISSION LINE
- VOLTAGE

REFERENCE DRAWINGS

REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	08/10/06	ISSUED FOR REVIEW	SAB	LJM
B	09/29/06	ISSUED FOR REVIEW	SAB	LJM
C	11/16/06	ISSUED FOR REVIEW	SAB	LJM
D	11/22/06	ISSUED FOR REVIEW	SAB	LJM

JOB NO. GKE001 DESIGN BY SAB

CREATED 08/02/06 CODE

PLOTTED 11/22/06 CHECKED BY LJM

LAST UPDATE BY SAB

ULTIMATE SCENARIO TRANSMISSION LINE ROUTING MAP

DRAWN: SAB SCALE: 1"=2000'

CHECKED: LJM

APPROVED: LJM

FILENAME: ULTTRM-1

DRAWING NO.: ULTTRM-1

ISSUE: D

SUMMARY OF FACILITY

RELIABILITY

Regardless of which scenario is selected the energy consumers require a reliable system. Reliability is defined by most people as a lack of outages and length of outages when they occur. The occasional blink is okay, but the two to three minutes or longer of darkness is unacceptable, unless accompanied by a major act of God.

The City of Gardner cannot control what happens outside of their jurisdiction regarding the efforts to ensure a reliable system. The electric utility is very desirous to provide a very reliable system. They have already implemented several items to that end. The Engineer will follow the direction set by the utility.

SUBSTATION

The North Waverly Substation and the connecting transmission line was very timely. The ability to provide reliable service this past year would have been questionable without these assets.

The other two substations, Santa Fe and Energy Center provide service through 2020 with proper modifications.

TRANSMISSION

The City of Gardner has made a wise choice to match KCPL transmission voltage of 161 kV.

The substations each require 161 kV transmission service. The possibility of additional interconnects with Kansas City Power & Light (KCPL) exists but were not considered for the purpose of the Master Plan. The reason is simply reliability. The City has tremendously more control over their own transmission line than that of KCPL. When an outage occurs, the choice of what to restore first lies with the Owner of the asset. They MAY or MAY NOT choose to restore transmission lines first that are in City of Gardner's best interest.

Cities begin to increase in population thus, all infrastructure must grow proportionally. When the electric load begins to grow then the electric utility must grow their infrastructure simultaneously to maintain the requirement of a reliable system. The attachment of substations on a sister utility transmission line can be a very viable option. The considerations for utilizing a sister utility transmission must be based on previous reliability experience and exposure. Exposure translates to miles of transmission between breakers, route of transmission line and other sources for power supply to this specific line section. The evaluation of sister utility transmission lines are out of the scope of our study.

The most reliable electric utility system consists of the majority of the system served by a loop design.

The occurrence of a single contingency anywhere in the looped system; on a transmission line or other component will have a very low probability of interrupting any electric service and causing a loss in revenue.

The occurrence of a single contingency anywhere on a radial system will have a very high probability of causing loss in revenue.

The existing transmission system is radial from Santa Fe Substation to both North Waverly Substation and Energy Center Substation.

Therefore the Master Plan recommends a looped transmission system inside the City of Gardner service area for both scenarios'.

Minimum Service Area

The majority of the Gardner system is supplied by 161 kV radial transmission lines until 2015. There will, in all likelihood, be at least two (2) points where purchased power from Grand River Dam Authority and/or KCPL will enter the system depending on future agreements. The Santa Fe Substation which is the sole interconnect, will remain as a tie point and most likely South Waverly Substation will become the second point.

This places all the City substations in a loop configuration after 2015.

The loop configuration allows for any single contingency without the loss of service to any customer but until 2015 the system is vulnerable to a single contingency.

The transmission line requirements for the two (2) scenarios are shown both graphically Minimum Service Area Scenario Approach and Supporting Documents.

Transmission One Line (MINSYS-1)
Transmission Line Routing Map (MINTRM-1)

Ultimate Service Area

The complete Gardner system is looped by a 161 kV transmission line. There will, in all likelihood, be at least two (2) points where purchased power from Grand River Dam Authority and/or KCPL will enter the system depending on future agreements. The Santa Fe Substation which is currently the sole interconnect, will remain as a tie point and either South Waverly Substation or BNSF Substation could become the second point.

Two (2) tie points and the loop configuration coupled with generation equates to a very reliable and well thought out electric system.

This places all the City substations in a loop configuration after 2013.

The loop configuration allows for any single contingency without the loss of service to any customer.

The transmission line requirements for the ultimate scenario is both shown graphically on drawings located in the Ultimate Service Area Scenario Approach and Supporting Documents.

Transmission One Line (ULTSYS-1)
Transmission Line Routing Map (ULTTRM-1)

12.5 kV FEEDERS

The load around each substation must be served via 12.5 kV feeders. The Engineer only addressed the main overhead trunk line. The Engineer modeled the main trunk feeders and determined that two (2) miles is an ideal maximum length. The service areas are designed around this fact. The electric utility and the Engineer understand the measures that can be taken to lengthen the feeder service area while maintaining quality service. The options were not considered in the Master Plan.

The feeder requirements are depicted on four feeder maps for each year on Feeder Routing Maps (FRM-(1-4)-Year). These maps divide the system into the basic four quadrants. This allows the

scale of the map to be reasonable and still be printed where they fit into the Master Plant reasonably.

The infrastructure improvements required to support the growth associated with each scenario has been driven in the main by load requirements at individual substations and not necessarily system wide requirements.

The term Engineer shall apply to Meers Engineering, Inc. and City shall apply to City of Gardner throughout this report.

A single feeder map is produced for each year.

The existing feeders are shown in a light solid line.

The Minimum Scenario feeders are shown in a heavy solid line.

The Ultimate Scenario feeder additions onto the Minimum are shown in a heavy dotted line.

Each feeder section has an alpha identifier that ties to a summary in the yearly CIP portion of the Executive Summary.

The Engineer chose to begin with the first of the alphabet for each year rather than having missing letters on the maps in later years.

CITY OF GARDNER, KANSAS
MASTER PLAN
YEAR 2007

SYSTEM GROWTH

The peak in 2006 showed a significant increase over the previous years increase in peak. The maximum increase in peak from year to year in the previous six years was 3.1 MW. The increase from 2005 to 2006 peak was 7.5 MW. This increase is in line with the projected population growth and area build out defined by Community Planning. We believe the year 2006 begins the growth cycle for the City.

The philosophy set forth in the Executive Summary established the projected peak in 2007 to be 43.4 MW or an increase of approximately 8 MW.

The action items will be triggered either by the System Capacity/System Peak Loading Curve or Load Growth and Modification Curve on a substation.

The projected 2007 peak of 43.4 MW is well below any trigger point except when we approach the contingency goal on Santa Fe Substation. However, the projected peak without load movement on Santa Fe Substation is 29.75 MVA which is well above the action threshold of 27 MVA. This load includes approximately 4 MVA transferred from Energy Center Substation to relieve that transformer.

