

5.0 Improvement Plan for 4,450 Acres (Existing and Tier I Areas)

This section presents the improvement plan for the basin area at 4,450 acres upstream of MH AA6-68. This improvement plan relates to areas identified in the Lincoln/Lancaster County 2025 Comprehensive Plan as Existing and Tier I. This section incorporates the information identified in the Findings and Evaluation of Investigations in the Project Area Section and the Summary of Alignment Studies and Trunk Sewer Evolution Section. This section also includes the applicable standards and guidelines for sewer design, sewer service areas, design flows and sewer modeling, construction methods and materials, and project approval requirements for the improvement plan for 4,450 acres of development.

5.1. Applicable Standards and Guidelines

The basis of design for the improvement plan (4,450 acres) will utilize the following standards and guidelines:

- City of Lincoln Standard Plans and Specifications.
- Recommended Standards for Wastewater Facilities, Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers (10 States Standards).

5.2. Sewer Services Areas (Development Areas)

The Tier I service areas identified in the *Lincoln Wastewater Facilities Plan Update* (April 2003, by Brown and Caldwell) were used as the basis for service areas for the preliminary evaluations. This document indicates an existing basin acreage served of 3,661 acres with an additional 2,961 acres served in Tier I, for a total of 6,622 acres.

The basin areas were reevaluated utilizing the recent 2025 Lincoln/Lancaster County Comprehensive Plan amendment for the Airport West Subarea Plan. The existing, Tier IA, and Tier IB development areas are indicated in Figure 1-1 and in Table 5-1. The existing collection system is illustrated on Figure 4-1.

	West of Oak Creek (acres)	East of Oak Creek (acres)	Basin Total (acres)
Existing Areas	1,550	1,305	2,855
Tier IA	195	322	517
Tier IB	725	353	1,078
Total	2,470	1,980	4,450

5.3. Design Flows and Sewer Modeling (Existing and Tier I)

The City of Lincoln standard wastewater flow generation equation that is used to estimate design flows is:

$$Q = [0.01726 * (A^{0.8})] + [0.003 * A]$$

Where: Q = Peak Design Flow (cfs)

A = Total Acres (acres)

Additional sewer sizing parameters are summarized in Table 5-2.

Design d/D	1.00
Determination of Area, A	Gross acreage excluding aggregate area in excess of 50 acres of public or private park lands, golf courses, cemeteries, or dedicated open space
Adjustments to Q	Potential adjustment due to commercial or industrial peak flows.
Minimum diameter	8 inches
Manning's "n"	0.013
Slope	Ten States Standards

The areas from Figure 1-1 were cumulated for the Model Nodes indicated in Table 5-3 for the existing trunk sewer to reflect “Existing Service Areas” and “Tier I Service Areas” for the West Side of Oak Creek to MH AA7-23 (West Mathis Street west of the siphon), East Side of Oak Creek to MH AA7-21 (West Mathis Street east of the siphon), and Oak Creek Trunk Sewer from MH AA6-68 to the Theresa Street WWTF. The areas (acres) were then converted into flow (cfs) and modeled with SWMM Version 5 using surveyed manhole invert and rim elevations. The results of the modeling of the existing collection system are illustrated on Figure 4-2: Existing Sewer Capacities. The Model Node locations for the existing sewer are indicated in Appendix E.

The Kawasaki manufacturing facility’s flow contribution was determined to be 0.3 cfs based on historic flow information compiled by LWWS. This flow condition was used as a basis of input into the sewer model versus using 166 acres (1.5 cfs) for the area of the facility.

Table 5-3: Hydraulic Model Inputs for Existing Oak Creek Basin

West Side of Oak Creek to MH AA7-23									
Model Node	Input Designations	Existing Service Area Input (acres)	Existing Service Area Input (cfs)	Existing Service Area Total (acres)	Existing Service Area Total (cfs)	Tier I Service Area Input (acres)	Tier I Service Area Input (cfs)	Tier I Service Area Total (acres)	Tier I Service Area Total (cfs)
AA8-126	P-4 E-10	60	0.6	60.0	0.6	60	0.6	60.0	0.6
AA8-33	P-3 E-10	347	3.3	407.0	3.3	347	3.3	407.0	3.3
AA7-226	E-9	360	5.2	767.0	5.8	360	5.2	767.0	5.8
	E-8	0	0.0	767.0	5.8	0	0.0	767.0	5.8
AA7-26	E-11	91	0.6	858.0	6.4	91	0.6	858.0	6.4
AA7-271	E-12	246	1.6	1104.0	8.0	341	2.2	1199.0	8.6
BB7-11	E-13	76	0.5	1180.0	8.5	670	4.1	1869.0	12.8
AA7-23	E-14	370	2.3	1550.0	10.8	601	3.6	2470.0	16.3
	Total	1550				2470			

