SALT CREEK BASIN

10.1 SALT VALLEY TRUNK SEWER SYSTEM

As previously stated in Section 4.2.1, the Salt Valley Trunk Sewer conveys wastewater from several drainage systems to the Theresa Street WWTF as outlined in Table 10.1 below. Also shown in the table are the areas which contributed flows to the Salt Valley System for the different modeling scenarios. The following projects that have recently been constructed, are under construction, in design, or planned, have been included in the model of the existing system.

1. Phase V of the Salt Valley Trunk Relief Sewer.
2. Upper Southeast Trunk Sewer and Sub-basin Sewers.

Based on these areas, and associated flows several hydraulic model scenarios were run as discussed below. A schematic plan view of the Salt Valley Trunk Sewer system with other contributory basins is presented in Figure 10.1. The model output for all of the scenarios discussed in this Chapter are located in Appendix D.

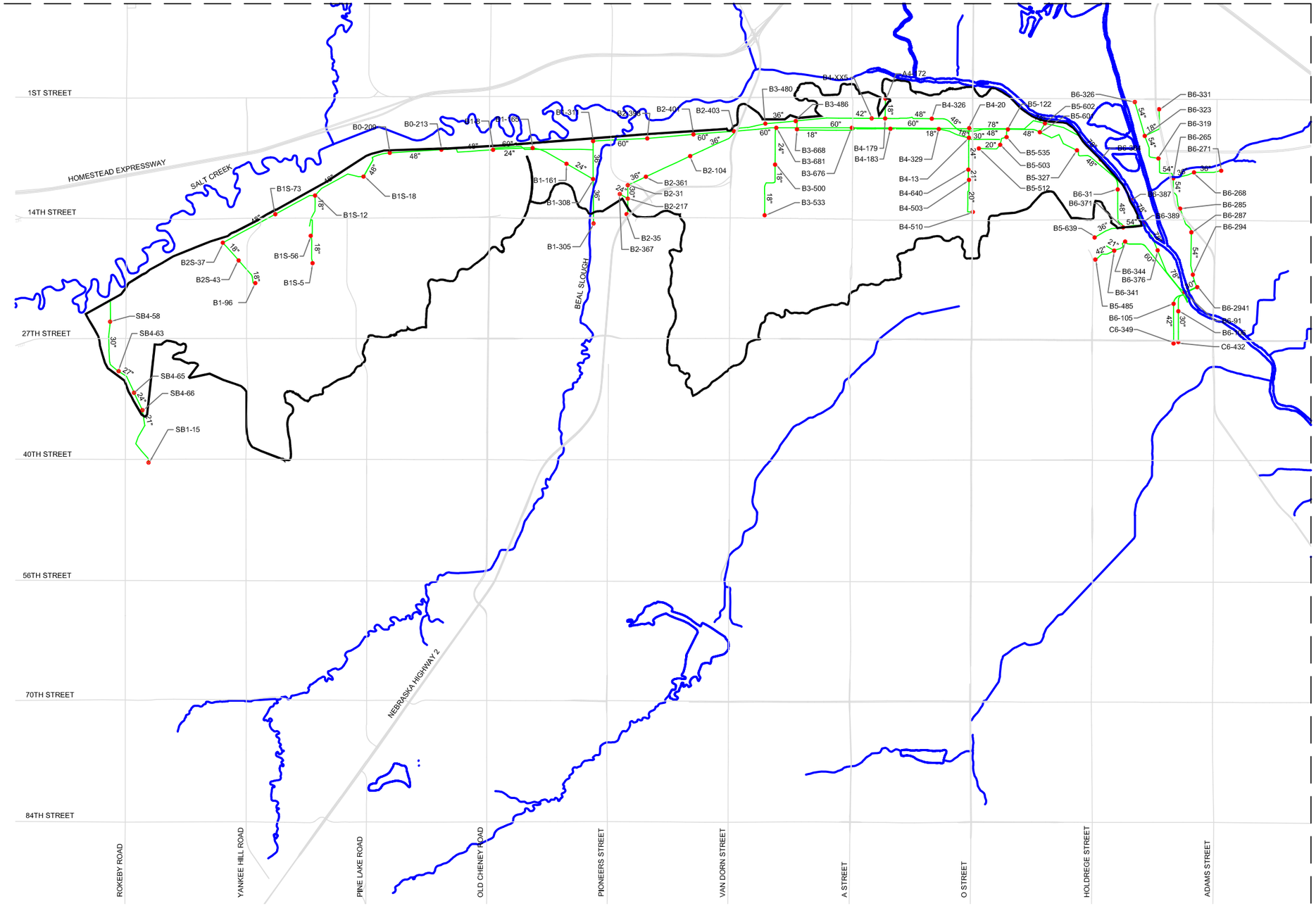
10.2 EXISTING CONDITIONS

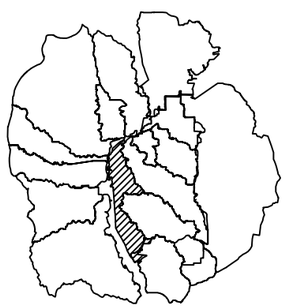
10.2.1 Model Results

The existing system was modeled using a total tributary area to the system of 15,857 acres, which resulted in a peak flow of 87 cfs. Based on this flow, there was no surcharging in the new system, with a d/D that varied between 0.25 and 0.90. For this modeling effort it was assumed that no flow controls were incorporated in the cross over connections between the old and new Salt Valley Trunk Sewer system. This assumption allows the model to determine the flow that is diverted from the old to the new Salt Valley Sewers. During these conditions the flow in the 48-inch Salt Valley Trunk Sewer drained into the new Salt Valley Trunk Sewer resulting in minimal flows in the 48-inch system downstream from the cross over connections.

10.2.2 Improvements

Due to the satisfactory performance of the modeled system with the peak existing flows, no immediate recommendations are proposed. However, several reaches of the trunk sewer system have modeled velocities less than 2 ft/sec, as shown in Figure 10.2. These areas should be monitored to determine if solids deposition is occurring. If deposition is noted the sewer line may be hydro-flushed on a regular frequency by the collection system operations and maintenance staff to ensure full pipe diameter capacity is maintained. It should be noted as flows and corresponding velocities increase the potential for deposition decreases.





KEY MAP

NOTES:

1. ONLY 18" AND LARGER PIPES INCLUDED IN MODEL.

Figure No. 10.1
SALT CREEK BASIN TRUNK SEWER SYSTEM
WASTEWATER FACILITIES MASTER PLAN UPDATE - 2007
CITY OF LINCOLN, NEBRASKA

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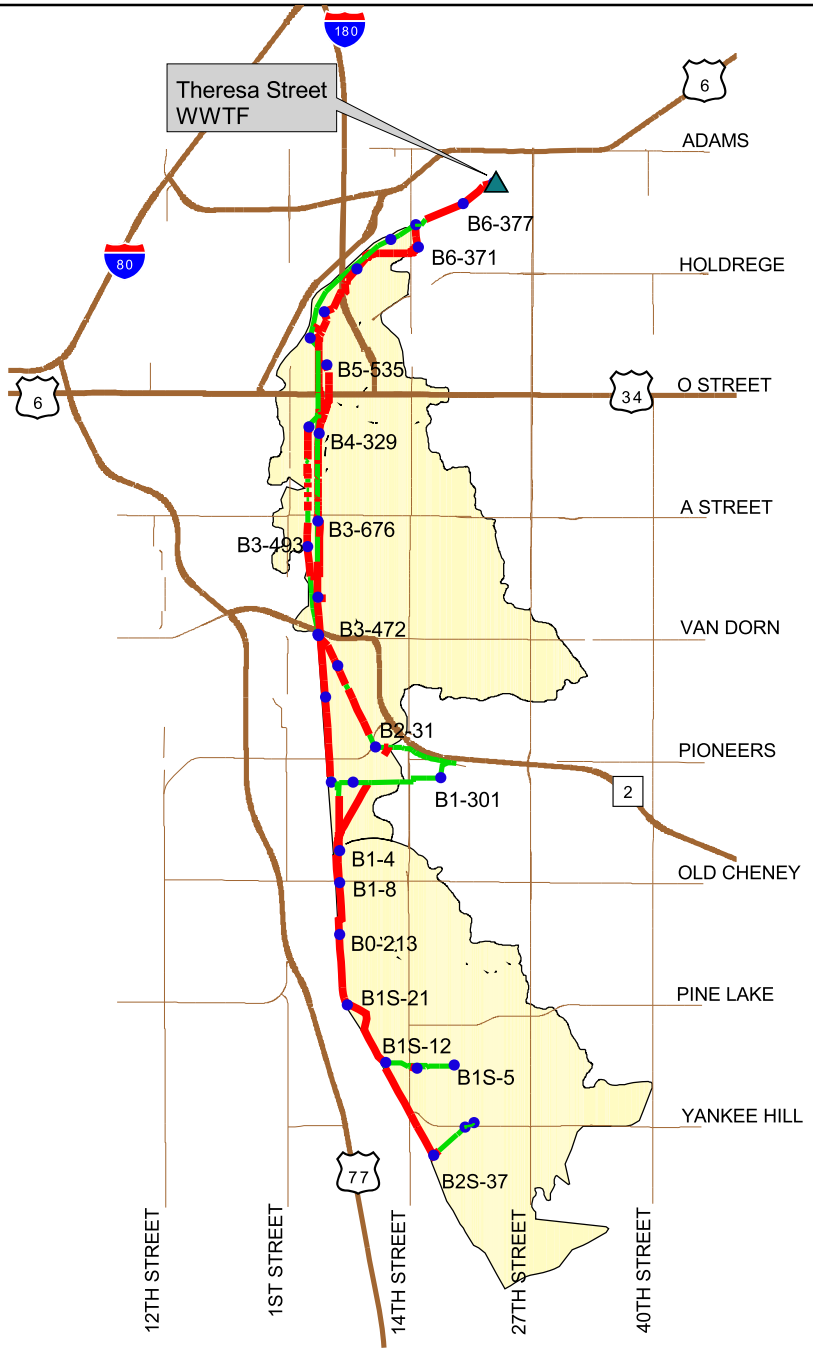

