8.0 Conclusions and Recommendations

8.1. Conclusions

The goal for the Oak Creek Basin Trunk Sewer and Sub-Basin Sewers project was to maximize long-term value. The City of Lincoln/Lancaster County Comprehensive Plan, Airpark West Subarea plan, and LWWS Facility Master Plan were each factored into the proposed alignments and phased development plan. By considering "Developed Areas" in the "Existing Areas" identified in the Comprehensive Plan, a more realistic phased approach to the project was achieved. The trunk sewer evaluation in Section 3 identified an additional 1,500 acres of capacity that can be served in the subbasin without costly parallel/replacement projects to achieve the capacity.

Major improvements for Segments E-2, E-4, and E-5 were identified to be delayed to account for the lack of identified development in the project area. Quantifiable flow capacities for each segment were identified to allow LWWS the greatest flexibility in planning future projects in the basin. These flow capacities were thoroughly analyzed with SWMM to ensure accurate modeling results. The proposed alignments minimize the overall disruption of the area, create a cost-effective solution for near-term needs that are easily adaptable to long-term growth.

8.2. Summary of Additional Study in Appendix G

The study was conducted to identify the maximum expected capacity for Segment E-2 and is included in Appendix G. The purpose of the study was to determine if sewer replacement for Segments R-1 and R-2 could be delayed until the CIP could include these segments. This would require delaying the projects until after 2012.

This study identified an average flow rate metered in the system of 0.00126 cfs/acres with a recorded peaking factor of 2.34 at Manhole 279. To provide a factor of safety, the peaking factor used for the analysis was increased to 3.0 to provide a resultant flow rate of 0.0038 cfs/acre. This flow rate is much less than the City's Design Flow Equation rate of 0.0062 cfs/acre. The study assigned the 0.0038 cfs/acre as the current flow rate at Year 2005 and identified only 1,176 developed acres in the basin. The study then assigned the 0.0062 cfs/acre as the future flow rate at Year 2025 and identified a total Tier I buildout area of 4,379 acres. With these two data points, a constant growth curve was created as indicated in the Appendix. This growth curve indicated that replacement of Segment E-2 could be delayed until 2015. This study assumed that improvements to E-3 and a new 24 inch siphon barrel were constructed.

The study recommended that LWWS continue to monitor flows at the meter in the system and to track growth within the basin and determine corresponding flows in the collection system as it occurs.

8.3. Summary of Additional Study in Appendix H

A second study of project alternatives for a Tier I design flow condition was performed to determine what impact varying the 'n' factors for the pipe, the design flow contribution rate, and considering in-basin pumping as indicated below:

- 'n' factors of 0.013, 0.011, and 0.009
- Design flow contribution rates of 0.0062 cfs/acre, 0.0038 cfs/acre, 0.0057 cfs/acre, and 0.00493 cfs/acre
- In-basin pumping versus a gravity system.

This study produced twelve (12) independent alternatives that were modeled and then opinion of probable project costs were created for each alternative.

The results of this analysis concluded that the costs for each of the twelve independent alternatives does not vary more than 11% from the least to most costly alternative. A primary reason for this small differential is related to the minimum slope requirement that controls the pipe sizes for much of the system. The Oak Creek Basin through the Air Park area is very flat. Even when differentiating the flow contribution rates and 'n' factors, the sewer size is driven strictly by minimum slopes. The advantages for in-basin pumping are negated when consideration for capital costs for construction of lift stations are included. Therefore, the City's Design Flow Equation, 'n' factor of 0.013, and a gravity system remain as the basis of design for this project.

8.4. Project Costs

The project costs for the 5,950 acres phased development plan (Existing, Tier I, and 1,500 acres of Tier III) are listed in Table 8-1: Opinion of Probable Project Costs (5,950 acres of Development in Basin). The project costs for the 4,450 acres phased development plan (Existing and Tier I) are listed in Table 8-2: Opinion of Probable Project Costs (4,450 acres of Development in Basin). These costs were determined using the average bid results for the West 'O' Street Trunk Sewer Extension Project – Phases 1 and 2, and the Upper Southeast Salt Creek Subbasin Sewer – Phase 1, and Upper Southeast Salt Creek Trunk Sewer projects. These costs include 15% contingencies in the Construction Cost. The construction cost for all of the segments results in a cost of approximately $8.71/dia-in/LF for the 5,950 acre development plan and $7.97/dia-in/LF for the 4,450 acre development plan. Both of these construction costs includes a 15% contingency.

