CITY OF LINCOLN
NEBRASKA

Executive Summary

Update of Wastewater Facilities Master Plan

November 2007

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EXECUTIVE SUMMARY

1.1 BACKGROUND

The City of Lincoln last updated their Wastewater Facilities Master Plan in 2003. Since that time the City's population has continued to grow at a steady rate. This growth is the main driving factor for this Wastewater Facilities Master Plan Update and the system improvements that will be identified. Since the last facilities plan update there have been several improvements made to the wastewater systems that have changed and modified the system capacities. These changes need to be incorporated into the overall system wide evaluation that will determine how these changes and modifications affect the overall system capacity and operating characteristics. In addition to identifying new facilities, this Master Plan Update will also identify existing facilities that need to be upgraded or rehabilitated to efficiently serve the existing as well as future service needs.

This updated Wastewater Facilities Master Plan has been developed in conjunction with the 2030 Lincoln City-Lancaster County Comprehensive Plan. The Comprehensive Plan has identified three growth tiers for the City of Lincoln.

The improvements outlined in this Master Plan were developed for planning purposes only. Design assumptions and specific criteria should be further investigated and defined when specific project implementation begins through detailed engineering and site studies. Although the final design features may depart from those described herein, these improvements are representative of the facilities required by the City of Lincoln and can be used for long range planning.

1.2 PLANNING GOALS AND OBJECTIVES

The overall goal of this Wastewater Facilities Master Plan Update is to determine and verify the capacity of the existing facilities and identify collection and treatment system modifications that are required to:

1. Provide efficient wastewater collection and treatment service for existing as well as future users in the City of Lincoln.
2. Provide for continued protection of public health and the environment.
3. Comply with relevant local, State, and Federal operating permits, regulations, and other requirements.
4. Continue growth and development policies of providing gravity sanitary sewer service in drainage basins.

1.3 STUDY AREA BOUNDARIES

The study area encompasses approximately 290 square miles of land, of which approximately 83 square miles of land are presently served by the City's sanitary sewer

system. This area includes the entire City of Lincoln, Nebraska, as well as areas located within Lancaster County. The City of Lincoln's wastewater collection system is currently serving 13 drainage basins, with service in four additional basins planned in the future for a total of 17 basins. The drainage basins are shown in Figure 1.1.

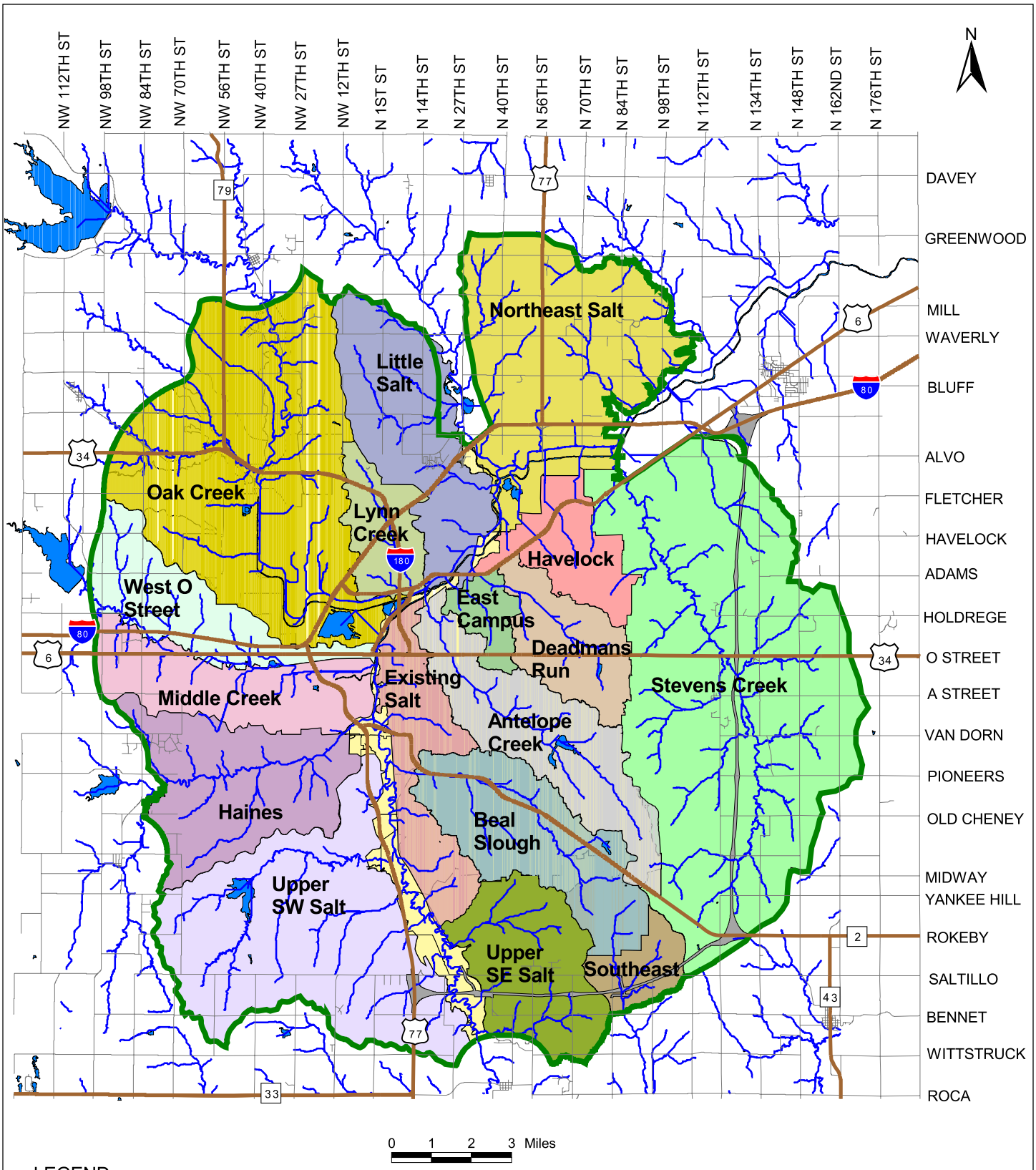
The study area is divided into three growth tiers. Tier I reflects the future service area where wastewater services are anticipated by 2030. Tier I areas currently encompass an area of 52 square miles which could generally expect service within the next 25 years. Tier I areas are those that are generally contingent with the existing City boundaries and development.

Tier II areas encompass approximately 70 square miles and are generally located further from the existing City service area. Tier II represents a potential longer term growth area which may not need service for 25 years or longer.

Tier III areas are currently identified as approximately 85 square miles. Services in these areas are only considered in this update as future long term growth. The improvements identified for Tier III areas will be considered conceptual, and be of less detail than those identified for Tier I and Tier II areas.

1.4 POPULATION PROJECTIONS

Due to the expected service life of 50 plus years for collection system components, it is advantageous to project population growth for a 50-year planning period. This Master Plan Update estimates future wastewater utility needs for both 25 and 50 (plus) year planning horizons. It is anticipated that the population will continue to grow at a steady rate throughout the future years. The 2030 Lincoln City/Lancaster County Comprehensive Plan is based on an assumed 1.5% annual population growth rate. For the purposes of this study, the 1.5% growth rate was used for the 50-year period of this Master Plan Update. The population projections from the year 2005 to 2060 is outlined in Table 1.1 below.



LEGEND

- Highways
- Streets
- Study Area Boundary (2030 Comprehensive Plan Tier III Limits)
- Streams and Lakes
- Beltway

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Figure 1.1 Study Area Boundaries
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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Table 1.1 Population Projections from 2005 to 2060 (1) Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska		
Year	City of Lincoln	Lancaster County
	Population	Population
2005 (2)	243,015	269,634
2010	261,796	290,473
2015	282,029	312,922
2020	303,825	337,106
2025	327,306	363,159
2030	352,601	391,225
2035	379,852	421,460
2040	409,208	454,032
2045	440,833	489,122
2050	474,903	526,923
2055	511,605	567,646
2060	551,144	611,516

Notes:

1. Population projections adopted from 2030 Lincoln/Lancaster County Comprehensive Plan, at an annual growth rate of 1.5 percent.
2. 2005 population is a U.S. Census estimate.

1.5 COLLECTION SYSTEM MODELING

XP-SWMM, a commercial version of the United States Environmental Protection Agency (U.S. EPA) SWMM dynamic model was used for the hydraulic collection system modeling on this project. XP SWMM, marketed by XP-software, is a dynamic-state analysis tool and is an extremely powerful program for the design and analysis of flows in pipe networks. Since its inception, SWMM has been used in thousands of sanitary sewer system and stormwater studies throughout the world. Typical applications include designing control strategies for minimizing combined sewer overflows and evaluating the impact of inflow and infiltration on such systems.

Using a dynamic model over static models that have been used in the past provides a more realistic evaluation of how flows actually behave in the system, taking into account the time of travel and the physical conditions of the pipe. Additionally, the effects of transient waves that can exist in the collection system can be determined.

The results of the collection system modeling for the individual basins are outlined in Chapters 10 through 22 and summarized in Chapter 23. The tributary area and modeled peak flows for the existing, Tier I, and Tier II conditions for the Theresa Street WWTF drainage basins are outlined in Table 1.2 and shown in Figure 1.2. Likewise for the NE WWTF drainage basins, this information is shown in Table 1.3 and Figure 1.3.

Table 1.2 Modeled Theresa Street WWTF Drainage Areas (1,2)
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Basin	Existing Area (acres)	Tier I Area (acres)	Tier II Area (acres)	Tier III Area (acres)
Salt Valley	5,475	5,475	5,475	5,475
Antelope Creek	7,866	8,336	8,336	8,336
Beal Slough	6,874	8,750	8,750	8,750
Upper Southeast Salt	0	4,119	7,279	7,279
Upper Southwest Salt	0	2,078	8,405	18,041
Haines Branch	297	1,117	5,095	6,409
Middle Creek	1,389	2,936	4,839	7,489
West ‘O’ Street	1,042	2,785	4,833	7,059
Oak Creek	4,538	7,162	13,342	21,767
Lynn Creek	2,865	3,323	3,323	3,323
Little Salt Creek	3,314	3,864	5,308	9,376
East Campus	865	865	865	865
Southeast	0	0	0	3,494
Totals	34,525	50,810	75,850	107,663

Notes:
1. Areas as of July 1, 2006.
2. Based on information provided by LWWS.