The shifting of load requires the construction of 12,470 volt distribution feeders. These are as itemized below:

Refer to 2007 Feeder Routing Maps FRM-1-2007; #1 - #4

Minimum Scenario

A. New Feeder NW55 from North Waverly Substation South along Waverly Road (2 miles)

B. Extend Feeder NW53 South from 167th parallel to Poplar (1 mile)

C. Extend Feeder SF46 from I-35 to existing feeder at Center Street North of 188th Street (0.4 miles)

Ultimate Scenario

D. Extend Feeder NW51 South from 175th to feed construction power at the new BNSF Logistic Park (2.8 miles)

E. Extend Feeder NW55 South from US 56 to feed construction power at the new BNSF Logistic Park (2.8 miles)

F. Extend Feeder EC24 along I-35 to feed new development along 175th Street (2.2 miles)

Based on the Electric System Growth Model, the majority of the growth in the load served by the Gardner Electric Utility will come from infill within existing developed areas. These drawings predict that there will be new development west of Waverly between 167th and 175th Street, adjacent to Kill Creek Middle School, along Center Street near the I-35 interchange, north of

175th, southeast of I-35 at the far east side of town. It is also indicated that construction of the BNSF Logistic Park will begin along the BNSF right-of-way on the west side of town.

The 2007 Electric Service Load Map (LGM-1-2007) displays the active electric service areas.

SUBSTATION CAPACITY

The City will have a total transformation capacity of 72 MVA available at the peak in this year.

Substation	Transformation Capability MVA	Action Threshold MVA	Contingency Goal MVA	Number of Transformers
Energy Center	12	10.8	9.0	1
Santa Fe	30	27	22.5	2 (15 MVA each)
North Waverly	30	27	22.5	1

SUBSTATION LOADING

The existing load and projected growth is concentrated around the existing center of town and existing infrastructure. Therefore, Santa Fe Substation and Energy Center Substation are scheduled to receive the majority of the new load.

North Waverly Substation was constructed in 2005, however due to its proximity to existing load there was minimal load placed on the 18/24/30 MVA transformer.

The peak loading in 2006 was as set forth below:

Substation	Transformer Number	Transformer Peak Loading	Substation Peak Loading
Energy Center	2	8.67	8.67
Santa Fe	3	13.72	25.86
Santa Fe	4	12.13	
North Waverly	5	.45	.45

SYSTEM EVALUATION

The Energy Center Substation is approaching the contingency goal.

The Santa Fe Substation is well above the contingency goal and virtually at the action threshold.

The North Waverly Substation was very lightly loaded.

The Engineer has verbally conferred with the City regarding this scenario. Remedial action has begun. The City already initiated steps to extend and reconnect feeders from North Waverly Substation south toward the center of town and pick up some load for the 2007 winter and summer peak.

New main feeder trunks are constructed to relieve load on Santa Fe Substation and pick up new commercial park load between the Interstate and 175th Street.

We have projected the peak based on this redistribution of load as follows:

Substation	Transformer Number	Transformer Peak MVA	Substation Peak Loading
Energy Center	2	9.5	9.5
Santa Fe	3	11.2	20.9
Santa Fe	4	9.7	
North Waverly	5	14.2	14.2

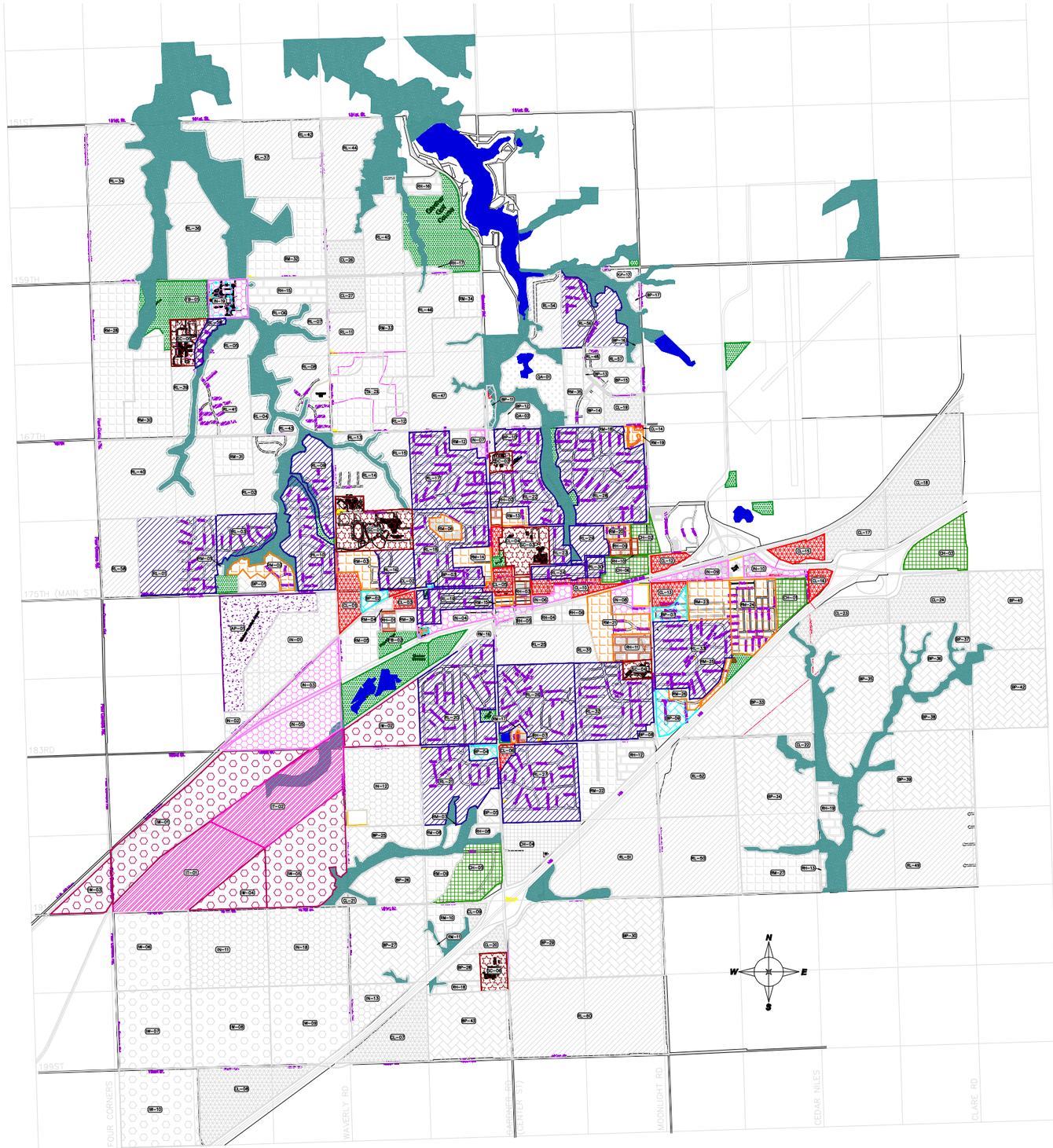
The Energy Center Substation peak is above the contingency goal but well within the capacity of the transformer.

