Chapter 2

INTRODUCTION

2.1 SCOPE OF THIS MASTER PLAN UPDATE

In 2007 the City of Lincoln, NE, approved a Master Plan and CIP update. As part of that work the complete collection system was modeled using XP-SWMM in the full dynamic mode. Since that time the City has performed additional flow monitoring in the collection system, and completed certain CIP projects in the collection system and at the wastewater treatment plants.

The scope of this Master Plan Update is not to perform an all encompassing City wide Master Plan Update as completed in 2007, but to focus on specific areas where changes or improvements have been made. The specific areas that will be updated are as follows:

• Update growth projections and flows.
• Update the write up on the existing wastewater treatment plants to include recent improvements.
• Summarize nutrient removal strategies used in neighboring states and potential nutrient removal requirement for the City of Lincoln, NE.
• Discuss the potential for green energy by increasing the volatile solids loading in the digesters at the Theresa Street WWTF by accepting FOG and industrial waste.
• Update the dynamic hydraulic model of the collection system with the updated flow monitoring data.
• Re-evaluate the need for and timing of storage in the collection system based on the new flow monitoring data.
• Based on the new flow data update the evaluation for the Salt Valley Trunk Sewer System.
• Due to the updated hydrographs and the CIP projects completed, update the Stevens Creek Trunk Sewer evaluation.
• Update the Deadmans Run Trunk Sewer with the new Regent Heights sewer connection to the Stevens Creek Basin Trunk Sewer.
• Update the storage requirements for the Southwest Salt Creek Basin based on the new flow data.
• Update the Lift Station evaluation to include the newly completed improvements.
• Update the CIP.
2.2 REASONS FOR UPDATING THE MASTER PLAN

The City of Lincoln last updated their Wastewater Facilities Master Plan in 2007. Since that time the City’s population has continued to grow, but at a slower rate than anticipated in 2007. Since the growth rate has slowed, the improvements planned in the 2007 update may no longer be needed, or may be postponed for several years until the flows dictate the need for the improvements. Since the last facilities plan update there have been improvements made to the wastewater treatment and collection systems that may 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. The ever changing impacts that new and proposed regulations have on the facilities will also be factored into the evaluation to determine future needs.

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.

Generally, the information contained in this update will be used for general planning, identifying capital improvement projects, asset management, and as an aid in determining funding requirements.

2.3 2040 COMPREHENSIVE PLAN

This updated Wastewater Facilities Master Plan has been developed in conjunction with the 2040 update of the Lincoln/Lancaster County Comprehensive Plan. Consistent with previous studies, the Comprehensive Plan has identified three tiers of growth for the City of Lincoln.

Tier I reflects the future service area where wastewater services are anticipated by 2040. Tier I areas currently encompass an area of 36,542 acres which could generally expect service by the year 2040. The Tier I areas are those that are generally contingent with the existing City boundaries and development. Tier I areas are to be developed before 2040 and are divided into three sub tiers which include Tier IA, IB, and IC. Tier IA areas are in the planning stages for development or are planned to be developed in the near future (2020) and encompass 14,791 acres. Tier IB areas are those areas that are planned to be developed by the year 2025 and encompass 11,213 acres. Finally, Tier IC areas are planned to be developed by year 2040 and encompass 10,538 acres. Tier II areas encompass approximately 21,634 acres and are generally located further from the existing City service area. Tier II represents a potential longer term growth area and are planned to be completely developed by the year 2060. Tier III areas are currently identified as approximately 83,608 acres. Services in these areas are only considered in this update as future long term growth starting in 2060 with full development in 100 years from the present (approximately 2110). Therefore, the improvements and recommendations identified for
Tier I areas will be in greater depth than those in Tier II areas. Likewise, the improvements identified for Tier III areas will be considered conceptual, and be of less detail than those identified for Tier II.

2.4 FACTORS THAT AFFECT FACILITIES PLANNING

Since the completion of the 2007 Wastewater Facilities Plan Update, a number of factors that affect the planning and design of improvements to the wastewater systems have been identified.

