

### **3.0 Summary of Trunk Sewer Evaluation and Alignment Studies**

The purpose of the Oak Creek Basin and Trunk Sewer alignment study is to determine the optimum alignments to provide for current and future growth in the basin. The procedure for identifying the optimal alignments is as follows:

- a. Evaluate and model the existing, Tier I, and future wastewater flow rates and capacities in the existing trunk sewer from Manhole AA6-68 (located on the west side of the Lincoln Airport main runway) east to the Theresa Street WWTF.
  
- b. Identify improvements for the existing trunk sewer and compare these improvements to the Facility Plan Update (April 2003). The capacities from the identified improvements are utilized for the evaluation of the collection system capacities.
  
- c. Evaluate the existing, Tier I, and future wastewater flow rates and capacities in the existing collection system upstream from Manhole AA6-68.
  
- d. Based on the available capacity identified in the existing trunk sewer; determine where future development areas could be located within the basin. Identify the necessary collection system improvements to serve existing, Tier I, and future development areas.

#### **3.1 Trunk Sewer Evaluation**

The existing trunk sewer (Figure 3-1) was modeled and evaluated to determine the existing and Tier I flow rates and capacities. No Tier II development areas have been identified to be served to-date in the basin. A manhole survey was conducted to obtain the actual invert elevations of the trunk sewer for the modeling. The trunk sewer was modeled utilizing EPA SWMM Version 5.0. The flow inputs for the trunk sewer are indicated in Table 3-1: Hydraulic Model Inputs for Existing Oak Creek Basin.

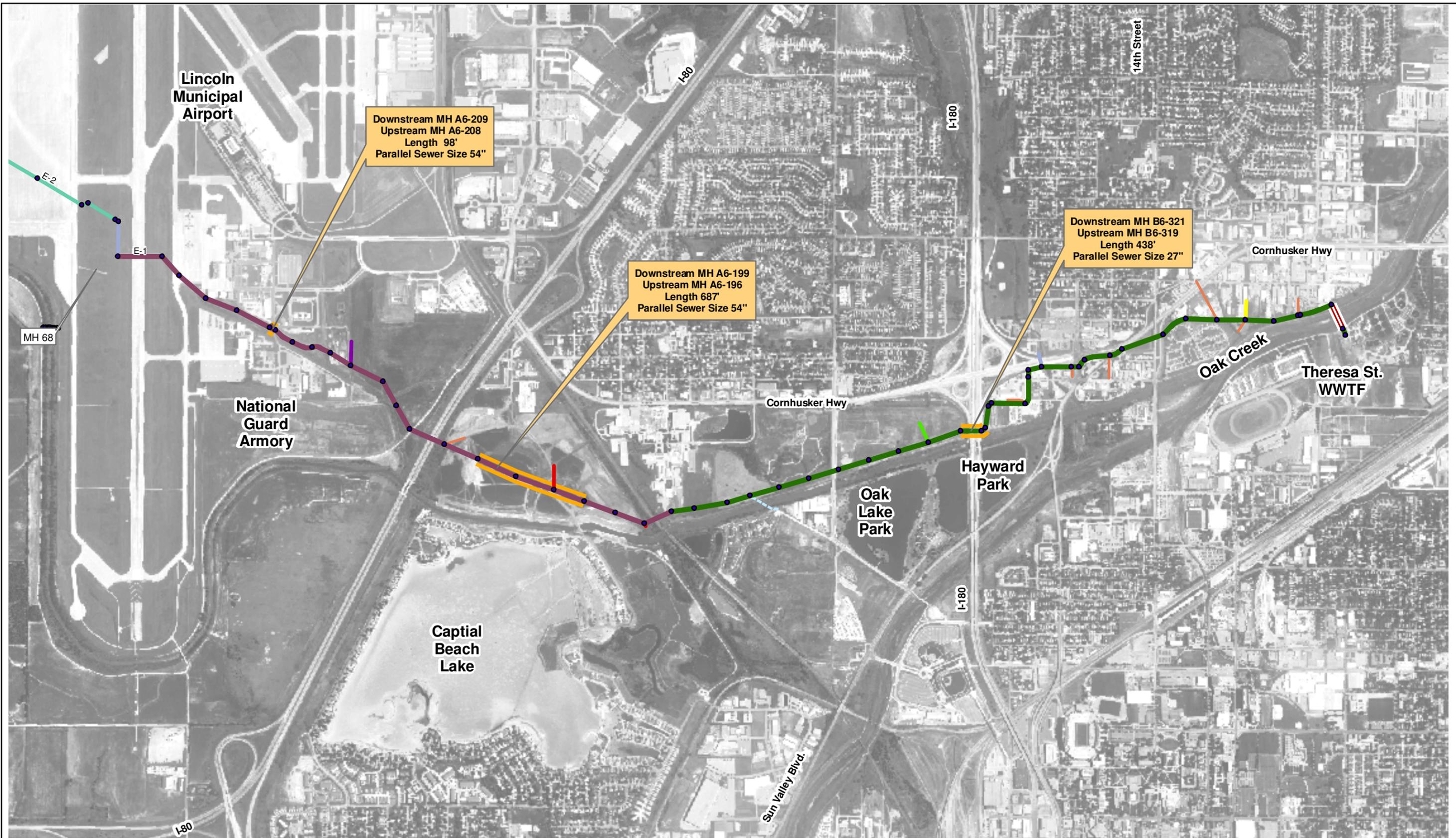
The Lincoln Wastewater Facilities Plan has indicated improvements that would be required to the trunk sewer to convey Tier I flows without submergence. These improvements are indicated in Table 3-2: Facility Plan Update Identified Trunk Sewer Improvements and in Figure 3-1. The data utilized for the identified improvements was not available to confirm the recommendations.