CAPITAL IMPROVEMENT PROJECTS

See attached 2007 Capital Improvement Budget.

2007 CAPITAL IMPROVEMENT BUDGET

Item	Minimum Scenario Quantity	Minimum Scenario Cost	Minimum Scenario Total	Ultimate Scenario Quantity	Ultimate Scenario Cost	Ultimate Scenario Total
Distribution Feeder Construction (Including Labor and Materials):						
A) New Feeder NW55 from North Waverly Substation South along Waverly Road	2.0 Miles	$105,600.00	$215,980.00	2.0 Miles	$105,600.00	$215,980.00
B) Extend Feeder NW53 South from 167th parallel to Poplar	1.0 Miles	$105,600.00	$107,040.00	1.0 Miles	$105,600.00	$107,040.00
C) Extend Feeder SF46 from I-35 to existing feeder at Center Street North of 188th Street	0.4 Miles	$105,600.00	$38,540.00	0.4 Miles	$105,600.00	$38,540.00
D) Extend Feeder NW51 South from 175th to feed construction power at the new BNSF Logistic Park	0.0 Miles	$105,600.00	$0.00	2.8 Miles	$105,600.00	$296,640.00
E) Extend Feeder NW55 South from US 56 to feed construction power at the New BNSF Logistic Park	0.0 Miles	$105,600.00	$0.00	2.8 Miles	$105,600.00	$291,120.00
F) Extend Feeder EC24 along I-35 to feed new development along 175th Street	0.0 Miles	$105,600.00	$0.00	2.2 Miles	$105,600.00	$228,100.00
12.5 KV Distribution Construction Total			**$361,560.00**			**$1,177,420.00**
Contingency		20%	$72,312.00		20%	$235,484.00
Engineering		10%	$43,387.20		10%	$141,290.40
12.5 KV Distribution CIP Total			**$477,259.20**			**$1,554,194.40**
BNSF Substation Sight Purchase	0.0 Acre	$40,000.00	$0.00	3.0 Acre	$40,000.00	$120,000.00
Capital Improvement Program Budget Totals			**$477,259.20**			**$1,674,194.40**



- LOW DENSITY RESIDENTIAL
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GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.
209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

AREAS IN GRAY ARE CONSIDERED UNDEVELOPED FOR THIS YEAR.

LEGEND

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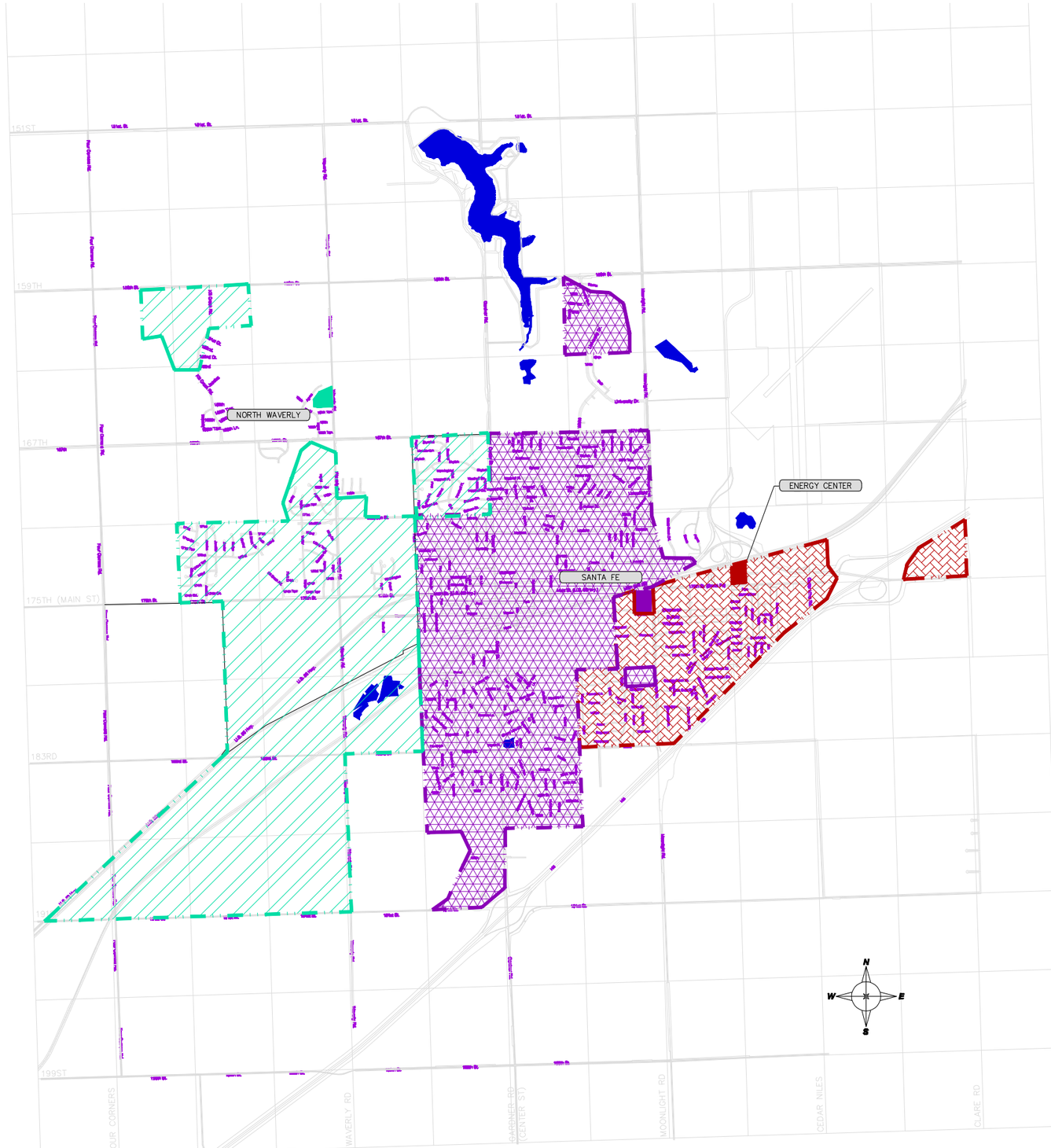
JOB NO. GKE001 DESIGN BY SAB
CREATED 9/26/06 CODE
PLOTTED 11/22/06 CHECKED BY LJM
LAST UPDATE BY SAB

2007 ELECTRIC SYSTEM LOAD GROWTH MAP

DRAWN: SAB SCALE: 1"=2000'
CHECKED: LJM DRAWING NO.: ISSUE:
APPROVED: LJM
FILENAME: LGM-1 LGM-1-2007 C



GARDNER

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MEERS ENGINEERING INC.