2.4.1 Population Growth

The City of Lincoln population has historically increased over time. Although the growth rate has slowed over the last few years, growth is expected to continue for the foreseeable future. It is envisioned that this growth will tax existing wastewater collection and treatment systems at some time in the future. The intent of this update is to identify the improvements needed to accommodate the anticipated growth for the planning periods.

2.4.2 Regulatory Changes

Regulations that affect the operation and maintenance of wastewater collection and treatment systems are continually being updated and modified to meet changing conditions. These changes in regulations have a direct impact on the level of future treatment required and the quality of the discharged effluent and other byproducts generated by the treatment process. Regulations that impact the collection and treatment of wastewater are addressed in more detail in Chapter 6.

2.4.3 Condition and Age of Facilities

The City’s wastewater collection system dates back to 1888 when the first sanitary sewer lines were installed in the Lincoln area. The older sections are considered to be outdated with respect to materials of construction and current construction techniques. Replacement and/or rehabilitation of less than 1.0-percent of the existing older lines, and other lines in need of replacement/repair currently occurs on an annual basis. Increasing the amount of funding for additional replacement and rehabilitation of older and critical lines may be necessary to provide reliable service and to minimize the quantity of extraneous Infiltration and Inflow (I/I) that enters the system.

The original wastewater treatment facilities were constructed at the current Theresa Street site in 1923. The system was upgraded and expanded in the 1940’s to include the trickling filter process. Subsequent expansions in 1966 and 1973 added the west side and east side activated sludge treatment trains. Most recently in the year 2007 the WWTF was expanded to include nitrification which resulted in the AAD capacity of the treatment facility to 27 mgd.
The Northeast WWTF was placed into service in 1981. In 2004, the facility was expanded to bring the total average daily capacity of the WWTF to 10 mgd.

2.5 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 to 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.

2.6 IDENTIFIED IMPROVEMENTS

Because future growth details such as the location of roads and other features are not known at this time, the facilities plan update addresses future wastewater collection and treatment needs in a general way. For example, identified extensions to the trunk sewer system are generally shown following the natural drainage such as creeks and streams. As development proceeds into specific areas, the actual physical characteristics and final locations of the wastewater collection system will need to be determined and finalized through additional detailed engineering and siting studies.

2.7 RELATED STUDIES, REPORTS, AND DOCUMENTS

During the course of preparing this update, several related studies, reports, memorandums, improvement plans, and other documents were prepared for the City of Lincoln, were used, referenced and incorporated into this work. The following list includes, but is not limited to the documents that were incorporated into the preparation of this update:

1. Lincoln Wastewater System Sewer System management Plan, 2013, Carollo Engineers.
15. Final Design Memorandum, Middle Creek Drainage Basin and West ‘D’ Street Lift Station Trunk Sewers, Kirkham Michael & Associates.
17. West Salt Creek Trunk Sewer Alignment Study Report, August 2007, Black & Veatch and Olsson Associates.
20. Solids Handling and Processing Improvements at Northeast WWTF Technical Memorandum’s 1, 2, and 3, HDR Engineering, Inc.
21. Study and Evaluation of Solids Treatment and Handling at the Theresa Street and Northeast Wastewater Treatment Facilities, January 2007, HDR.
22. Design Memorandum, NE WWTF Nitrification Improvements, October 2003, Black & Veatch.
24. Memorandum, Theresa Street WWTF Flood Storage Evaluation (Draft), July 28, 2007, CDM.
25. Theresa Street WWTF Odor Abatement Study.
27. Other, numerous Collection System and Wastewater Treatment Facility Improvement Project Plans and Reports.
2.8 GENERAL TERMINOLOGY

The following terms and abbreviations are of special interest and are used throughout this report. It should be noted that this is not a complete list and that there are other abbreviations that are used in this document as well as those used to identify City facilities.

2.8.1 Facilities

Northeast Wastewater Treatment Facility (Northeast WWTF). The Northeast WWTF is a 10.0 mgd activated sludge treatment plant located near Cornhusker Highway and 70th Street.