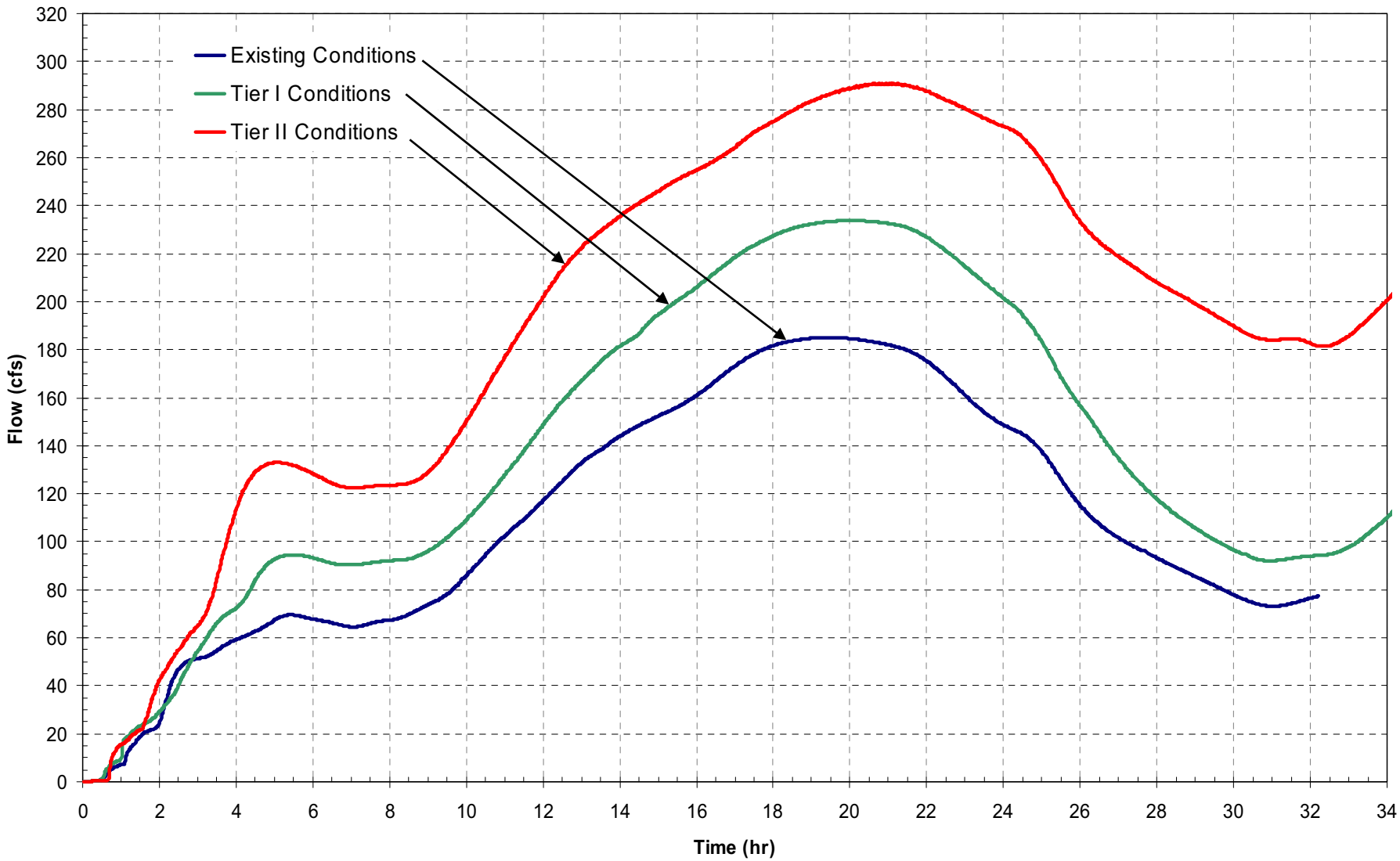

Figure 1.2
Modeled Peak Collection System Flows
at Theresa Street WWTF
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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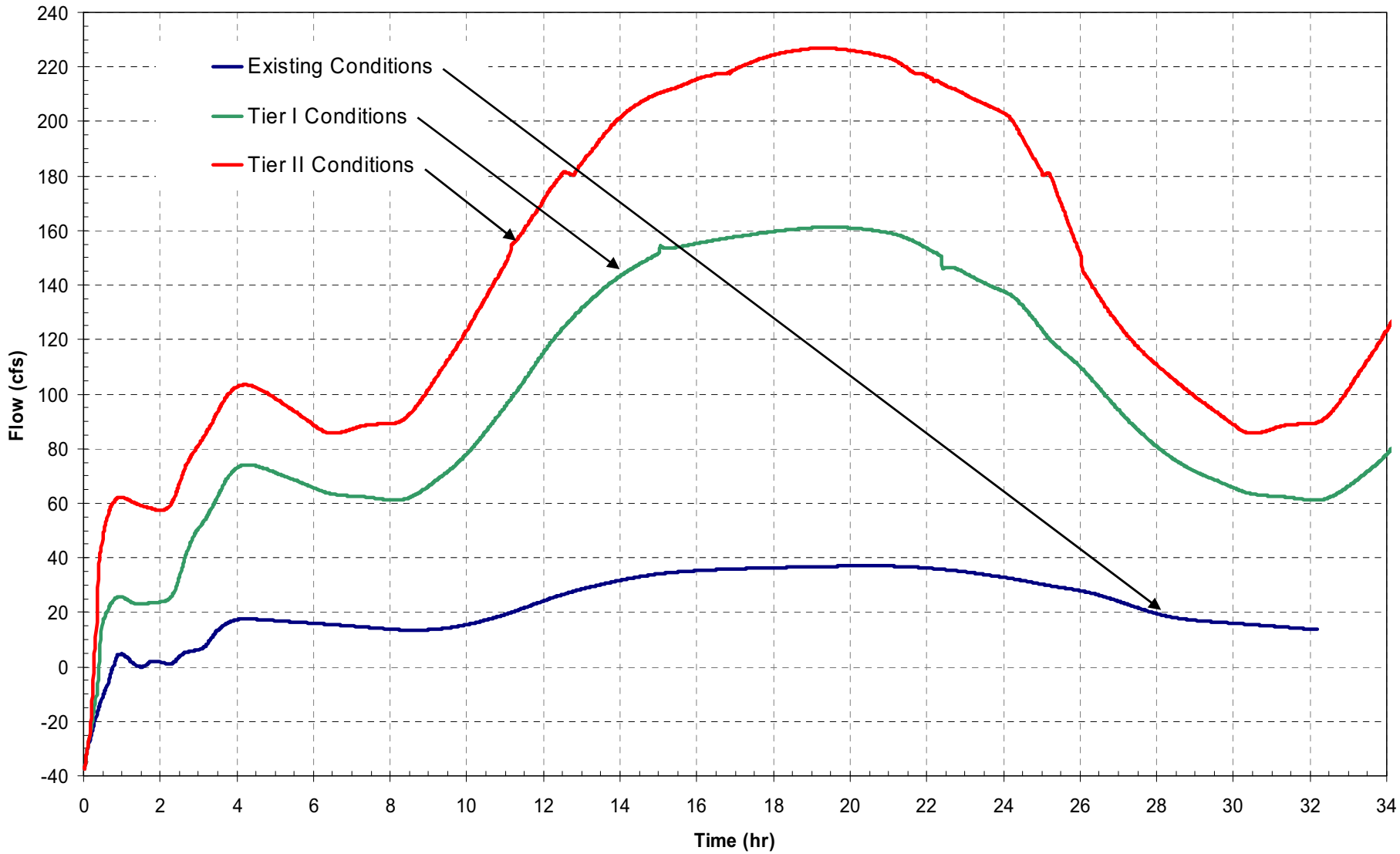

Figure 1.3
Modeled Peak Collection System Flows
at Northeast WWTF
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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Table 1.3 Modeled NE WWTF Drainage Areas [1,2] Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska				
Basin	**Existing Area (acres)**	**Tier I Area (acres)**	**Tier II Area (acres)**	**Tier III Area (acres)**
Deadmans Run	4,898	4,898	4,898	4,898
Havelock	3,881	4,681	4,681	4,681
Northeast Salt	264	2,610	4,213	13,717
Stevens Creek	366	9,409	26,642	36,450
Totals	9,409	21,598	40,434	59,746

Notes:
1. Areas as of July 1, 2006.
2. Based on information provided by LWWS.

1.6 COLLECTION SYSTEM IMPROVEMENTS

The results of the collection system modeling discussed in Chapters 10 through 23, is summarized in Tables 1.4 and 1.5 below and shown schematically in Figures 1.4, 1.5, and 1.6. The modeling identified over one million feet of pipelines over the 100-year planning period. In the modeling exercise, improvements were identified to maximize the use of existing pipelines. To minimize surcharging, 42.0 million gallons of collection system storage were identified for the planning period as shown schematically in Figure 1.7. Lift station improvements were also identified in the West 'O' Street, Middle Creek, Haines Branch, and Southeast Basins.

A schematic drawing showing an example of a storage facility is shown in Figure 1.8. A generalized site plan showing a layout of storage facilities is shown in Figure 1.9. Included in Figure 1.9 are planning level land area requirements including minimum buffer zones. It should be noted that the actual size of the storage facility, land area requirements, and buffer zones be determined on a site specific basis through detailed engineering and siting studies.

Table 1.4 Summary of Collection System Pipeline Improvements [1]
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

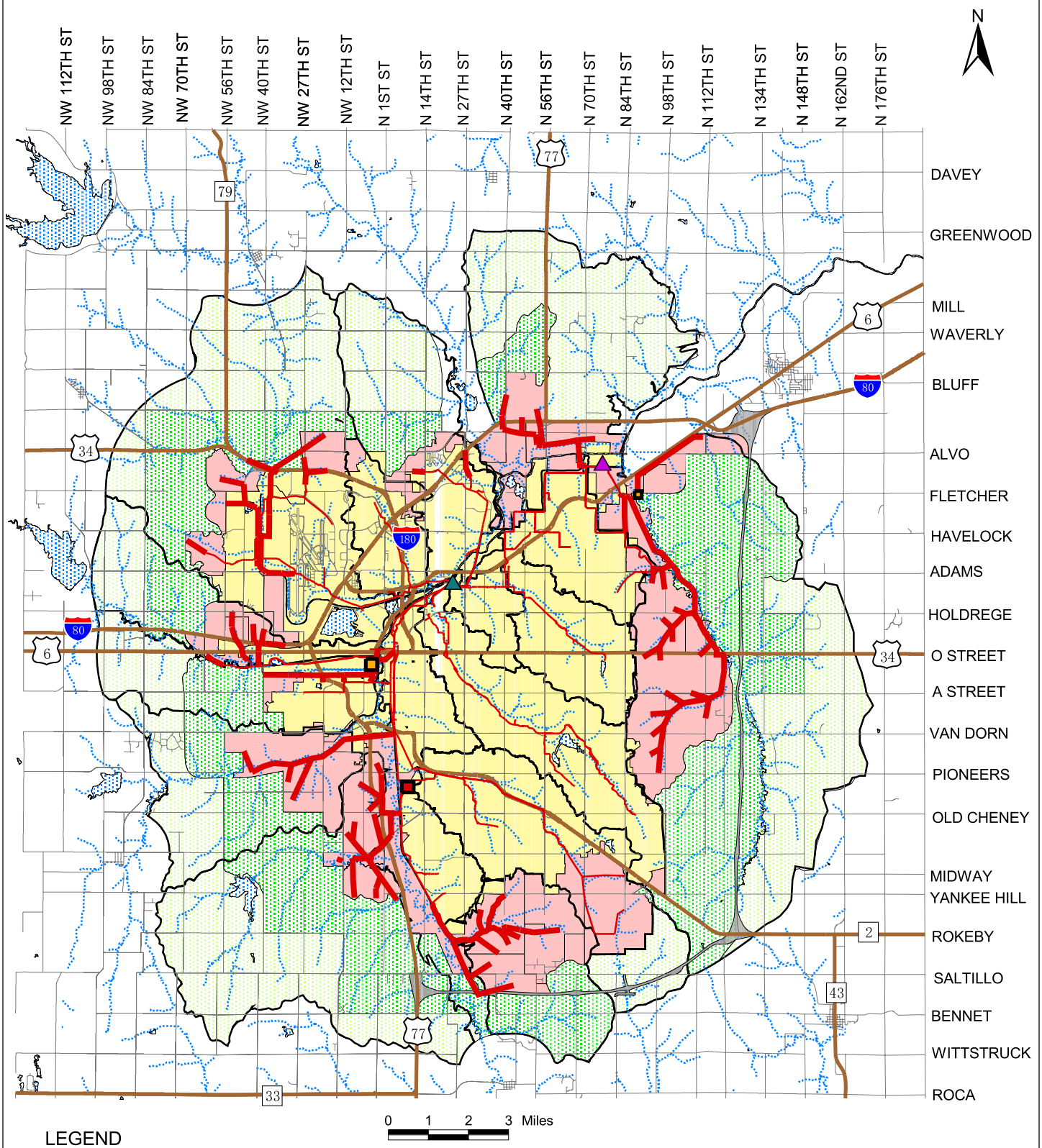
Basin	Tier I [2]	Tier II [3]	Tier III [3]	Basin Total
Salt Valley [4]	5,700 ft	-	-	5,700 ft
Antelope Creek	-	-	-	-
Beal Slough	-	-	-	-
Upper SE Salt	41,543 ft	16,198 ft	-	57,741 ft
Upper SW Salt	47,668 ft	75,636 ft	48,158 ft	171,462 ft
Haines Branch	66,268 ft	35,949 ft	36,897 ft	139,114 ft
West 'O' & Middle Creek	43,780 ft	68,031 ft	74,572 ft	186,383 ft
Oak Creek & Lynn Creek	44,936 ft	39,852 ft	104,065 ft	188,853 ft
Little Salt Creek	8,942 ft	26,981 ft	31,412 ft	67,335 ft
Deadmans Run, East Campus, Havelock	-	-	-	-
Northeast Salt	41,216 ft	31,290 ft	96,425 ft	168,931 ft
Stevens Creek	96,163 ft	177,282 ft	94,953 ft	368,398 ft
Southeast	-	-	32,134 ft	32,134 ft
Total	**396,216 ft**	**471,219 ft**	**518,616 ft**	**1,386,051 ft**