**Table 3-1: Hydraulic Model Inputs for Existing Oak Creek Basin**

<b>West Side of Oak Creek to MH AA7-23</b>									
<b>Model Node</b>	<b>Input Designations</b>	<b>Existing Service Area Input (acres)</b>	<b>Existing Service Area Input (cfs)</b>	<b>Existing Service Area Total (acres)</b>	<b>Existing Service Area Total (cfs)</b>	<b>Tier I Service Area Input (acres)</b>	<b>Tier I Service Area Input (cfs)</b>	<b>Tier I Service Area Total (acres)</b>	<b>Tier I Service Area Total (cfs)</b>
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
	<b>Total</b>	<b>1550</b>				<b>2470</b>			

<b>East Side of Oak Creek to MH AA7-21</b>									
<b>Model Node</b>	<b>Input Designations</b>	<b>Existing Service Area Input (acres)</b>	<b>Existing Service Area Input (cfs)</b>	<b>Existing Service Area Total (acres)</b>	<b>Existing Service Area Total (cfs)</b>	<b>Tier I Service Area Input (acres)</b>	<b>Tier I Service Area Input (cfs)</b>	<b>Tier I Service Area Total (acres)</b>	<b>Tier I Service Area Total (cfs)</b>
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
	<b>Total</b>	<b>1305</b>				<b>1980</b>			

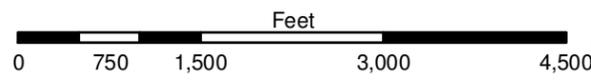
<b>Trunk Sewer (MH-68 to Theresa Street WWTF)</b>									
<b>Model Node</b>	<b>Input Designations</b>	<b>Existing Service Area Input (acres)</b>	<b>Existing Service Area Input (cfs)</b>	<b>Existing Service Area Total (acres)</b>	<b>Existing Service Area Total (cfs)</b>	<b>Tier I Service Area Input (acres)</b>	<b>Tier I Service Area Input (cfs)</b>	<b>Tier I Service Area Total (acres)</b>	<b>Tier I Service Area Total (cfs)</b>
			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
	<b>Total</b>	<b>4568</b>				<b>4568</b>			



"source"; "file path"; "date"; "user initials"

**Legend**

- |               |            |     |     |     |          |
|---------------|------------|-----|-----|-----|----------|
| Existing Pipe | 4"         | 10" | 18" | 27" | 48"      |
| Siphon        | 6" Service | 12" | 21" | 30" | 54"      |
| Private       | 8"         | 15" | 24" | 36" | Manholes |