Theresa Street Wastewater Treatment Facility (Theresa Street WWTF). The Theresa Street WWTF is a 27 mgd activated sludge treatment plant located near the intersection of 27th Street and Theresa Street.

Wastewater Treatment Facility (WWTF). A WWTF is a wastewater treatment facility where the wastewater undergoes a series of physical, biological and/or chemical treatment processes required to meet the facilities discharge requirements.

2.8.2 Wastewater Flow

Annual Average Daily Flow (AAD) - The average daily flow that passes through a facility on an annual basis is expressed as the annual average daily flow (AAD).

Gallons per Capita per Day (gpcd) - The average wastewater yield per person per day.

Maximum Month Average Day (MMAD) - The maximum month average day flow is the average daily flow rate for the month of maximum wastewater flow.

Million Gallons per Day (mgd) - The amount of flow expressed in millions of gallons per day.

Peak Daily Flow (PDF) - The peak daily flow represents the maximum flow rate entering the WWTF during a single day.

Peak Hourly Flow (PHF) - The maximum flow entering the WWTF during any one hour period.

Infiltration and Inflow (I/I) - Infiltration is groundwater that enters the collection system through leaking pipes or manholes. Inflow is the extraneous surface water that enters into the system though leaking manhole covers, roof drains, and similar sources.

Rainfall Dependent Infiltration and Inflow (RDII) - RDII is the inflow and infiltration that is attributed to precipitation events.

Peak Wet Weather Flows (PWWF) - Peak wet weather flows are extremely high flows that occur in conjunction with an unusually large precipitation event.
Sanitary Sewer Overflow (SSO) - Situation where conveyed wastewater in sanitary sewer collection systems overflows. This generally occurs at manholes and junction structures, but can occur at other locations.

2.8.3 Wastewater Constituents

Five Day Biological Oxygen Demand (BOD₅) - One factor defining wastewater strength is its five day biochemical oxygen demand (BOD₅). BOD₅ is described as the amount of oxygen required over a five-day period at 20°C by bacteria while stabilizing decomposable organic matter under aerobic conditions.

Carbonaceous Biological Oxygen Demand (CBOD) - A measure of the carbon-containing substances remaining in wastewater that may exert a demand for oxygen when released into a stream.

Chemical Oxygen Demand (COD) - The COD is used to measure the strength of the wastewater. To determine the amount of oxygen required to stabilize the waste the organic matter is converted to carbon dioxide and water under acidic conditions.

Total Suspended Solids (TSS) - TSS is defined as the amount of suspended material in the wastewater.

Total Kjeldahl Nitrogen (TKN) – TKN represents the combination of organic nitrogen and ammonia that is present in the influent wastewater.

Ammonia (NH₃) – NH₃ is a wastewater parameter that is measured both on the influent and effluent.

Nitrate (NO₃) – When NH₃ is aerated (oxidized) under aerobic conditions in the wastewater treatment facility it is converted to NO₃. NO₃ may further be reduced to nitrogen gas (N) in anoxic conditions.

Phosphorus (P) – P is another important parameter used to characterize the wastewater. Orthophosphates and polyphosphates are the primary compounds of interest in water quality and wastewater treatment facility design and operation.

2.9 WASTEWATER AND SOLID WASTE ORGANIZATION

The City of Lincoln’s Wastewater Division is under the Public Works Department and is responsible for all aspects of operating and maintaining the sanitary sewer collection system and wastewater treatment facilities. The Wastewater Collection Section is under the Wastewater Division and is responsible for maintaining, repairing, and operating the City’s sanitary sewer collection system. Shown in Figure 2.1 is the Organizational Chart.
2.10 ACKNOWLEDGMENTS

The Lincoln Wastewater System (LWWS) was an integral partner in the development of this Wastewater Facilities Master Plan Update. To that end acknowledgments are given to:

1. Mr. Gary Thalken, Sanitary Engineer.
2. Mr. Brian Kramer, Superintendent of Wastewater Collection.
3. Mr. Steve Crisler, Superintendent of Water Pollution Control.
4. Mr. Bradley Barber, Assistant Supt. of Operations.