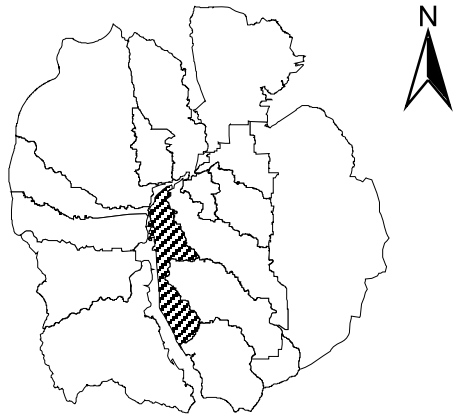

LEGEND

Pipe Velocity, ft/sec

- v > 2.0
- v <= 2.0
- Highways
- Streets
- Existing Service Area

0 1 2 Miles

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Figure 10.2 - Location of Pipes With Velocities <=2.0 ft/sec - Existing Conditions
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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Table 10.1 Salt Valley Trunk Sewer System Existing and Future Tributary Areas
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Basins [2, 3]	Existing Area (acres)	Tier I Area (acres)	Existing Tier I Area (acres)	Tier II Area (acres)	Existing Tiers I, II Area (acres)	Tier III Area (acres)	Existing Tiers I, II, III Area (acres)
Antelope Valley [1]	510	5	515	0	515	0	515
Salt Valley [4]	5,475	0	5,475	0	5,475	0	5,475
West 'O'	1,042	1,743	2,785	2,048	4,833	2,226	7,059
Middle Creek	1,389	1,547	2,936	1,903	4,839	2,650	7,489
Haines Branch	297	820	1,117	3,978	5,095	1,314	6,409
Beal Slough	6,874	1,876	8,750	0	8,750	0	8,750
Upper SE Salt	0	4,119	4,119	3,160	7,279	0	7,279
Upper SW Salt	0	2,078	2,078	6,327	8,405	9,636	18,041
Totals	15,857	12,188	27,775	17,416	45,191	15,826	61,017

Notes:
1. This area of the Antelope Valley drainage area is served by Salt Valley Trunk Sewer .
2. Areas as of July 1, 2006
3. Based on information provided by LWWS.
4. Includes sub-basins SC-1 through SC-15

10.3 TIER I CONDITIONS

10.3.1 Modeling Results

The Tier I scenario was modeled using existing service area plus the Tier I areas as outlined in Table 10.1 above. The total tributary area modeled is approximately 27,775 acres, which corresponds to a peak flow of approximately 147 cfs (95 mgd) at the Theresa Street WWTF.

Model simulations of the Tier I conditions indicated that no SSOs occur in the Salt Valley trunk sewer system. However, a three to four hour surcharge condition occurred in the recently constructed Salt Valley Trunk Sewer between manhole B1-5 on the lower end (near 1st St and Old Cheney Rd) to manhole B3-675 at the upper end (near 2nd St and 'A' St) of Salt Valley Relief Trunk Sewer Phase V project near Old Cheney and Salt Creek. In this sewer, 13,198 feet of pipe exceeded a d/D ratio of 95 percent indicating the line may be undersized for the Tier I flows. The surcharged pipes under this scenario are presented in

Table10.2. The table shows that d/D ratio varied between of 1.06 to 2.0. The maximum surcharging of the 60-inch diameter pipe is projected to be almost 5 feet and reach within about 8 feet of the rim at manhole B1-289. This surcharging is of a very short duration only during peak flows. Due to the minimal height and length of surcharging it is not expected to cause any operational or environmental problems. The locations of the surcharged pipes are shown in Figure 10.3 and the hydraulic profile of these capacity deficient pipes is shown graphically in Figure 10.4.

The primary cause of this surcharged condition is related to the recently constructed Phase IV of the Salt Valley Trunk Sewer. This phase of 60-inch diameter sewer is located between manhole B1-310 at the upper end to manhole B4-743 at the lower end. This reach of pipe has a full capacity of around 50 cfs, while the 60-inch diameter Phase V sewer has a full capacity of around 100 cfs. The flow entering Manhole B1-310 (upper end of Salt Valley Phase IV) is 51 cfs from the south (Phase V of the Salt Valley Trunk Sewer) and 28 cfs from the east (Beal Slough Phase I project). The total flow of 79 cfs exceeds the capacity of the 60-inch pipe. This causes backwater effect and increases the d/D ratio.

During these conditions, the wastewater in the 48-inch Salt Valley Trunk Sewer still preferred to flow into the larger trunk sewer at the crossovers. However, due to the depth of flow in the larger trunk, the flow in the 48-inch sewer increased and the d/D ranged between 0.1 and 0.93. This indicates that the 48-inch pipe is not maximized under these conditions. Approximately 98 percent of the flow in old Salt Valley system is diverted to the new system at Manhole B4-742.

10.3.2 Identification of Alternatives

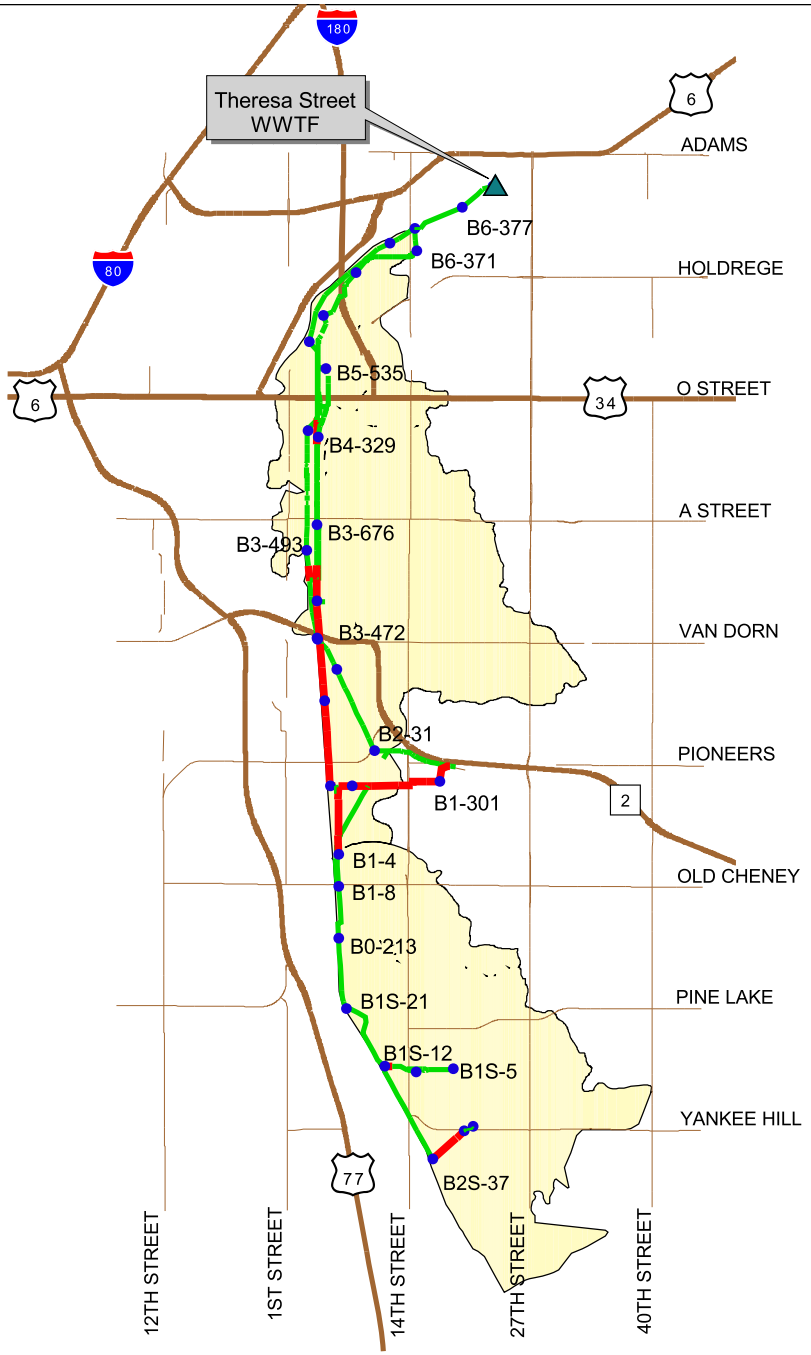
Alternatives were identified and evaluated to mitigate the problems identified under Tier I flow conditions. These alternatives include flow maximization, increased conveyance capacity, storage, and I/I flow reduction.

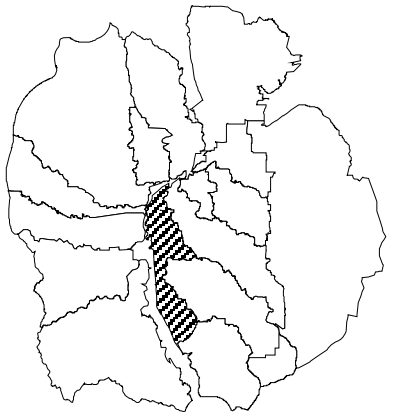
10.3.2.1 Flow Maximization in the Existing System

No SSOs were identified under the Tier I flow scenario. However, as indicated in Table 10.3, about twenty-one pipes were identified to have surcharged conditions. The results also show that the d/D ratio in the older 48-inch trunk parallel Salt Valley Trunk Sewer system ranged between 0.1 and 0.93. This shows that the flow in the older 48-inch sewer is not maximized.

For these improvements, it was assumed that no new structures would be built. Existing flow control structures in the Salt Valley Trunk Sewer, and planned interconnections in the proposed Beal Slough parallel trunk sewers would be used, and modified as needed to direct the flow into the older Salt Valley Trunk Sewer.