**Existing Trunk Sewer to Theresa Street WWTP and Facility Plan Update Recommended Improvements**

Oak Creek Basin and Trunk Sewer

DATE	5/12/06
FIGURE	3-1

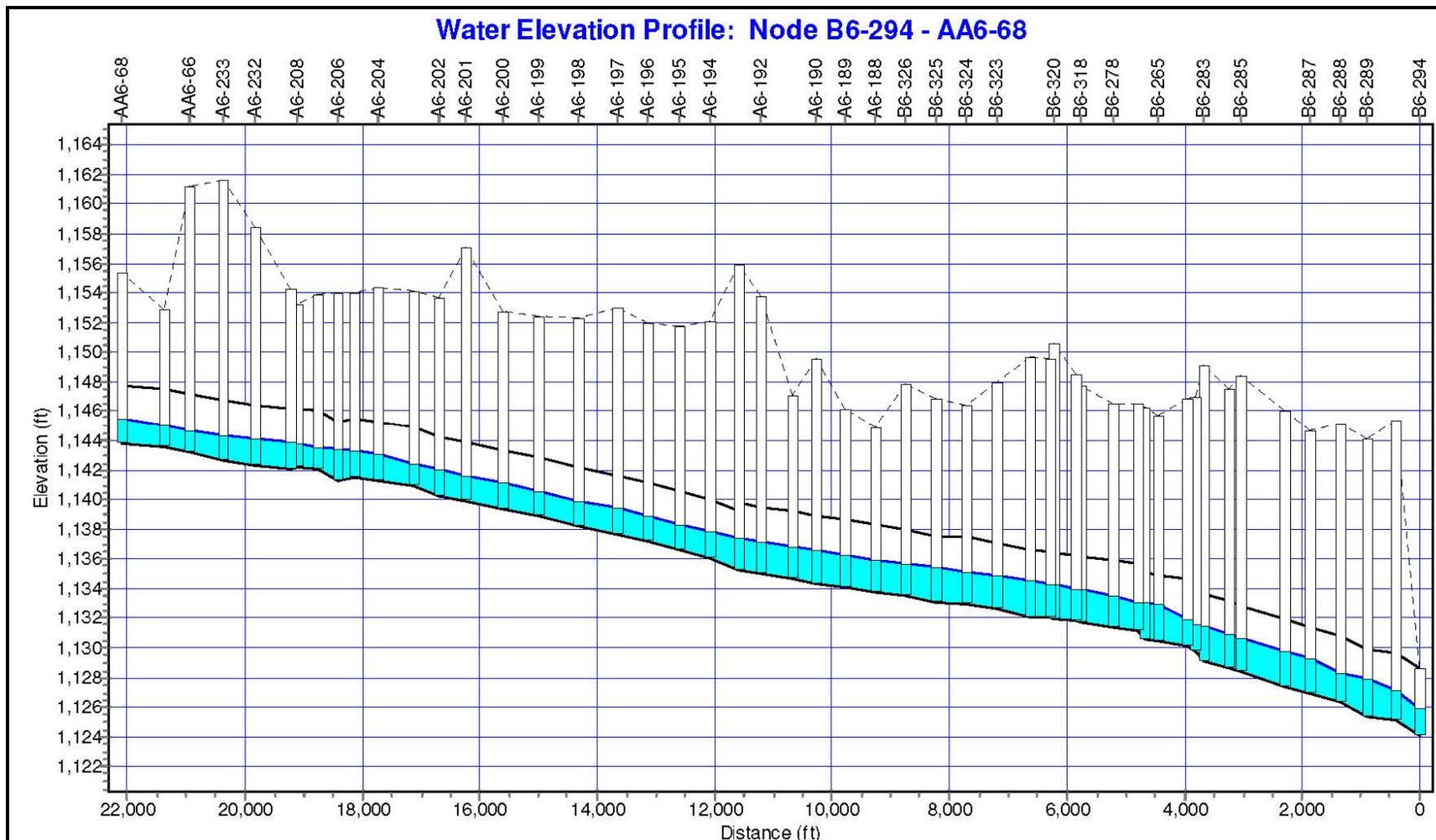
<b>Downstream Manhole</b>	<b>Upstream Manhole</b>	<b>Length</b>	<b>Parallel Sewer Size</b>	<b>Approximate Location</b>
A6-209	A6-208	98	54	Nebraska Air National - Guard Armory
A6-199	A6-196	687	54	From I-80 east to the BNSF Railway Line
B6-321	B6-319	438	27	East of I-180