Notes:
1. Includes all sizes of pipes including forcemains.
2. Tier I values include pipelines 10-inches and larger.
3. Tiers II and III values generally includes pipelines 15 inches and larger.
4. Relining existing pipe.

Table 1.5 Summary of Collection System Storage Improvements [1]
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Basin	Tier I	Tier II	Tier III	Basin Total
Salt Valley	2.0	1.5		3.5
Upper SW Salt		4.0	3.0 [2]	7.0
Haines Branch		3.0	3.0 [2]	6.0
West 'O' & Middle Creek		4.5	2.0	6.5
Oak Creek & Lynn Creek		2.5	7.5	10.0
Southeast			3.0	3.0
Salt Creek Basin Tier III Improvements			6.0	6.0
Total	**2.0 MG**	**15.5 MG**	**18.5 MG**	**42.0 MG**

Notes:
1. Values are in millions of gallons (MG).
2. Additional storage of 3.0 MG each located at Haines Branch and Upper Southwest Basins as identified in Theresa St WWTF Tier III drainage basins improvements Alternative 4 in Chapter 24.



LEGEND

- Northeast WWTF
- Theresa Street WWTF
- Lift Station
- Storage
- Existing Sewers
- Tier I Sewers

Growth Tiers

- Existing Service Area
- Tier I
- Tier II
- Tier III

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Figure 1.4 Planning Area Tier I Improvements
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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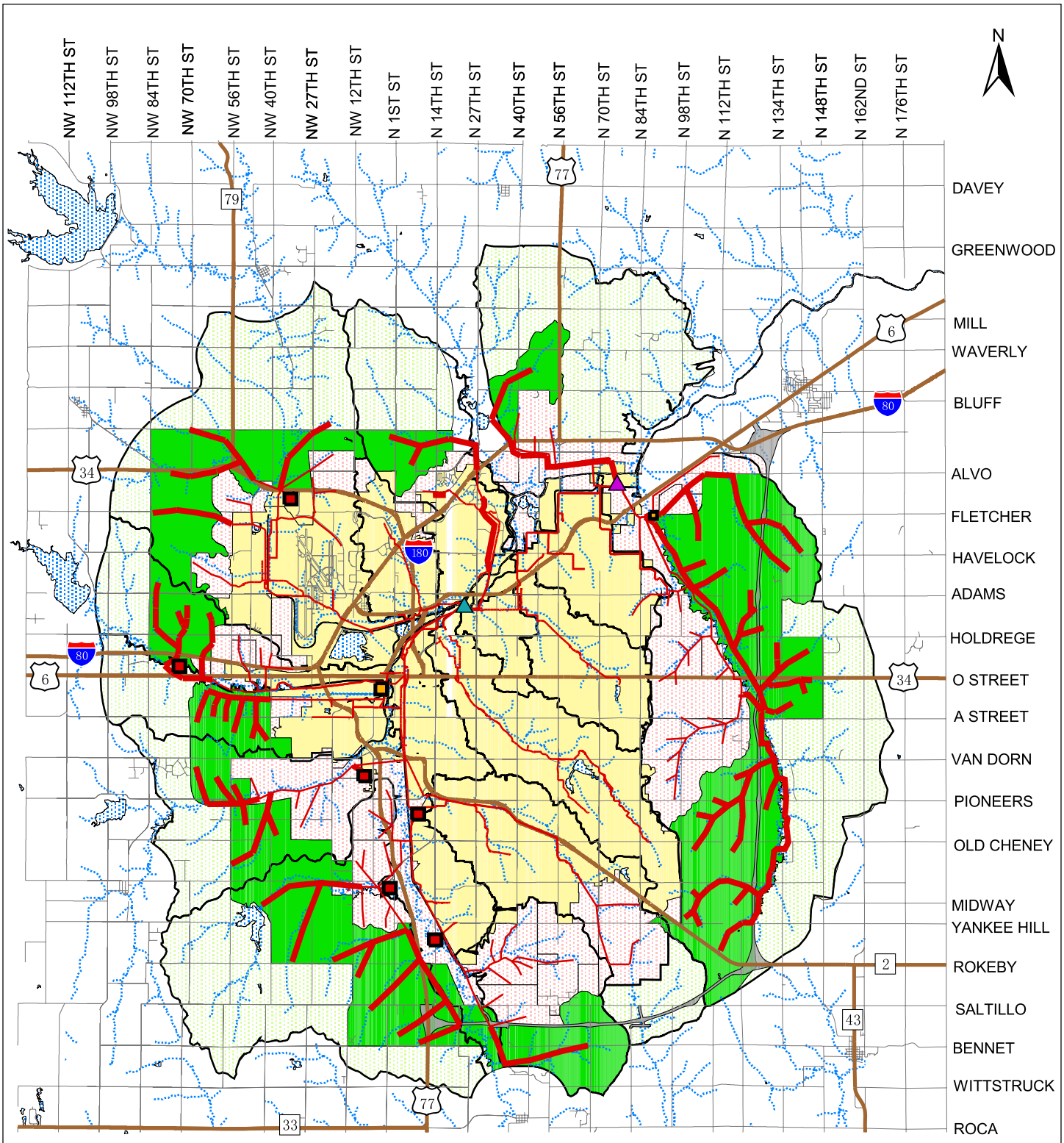

LEGEND

- Northeast WWTF
- Theresa Street WWTF
- Lift Station
- Storage
- Existing & Tier I Sewers
- Tier II Sewers

Growth Tiers

- Existing Service Area
- Tier I
- Tier II
- Tier III

0 1 2 3 Miles

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Figure 1.5 Planning Area Tier II Improvements
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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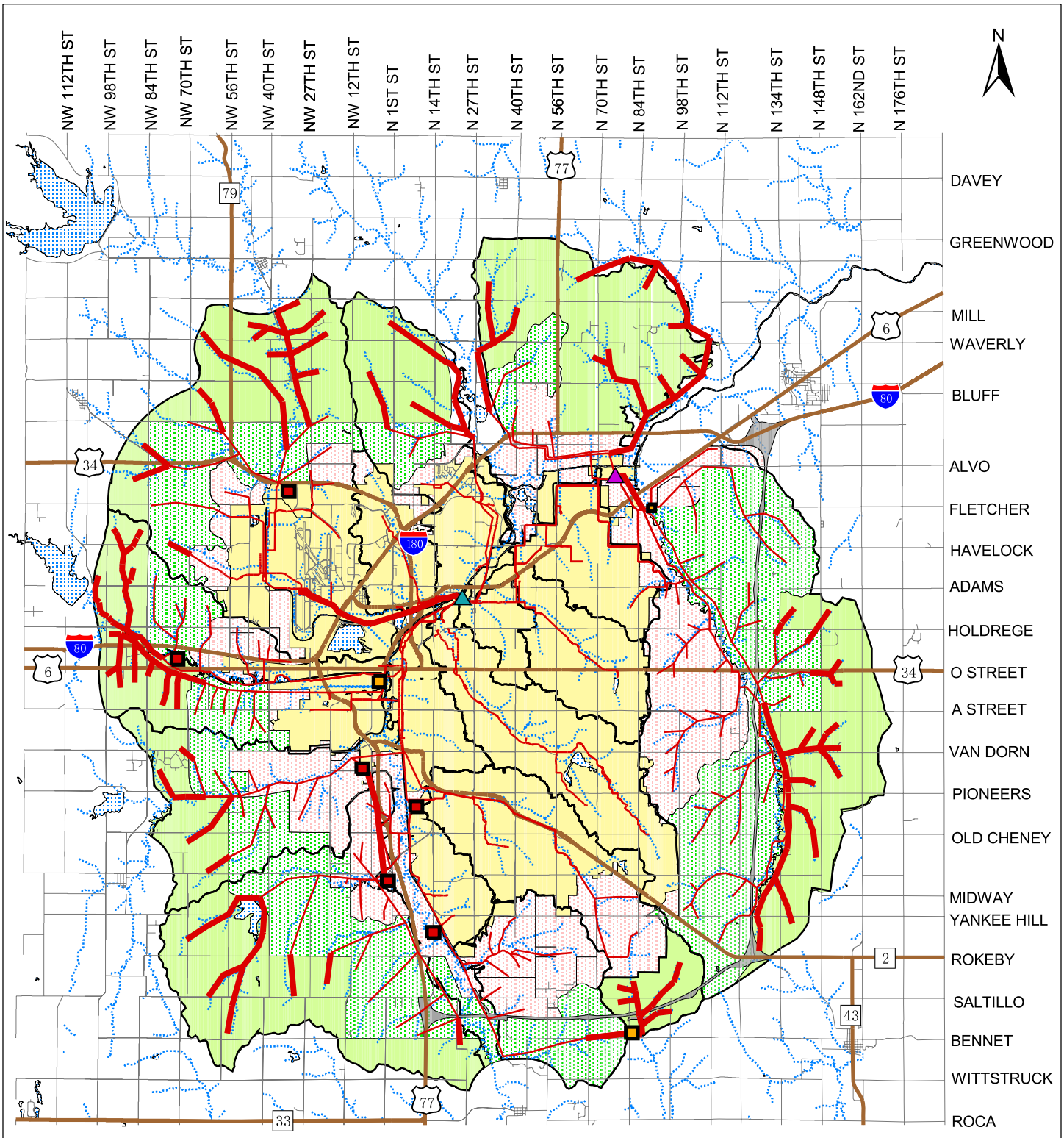