Table 10.2 Surcharged Pipes Salt Valley System - Tier I Conditions Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska						
Pipe ID	**US Manhole**	**DS Manhole**	**Diameter (ft)**	**Length (ft)**	**Flow (cfs)**	**d/D**
PP197	B1-5	B1-4	5.0	215	42.89	1.06
PP198	B1-4	B1-3	5.0	748	43.50	1.29
PP199	B1-3	B1-2	5.0	754	44.13	1.47
PP200	B1-2	B1-1	5.0	754	44.22	1.66
L762	B1-1	B1-310	5.0	260	44.24	1.84
PP277	B1-310	B1-311	5.0	239	71.19	1.97
PP278	B1-311	B1-289	5.0	233	71.19	2.00
PP279	B1-289	B1-290	5.0	709	71.19	2.00
PP280	B1-290	B2-397	5.0	738	71.19	1.94
PP281	B2-397	B2-398	5.0	700	71.19	1.87
PP282	B2-398	B2-399	5.0	651	71.19	1.81
PP283	B2-399	B2-400	5.0	660	71.19	1.75
PP284	B2-400	B2-401	5.0	717	71.19	1.71
PP285	B2-401	B2-402	5.0	726	71.19	1.64
PP286	B2-402	B2-403	5.0	1054	71.19	1.59
PP287	B2-403	B3-678	5.0	1051	74.42	1.51
PP288	B3-678	B3-679	5.0	575	75.06	1.38
PP289	B3-679	B3-681	5.0	217	75.98	1.34
PP304	B3-681	B3-682	5.0	932	74.41	1.27
PP305	B3-682	B3-683	5.0	632	75.22	1.17
PP306	B3-683	B3-675	5.0	632	75.20	1.10





LEGEND

Pipe Surcharge Conditions

- d/D <= 1.0
- d/D > 1.0
- Highways
- Streets
- Existing Service Area

0 1 2 Miles

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Figure 10.3 - Location of Surcharged Pipes
Tier I Conditions
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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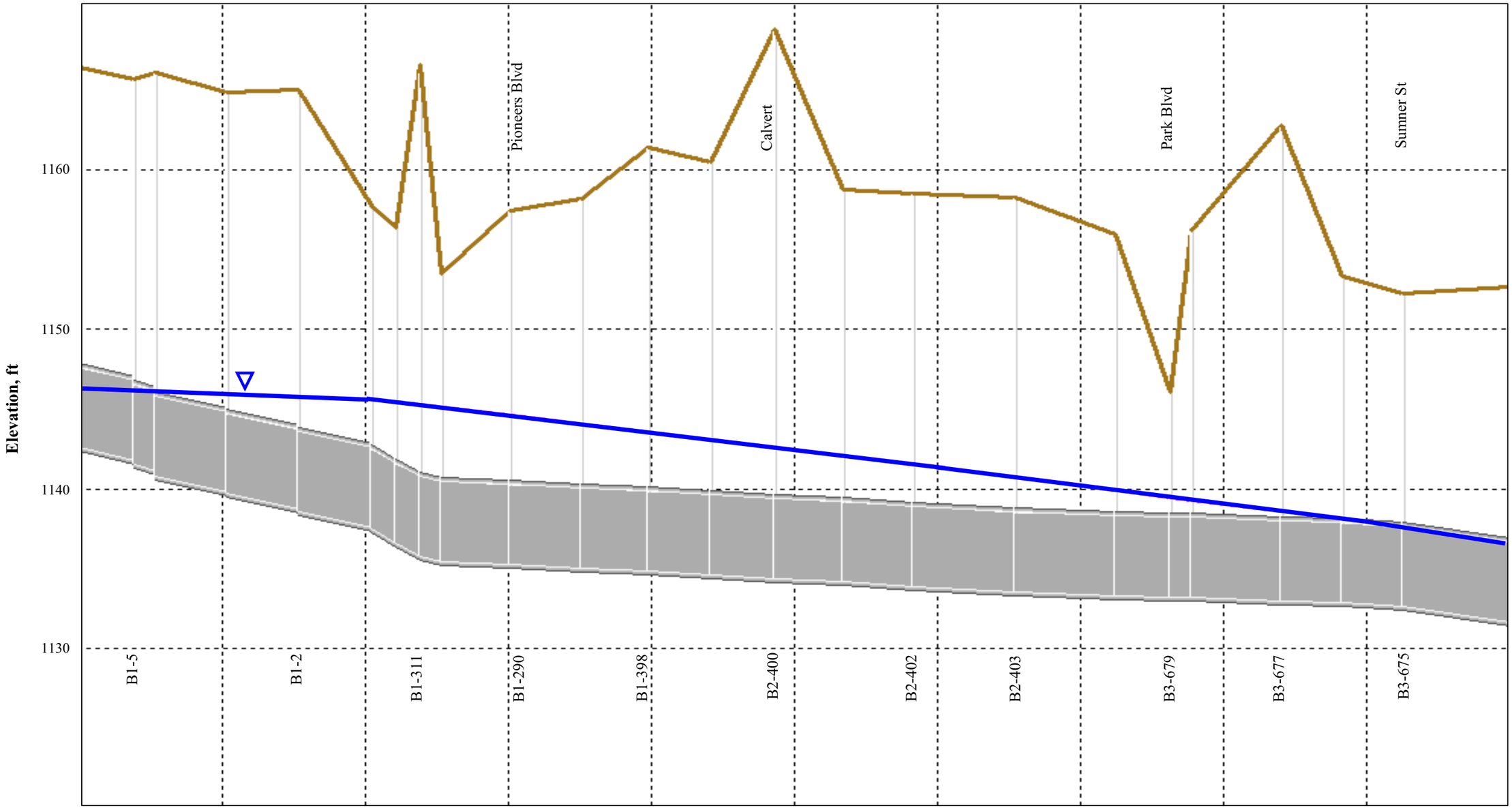

Figure 10.4 Hydraulic Profile of Existing System – Tier I Conditions
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Table 10.3 Results of Flow Maximization of Existing System Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska							
Pipe ID	US Manhole	DS Manhole	Dia. (ft)	Peak Flow (cfs)		d/D	
				W/O Flow Max.	W Flow Max.	W/O Flow Max.	W/Flow Max.
PP197	B1-5	B1-4	5.0	42.89	40.46	1.06	0.60
PP198	B1-4	B1-3	5.0	43.50	40.72	1.29	0.81
PP199	B1-3	B1-2	5.0	44.13	42.09	1.47	1.00
PP200	B1-2	B1-1	5.0	44.22	43.38	1.66	1.19
L762	B1-1	B1-310	5.0	44.24	44.04	1.84	1.37
PP277	B1-310	B1-311	5.0	71.19	65.36	1.97	1.51
PP278	B1-311	B1-289	5.0	71.19	65.36	2.00	1.54
PP279	B1-289	B1-290	5.0	71.19	65.36	2.00	1.54
PP280	B1-290	B2-397	5.0	71.19	65.36	1.94	1.49
PP281	B2-397	B2-398	5.0	71.19	65.36	1.87	1.45
PP282	B2-398	B2-399	5.0	71.19	65.36	1.81	1.40
PP283	B2-399	B2-400	5.0	71.19	65.36	1.75	1.35
PP284	B2-400	B2-401	5.0	71.19	65.36	1.71	1.33
PP285	B2-401	B2-402	5.0	71.19	65.36	1.64	1.28
PP286	B2-402	B2-403	5.0	71.19	65.35	1.59	1.25
PP287	B2-403	B3-678	5.0	74.42	68.63	1.51	1.19
PP288	B3-678	B3-679	5.0	75.06	68.62	1.38	1.10
PP289	B3-679	B3-681	5.0	75.98	68.61	1.34	1.03
PP304	B3-681	B3-682	5.0	74.41	71.72	1.27	1.01
PP305	B3-682	B3-683	5.0	75.22	72.52	1.17	0.91
PP306	B3-683	B3-675	5.0	75.20	72.51	1.10	0.85

The flow maximization alternative involves maximizing the flows in the existing system especially flow in 48-inch sewer of the old Salt Valley system. Rating curves were developed to control flows from the old system to new system at manholes B1-93 and B4-472. At manhole B1-93, the rating curve was developed such that approximately 29 percent of the flow in the old system is diverted to the new system. The rating curve at manhole B4-742 was developed to allow no flow from the old system to new system. The hydraulic model was modified to represent this alternative. The results of maximizing the flow downstream from crossover at manholes B5-614 and B4-397 are shown schematically in Figure 10.5.

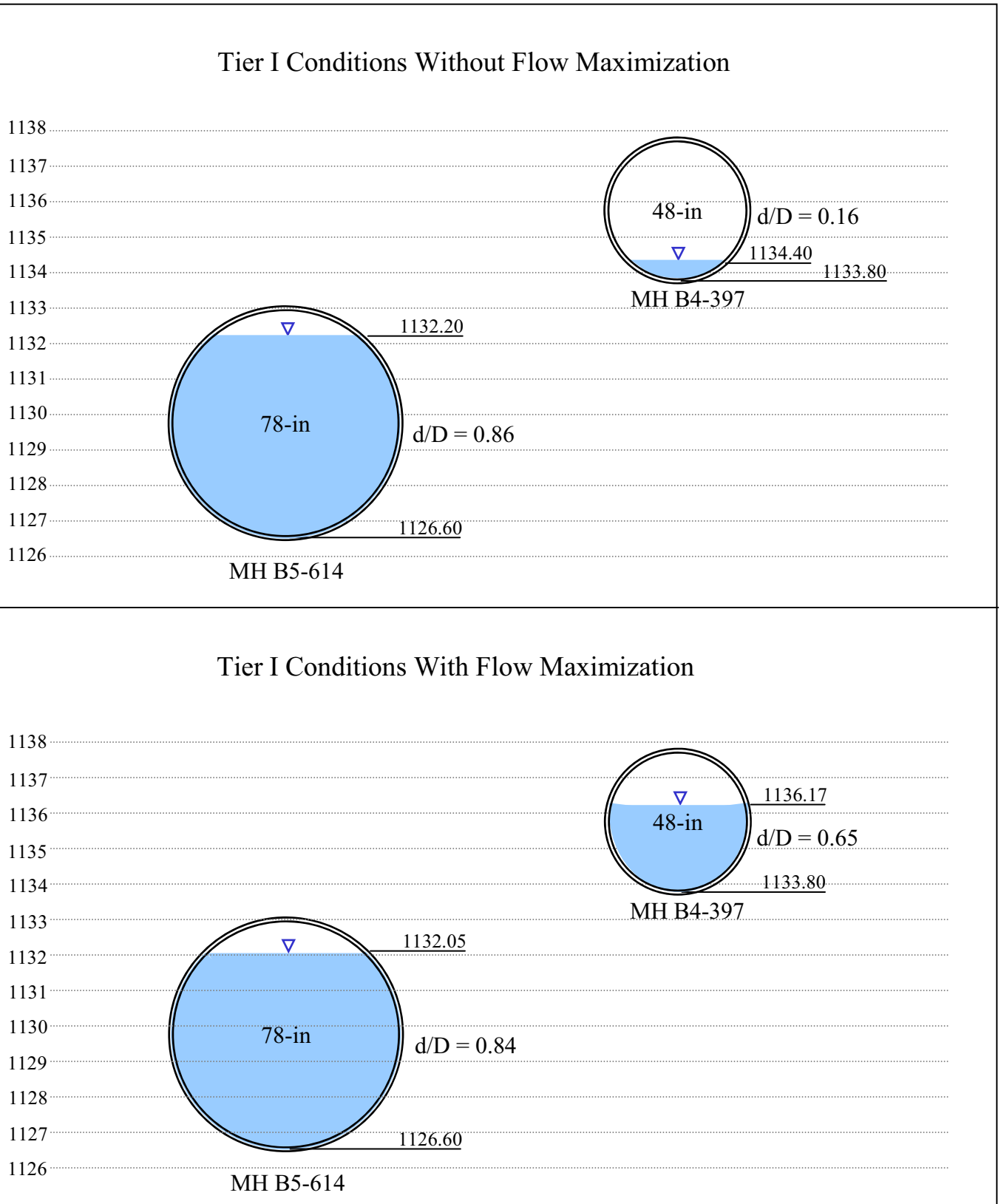

Figure 10.5 Modeled Water Surface Levels
With and Without Flow Maximization – Tier I Conditions
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Table 10.3 shows that by maximizing the flows in the existing system the maximum surcharged depth of the pipes decreased from 5 feet to 2.7 feet. In addition to decreasing the surcharged depth, the number of surcharged pipes decreased from 21 to 15.