If the improvements to the trunk sewer as identified in Table 3-2 are constructed, the trunk sewer capacity created at Manhole 68 is 36.0 cfs, which is 8.2 cfs beyond the required Tier I flow condition. If the 8.2 cfs were directly converted to acres using the City’s flow equation, it would convert to approximately 1,135 acres. At Manhole 68, there currently exists a capacity of 27.8 cfs (4,475 acres) and adding an additional 8.2 cfs would create a capacity of 36.0 cfs (5967 acres) utilizing the City’s design flow equation. The differential service areas between 27.8 cfs (4475 acres) and 36.0 cfs (5967 acres), creates an additional 1492 acres of service area as indicated in Table 3-3: Additional Service Area Capacity at Manhole 68.

<b>Flow (cfs)</b>	<b>Area (acres)</b>
36.0	5967
-27.8	-4475
<b>8.2 cfs</b>	<b>1492 acres</b>

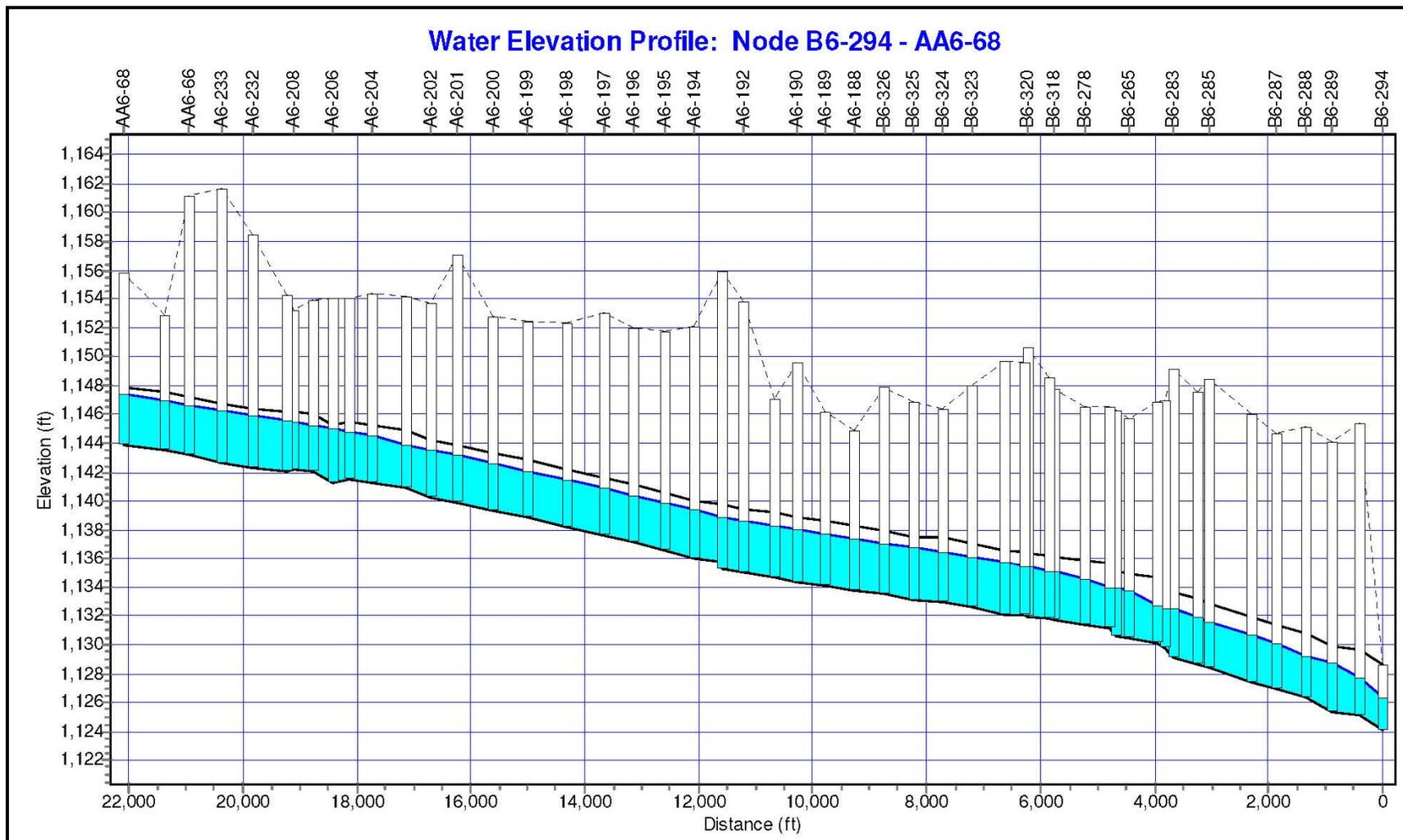
As indicated above, the Trunk Sewer was modeled with SWMM Version 5.0 with surveyed manhole invert and rim elevations. Losses in manholes were considered negligible based on the City of Lincoln design requirements for providing formed and benched inverts in the manholes during normal flow conditions. Losses in manholes for submerged conditions were assumed to have a 0.7 head loss factor. The results of the SWMM model for the Trunk Sewer in a Tier I flow condition is indicated in Figure 3-2. From this figure, the Trunk Sewer capacity is clearly indicated to be sufficient without parallel improvements. In addition, Figure 3-3 illustrates the Trunk Sewer flow condition with an additional 1,500 acres contributing flow at Manhole AA6-68. This accounts for the future growth areas in the Oak Creek Basin beyond a Tier I design flow. At manhole A6-206, the Trunk Sewer does not have any additional capacity beyond the identified 1,500 acres.