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2007 SUBSTATION SERVICE AREA MAP

DRAWN: SAB SCALE: 1"=2000'

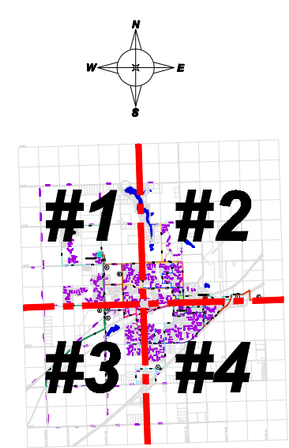
CHECKED: LJM

APPROVED: LJM

FILENAME: SSM-1

DRAWING NO.: SSM-1-2007

ISSUE: C



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NEW ULTIMATE SCENARIO FEEDER

NEW MINIMUM SCENARIO FEEDER

FEEDER MODIFICATION DESIGNATOR: REFER TO MASTER PLAN FOR THE YEAR SHOWN FOR MORE INFORMATION.

EC21
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- TRANSFORMER NUMBER
- SUBSTATION

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2007 FEEDER ROUTING MAP SECTION #1

DRAWN: SAB SCALE: 1"=1000'

CHECKED: LJM DRAWING NO.: ISSUE:

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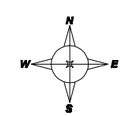
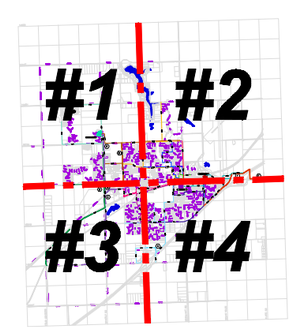
FILENAME: FRM-1 **FRM-1-2007** **C**





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2007 FEEDER ROUTING MAP SECTION #2

DRAWN: SAB SCALE: 1"=1000'

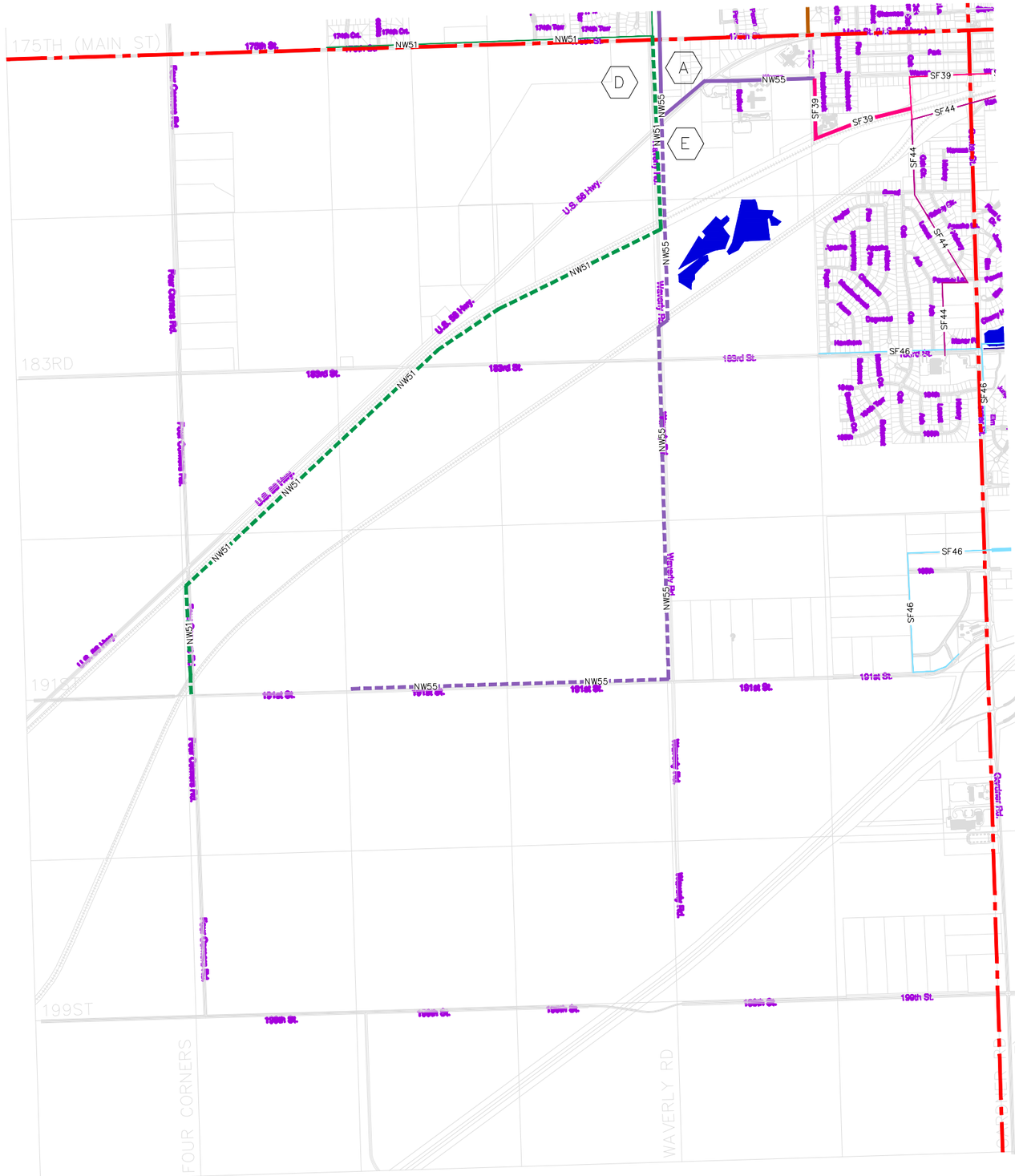
CHECKED: LJM

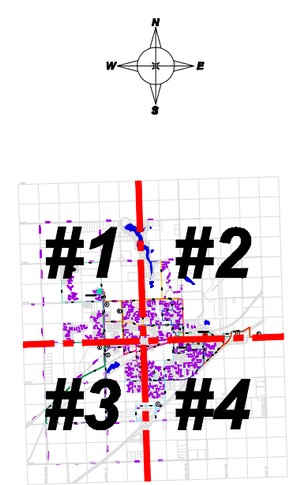
APPROVED: LJM

FILENAME: FRM-2

DRAWING NO.: FRM-2-2007

ISSUE: C





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2007 FEEDER ROUTING MAP SECTION #3