10.3.2.2 Storage with Flow Maximization Alternative

To completely eliminate the surcharged condition identified under Tier I flow conditions, a storage facility located near Manhole B1-310 (see Figure 10.6) was modeled in addition to maximizing the flow in the existing system. The results of this analysis are shown in Table 10.4 below.

Table 10.4 Simulation Results of Storage with Flow Maximization
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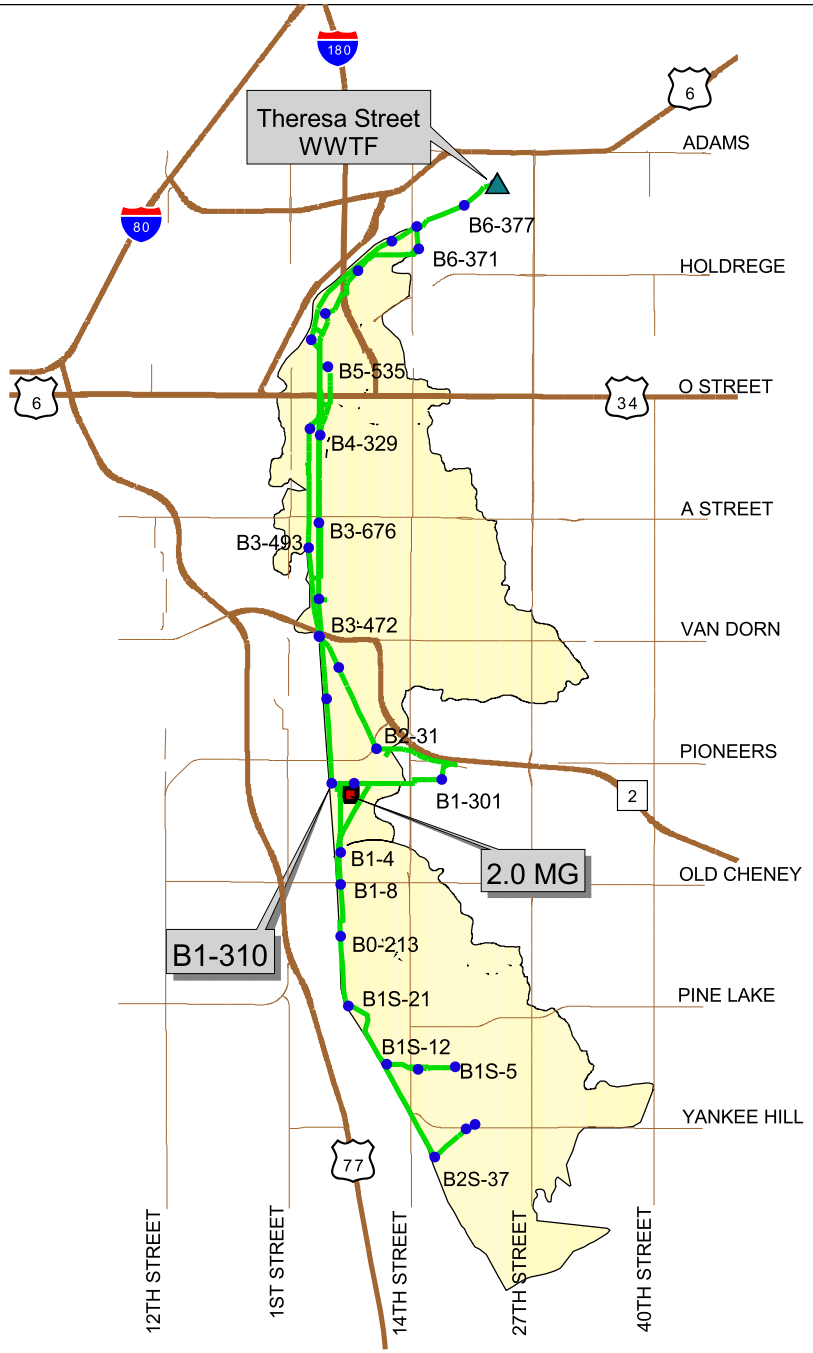
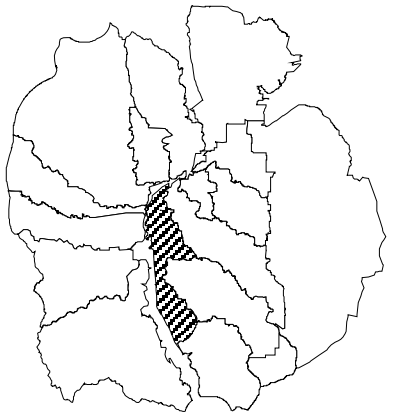
City of Lincoln, Nebraska

Pipe ID	US Manhole	DS Manhole	Dia. (ft)	Peak Flow (cfs)		d/D	
				W/O Storage	With Storage	W/O Storage	With Storage
PP197	B1-5	B1-4	5.0	42.89	40.60	1.06	0.41
PP198	B1-4	B1-3	5.0	43.50	40.60	1.29	0.46
PP199	B1-3	B1-2	5.0	44.13	40.59	1.47	0.53
PP200	B1-2	B1-1	5.0	44.22	40.62	1.66	0.66
L762	B1-1	B1-310	5.0	44.24	41.04	1.84	0.85
PP277	B1-310	B1-311	5.0	71.19	65.94	1.97	0.99
PP278	B1-311	B1-289	5.0	71.19	54.13	2.00	1.03
PP279	B1-289	B1-290	5.0	71.19	54.12	2.00	1.03
PP280	B1-290	B2-397	5.0	71.19	54.10	1.94	1.01
PP281	B2-397	B2-398	5.0	71.19	54.09	1.87	1.00
PP282	B2-398	B2-399	5.0	71.19	54.08	1.81	0.97
PP283	B2-399	B2-400	5.0	71.19	54.08	1.75	0.97
PP284	B2-400	B2-401	5.0	71.19	54.08	1.71	0.97
PP285	B2-401	B2-402	5.0	71.19	54.08	1.64	0.96
PP286	B2-402	B2-403	5.0	71.19	54.08	1.59	0.96
PP287	B2-403	B3-678	5.0	74.42	57.38	1.51	0.95
PP288	B3-678	B3-679	5.0	75.06	57.38	1.38	0.90
PP289	B3-679	B3-681	5.0	75.98	57.38	1.34	0.86
PP304	B3-681	B3-682	5.0	74.41	60.52	1.27	0.85
PP305	B3-682	B3-683	5.0	75.22	61.35	1.17	0.79
PP306	B3-683	B3-675	5.0	75.20	61.35	1.10	0.73





Key Map

N

LEGEND
- Salt Valley Pipes
- Highways
- Streets
- Storage Basin
- Existing Service Area

0 1 2 Miles

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Figure 10.6 - Location of Storage
Tier I Conditions
Salt Valley Basin Trunk Sewer
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To model this scenario, a flow diversion curve was developed to divert approximately 18 percent (11.8 cfs) of the peak flow at manhole B1-311 to the storage facility. This analysis revealed that a storage volume of about 2.0 MG is needed to store the flow for about four hours. The results shown in Table 10.4 above and graphically in Figure 10.7 indicate that this alternative will eliminate all the surcharging identified under Tier I flow conditions. This location near manhole B1-310 is the same location identified in the Draft Siting Study Southwest Wastewater Facility prepared by Black & Veatch, March 2007.

10.3.2.3 I/I Flow Reduction

The capacity problems identified under the Tier I flow conditions are directly related to projected peak wet weather flow. Therefore, if a portion of the RDI/I flow associated with peak wet weather conditions could be reduced, the impacts these peak flows have on the collection system capacity could also be reduced.

Capacity limitations caused by RDI/I flow can be managed either by reducing the I/I contribution, conveying the excess flow through larger sewers, utilizing storage basins, or a combination of these. Infiltration control can be costly and is generally accomplished by repairing or replacing older sewer mains and/or laterals and minimizing extraneous flow from sump pumps, foundation drains, etc. Expansion of wastewater conveyance and storage capacity can also be expensive and is normally accomplished by eliminating bottlenecks with relief sewers, pump stations, or by constructing storage for excess flow. An I/I flow reduction plan consisting of a series of simulation runs was developed to determine tradeoffs between I/I flow reductions as compared to construction of increased sewer capacity and/or storage facilities.

In conjunction with wet weather hydrographs, flow projections were used to produce various scenarios to evaluate five I/I flow reduction targets. The RDI/I flow reduction target levels ranged from 10 to 30 percent. It was assumed that the ratio of peak wet weather flow derived from the City's equation to peak dry weather flow is approximately 5. Therefore, the I/I component of the peak wet weather flow can be approximated as