**Figure 3-2: Trunk Sewer – MH 68 to Theresa Street WWTF  
(Tier I Flows)**



**Figure 3-2**

**Figure 3-3: Trunk Sewer – MH 68 to Theresa Street WWTF  
(Tier I + Future 1,500 Acres)**



**Figure 3-3**

### **3.2 Summary of Alignment Studies**

Portions of the existing collection system lack capacity to convey existing and Tier I flows. The following locations have been identified for removal or replacement

- **Oak Creek Siphon** along West Mathis Street (MH AA7-21 to MH AA7-24) (remove and replace)
- **E-2**, Trunk Sewer from Manhole AA6-68 to NW 38<sup>th</sup> Street (MH AA7-15) along West Mathis Street (undersized/parallel)
- **E-3**, Sewer along West Mathis from NW 38<sup>th</sup> Street to NW 41<sup>st</sup> Street (MH AA7-15 to MH AA7-21) (relay/parallel/replace)
- **E-3**, Sewer along NW 41<sup>st</sup> Street from West Mathis to Airpark Road (MH AA7-21 to MH AA7-300) (parallel/replace)
- **E-4**, Sewer along NW 41<sup>st</sup> Street from Airpark Road to West Cumming Street (MH AA7-21 to MH AA8-158) (parallel/replace)
- **E-5**, Sewer along NW 41<sup>st</sup> Street from West Cumming Street to Airport Road (MH AA8-158 to MH AA8-164) (future construction of intermodal project)
- **E-6d**, Sewer along NW 27<sup>th</sup> Street west of Kawasaki manufacturing facility (undersized)

The trunk sewer improvements identified in section 3.2 provide a flow capacity for the existing, Tier I, and future flow conditions. A flow rate of 8.2 cfs, which equates to 1,492 (~1,500) acres of future development beyond a Tier I and II flow condition, was identified with the improvements to the trunk sewer. A determination of where the 1,500 acres will be placed in the basin will affect the optimum sizing of the collection system improvements. The existing 21/24 inch sewer which extends along the existing drainage way south of West Mathis Street from approximately NW 60<sup>th</sup> Street east to NW 48<sup>th</sup> Street (MH AA7-271 to MH BB7-11) was modeled and determined to have a capacity of 200 acres beyond the Tier I flow condition.

The City of Lincoln Planning Department indicated that the 1,500 acres of additional area could be developed on either side of Oak Creek; therefore, sizing of the proposed collection system improvements assumed either:

- 1,500 acres of development on the east side of Oak Creek north of Highway 34, or
- 200 acres of development north of West Adams Street and west of the identified Tier IB areas in Figure 1-1, and the additional 1,300 acres north and west of Oak Creek.