LEGEND

- Northeast WWTF
- Theresa Street WWTF
- Lift Station
- Storage
- Existing, Tier I, & Tier II Sewers
- Tier III Sewers

Growth Tiers

- Existing Service Area
- Tier I
- Tier II
- Tier III

0 1 2 3 Miles

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Figure 1.6 Planning Area Tier III Improvements
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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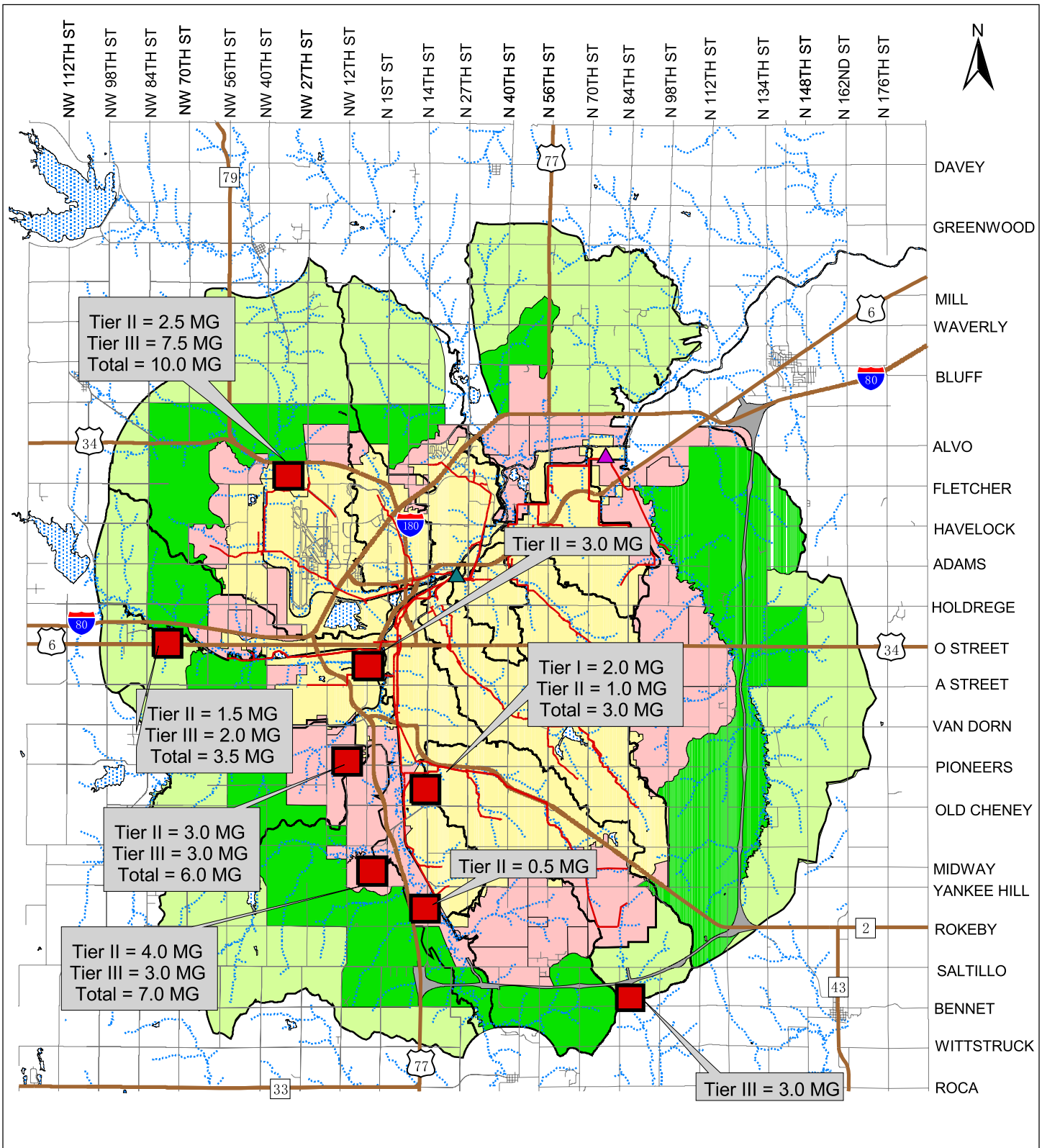

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Figure 1.7 Planning Area Storage Improvements
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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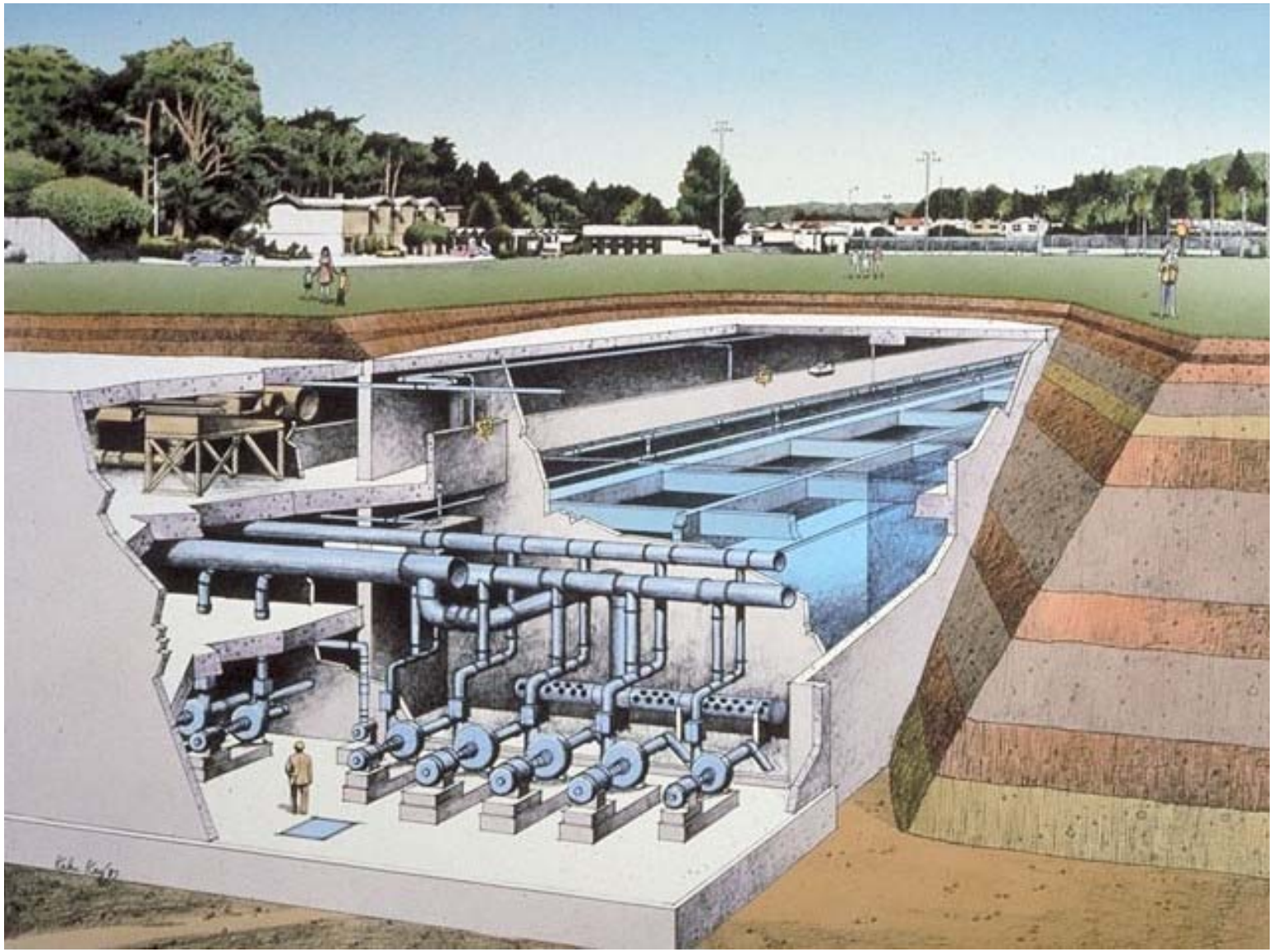

Figure 1.8
Schematic Drawing of Storage Facilities
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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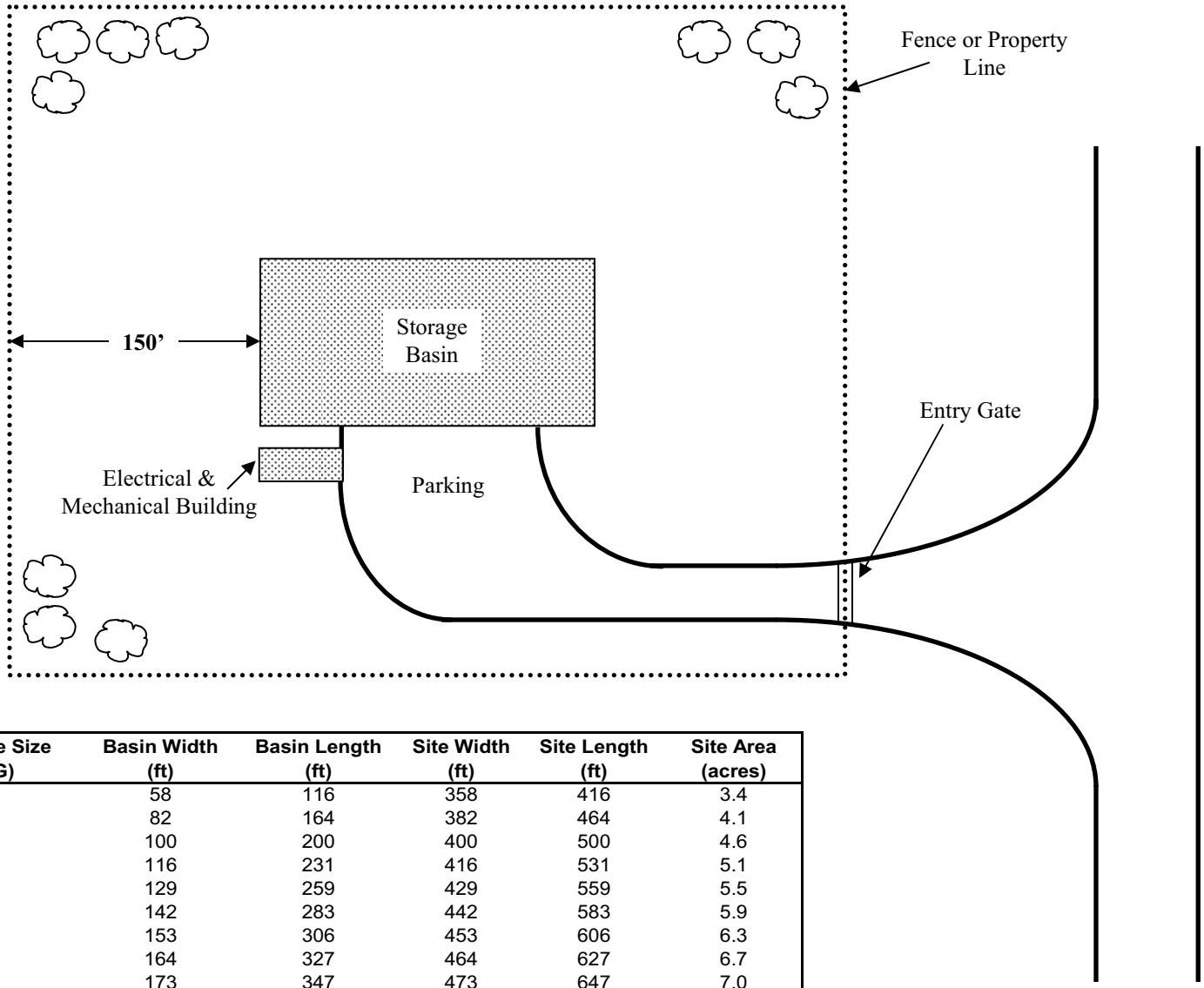

Storage Size (MG)	Basin Width (ft)	Basin Length (ft)	Site Width (ft)	Site Length (ft)	Site Area (acres)
1	58	116	358	416	3.4
2	82	164	382	464	4.1
3	100	200	400	500	4.6
4	116	231	416	531	5.1
5	129	259	429	559	5.5
6	142	283	442	583	5.9
7	153	306	453	606	6.3
8	164	327	464	627	6.7
9	173	347	473	647	7.0
10	183	366	483	666	7.4

Notes:
1. Storage basin sized based on 20 feet working depth.
2. Basin dimensions sized assuming 2:1 length to width ratio.
3. Site dimensions/area includes 150 ft buffer around storage basin.