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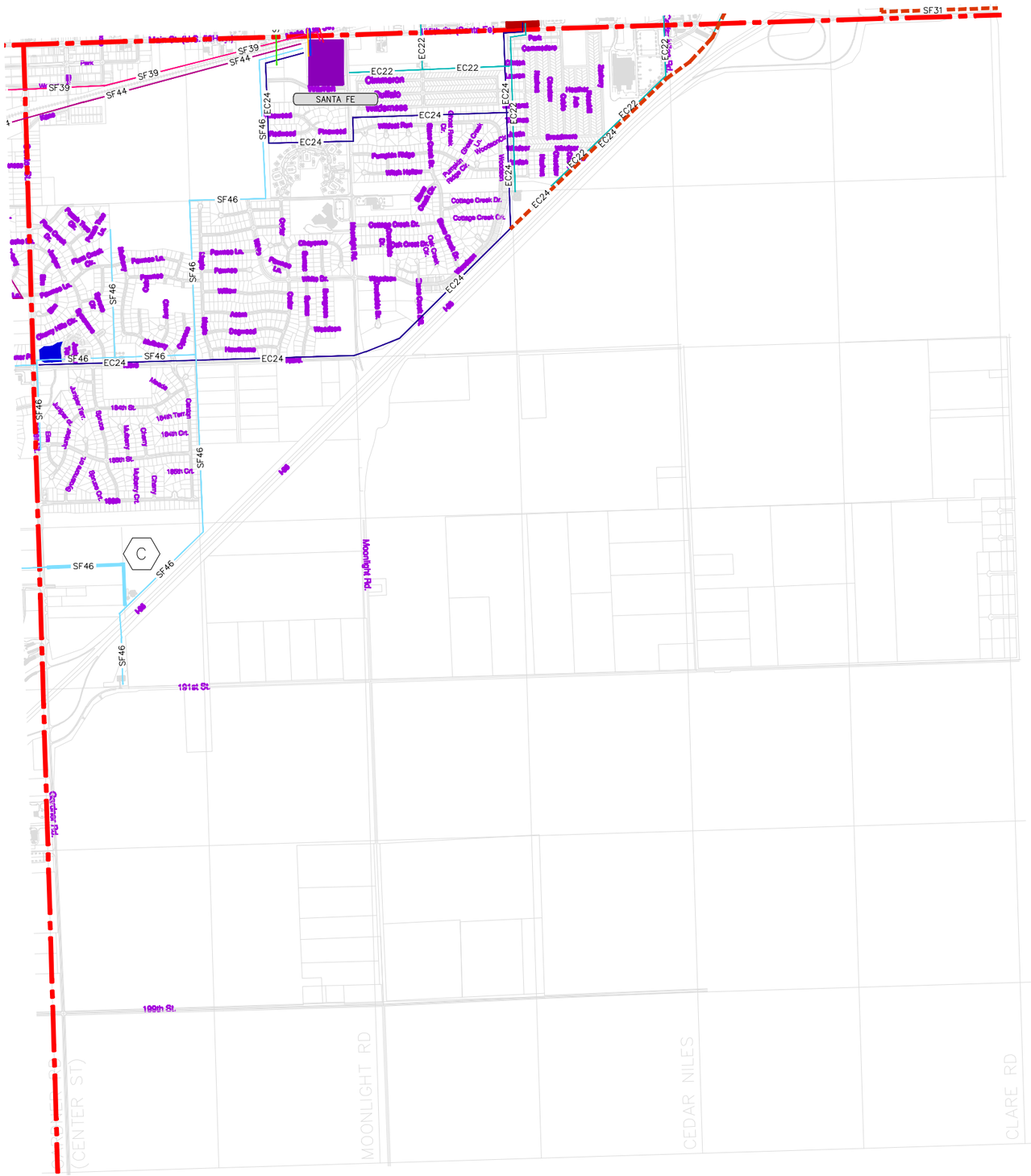
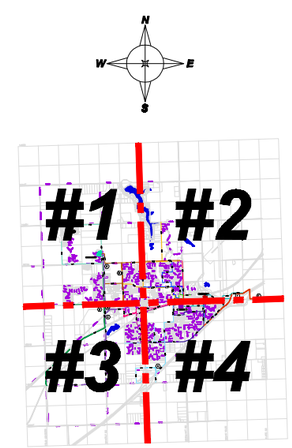
CHECKED: LJM DRAWING NO.: ISSUE:

APPROVED: LJM

FILENAME: FRM-3 FRM-3-2007 C





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Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

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2007 FEEDER ROUTING MAP SECTION #4

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CHECKED: LJM

APPROVED: LJM

FILENAME: FRM-4

DRAWING NO.: FRM-4-2007

ISSUE: C

CITY OF GARDNER, KANSAS
MASTER PLAN
YEAR 2008

SYSTEM GROWTH

The system peak in 2008 is projected to be 53.8 MVA

Refer to 2008 Feeder Routing Maps FRM-1-2008; #1 - #4

Minimum Scenario

Extend Feeder SF44 East along 183rd to Center (0.1 miles)

Based on the Electric System Growth Model, the majority of the growth in the load served by the Gardner Electric Utility will come from infill within existing developed areas. There is new growth predicted in the area south of the BNSF RR between Center and Moonlight, west of Waverly, north of 175th, along 175th, east of Cedar Niles and adjacent to the BNSF Logistic Park.

The 2008 Electric Service Load Map (LGM-1-2008) displays the active electric service areas.

SUBSTATION CAPACITY

The City will have a total transformation capacity of 87 MVA available at the peak in this year.

Substation	Transformation Capability MVA	Action Threshold MVA	Contingency Goal MVA	Number of Transformers
Energy Center	12	10.8	9.0	1
Santa Fe	45	40.5	33.75	2
North Waverly	30	27	22.5	1

SUBSTATION LOADING

The load growth is beginning to expand away from Highway 56 in both a north and south direction. Therefore, the load on North Waverly Substation is naturally increasing as areas develop closer to the substation. Without making any adjustments in the individual transformer service areas the Engineer projects the peak load for 2008 would be as set forth below:

Substation	Transformer Number	Transformer Peak Loading	Substation Peak Loading
Energy Center	2	8.45	8.45
Santa Fe	3	14	30.2
Santa Fe	4	16.2	
North Waverly	5	2.31	2.31

This simply points out that the redistribution of load is essential.

We have projected the peak based on this redistribution of load as follows:

Substation	Transformer Number	Transformer Peak MVA	Substation Peak Loading
Energy Center	2	5.4	5.4
Santa Fe	3	19.0	29.5
Santa Fe	4	10.4	
North Waverly	5	20.9	20.9

SYSTEM EVALUATION

The Energy Center Substation is in good condition load wise with the shifts of load to feeder SF31.

The Santa Fe Substation is satisfactory following Transformer SF161T3 change out to a 18/24/30 MVA transformer.

The second transformer is scheduled for change out prior to 2010 peak.