East Side of Oak Creek to MH AA7-21									
Model Node	Input Designations	Existing Service Area Input (acres)	Existing Service Area Input (cfs)	Existing Service Area Total (acres)	Existing Service Area Total (cfs)	Tier I Service Area Input (acres)	Tier I Service Area Input (cfs)	Tier I Service Area Total (acres)	Tier I Service Area Total (cfs)
AA8-174	E-7 & E-6C	387	3.2	387.0	3.2	387	3.2	387.0	3.2
AA9-114	E-6D	0	0.0	387.0	3.2	675	4.5	1062.0	7.7
AA8-171	E-6B	121	0.9	508.0	4.0	121	0.8	1183.0	8.5
AA8-165	E-6A	52	0.4	560.0	4.4	52	0.3	1235.0	8.8
AA8-164	E-5 & Orange-2	319	2.1	879.0	6.5	319	2.0	1554.0	10.8
AA8-158	E-4	177	1.1	1056.0	7.7	177	1.1	1731.0	11.9
AA7-244	E-3	138	0.9	1194.0	8.6	138	0.8	1869.0	12.8
AA7-21	R3 & R2	111	0.7	1305.0	9.3	111	0.7	1980.0	13.4
	Total	1305				1980			

Trunk Sewer (MH-68 to Theresa Street WWTF)									
Model Node	Input Designations	Existing Service Area Input (acres)	Existing Service Area Input (cfs)	Existing Service Area Total (acres)	Existing Service Area Total (cfs)	Tier I Service Area Input (acres)	Tier I Service Area Input (cfs)	Tier I Service Area Total (acres)	Tier I Service Area Total (cfs)
			2855.0	2855.0	18.6		4450.0	4450.0	27.7
A6-209	Existing Inputs	112	0.6	2967.0	19.2	112	0.6	4562.0	28.3
A6-208		66	0.4	3033.0	19.6	66	0.4	4628.0	28.7
A6-204		467	2.7	3500.0	22.3	467	2.6	5095.0	31.2
A6-197		176	1.0	3676.0	23.3	176	1.0	5271.0	32.2
A6-194		842	4.7	4518.0	28.0	842	4.6	6113.0	36.8
A6-190		20	0.1	4538.0	28.2	20	0.1	6133.0	36.9
B6-323		689	3.8	5227.0	32.0	689	3.7	6822.0	40.6
B6-280		115	0.6	5342.0	32.6	115	0.6	6937.0	41.2
B6-265		1733	9.4	7075.0	42.0	1733	9.2	8670.0	50.4
B6-284		59	0.3	7134.0	42.3	59	0.3	8729.0	50.7
B6-289		289	1.5	7423.0	43.8	289	1.5	9018.0	52.2
	Total	4568				4568			

5.4. Sewer Replacement Evaluation

The proposed sewer alignments identified in Figure 4-3 were modeled with SWMM to verify the flow conditions in the sewer were capable of meeting the Existing and Tier I flow conditions. Table 5-4 lists the hydraulic model inputs for the 4,450 acre (Tier I) flow conditions. The model nodes for the proposed sewer alignments are indicated in Appendix E.

Segment E-3 has a capacity of 2.45 cfs. Based on existing modeling, surcharging is currently occurring in the sewer during peak flow rates. The surcharging is limited to the transition from E-4. As further development occurs in the northern part of the basin, the surcharging may become problematic. Segment E-3 requires a replacement sewer of 36 inches to convey the Existing and Tier I flow condition provided Segments R-1 and R-2 are constructed prior to E-3. If E-3 is constructed prior to R-1 and R-2, then E-3 will require a replacement sewer of 42 inches to convey the flow.