$$q_{i/i} = 0.8Q_p$$

Where

$q_{I/I}$ = flow due to inflow and infiltration

Q_p = peak wet weather flow

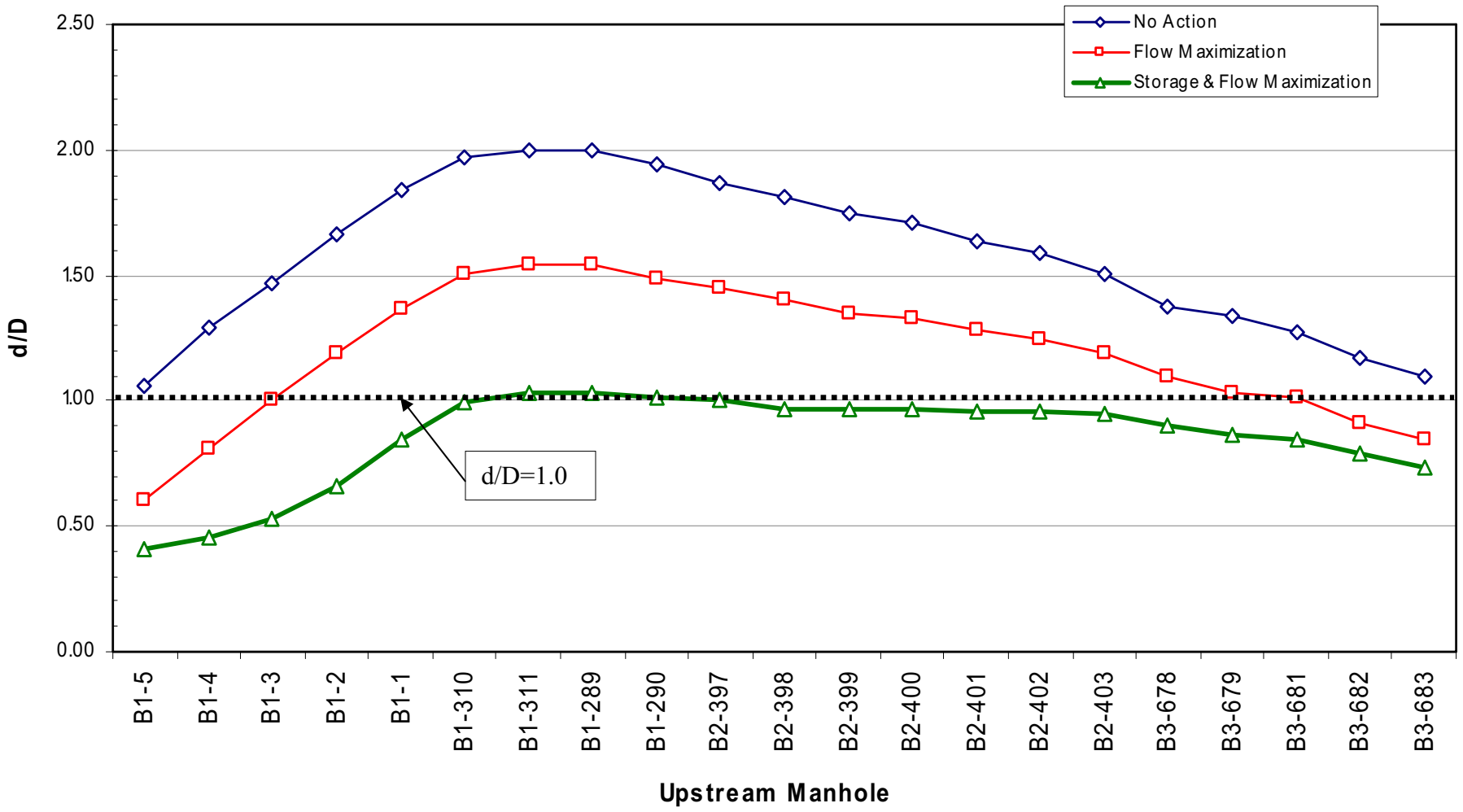

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Figure 10.7
Comparison of Water Surface Elevations
Tier I Conditions
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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For α percent I/I flow reduction target, the peak wet weather flow used in the simulation can be written as:

$$Q_\alpha = \left[1 - \frac{\alpha}{100}\right] \times 0.8Q_p + 0.2Q_p$$

Where

$0.2Q_p$ = peak dry weather flow.

The results of the five simulation runs are summarized for the surcharged pipes identified under Tier I flow conditions in Table 10.5. The table indicates that an I/I flow reduction target between 15 and 20 percent will eliminate surcharged conditions identified under Tier I conditions. Figure10.8 compares the water surface elevations for the various RDI/I flow reduction targets.

Table 10.5 Comparison of d/D Ratios for various I/I Flow Reduction Target Levels Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska								
Pipe ID	US Manhole	DS Manhole	d/D Ratio for I/I Reduction Target Indicated					
			0%	10%	15%	20%	25%	30%
PP197	B1-5	B1-4	1.06	0.40	0.38	0.37	0.36	0.35
PP198	B1-4	B1-3	1.29	0.52	0.45	0.41	0.40	0.39
PP199	B1-3	B1-2	1.47	0.67	0.56	0.45	0.41	0.39
PP200	B1-2	B1-1	1.66	0.85	0.73	0.58	0.50	0.45
L762	B1-1	B1-310	1.84	1.04	0.92	0.77	0.69	0.63
PP277	B1-310	B1-311	1.97	1.19	1.07	0.92	0.84	0.78
PP278	B1-311	B1-289	2.00	1.22	1.11	0.96	0.89	0.83
PP279	B1-289	B1-290	2.00	1.22	1.11	0.96	0.89	0.83
PP280	B1-290	B2-397	1.94	1.20	1.09	0.95	0.88	0.83
PP281	B2-397	B2-398	1.87	1.17	1.07	0.95	0.88	0.83
PP282	B2-398	B2-399	1.81	1.14	1.04	0.93	0.87	0.82
PP283	B2-399	B2-400	1.75	1.12	1.03	0.93	0.87	0.83
PP284	B2-400	B2-401	1.71	1.11	1.02	0.93	0.87	0.83
PP285	B2-401	B2-402	1.64	1.08	1.00	0.93	0.88	0.83
PP286	B2-402	B2-403	1.59	1.07	0.99	0.93	0.88	0.84
PP287	B2-403	B3-678	1.51	1.04	0.97	0.92	0.88	0.84
PP288	B3-678	B3-679	1.38	0.97	0.92	0.88	0.84	0.81
PP289	B3-679	B3-681	1.34	0.92	0.87	0.84	0.81	0.77
PP304	B3-681	B3-682	1.27	0.90	0.85	0.82	0.79	0.76
PP305	B3-682	B3-683	1.17	0.83	0.80	0.77	0.74	0.71
PP306	B3-683	B3-675	1.10	0.77	0.74	0.71	0.68	0.66

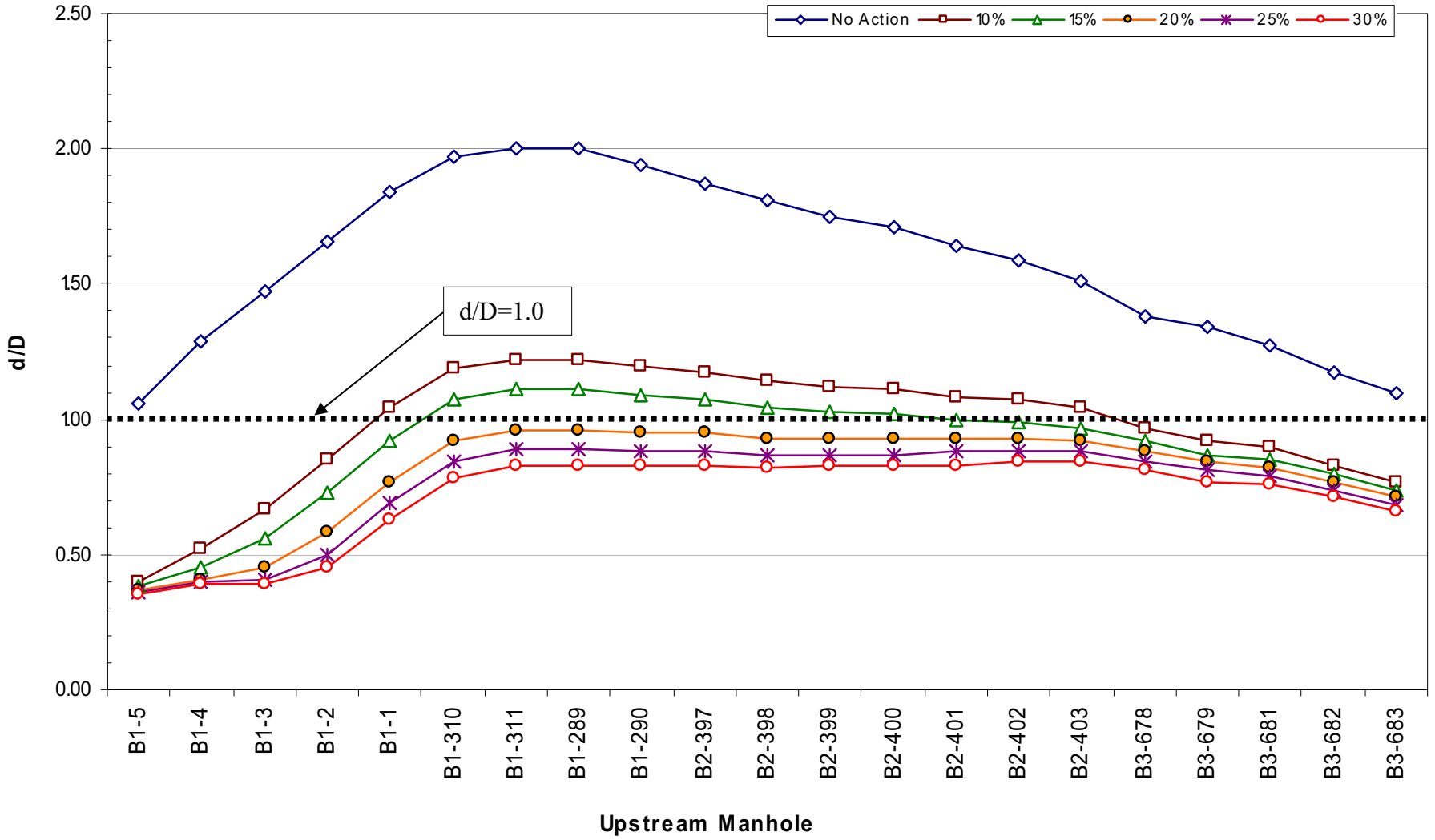

Figure 10.8
Comparison of Water Surface Elevations for Various I/I Flow Reduction Target Levels – Tier I Conditions
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10.4 TIER II CONDITIONS

10.4.1 Modeling Results

The Tier II flow conditions were modeled in the existing system, based on 45,191 acres with a peak flow of approximately 229 cfs. The simulation results show that the Salt Valley sewer system does not have sufficient capacity to convey the peak wet weather flows under Tier II conditions. The capacity shortages are manifested most noticeably in the modeled SSO's at nine locations. The overflows occurred between simulated hours of 1:00PM and 11:00PM and were of medium duration ranging from 3 to 5.5 hours. Table 10.6 provides a summary of capacity related overflows under Tier II conditions. All the high levels occurred along the Salt Valley main trunk system in the low-lying areas upstream from the siphon across Antelope Creek. The modeled water surface level exceeded the top of the manholes by 0.08 feet to 5.24 feet.

The Salt Valley trunk sewers with d/D ratios that exceeded 95 percent are listed in Table 10.7. The relative locations of these pipes within the existing Salt Valley system are displayed in Figure 10.9. The figure shows the collection system with pipe identification and color-coding showing the locations where pipes were running greater than 95 percent of capacity. The limited conveyance capacity was the source of the calculated high water surface levels in the pipes and manholes in this area under Tier II peak flow conditions. The hydraulic profile of the capacity deficient sections of the Salt Valley trunk sewer is shown schematically in Figure 10.10.