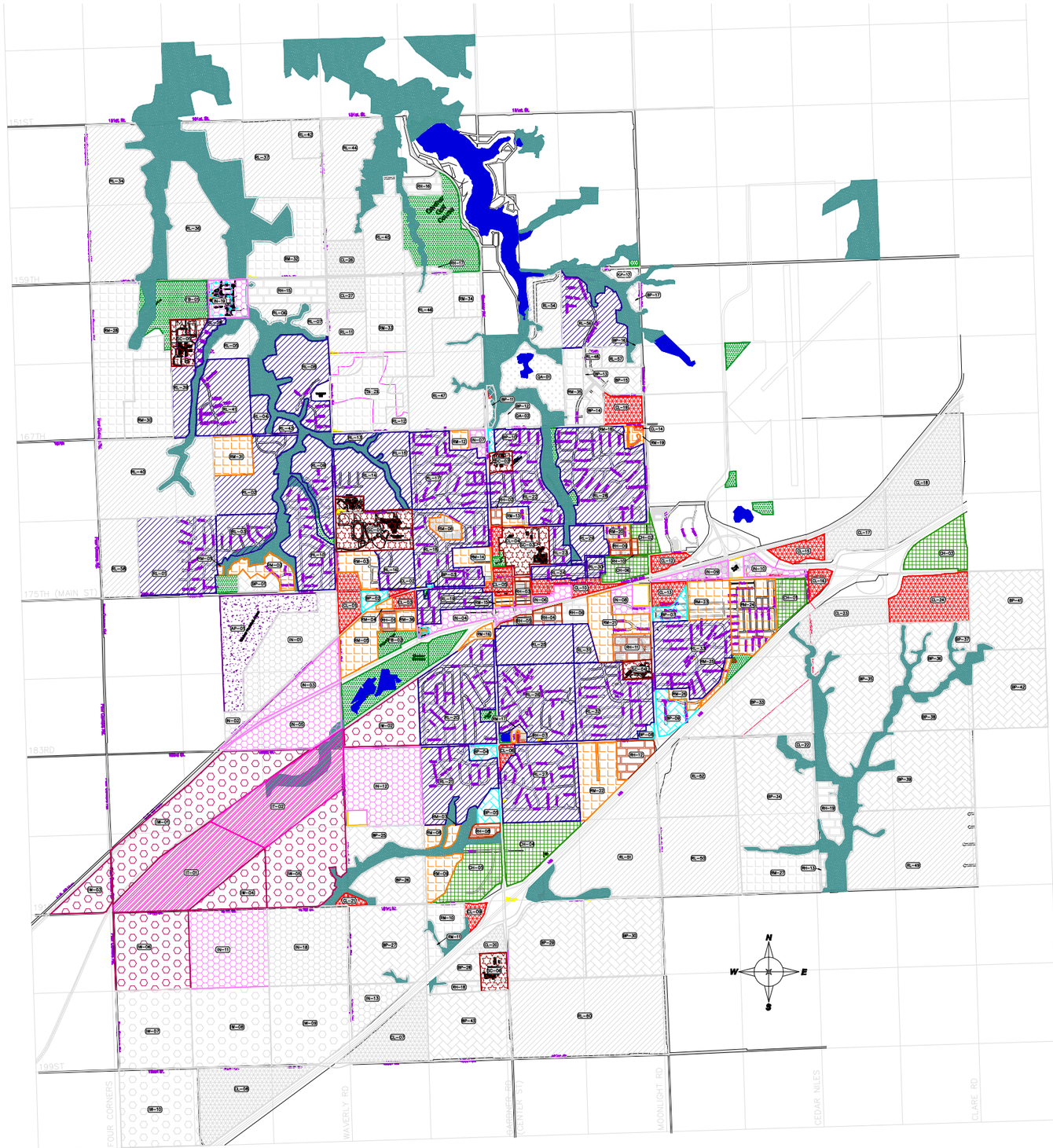
The construction power for BNSF Intermodal site is added to North Waverly Substation due to simple geography and available capacity. The feeder is longer than desired, however the economical choices are limited to provide construction power.

CAPITAL IMPROVEMENT PROJECTS

See attached 2008 Capital Improvement Budget.

2008 CAPITAL IMPROVEMENT BUDGET

Item	Minimum Scenario Quantity	Minimum Scenario Cost	Minimum Scenario Total	Ultimate Scenario Quantity	Ultimate Scenario Cost	Ultimate Scenario Total
Substation Construction (Including Labor and Materials):						
Santa Fe Substation (Upgrade)						
161-12.5 KV Transformers 18/24/30 KVA (SF161T3)	1.0 Per	$1,000,000.00	$1,000,000.00	1.0 Per	$1,000,000.00	$1,000,000.00
Relocate Transformer Old SF161T4 to Storage	1.0 Per	$4,000.00	$4,000.00	1.0 Per	$4,000.00	$4,000.00
161KV Breakers	1.0 Per	$60,000.00	$60,000.00	1.0 Per	$60,000.00	$60,000.00
Substation Package	1.0 Per	$75,000.00	$75,000.00	1.0 Per	$75,000.00	$75,000.00
Labor	1.0 Per	$279,000.00	$279,000.00	1.0 Per	$279,000.00	$279,000.00
Substation Construction Total			**$1,418,000.00**			**$1,418,000.00**
Contingency		20%	$283,600.00		20%	$283,600.00
Engineering		10%	$170,160.00		10%	$170,160.00
Substation CIP Total			**$1,871,760.00**			**$1,871,760.00**
Distribution Feeder Construction (Including Labor and Materials):						
A) Extend Feeder SF 44 East along 183rd to Center	0.1 Miles	$105,600.00	$13,120.00	0.1 Miles	$105,600.00	$13,120.00
12.5 KV Distribution Construction Total			**$13,120.00**			**$13,120.00**
Contingency		20%	$2,624.00		20%	$2,624.00
Engineering		10%	$1,574.40		10%	$1,574.40
12.5 KV Distribution CIP Total			**$17,318.40**			**$17,318.40**
Capital Improvement Program Budget Totals			**$1,889,078.40**			**$1,889,078.40**



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MEERS ENGINEERING INC.
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NOTES

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LEGEND

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2008 ELECTRIC SYSTEM LOAD GROWTH MAP