Segment E-2 is flow restricted because of negative slopes as the sewer crosses the existing 84 inch storm sewer near NW 38th Street along West Mathis Street. Segment E-2 will be replaced with a new 48 inch trunk sewer (Red-1) that extends west from MH 68 and along the north side of Oak Creek to a proposed Siphon south of West Mathis Street. The sewer will then split into a 42 inch trunk sewer (Red-2) to convey flows from E-3 and a 36 inch trunk sewer (Pink-1), which is located on the west side of the new siphon.

The existing siphon across Oak Creek south of West Mathis Street does not effectively function in the basin. Routine maintenance of the structure is required to prevent surcharging of the collection system to the west of the siphon. Replacement of the existing siphon with a new siphon structure would necessitate replacement of Segment E-2 with Red-1, Red-2, and Pink-1. The effective capacity of the siphon could be increased with the addition of a 24 inch barrel and reconfiguration of the existing siphon structure. This would allow for increased capacity and delay of segments R-1 and R-2 to better correspond with the existing CIP plan.

Segment E-2 east of NW 38th Street to Manhole 68 will remain in service to convey flows from the existing 40 acres of development located at NW 38th Street and West Mathis Street. Alternatives for conveyance of this area to the new Red-2 would require a 24 inch sewer because of grade limitations. Alternatives for paralleling and replacing Segment E-2 are discussed in Section 7 - Additional Study of Sewer Alternatives along West Mathis Street.

Table 5-4: Hydraulic Model Inputs for Proposed System Flows

West Side of Oak Creek to the Proposed Siphon					
Model Node	Input Designations	Future Service in West Input (acres)	Future Service in West Input (cfs)	Future Service in West Total (acres)	Future Service in West Total (cfs)
P3-379+09	Pink-4 (E-10)	60	0.6	60.0	0.6
P2-P3-375+65	Pink-3 (E-10)	347	2.7	407.0	3.3
P2-P3-343+25	Pink-2 (E-9)	360	2.5	767.0	5.8
P1-P2-312+57	E-11 & E12 & E13	1102	6.9	1869.0	12.8
P1-304+11	E-14	601	3.6	2470.0	16.3

East Side of Oak Creek to West Mathis Street					
Model Node	Input Designations	Future Service in West Input (acres)	Future Service in West Input (cfs)	Future Service in West Total (acres)	Future Service in West Total (cfs)
O2-287+57	Orange-2	225	2.0	225.0	2.0
O1-O2-249+79	E-6 A-D & E-7	1235	8.3	1460.0	10.2
O1-O2-246+19	E-5/Orange-1	94	0.6	1554.0	10.8
Y1	E-4/Yellow-1	177	1.1	1731.0	11.9
E1-Y1-186+63	E-3	138	0.8	1869.0	12.8
R2-E1-158+02	R-3	40	0.2	1909.0	13.0

Trunk Sewer (MH-68 to Theresa Street WWTF)					
Model Node	Input Designations	Future Service in West Input (acres)	Future Service in West Input (cfs)	Future Service in West Total (acres)	Future Service in West Total (cfs)
			27.3	4379.0	27.3
A6-209	Existing Inputs	112	0.6	4491.0	27.9
A6-208		66	0.4	4557.0	28.3
A6-204		467	2.6	5024.0	30.8
A6-197		176	1.0	5200.0	31.8
A6-194		842	4.6	6042.0	36.4
A6-190		20	0.1	6062.0	36.5
B6-323		689	3.7	6751.0	40.2
B6-280		115	0.6	6866.0	40.8
B6-265		1733	9.2	8599.0	50.0
B6-284		59	0.3	8658.0	50.4
B6-289		289	1.5	8947.0	51.9

Segment 6c and 6d west of Kawasaki consists of a 15 inch sewer that transitions to an 18 inch sewer at Manhole A9-114. The 15 inch sewer is only capable of conveying flows from 402 acres as indicated in Figure 4-7. Tier I contributions north of Highway 34 requires flows from 675 acres (Figure 1-1) to be conveyed; therefore, the 15 inch sewer will either have to be paralleled or pipe bursted to convey the additional flow. The timing for this parallel/pipe bursting will have to coincide with any planned development. The required sewer size for parallel/pipe bursting is a minimum of 18 inches as indicated in Figure 4-8.

Segments E-4 and E-5 have sufficient capacity to convey the “Developed Areas” through 2017 and 2018. Yellow-2 and Orange-1 will be constructed to provide parallel relief for these sewers when their capacity is reached.