Table 10.6 Manholes with Modeled SSO's Under Tier II Conditions
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Node ID	Invert Elevation (ft)	Modeled Water Surface Elevation (ft)	Modeled Depth of Water (ft)
B1-289	1135.46	1158.77	23.31
B3-679	1133.24	1149.65	16.41
B1-310	1136.55	1159.55	9.00
B1-1	1137.48	1159.93	22.45
B1-290	1135.25	1158.01	22.76
B1S-75	1166.57	1176.54	9.97
B1S-16	1163.73	1173.58	9.85
B1S-17	1163.18	1172.99	9.81
B1S-14	1164.33	1174.74	10.00

Notes
1 - The Depth of Water is caculated from the Manhole Invert.

Table 10.7A Surcharged Pipes Salt Valley System - Tier II Conditions
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

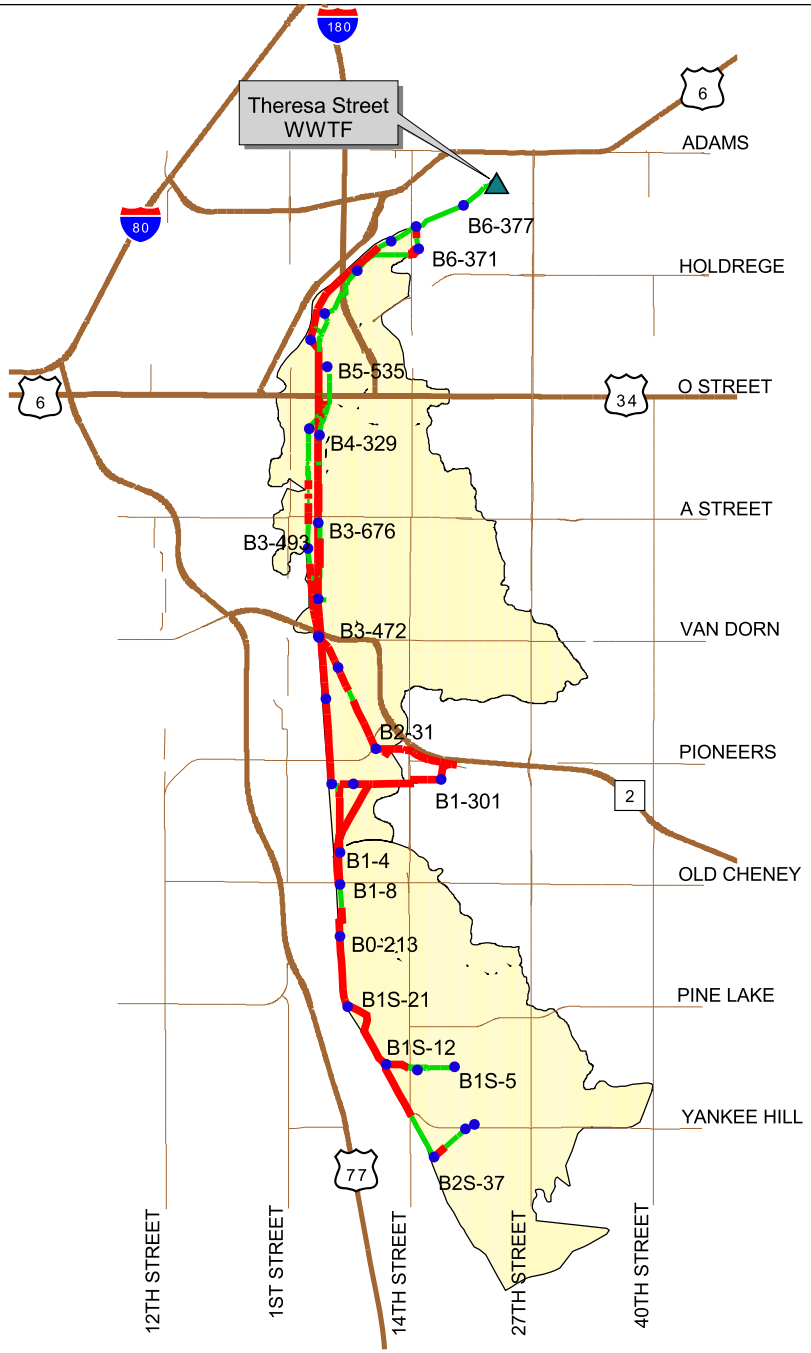
Pipe ID	US Manhole	DS Manhole	Diameter (ft)	Length (ft)	Flow (cfs)	d/D
P1	SB4-57	MH-12	4.00	512	41.58	2.07
P2	MH-12	MH-11	4.00	531	41.58	2.11
P3	MH-11	MH-10	4.00	564	41.58	2.13
P4	MH-10	MH-9	4.00	526	41.58	2.17
P5	MH-9	MH-8	4.00	519	41.57	2.21
P6	MH-8	MH-7	4.00	542	41.57	2.24
P7	MH-7	MH-6	4.00	549	41.57	2.28
P8	MH-6	MH-5	4.00	507	41.56	2.31
P9	MH-5	MH-4	4.00	322	41.56	2.33
P10	MH-4	B2S-37	4.00	398	41.56	2.38
PP232	B2S-37	B2S-38	4.00	418	48.26	2.39
PP233	B2S-38	B2S-39	4.00	400	48.26	2.40
PP234	B2S-39	B2S-40	4.00	600	48.26	2.42
PP235	B2S-40	B1S-72	4.00	600	48.26	2.43
PP236	B1S-72	B1S-73	4.00	600	48.25	2.45
PP237	B1S-73	B1S-74	4.00	548	48.25	2.47
PP238	B1S-74	B1S-75	4.00	602	48.25	2.49
PP239	B1S-75	B1S-76	4.00	561	47.65	2.51
PP240	B1S-76	B1S-12	4.00	239	47.65	2.65
PP241	B1S-12	B1S-13	4.00	424	51.27	2.65
PP242	B1S-13	B1S-14	4.00	352	51.27	2.62
PP243	B1S-14	B1S-15	4.00	509	51.16	2.60
PP244	B1S-15	B1S-16	4.00	448	51.18	2.51
PP245	B1S-16	B1S-17	4.00	483	50.72	2.46
PP246	B1S-17	B1S-18	4.00	226	50.61	2.45
PP247	B1S-18	B1S-19	4.00	392	50.62	2.45
PP248	B1S-19	B1S-20	4.00	437	50.62	2.39
PP249	B1S-20	B1S-21	4.00	118	50.74	2.32
PP250	B1S-21	B0-208	4.00	316	50.86	2.32
PP251	B0-208	B0-209	4.00	483	50.77	2.35
PP252	B0-209	B0-210	4.00	594	50.74	2.28
PP253	B0-210	B0-211	4.00	521	50.75	2.10
PP254	B0-211	B0-212	4.00	544	50.79	2.01
PP255	B0-212	B0-213	4.00	605	50.73	1.99
PP256	B0-213	B0-214	4.00	655	50.73	1.93

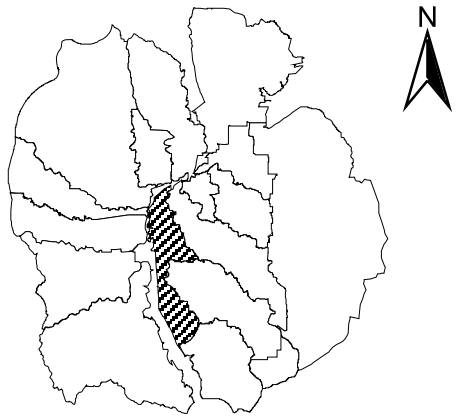
Table 10.7B Surcharged Pipes Salt Valley System - Tier II Conditions
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Pipe ID	US Manhole	DS Manhole	Diameter (ft)	Length (ft)	Flow (cfs)	d/D
PP257	B0-214	B0-215	4.00	152	50.77	1.82
PP258	B0-215	B0-216	4.00	565	51.29	1.82
PP259	B0-216	B0-217	4.00	413	51.29	1.68
L745	B0-217	B1-8	4.00	583	51.46	1.66
PP194	B1-8	B1-7	5.00	236	53.05	4.27
PP195	B1-7	B1-6	5.00	569	100.14	4.27
PP196	B1-6	B1-5	5.00	569	99.83	4.28
PP197	B1-5	B1-4	5.00	215	100.25	4.36
PP198	B1-4	B1-3	5.00	748	99.75	4.42
PP199	B1-3	B1-2	5.00	754	99.68	4.44
PP200	B1-2	B1-1	5.00	754	99.68	4.47
L762	B1-1	B1-310	5.00	260	97.59	4.59
PP277	B1-310	B1-311	5.00	239	120.78	4.67
PP278	B1-311	B1-289	5.00	233	120.78	4.67
PP279	B1-289	B1-290	5.00	709	87.19	4.66
PP280	B1-290	B2-397	5.00	738	87.06	4.55
PP281	B2-397	B2-398	5.00	700	87.07	4.44
PP282	B2-398	B2-399	5.00	651	87.07	4.33
PP283	B2-399	B2-400	5.00	660	87.07	4.23
PP284	B2-400	B2-401	5.00	717	87.07	4.14
PP285	B2-401	B2-402	5.00	726	87.07	4.02
PP286	B2-402	B2-403	5.00	1054	87.07	3.93
PP287	B2-403	B3-678	5.00	1051	112.06	3.79
PP288	B3-678	B3-679	5.00	575	112.06	3.46
PP289	B3-679	B3-681	5.00	217	108.76	3.28
PP304	B3-681	B3-682	5.00	932	104.51	3.21
PP305	B3-682	B3-683	5.00	632	101.74	2.97
PP306	B3-683	B3-675	5.00	632	101.73	2.82
PP307	B3-675	B3-676	5.00	1113	101.89	2.69
PP308	B3-676	B4-736	5.00	1010	102.46	2.57
PP309	B4-736	B4-738	5.00	816	107.41	2.47
PP310	B4-738	B4-739	5.00	824	109.33	2.37
PP502	B4-739	B4-741	5.00	847	110.28	2.25
PP412	B4-741	B4-743	5.00	1146	109.98	2.17
PP413	B4-743	B5-614	6.50	945	134.03	1.59
PP414	B5-614	B5-616	6.50	380	145.51	1.55