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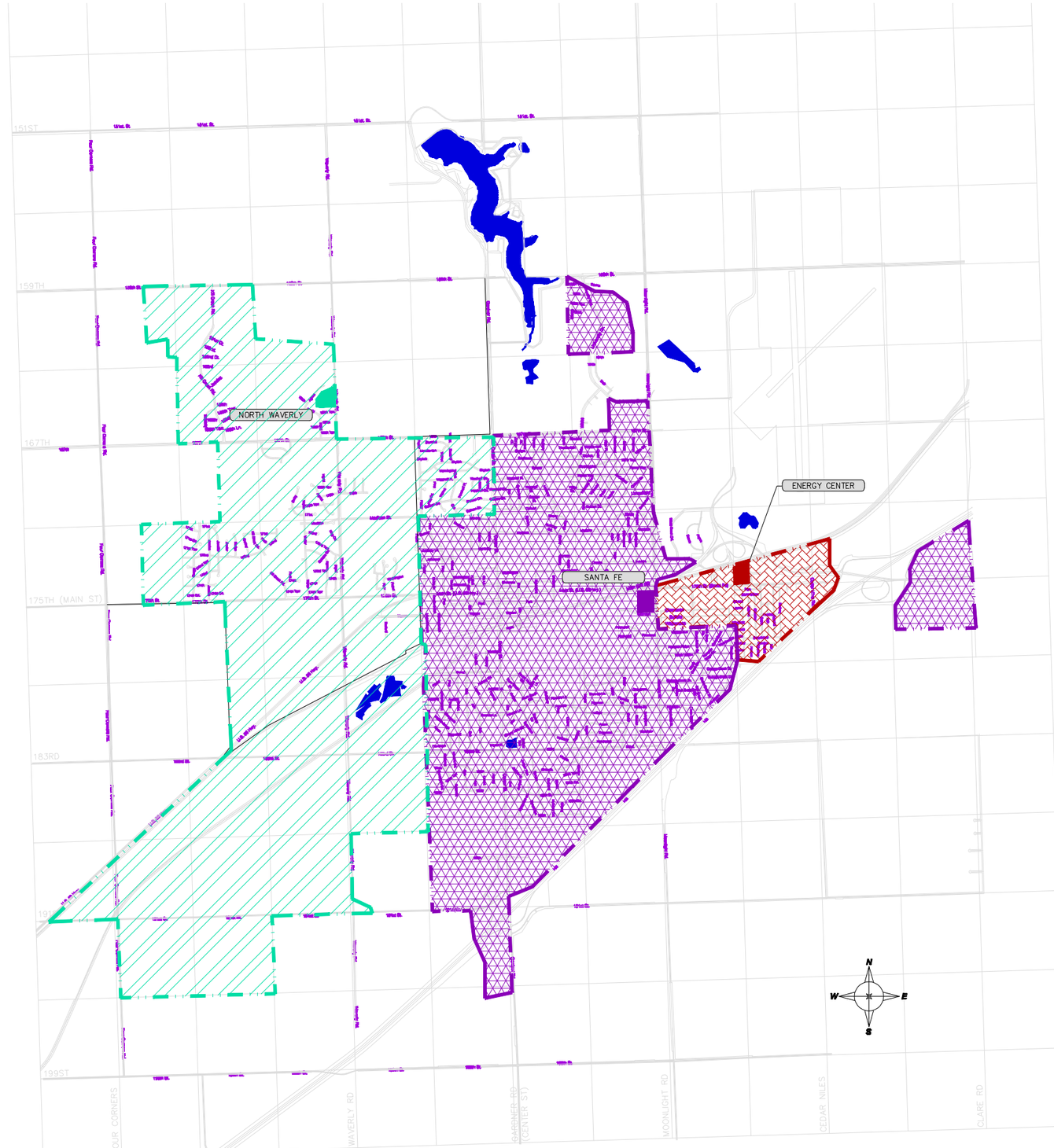
CHECKED: LJM DRAWING NO.: ISSUE:
APPROVED: LJM LGM-1-2008 C
FILENAME: LGM-1



GARDNER

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2008 SUBSTATION SERVICE AREA MAP

DRAWN: SAB SCALE: 1"=2000'

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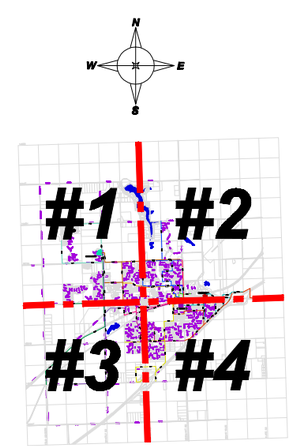
APPROVED: LJM

FILENAME: SSM-1

DRAWING NO.: SSM-1-2008

ISSUE: C



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2008 FEEDER ROUTING MAP SECTION #1

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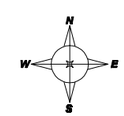

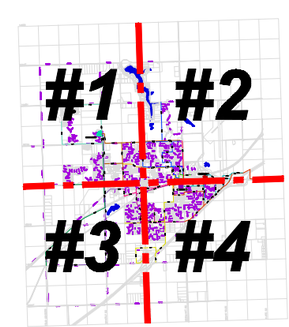

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2008 FEEDER ROUTING MAP SECTION #2

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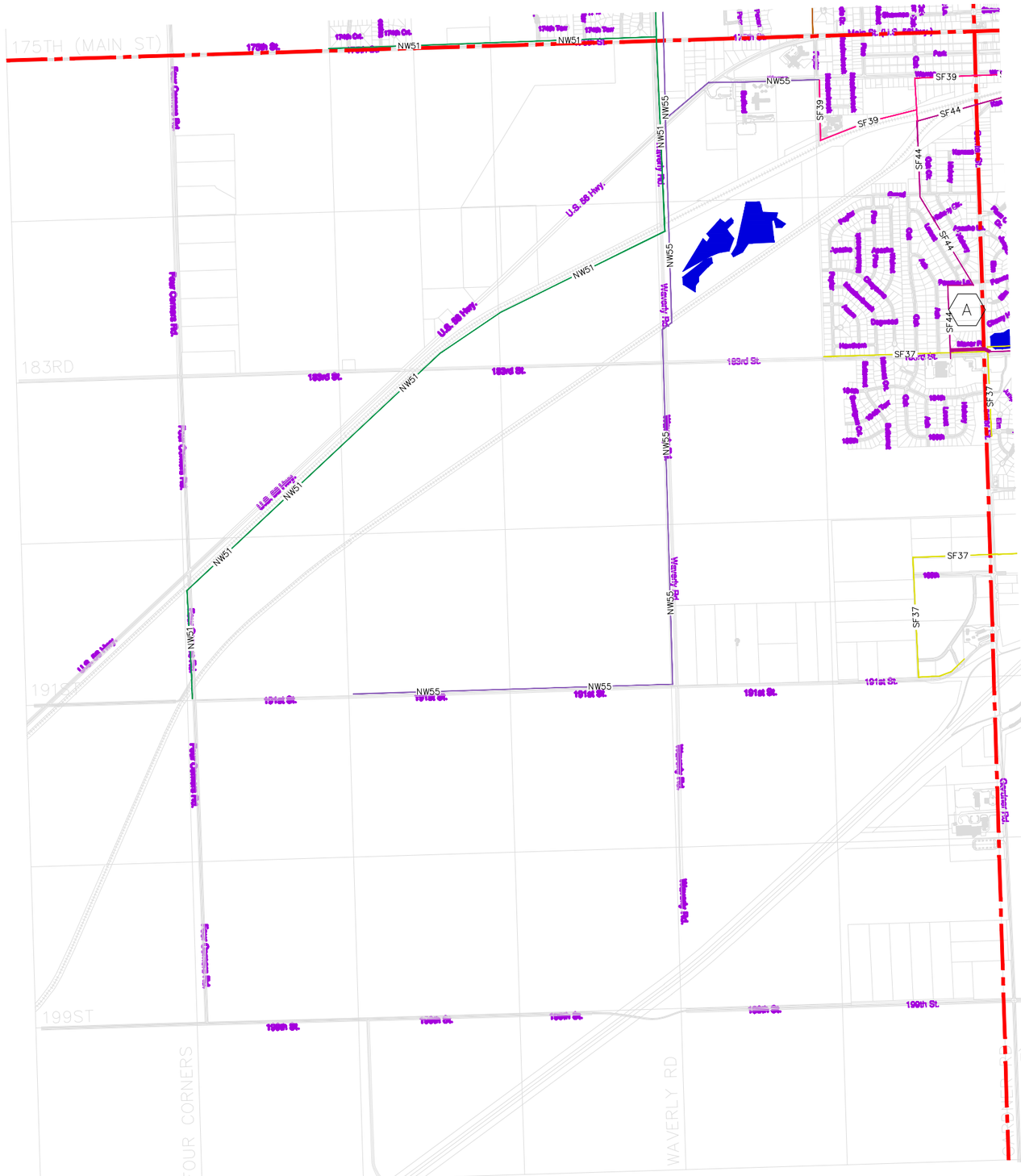
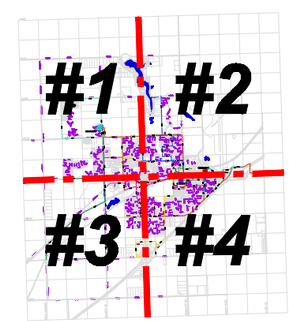
DRAWING NO.: FRM-2-2008