Segments E-9 and E-10 parallel NW 44th Street from West Mathis Street to north of West Cumming Street and the existing lift station. These sewers were installed in the 1940s at a shallow depth and have deteriorated significantly. Repair/slip lining of the sewers is not an option because of their condition. In addition, the proposed Airpark West Master Plan has identified the removal of NW 44th Street for construction of new commercial/industrial facilities. These facilities will necessitate the complete removal/abandonment of the sewer. A new sewer (Pink-2, 3, and 4) will parallel NW 42nd Street at a minimum slope to allow for gravity service north of Oak Creek and abandonment of the existing lift station. The timing for Pink 2, 3, and 4 will be dependant on development within the project area.

Phase	Existing Segment	Proposed Replacement	Capacity (cfs)	“Existing Areas” Replacement Date	“Developed Areas” Replacement Date
1	E-3	E-3	2.45 cfs	2005	2006
2	E-2	Red-1, Red-2, Pink-1 and Siphon	2.54 cfs	2005	2006*
3	E-6D	E-6D	3.30 cfs	As development requires.	
4	E-4	Yellow-2 and Orange-1	8.3 cfs	2006	2017
4	E-5	Yellow-2 and Orange-1	8.5 cfs	2009	2018
5	E-9	Pink-2	3.0 cfs	As development requires	
6	E-10	Pink-3 and Pink-4	0.7 cfs	As development requires	

*The existing sewer capacity of the siphon is insufficient for the Developed Area. Replacement of E-2 is contingent on construction of the new replacement sewer Red-1, Red-2, and Pink-1.

5.5. Siphon Design

Design of the proposed siphon across Oak Creek south of West Mathis Street utilized minimum, average, and maximum flows for 2005, 2025 (excluding 1,500 acres future development), and 2025 (including 1,500 acres future development). Two methods were used to identify the optimum barrel sizes for the siphon. The first method provided an individual siphon design for each flow condition as indicated in Table 4-6. The second method provides a composite siphon design for all flow conditions as indicated in Table 4-7. The goal of the siphon design was to provide a minimum flow velocity of 2 ft/s to flush the siphon during average flows while minimizing the total head loss through the siphon to less than 3 feet as indicated in Figure 4-9. The identified barrel sizes for the initial siphon are 8 inches, 16 inches, and 24 inches.

5.6. Connections to Existing and Future Sewers

The invert elevations for the proposed collection system illustrated on Figure 4-3 were compared to the existing collection system to allow for phased development of portions or all of the collection system. These critical elevations will allow for construction of segment E-3 without impacting the proposed improvements for Red-1, Red-2, and the Siphon.

5.7. Pipe Design

4.8.1 Pipe Materials

The pipe materials for this project include centrifugally cast fiberglass reinforced polymer mortar pipe (CCFRPMP-Hobas), solid and profile wall polyvinyl chloride pipe (PVC), and reinforced concrete pipe (RCP).

These pipe materials will be specified as listed below for the following sizes and installation methods.

<u>Pipe Diameter (inches)</u>	<u>Pipe Materials</u>
36" & larger-trenched	CCFRPMP, PVC, RCP
30" & smaller-trenched	CCFRPMP, PVC
36" & larger-tunneled (steel-cased, auger bored crossing)	CCFRPMP, PVC, RCP
30" & smaller-tunneled (steel-cased, auger bored crossing)	CCFRPMP, PVC
36" & smaller (Directional Drilled)	HDPE

RCP will be furnished with rubber and concrete joints and an internal plastic liner (T-Lok).

4.8.2 Embedment, Backfill, and Spoil

a. Pipe Embedment

Filter fabric will be placed around the pipe embedment to prevent migration of the embedment into the surrounding soils.

b. Trench Backfill

Fill under grass areas will be compacted to a minimum of 90%-92% density of standard proctor and fills under roads and streets will be compacted to a minimum of 95% density of standard proctor.

- c. Spoil Materials
Excess spoil will be disposed of by the Contractor.
- d. Groundwater Barriers
Groundwater barriers will be placed approximately every 500-1,000 feet along the alignment.

4.8.3 Sewer Line and Grade.

The sewer line may be curve-linear if necessary to reduce the required number of manholes.