Based on the Planning Department's recommendation, the proposed collection system was designed to allow for 1,500 acres of growth to potentially occur on either side of Oak Creek.

Alignment alternatives were discussed with LWWS and the Lincoln Airport Authority to identify acceptable corridors for the proposed trunk sewer improvements. The corridors identified included NW 41<sup>st</sup> Street, NW 42<sup>nd</sup> Street, and NW 38<sup>th</sup> Street for north/south alignments and West Mathis Street, Airpark Road, West Cumming Street, and Airport Road for east/west alignments. These alignment corridors are reflected in the City of Lincoln/Lancaster County Comprehensive Plan and the Airpark West Subarea Plan. The existing collection system located along NW 44<sup>th</sup> Street has been identified for removal in accordance with the Comprehensive Plan and Subarea Plan to allow for development as indicated in Figures 1-2 and 1-3.

Each segment of the existing collection system was modeled to determine the available capacity and at what point in time the segment will be required to be paralleled or replaced. A summary of the required schedule for improvements is indicated in Table 3-4. Two separate methods were used to determine when the capacity in each segment was reached. The first method assumed that the City of Lincoln/Lancaster County existing areas were fully developed. These areas are identified as "Existing Areas". In the Oak Creek Basin only 42% of the existing areas are developed; therefore this assumption is overly conservative. The second method evaluated each basin area in Figure 1-1 and assigned a relative development percentage. These areas are identified as "Developed Areas". A breakdown of the "Existing Areas" and "Developed Areas" for each sewer segment is included in Appendix F. Both methods assume complete development of the existing, Tier I, and Future areas by the year 2025 to conform to the Comprehensive Plan. The replacement dates identified for both methods are approximate and are subject to revision based upon the actual development rate that may occur in the basin. The growth rates identified in Appendix F are based on a linear growth rate for each method to achieve the 2025 Comprehensive Plan goal and vary only with relation to the assumed "existing" or "developed" areas in the basin. In addition, the allocation of the 1,500 acres of future flow will impact the replacement date for each segment.

<b>Segment</b>	<b>Capacity (cfs)</b>	<b>“Existing Areas” Replacement Date</b>	<b>“Developed Areas” Replacement Date</b>
E-2	2.54 cfs	2005	2006
E-3	2.45 cfs	2005	2006
E-4	8.3 cfs	2006	2017
E-5	8.5 cfs	2009	2018
E-6D	3.30 cfs	Supports only 402 acres of Tier I growth	

Two alignment alternatives were identified for the potential locations of two siphon crossings of Oak Creek. The first siphon crossing was identified along West Cumming Street to convey flows from the northeast through a major trunk sewer along the west side of Oak Creek. A second siphon would cross Oak Creek south of the existing siphon at West Mathis Street. Operation of the collection system would be difficult with two siphon crossing given the wide range of flow variation which will occur with further development in the basin. Therefore, alignment alternatives with two siphons were eliminated.

The Draft Sewer Alignment Evaluation that discusses each of the alignments is located in Appendix C and includes all eight proposed alignment alternatives.

### **3.3 Order of Magnitude OPPC**

Order of Magnitude Opinions of Probable Project Costs were created for the various alignments as part of the preliminary alignment study. As a result, the alignment alternatives were refined and examined in the subsequent study. The alternative alignments in the final analysis study varied based on the proposed siphon crossing location of Oak Creek. The siphon for Option 1 and 1A was located southwest of the 84 inch storm sewer outfall from the airport. The siphon for Option 2 and 2A was located adjacent to the existing siphon along West Mathis Street. Option 1 and 2 costs reflected an Existing and Tier I flow condition. Option 1A and 2A costs reflected an Existing, Tier I, and Future (1,500 acres) flow condition. The costs for these options varied between \$4,604,000 and \$4,803,000 for Existing and Tier I flow conditions and between \$6,335,000 and \$6,804,000 for Existing, Tier I, and Future (1,500 acres) flow condition. The costs were based on an assumed project cost of \$6.50/dia-in/LF. A breakdown of the costs for each segment is included in Appendix C.