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Figure 1.9
General Layout of Storage Facilities
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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1.7 THERESA STREET WWTF IMPROVEMENTS

1.7.1 Projected Flows

It is important to determine when the treatment facility expansions will be required in order to plan for future funding. To estimate the timing when improvements at the Theresa Street WWTF will be needed, the MMAD flows were projected at 1.5 percent as shown in Figure 1.10. This value has been used for past planning activities, and compares well with the historical population growth. At this growth rate a 12.6 mgd expansion would be required in approximately 2022 with a 5 mgd expansion around 2047, for a MMAD capacity of 45 mgd.

1.7.2 Summary of Theresa Street WWTF Tier I and II Improvements

The following improvements were identified in Chapter 24 to provide treatment capacity to meet the projected wastewater treatment needs. An overview of the major Tier I and II Improvements is shown in Figure 1.11.

Tier I Projects

- 2008 - Salt Creek Bank Stabilization Project.
- 2008 - Upgrade Sludge Presses.
- 2009 - Odor & Corrosion Control Facilities for the Solids Dewatering Facilities.
- 2010 - Add Rotary Drum Thickener.
- 2010 - Trucked Waste Improvements Project.
- 2010 - Electrical Power Reliability Project.
- 2012 - Construct Solids Storage Pad.
- 2012 - 2015 - Wet Weather Improvements.
- 2013 - 2015 - Digester Mixing Improvements.
- 2015 - Influent Wastewater Pump Replacement Project.
- 2017 - 2022 - 12.6 mgd Expansion.
- On-going Odor Control Projects.

Tier II Projects

- 2030 - Construct Fourth Anaerobic Digester.
- 2030 - 2033 - Peak Flow Storage or Treatment.
- 2050 - 2055 - 5 mgd Expansion.
- 2050 - 2053 - Peak Flow Storage or Treatment.

1.7.3 Summary of Theresa Street WWTF Tier III Improvements

The planning level costs for the four alternatives identified to handle Tier III flows are outlined in Table 1.6 below. The costs of the alternatives range from $416,000,000 for Alternative 4 (Increased Storage and Expand the Theresa Street WWTF) to $441,000,000 for Alternative 1 (SW WWTF and Expand the Theresa Street WWTF). The difference between these costs is only 6 percent.

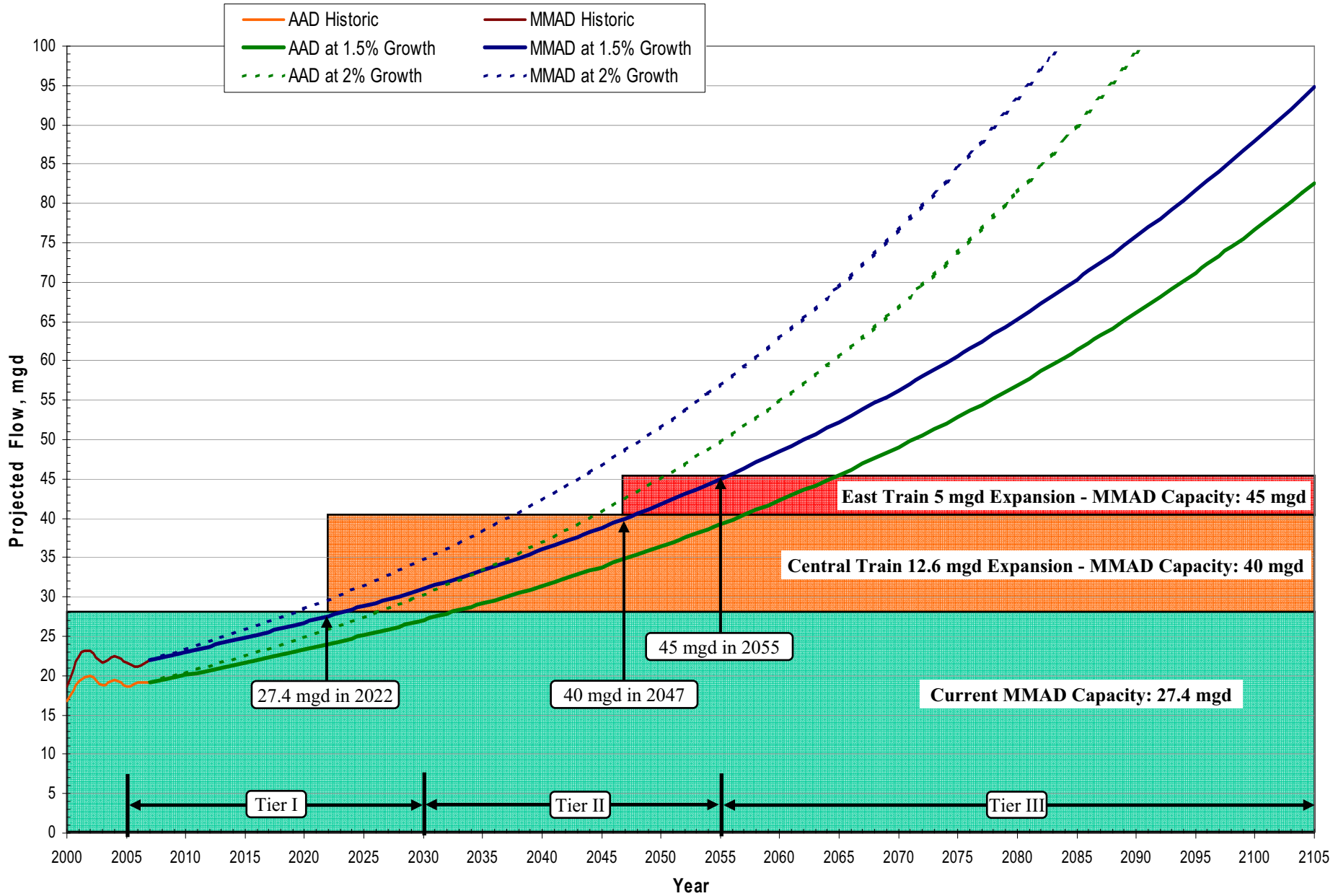

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Figure 1.10 Theresa Street WWTF Projected MMAD Flows
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1. Influent Pump Station / Headworks
2. Grit Removal Facilities
3. Primary Clarifiers
4. Recirculation Pump Station
5. Aeration Blower Building – Central Train
6. Pre-nitrification Basin
7. Aeration Basins
8. Final Clarifiers
9. Pre-Nitrification Basin
10. Solids Dewatering Building
11. Sludge Pumping Stations
12. Future Aeration Basins
13. Odor Control Facilities
14. Ultraviolet Disinfection Facilities
15. Chlorine Contact Basin
16. Digesters
17. Sludge Storage
18. Aeration/Solids Thickening Building
19. Scum Pump Building
20. Divisional/Administration Building
21. Main Electrical Switchgear Building
22. Collection System Operations and Maintenance Building
23. Electric Co-generation Building
24. Effluent Discharge Structure
25. Laboratory Building
26. Treatment Facility Maintenance Building
27. Liquid Waste / Grit Receiving Station
28. Liquid Waste / Septage Receiving Station
29. Future Primary Clarifier
30. Future Aeration Basin
31. Future Secondary Clarifier
32. Future Digester