5.8. Manholes

Manholes shall be placed at the intersections of all sanitary sewer lines, changes in horizontal or vertical alignment, at pipe diameter or material changes, and at the end of any terminating line. Manhole spacing for the straight portions of the sewer shall be approximately 600 to 800 feet or as appropriate for site specific conditions. City of Lincoln standard manhole LSP-200 will be used for sewers 8 to 12 inches in diameter; LSP-201 will be used for sewers 15 to 48 inches in diameter, and special designed or tee-based manholes will be used for manholes for sewers larger than 48 inches. Tee-based manholes may also be utilized for sewers 36 inches or larger.

5.9. Construction Techniques

Construction techniques anticipated for the selected improvement plan include the use of trenchless technologies for railroad crossings and major road crossings. The proposed crossing of Oak Creek may utilize horizontal directional drilling or open cut installation. The existing 15 inch sewer south of Highway 34 may be pipe bursted with a larger pipe to increase capacity. The remainder of the project would utilize open-cut trenching techniques.

5.10. Special Construction

5.10.1 Horizontal Auger Boring

Horizontal auger boring will be allowed using steel casing pipe with CCFRPMP, RCP, or PVC as the carrier pipe within the primary liner. Horizontal auger boring will be required for the following locations:

- a. Highway 34
- b. West Mathis Street (east side of Oak Creek)
- c. Airpark Road (east side of Oak Creek)
- d. West Mathis Street (west side of Oak Creek)
- e. Airpark Road (west side of Oak Creek)
- f. West Cumming Street (west side of Oak Creek)
- g. Airport Taxiway

5.10.2 Horizontal Directional Drilling

Horizontal Directional drilling with HDPE pipe will be evaluated as an alternative to open cut installation for the siphon crossing of Oak Creek.

5.10.3 Pipe Bursting

The 15 inch sewer that extends north from Kawasaki to Highway 34 may utilize pipe bursting to increase sewer capacity. There is insufficient area for a parallel sewer between the Union Pacific Railroad and NW 27th Street. In addition, a Sprint fiberoptic conduit is in the vicinity of the existing sewer.

5.10.4 84 Inch Storm Sewer Modifications

The existing 84 inch storm sewer that drains the tarmac area on the west side of the airport, conveys flow to Oak Creek. Installation of the proposed 48 inch trunk sewer will require modifications to the outlet of the storm sewer to maintain grade. The modifications will include replacement of the last 20 feet of the storm sewer with a 84 inch CMP outlet structure which transitions flow from the 84 inch storm sewer into three 42 inch storm sewers with the structure reinforced with H-piles to provide horizontal restraint.

5.11. Abandoning of Existing Sewers

The existing sewer E-3 will be abandoned. LES installed an overhead distribution line directly on top of the existing sewer. The existing sewer will be abandoned by demolishing the manholes 8 feet below existing grade and filling the sewer with flowable fill. The existing sewer E-2 will be abandoned in-place along West Mathis Street from

NW 41st Street to NW 38th Street. The remainder of the trunk sewer to MH 68 will be used to convey flows from businesses in the vicinity of NW 38th Street and West Mathis Street. These businesses are unable to be served through the proposed collection system because of the existing 84 inch storm sewer causing grade restrictions as discussed in paragraph 5.4. The existing sewer E-6D may be abandoned in-place or pipe-bursted to convey the required Tier I flows.

5.12. Project Approval Requirements

The following agencies will review and approve the Contract Documents prior to Awarding the project for construction:

1. Nebraska Department of Environmental Quality for minimum sanitary requirements.
2. Lower Platte South Natural Resources District and U.S. Army Corps of Engineers (USACE 404) permit for creek crossings.
3. Nebraska Department of Environmental Quality for National Pollutant Discharge Elimination System (NPDES) Permit for control of run-off during construction.
4. Lancaster County for “Application for Constructing Utilities on County Right-of-Way” for sewer placed in the Right-of-Way along Airport Road south of Highway 34. Contractor will need to indicate Lancaster County as additional insured for all project liability insurance purchased by the Contractor.
5. City of Lincoln/Lancaster County Building & Safety Department for “Flood Plain Development Permit Application”.
6. Lincoln Electric System “Letter of Understanding” for crossing LES easements.
7. Nebraska Department of Roads for construction in the right-of-way and tunnel crossing of Highway 34.