Table 10.7C Surcharged Pipes Salt Valley System - Tier II Conditions
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Pipe ID	US Manhole	DS Manhole	Diameter (ft)	Length (ft)	Flow (cfs)	d/D
PP415	B5-616	B5-617	6.50	757	153.01	1.54
PP416	B5-617	B5-618	6.50	820	144.43	1.50
PP417	B5-618	B5-619	6.50	538	144.29	1.47
PP418	B5-619	B5-602	6.50	520	144.21	1.44
PP420	B5-603	B5-604	6.50	783	136.08	1.36
PP421	B5-604	B5-605	6.50	765	135.73	1.35
PP422	B5-605	B6-384	6.50	626	135.47	1.31
PP423	B6-384	B6-385	6.50	800	135.14	1.27
PP424	B6-385	B6-386	6.50	850	134.70	1.22
PP425	B6-386	B6-387	6.50	571	134.31	1.17
PP426	B6-387	B6-388	6.50	428	134.14	1.16
PP427	B6-388	B6-389	6.50	710	134.14	1.16
PP419	B5-602	B5-603	6.50	851	136.28	1.41





LEGEND

Pipe Surcharge Conditions

- d/D <= 1.0
- d/D > 1.0
- Highways
- Streets
- Existing Service Area

0 1 2 Miles

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Figure 10.9 - Location of Surcharged Pipes
Tier II Conditions
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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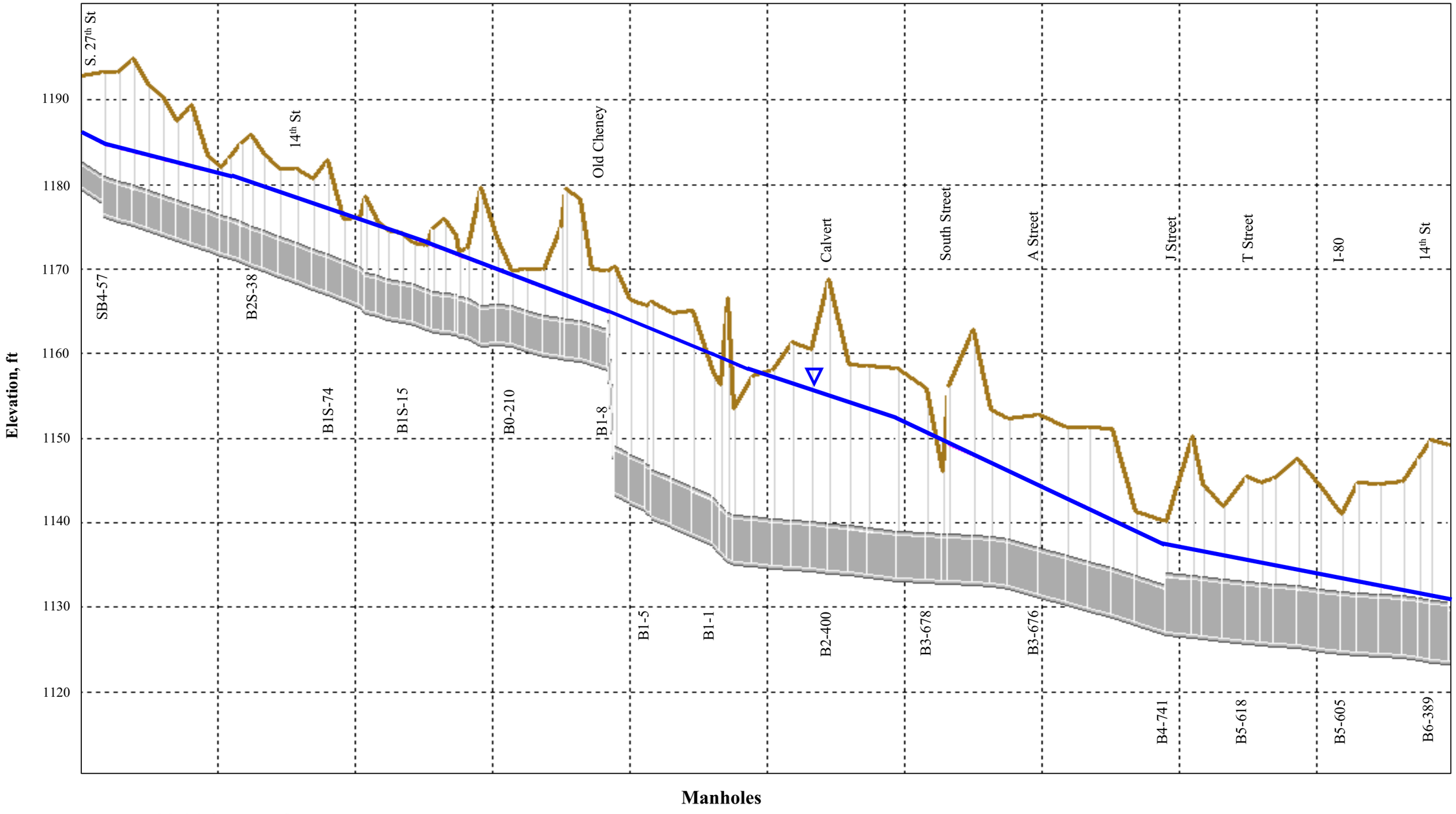

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NEBRASKA

Figure 10.10 Hydraulic Profile of Existing System – Tier II Conditions
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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10.4.2 Improvements/Recommendations

Recommendations were evaluated to eliminate problems identified under Tier II flow conditions. These recommendations include: increased conveyance capacity, storage, and RDI/I flow reduction. Flow maximization in the older parallel sewers was included in this evaluation as previously identified in the Tier I improvements.

10.4.2.1 I/I Flow Reduction

The simulation results for the five I/I flow reduction targets for the nine manholes with overflows (SSOs) identified under Tier II conditions for the existing system are summarized in Figure 10.11. The results indicate that I/I flow reduction alone is not effective in eliminating the overflows occurring under Tier II conditions.

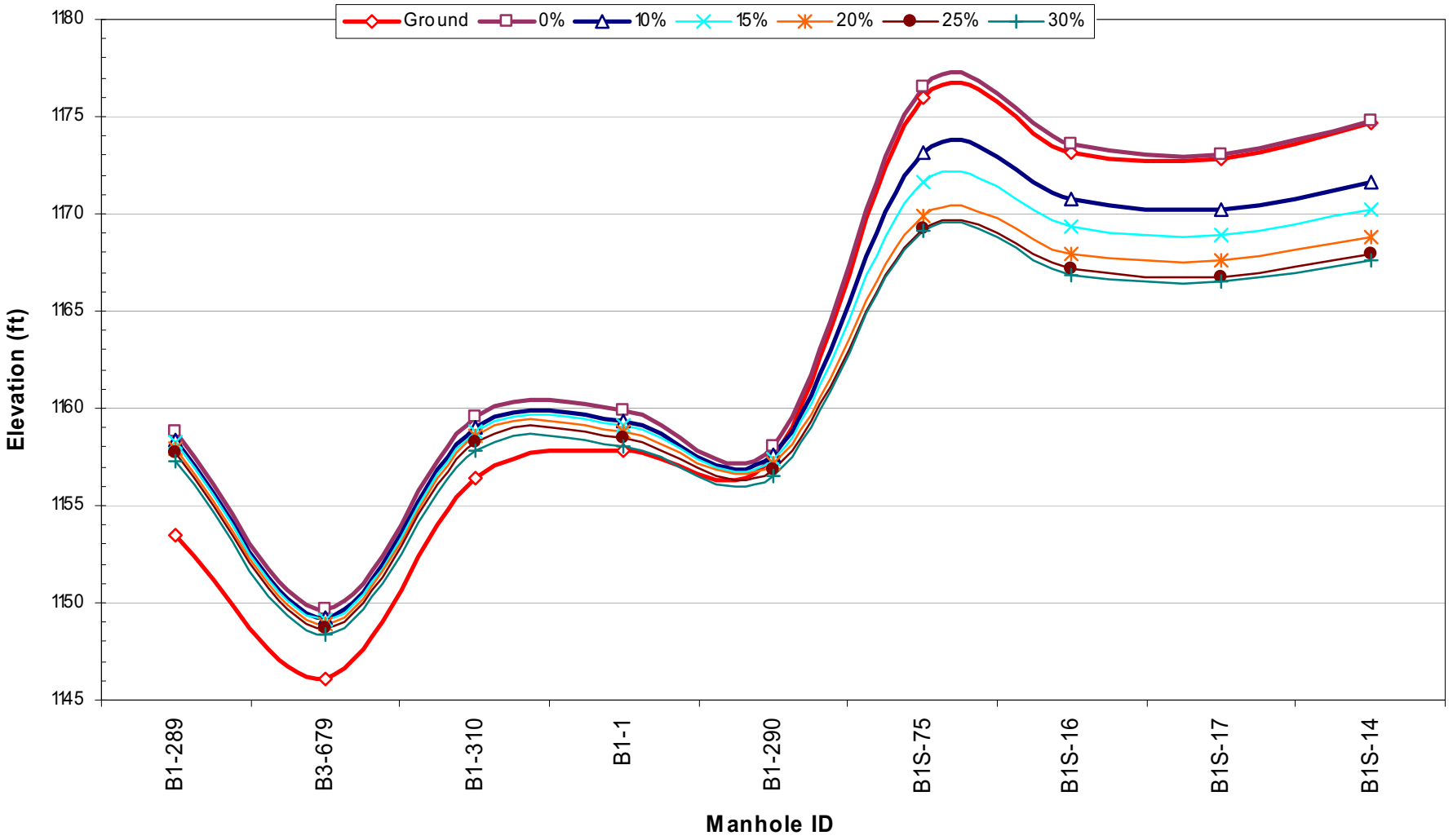
10.4.2.2 Storage and 20% I/I Flow Reduction Target

The I/I flow reduction model simulations indicate that I/I reduction is not effective to eliminate the simulated overflows. An alternative involving a combination of 20-percent I/I flow reduction, and storage was devised. This alternative involves reducing I/I by twenty percent, expanding the proposed storage facility near Manhole B1-310 and constructing a new storage facility near Manhole B2S-37, and diversion of a portion of the Tier II Haines Branch Basin flow to the proposed Upper Southwest Basin storage facility.

The 2.0 MG storage facility proposed near manhole B1-310 (southeast of Pioneers Blvd and 1st St) would be expanded to 3.0 or 4.0 MG of offline storage designed to temporarily hold wet weather flows that exceed the capacity of the bottleneck in the 60-inch sewer. After flow subsides, the stored wastewater would be conveyed back the Salt Valley system. The second storage facility is tentatively located in the Upper Southwest Basin upstream of where the Upper Southwest system joins the main stem of the Salt Valley Trunk system near manhole B2S-37 (south of Yankee Hill Rd and 14th St). The required volume of this storage facility is approximately 500,000 gallons. The general locations for these proposed storage facilities are shown in Figure 10.12.