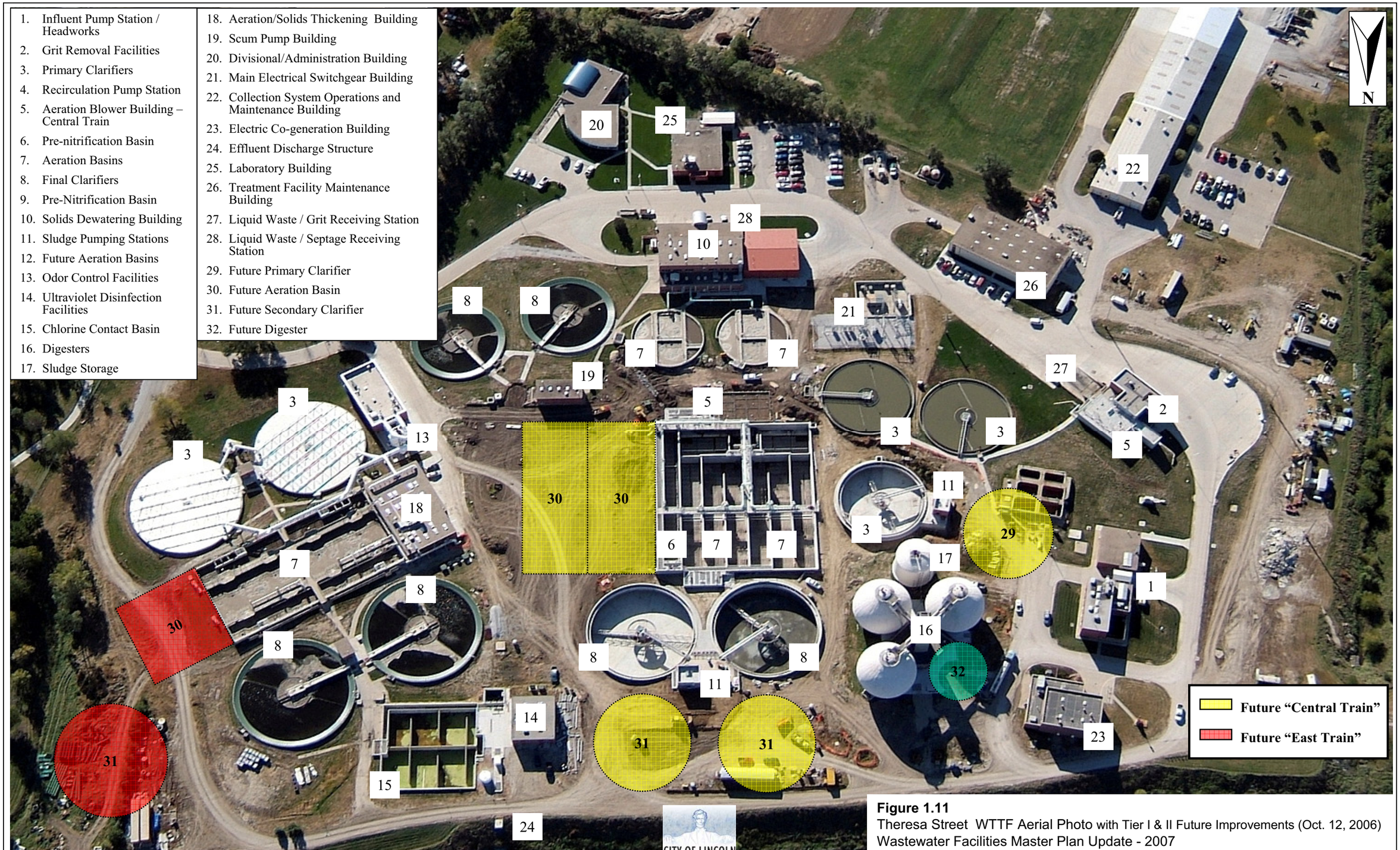

Figure 1.11
Theresa Street WTTF Aerial Photo with Tier I & II Future Improvements (Oct. 12, 2006)
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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The four alternatives identified for Tier III needs represent “equal” solutions with regard to handling Tier III flows. Additional alternatives and variations of the alternatives presented need to be considered in the future as the time and necessity for these improvements nears. For planning purposes, the costs for the alternatives presented are nearly equal since improvements are not needed for 50 years.

Table 1.6 Summary of Tier III Planning Level Costs Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska

Description	Planning Costs [1]
Alternative 1 - New SW WWTF	$441,000,000
Alternative 2 - West Side Sewer	$429,726,000
Alternative 3 - East Side Sewer	$427,910,000
Alternative 4 - Increased Storage	$416,000,000

Notes:
1. ENR CCI for Kansas City = 8512 (July 2006).

During the next 50 years, treatment technology will likely become more efficient, pipeline construction more water tight, and water conservation and I/I improvements more noticeable, all of which will influence the direction the City will take to handle Tier III flows. Emerging technologies such as the use of membrane bioreactors will likely be more common within the next 50 years. This technology requires a smaller footprint (less area) than that required by the current activated sludge process, and produces a very high quality effluent. If technologies such as membrane bioreactors are utilized, the Theresa Street WWTF may be capable of treating flows in excess of the 45 mgd using its existing tankage. Regardless, the configuration and treatment capacity of the Theresa Street WWTF, as well as the capacity of the trunk sewers and storage facilities should be periodically reviewed, updated, and modifications made as regulations change and as wastewater flows increase.

Alternative 4, “Increased Storage”, is the preferred alternative and is the basis for all improvements and calculations of the Wastewater Facilities Master Plan. The costs for this alternative are spread over a 20-year period starting in the year 2055.

1.8 NE WWTF IMPROVEMENTS

It is important to determine when the treatment facility expansions will be required in order to plan for future funding. A 2005-2006 MMAD flow of 6.5 mgd was used in flow projection calculations. The future growth of the drainage basins serving the Northeast WWTF is difficult to determine since most of the area is largely undeveloped at this time. Due to the

uncertainty in future growth, annual increases of 1.5-percent was used to develop flow projection curves for the Northeast WWTF as shown in Figure 1.12. Using a projected growth rate of 1.5 percent, which is consistent with the City Planning Department and past Master Plans, a 5.0 mgd expansion would be required in approximately 2036 with a second 5 mgd expansion around 2063. Projecting flows this far into the future is difficult at best. It is recommended that the City closely monitor the actual flows and continually update the planning as required for the next WWTF expansion. These expansions are also shown schematically in Figure 1.13. Specific improvements are outlined below.

1.8.1 Summary of NE WWTF Tier I, II, and III Improvements

Tier I Projects

- 2007 - Odor Control for the Thickened WAS Storage Facility.
- 2010 - Grit Removal Improvements.
- 2010 - 2018 -Northeast Wastewater Treatment Facility Expansion.
- 2011 - 2014 - Wet Weather Treatment Improvements.
- 2010 - 2015 - Electrical Power Reliability Project.
- 2012 - Expand the Solids Injection Site.
- 2022 - Replace the Rotary Drum Thickeners.
- On-going Odor Control Projects.

Tier II Projects

- 2025 - Peak Flow Storage or Treatment.
- 2031 - 2036 - 5 MGD Northeast Wastewater Treatment Facility Expansion.
- 2034 - Construct a Third Anaerobic Digester.

Tier III Projects

- 2055 - Peak Flow Storage or Treatment.
- 2058 - 2063 - 5 MGD Northeast Wastewater Treatment Facility Expansion.

1.9 EMERGING WWTF TECHNOLOGIES AND OTHER CONSIDERATION

The wastewater treatment industry is continually growing and improving. New technologies are emerging and being implemented on a continual basis to meet increasing regulatory requirements as well as to treat wastewater more efficiently.

Technologies that are currently being developed and in some cases implemented include membrane bioreactors, reverse osmosis, ultra filtration, pasteurization, sludge minimization technologies as well as others. In addition to liquid treatment, advances are being made in the solids handling and digestion processes. These include two phase digestion, pasteurization, and thermophyllic digestion.

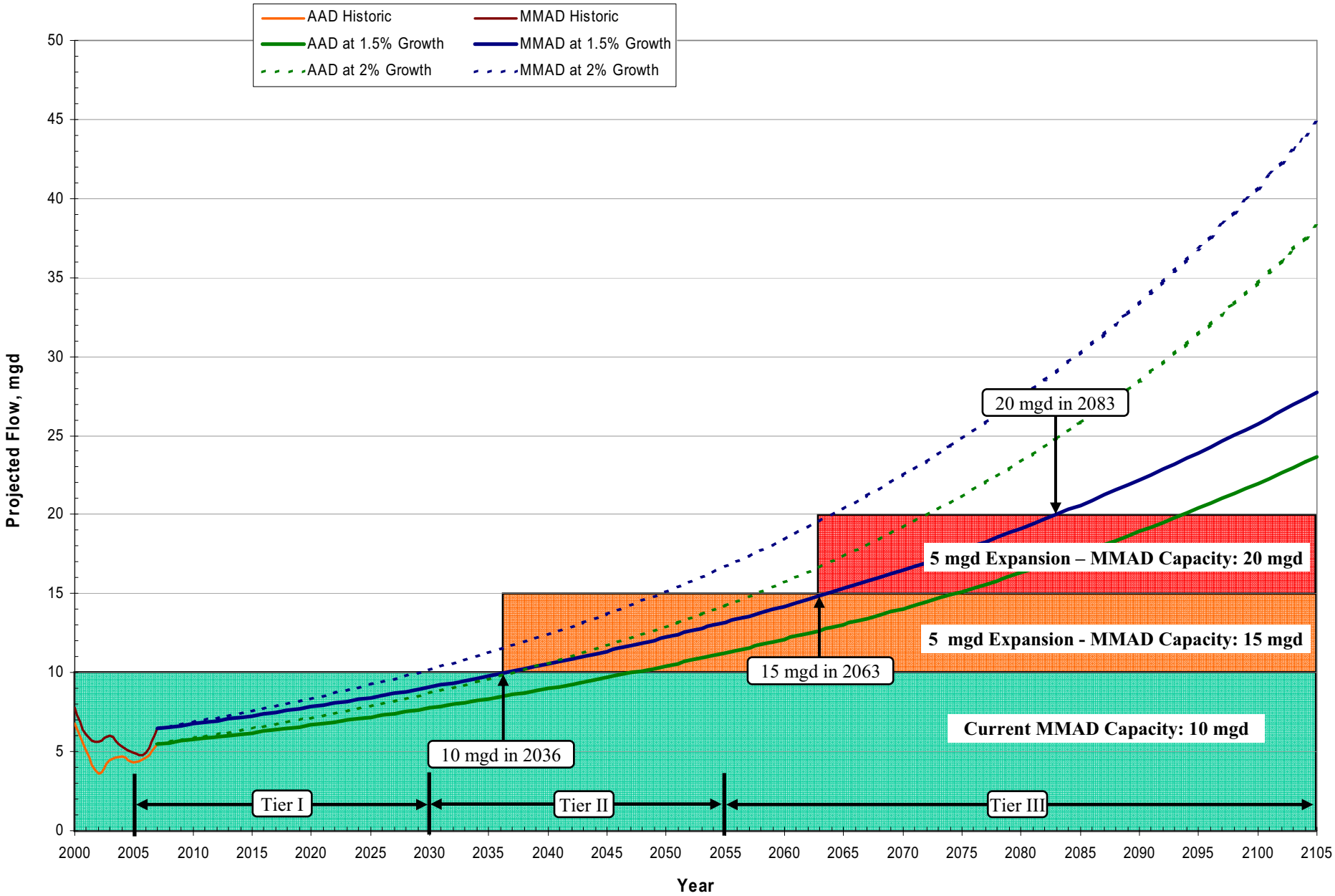

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Figure 1.12 Northeast WWTF Projected MMAD Flows
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City of Lincoln, Nebraska

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NOTES:

1. NOT ALL FUTURE FACILITIES SHOWN.

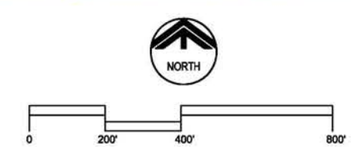

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Figure 1.13
Northeast WTTF Future Improvements
Wastewater Facilities Master Plan Update - 2007
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As the availability of high quality water becomes more valuable, the reuse of wastewater will become more economical. Water reuse is already being heavily used in the arid Southwest United States and in Florida. This reclaimed water is being used to irrigate parks, athletic fields, common grounds, and freeway landscaping.

Currently, LES is using treated water from the NE WWTF as cooling water. This trend of using reclaimed wastewater for industrial uses is expected to continue as the availability of water becomes more expensive and scarce, and the quality of the treated water increases.

Another process worth considering is the use of liquid only or “satellite” WWTF’s. These facilities are located in strategic areas where reclamation quality water is desired. These facilities are generally sized to produce a certain quantity of reclaimed water. The solids produced are then discharged back into the trunk sewer where they are treated at the larger facilities.

Two additional WWTF’s alternatives for the northern portion of the service area may have merit in the future as the City grows. The first WWTF alternative is to locate a WWTF in the northwest area of the City in the Oak Creek Basin. A WWTF in this area of the City may have advantages due to the large size of the Oak Creek Drainage basin and the capacity constraints that the Oak Creek Trunk Sewer will experience as the identified Tier II and Tier III (25 to 100 years) land areas are developed.