ISSUE: C





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2008 FEEDER ROUTING MAP SECTION #3

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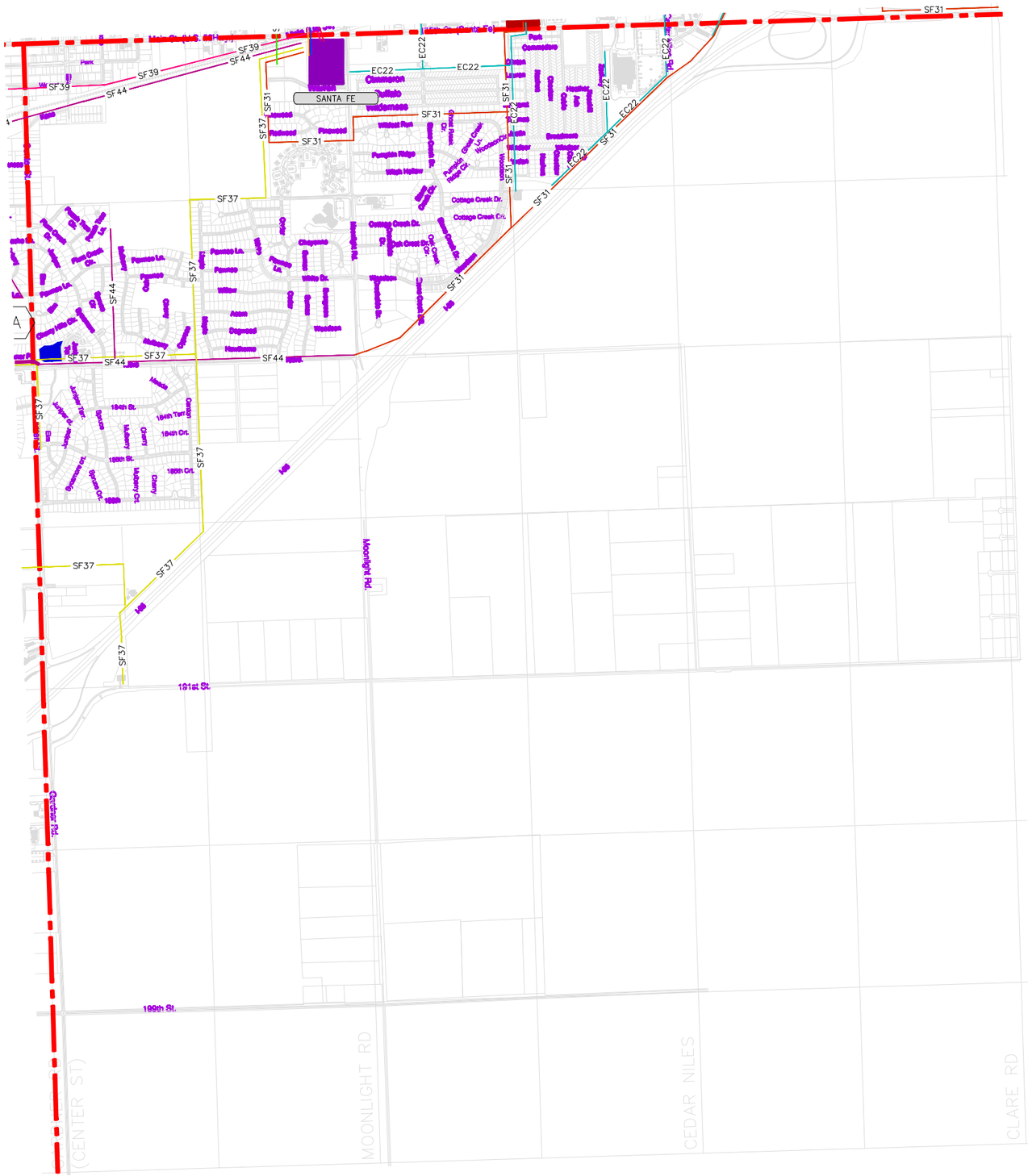
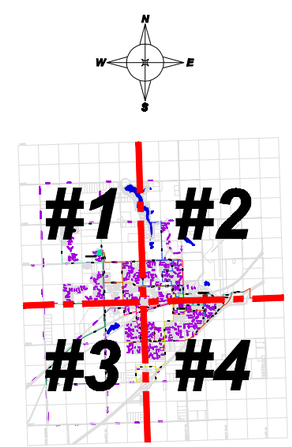
CHECKED: LJM DRAWING NO.: ISSUE:

APPROVED: LJM FRM-3-2008 C

FILENAME: FRM-3





KEY PLAN

GARDNER

Kansas Gardner Energy Center

ELECTRIC SYSTEM MASTER PLAN

MEERS ENGINEERING INC.

209 S. DANVILLE SUITE B-200 ◆ ABILENE, TEXAS (325) 691-1200

NOTES

LEGEND

EXISTING FEEDER

NEW ULTIMATE SCENARIO FEEDER

NEW MINIMUM SCENARIO FEEDER

FEEDER MODIFICATION DESIGNATOR: REFER TO MASTER PLAN FOR THE YEAR SHOWN FOR MORE INFORMATION.

EC21
- FEEDER NUMBER
- TRANSFORMER NUMBER
- SUBSTATION

REFERENCE DRAWINGS

REVISIONS

NO.	DATE	DESCRIPTION	BY	APPRVD
A	09/25/06	ISSUED FOR REVIEW	SAB	LJM
B	11/16/06	ISSUED FOR REVIEW	SAB	LJM
C	11/22/06	ISSUED FOR REVIEW	JRG	LJM

JOB NO. GKE001 DESIGN BY SAB

CREATED 09/01/06 CODE

PLOTTED 11/22/06 CHECKED BY LJM

LAST UPDATE BY JRG

2008 FEEDER ROUTING MAP SECTION #4

DRAWN: SAB SCALE: 1"=1000'

CHECKED: LJM

APPROVED: LJM

FILENAME: FRM-4

DRAWING NO.: FRM-4-2008

ISSUE: C