Table 8-1: Opinion of Probable Project Costs (5,950 acres of Development in Basin)				
Segment	**Construction Cost**	**Easement Costs**	**Eng, Legal, Admin. Costs**	**Total Project Cost**
E-3	$1,088,000	-	$218,000	$1,306,000
Additional Siphon Barrel	$255,000	-	$51,000	$306,000
E-6d	$428,000	$86,000	$103,000	$617,000
Red-1 and Red-2	$2,301,000	-	$460,000	$2,761,000
Pink-1 and New Siphon	$1,067,000	-	$213,000	$1,280,000
Orange-2	$1,189,000	$99,000	$258,000	$1,546,000
Pink-2, 3, and 4	$1,699,000	-	$222,000	$2,039,000
Yellow-2 and Orange-1	$1,724,000	-	$345,000	$2,069,000
Total Cost	**$9,751,000**	**$185,000**	**$1,870,000**	**$11,924,000**

Table 8-2: Opinion of Probable Project Costs (4,450 acres of Development in Basin)				
Segment	**Construction Cost**	**Easement Costs**	**Eng, Legal, Admin. Costs**	**Total Project Cost**
E-3	$1,088,000	-	$218,000	$1,306,000
Additional Siphon Barrel	$255,000	-	$51,000	$306,000
E-6d	$428,000	$86,000	$103,000	$617,000
Red-1 and Red-2	$2,248,000	-	$450,000	$2,698,000
Pink-1 and New Siphon	$981,000	-	$196,000	$1,177,000
Pink-2, 3, and 4	$1,439,000	-	$288,000	$1,727,000
Yellow-2 and Orange-1	$1,232,000	-	$246,000	$1,478,000
Total Cost	**$7,671,000**	**$86,000**	**$1,552,000**	**$9,309,000**

8.5. Recommended Phased Development Plan

The recommended phased development plan for the project is indicated in Table 8-3. The "Existing Areas" represents the design flow condition for areas identified as existing in the Comprehensive Plan. The actual areas where development has occurred to-date is reflected in the "Developed Areas". The development is significantly less than identified, thus the replacement date for portions of the collection system can be delayed. LWWS will have to monitor the development in the Oak Creek Basin to maximize their investment in the existing collection system.

Table 8-3: Phased Construction of the Proposed Collection System Improvements					
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
1	Existing Siphon	New 24" Barrel	2± cfs	2005	2006
2	E-6D	E-6D	3.30 cfs	As development requires.	
3	E-2	Red-1, Red-2,	5.2 cfs	2005	2015*
4	Improved Siphon	Pink-1 and New Siphon	14 cfs	2009	2020
5	E-4	Yellow-2 and Orange-1	8.3 cfs	2006	2017
5	E-5	Yellow-2 and Orange-1	8.5 cfs	2009	2018
6	E-9	Pink-2	3.0 cfs	As development requires	
6	E-10	Pink-3 and Pink-4	0.7 cfs	As development requires	
7	-	Orange-2	-	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 and Red-2.

8.6. Phase 1 Project

The first phase of the Oak Creek Basin Sewer project will involve parallel replacement of Segment E-3 with a new 42 inch sewer from West Mathis Street to West Airpark Road (MH AA7-21 to MH AA7-300). This sewer will be constructed to minimum grade requirements which will be able to convey Existing and Tier I flows, plus an additional 1,500 acres if necessary.

The additional 24 inch barrel constructed at the existing Oak Creek siphon will increase the capacity of the siphon from 2 cfs to approximately 14 cfs. The improved siphon will not be able to convey a Tier I design flow, but will extend the life of the siphon through approximately Year 2020.

8.7. 1,500 Acres of Tier III Development

This study identified two recommended development plans: 5,950 acres and 4,450 acres. As indicated in Section 3, there exists capacity in the existing trunk sewer from MH AA6-68 to the Theresa Street WWTF to convey this additional 1,500 acres beyond a Tier I flow condition. During the study, there was no indication from the Planning Department as to the specific location of the 1,500 Tier III acres provided. In addition, it was undetermined if the 1,500 acres would even be allowed to develop in the basin because of the additional cost to serve these potential Tier III areas. Phase 1 of the project can be designed and installed without a determination of the status of these 1,500 acres of Tier III area, but future sewer phases will require a decision on the location to minimize the capital costs of the project.