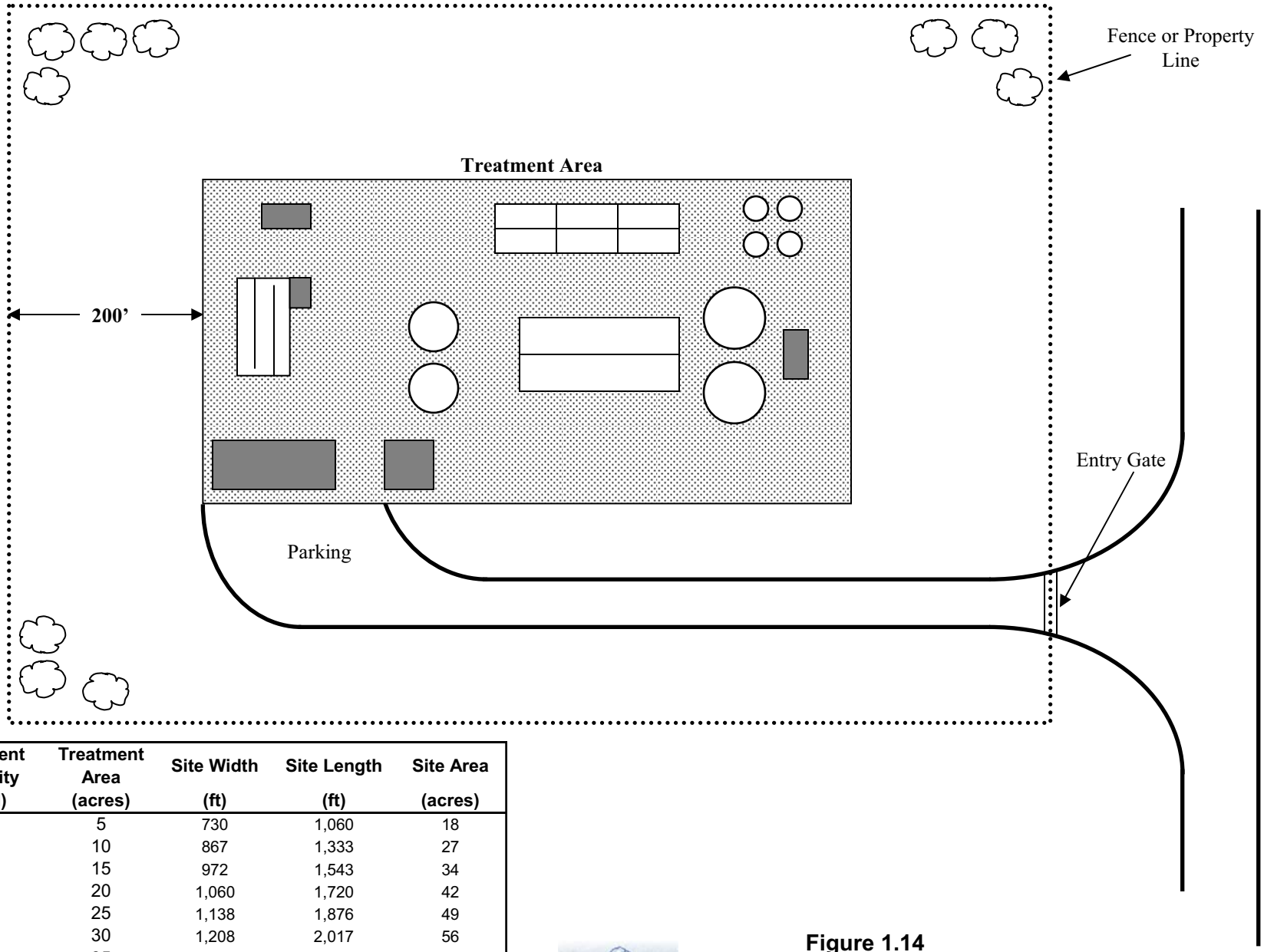
The second WWTF alternative is to explore a regional facility with the City of Waverly as the City grows to the east during the Tier III growth period (50 to 100 years).

A generalized planning level schematic site plan for WWTF’s is shown in Figure 1.14. Included in this figure are planning level land area requirements including minimum buffer zones. It should be noted that the actual size of the WWTF’s, land area requirements, and buffer zones should be determined based on detailed engineering and siting studies.

1.10 ADDITIONAL RECOMMENDATIONS

1.10.1 Collection System Operation and Maintenance

It is recommended that a 10-year collection system cleaning and videoing cycle be implemented. A 10 year cycle is typical for most large collection systems and is based on experience of achieving improved system performance from clean pipes, identifying repair needs earlier, and reducing major problems such as backups. In order to achieve a 10-year cycle for the current 978 miles of pipe in the system, assuming 35.5 miles per year per crew is kept the same, the current staffing need is 3 crews each for cleaning and videoing.



Treatment Capacity (mgd)	Treatment Area (acres)	Site Width (ft)	Site Length (ft)	Site Area (acres)
5	5	730	1,060	18
10	10	867	1,333	27
15	15	972	1,543	34
20	20	1,060	1,720	42
25	25	1,138	1,876	49
30	30	1,208	2,017	56
35	35	1,273	2,146	63

Notes:
1. One acre per mgd of treatment used for estimating land requirements.
2. Treatment area and site dimensions sized assuming 2:1 length to width ratio.
3. Site dimensions/area includes 200 ft buffer around treatment area.

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Figure 1.14
General Layout of WWTF Site
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1.10.2 Peak Flow Reduction

Reducing the peak flow will provide the City with the ability to serve the existing and future customers more efficiently. The reduction of peak flows not only extends the service area of the existing trunk sewers, but reduces impacts to the WWTF's as well. It is recommended that the City's current peak flow reduction programs be continued, and new opportunities be explored as they become available. These include:

- Continue to identify and reduce Inflow and Infiltration.
- Minimize and/or eliminate the discharge of foundation drains and sump pumps to the sanitary sewer system.
- Continue the service lateral repair program.
- Continue to encourage, and possibly require the use of low flow plumbing fixtures in all new construction.

1.10.3 Collection System Flow Monitoring Program

It is recommended that the collection system flow monitoring program not only continue, but be expanded. It is especially important that the flow monitoring program be in place when wetter than normal periods are realized. With this data in hand, the sanitary flow components as well as I/I flow components for individual basins and sub-basins can be determined. This information can then be used to model and evaluate the existing as well as proposed collection system components.

The City currently has the first step of the process in place, the basic flow monitoring program. The next step of the process is to expand and modify the program to collect flow data. The flow monitoring program should include flow monitoring sites for each major basin as well as larger sub-basins and sub-basins that have unique characteristic such as industrial facilities, institutional facilities, or are suspected of having unusually high I/I flow components. Temporary flow monitoring, routine data collection, and the collection of data during and after rainfall should also be part of the flow monitoring program. This program needs to be in place both during periods of dry weather flow as well as wet weather flow.

1.10.4 Hydraulic Modeling

It is recommended that the information from the recommended expanded flow monitoring program be used to develop future computer-simulated hydraulic models of the collection system. Modeling can provide a user with a variety of information, most importantly, the hydraulic capacity as it compares with peak flows imposed on the system. A model is only as good as the data it contains. Modeling protocol normally requires flow information in various forms including average, minimum, and peak base (dry-weather) flow; minimum, average, and seasonal peak infiltration; and inflow rate as it compares with selected design-level rainfall.

1.10.5 Industrial Pre-Treatment Program

It is encouraged that the City work with their 43 industrial dischargers and look for opportunities to reduce both the flows and loadings from these dischargers.

1.10.6 Wastewater Lift Stations

It is recommended that the City continue to fund an aggressive repair and replacement program to keep the wastewater lift stations in good operating condition. As the collection system grows, and improvements are made, opportunities for the elimination or combining of lift stations should be explored.

1.11 CIP - PLANNING LEVEL COSTS

The costs presented for the identified treatment and collection system improvements are based on assumptions outlined in Chapter 7, adopted from the current City CIP, or developed based on recent bid tabulations. The costs shown are for planning purposes only and should be confirmed based on more detailed engineering and design as projects are developed.

1.11.1 Collection System

A number of improvements have been identified for the collection system as outlined in Chapters 10 through 22. The pipeline alignments identified herein were based on existing GIS data including contours and streams, and were developed for planning purposes only. A summary of the collection system capital costs is outlined in Table 1.7. Shown graphically in Figure 1.15 are the planning level costs for the improvements based on 2006 dollars as well as costs based on an annual inflation rate of 3-percent.

1.11.2 Wastewater Treatment Facilities

Several improvements have been identified for the Theresa Street and NE WWTF's as outlined in Chapter 24. A summary of these costs is outlined in Table 1.8. Shown graphically in Figure 1.16 are the planning level costs for the improvements based on 2006 dollars as well as costs based on an annual inflation rate of 3-percent.

1.11.3 Combined Total Costs

Shown in Table 1.9 and Figure 1.17 are the combined planning level costs for the collection system as well as the wastewater treatment facilities for all of the improvements identified in this Master Plan Update.

Table 1.7 Summary of Collection System Improvement Costs [1]
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Basin	Tier I	Tier II	Tier III	Basin Total
Salt Valley	$9,300,000	$6,000,000	-	$15,300,000
Antelope Creek	$750,000	-	-	$750,000
Beal Slough	$9,530,000	-	-	$9,530,000
Upper SE Salt	$11,691,000	$4,430,000	-	$16,121,000
Upper SW Salt	$19,020,000	$38,510,000	$11,950,000	$69,480,000
Haines Branch	$15,840,000	$18,810,000	$8,650,000	$43,300,000
West 'O' & Middle Creek	$21,620,000	$31,880,000	$22,400,000	$75,900,000
Oak Creek & Lynn Creek	$16,820,000	$20,670,000	$57,330,000	$94,820,000
Little Salt Creek	$2,470,000	$10,180,000	$7,230,000	$19,880,000
Deadmans Run, East Campus, Havelock	-	-	-	-
Northeast Salt	$14,260,000	$13,710,000	$34,260,000	$62,230,000
Stevens Creek	$81,530,000	$68,750,000	$24,820,000	$175,100,000
Southeast			$21,540,000	$21,540,000
Total	**$202,831,000**	**$212,940,000**	**$188,180,000**	**$603,951,000**

Notes:
1. ENR CCI for Kansas City 8512 (July 2006).

Table 1.8	Summary of Wastewater Treatment Facility Improvement Costs [1,2] Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska			
Basin	**Tier I**	**Tier II**	**Tier III**	**Total**
Theresa Street WWTF	$133,369,000	$81,000,000	$416,000,000	$630,369,000
Northeast WWTF	$37,504,000	$25,000,000	$60,000,000	$122,504,000
Total	**$170,873,000**	**$106,000,000**	**$476,000,000**	**$752,873,000**

Notes:
1. ENR CCI for Kansas City 8512 (July 2006).

Table 1.9	Total of Collection and WWTF Improvements Costs [1,2] Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska			
	Tier I	**Tier II**	**Tier III**	**Total**
Total	**$373,704,000**	**$318,940,000**	**$664,180,000**	**$1,356,824,000**

Notes:
1. ENR CCI for Kansas City 8512 (July 2006).

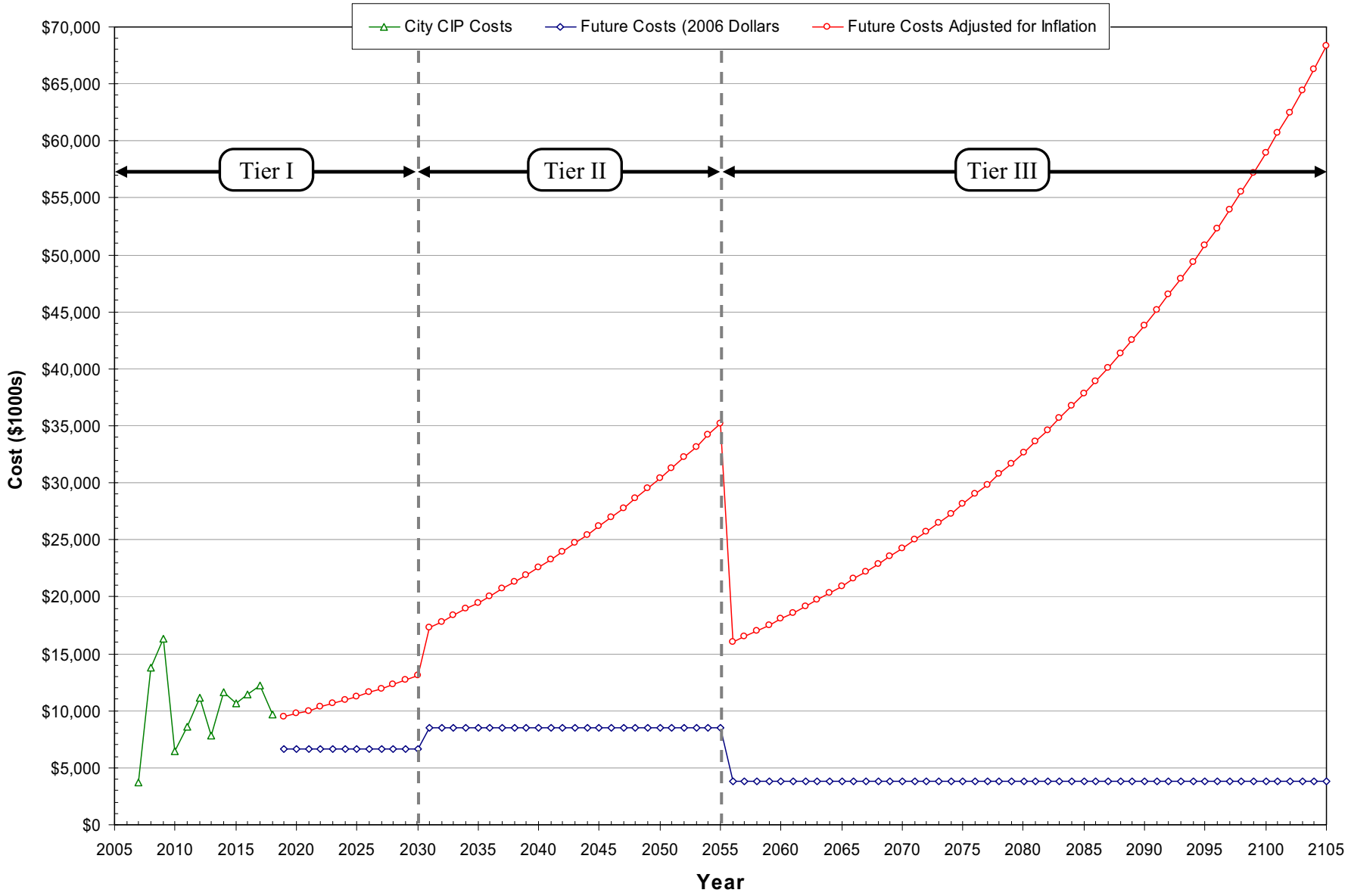

Figure 1.15
Annual Cost of Collection System Improvements
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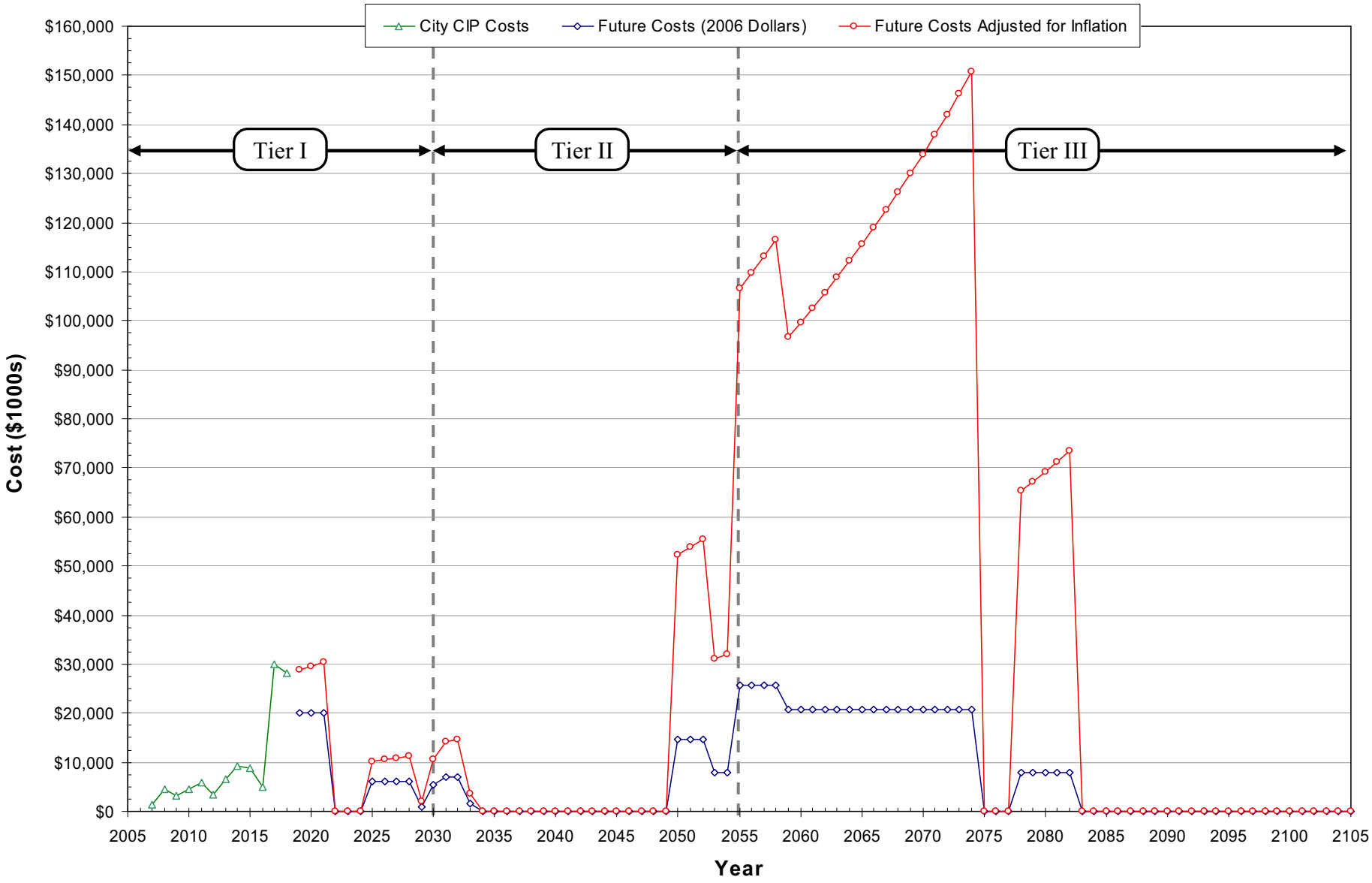

Figure 1.16
Annual Cost of Theresa Street & Northeast WWTF Improvements
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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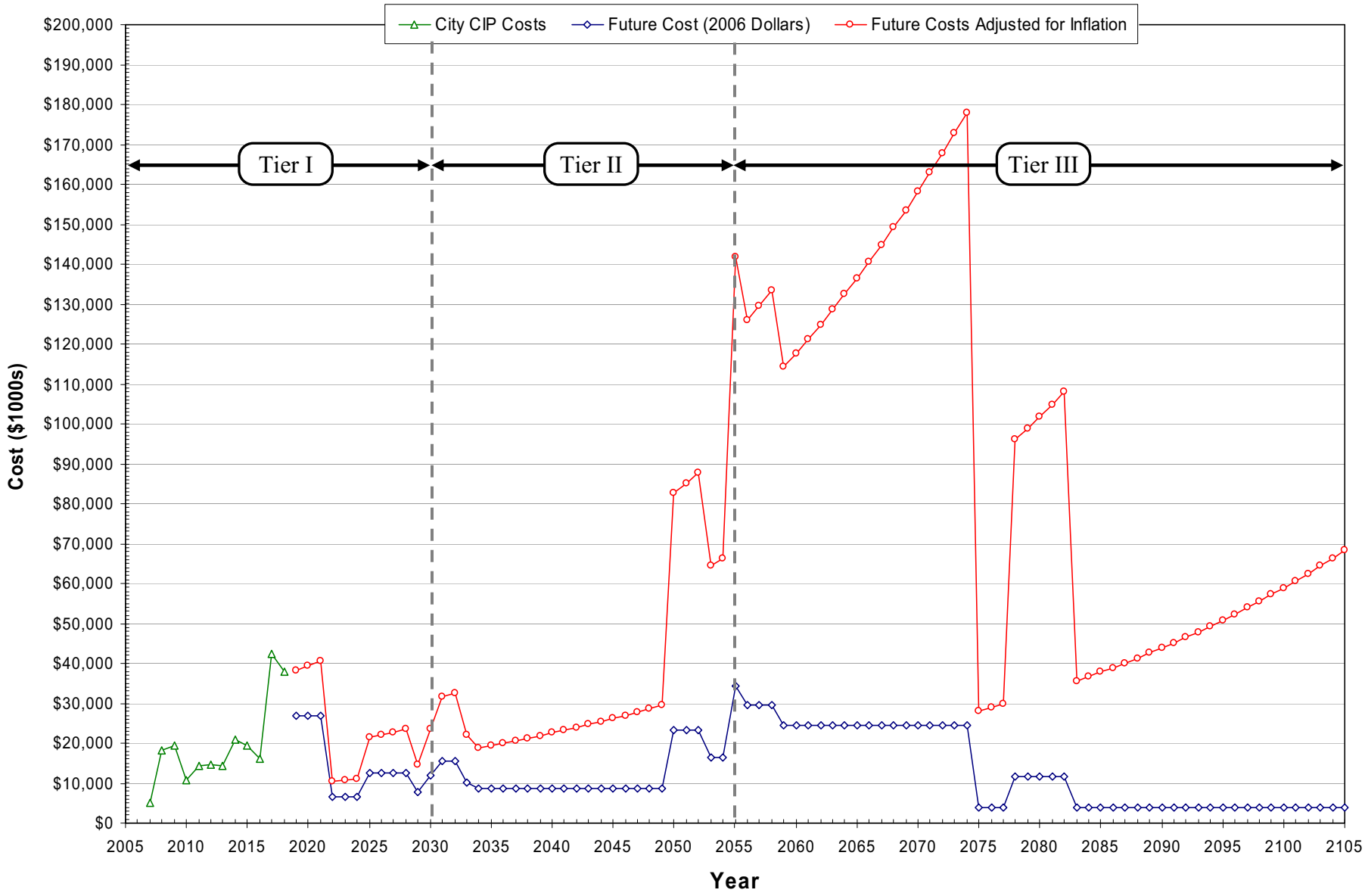

Figure 1.17
Summary of Annual Costs of Improvements
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