These improvements, along with the storage improvements in the Upper SW Basins (Chapter 14) Haines Branch Basin (Chapter 15) and the West ‘O” and Middle Creek Basins (Chapter 16), will allow the Main Stem of the Salt Valley Trunk Sewer to adequately convey the Tier II flows to the Theresa Street WWTF. Shown in Figure 10.13 is Tier II Hydraulic Profile of the Salt Valley Trunk Sewer under Tier II conditions with the above identified improvements modeled.

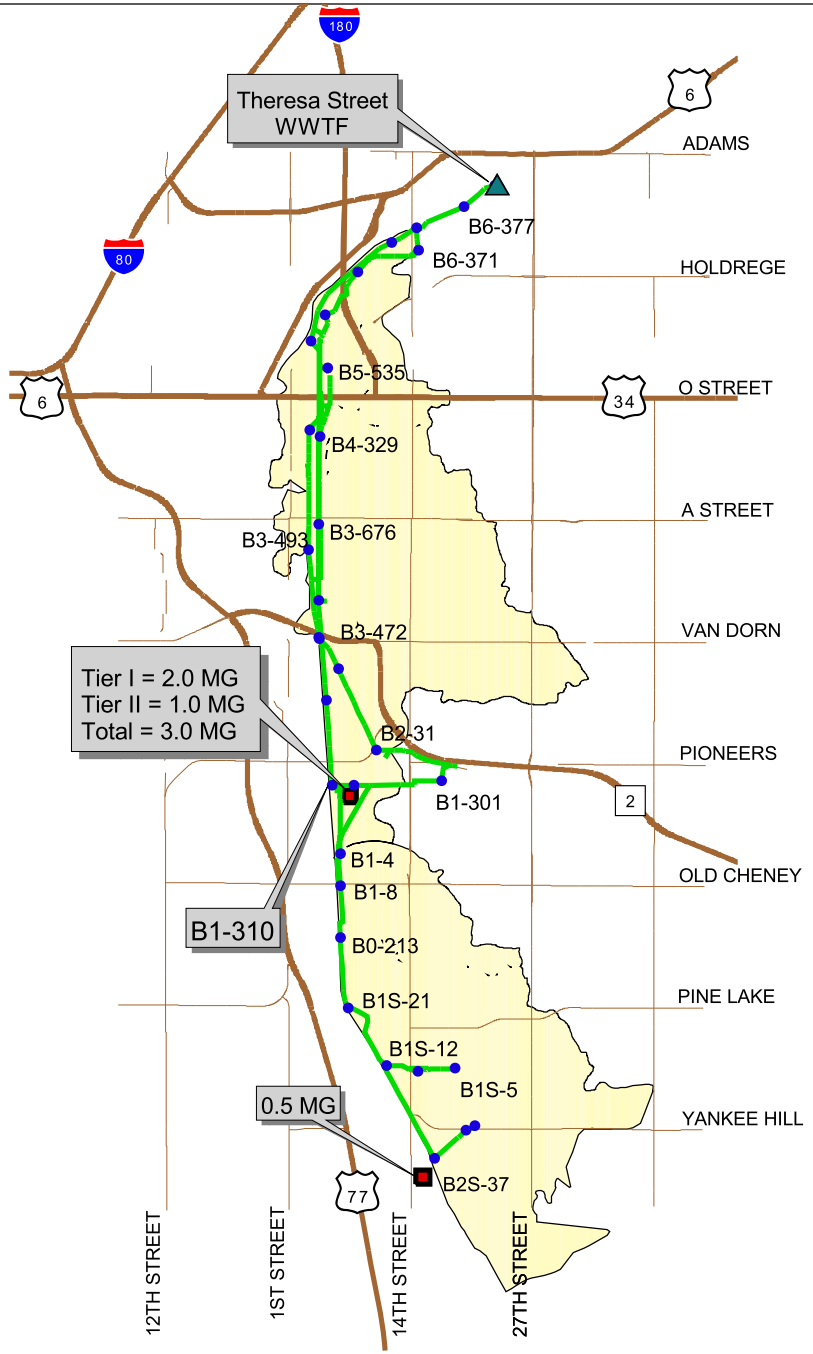
It should be noted that the capacity of the storage facilities would increase by approximately 5-percent if the assumed I/I flow reduction is not realized.

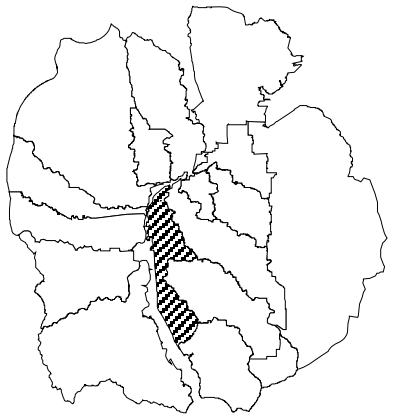


Note:

Existing system with Tier II flows and no storage.

Figure 10.11
Comparison of Water Surface Elevations for Various I/I Flow Reduction Target Levels – Tier II Conditions
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska





LEGEND
- Salt Valley Pipes
- Highways
- Streets
- Storage Basins
- Existing Service Area

0 1 2 Miles

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Figure 10.12 - Location of Storage
Tier II Conditions
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

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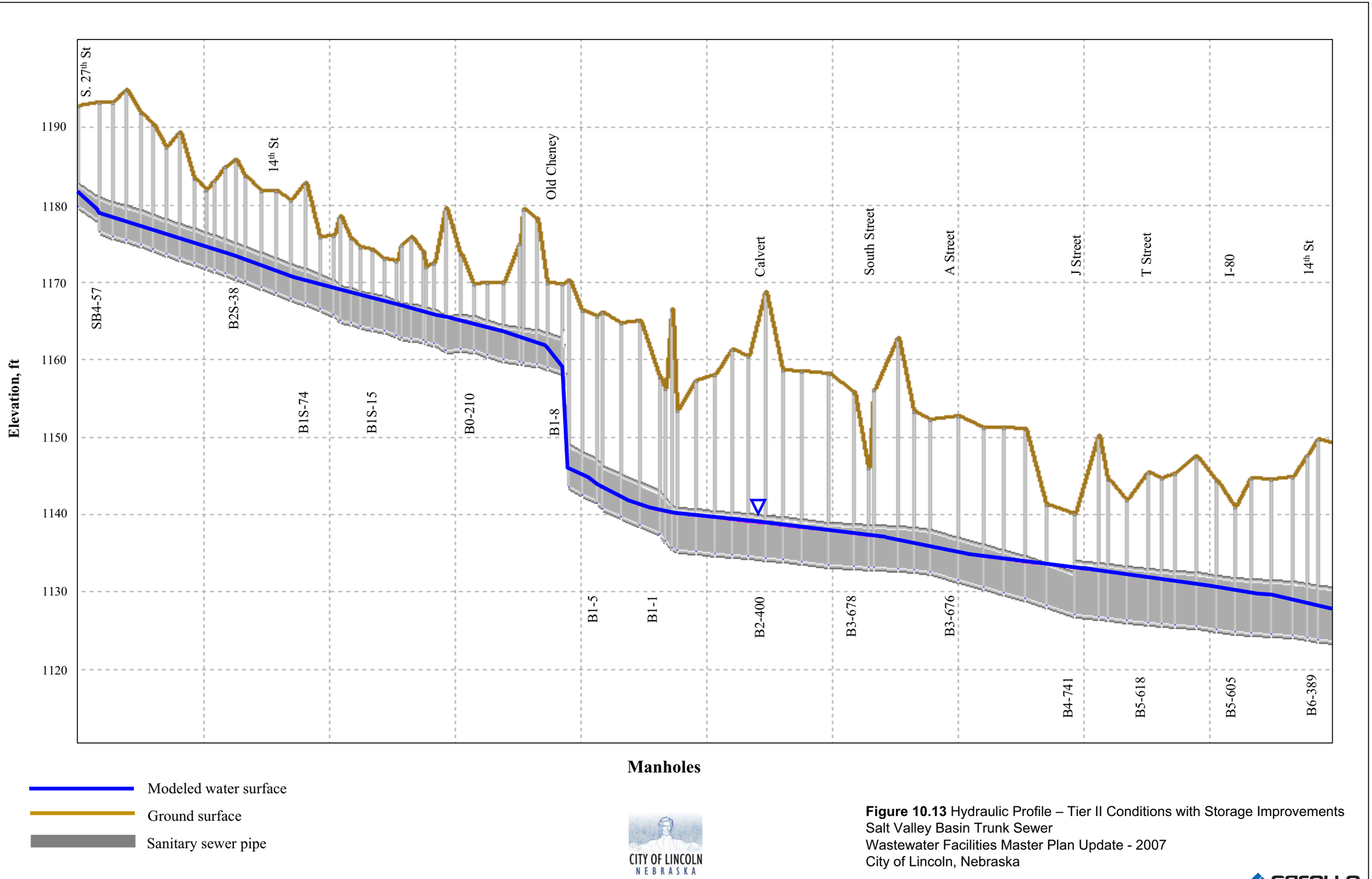

Figure 10.13 Hydraulic Profile – Tier II Conditions with Storage Improvements
Salt Valley Basin Trunk Sewer
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

10.5 TIER III CONDITIONS

10.5.1 Model Results

For the Tier III model, 61,017 acres with a corresponding flow of 302 cfs were introduced into the existing system. This revealed that severe surcharging backups into private property, flooding, and overflows of the sewer system occurred during Tier III conditions. At these flows the model simulation indicates that the Salt Valley Basin Trunk Sewer system is inadequate to convey Tier III flows.

10.5.2 Improvements

At the point in time when the flows from the Tier III build-out conditions are realized, the City will need major capacity improvements in place for the Salt Creek Interceptor. These improvements are also inter-related to other sewers in the system and the capacity of the Theresa Street WWTF. These improvements are discussed in more detail in Chapters 14, 15, 16, and 24.

10.6 SUMMARY OF RECOMMENDED IMPROVEMENTS

Recommendations for maintenance and improvements for the Salt Valley Trunk Sewer System include:

- Monitor and provide regular cleaning of existing sewer lines to maintain full pipe capacity.
- Tier I Flows:
    - Storage with flow maximization and ongoing I/I reduction.
- Tier II Flows:
    - Storage with I/I flow reduction.
- Tier III Flows:
    - Southwest WWTF
    - Storage

A summary of the improvement projects identified with planning costs is outlined in Table 10.8. To maximize the use of the recommended storage facilities it is recommended that they also be designed, constructed, and operated to dampen the diurnal peaks throughout the trunk sewer system. Dampening the diurnal peaks will result in maximizing the trunk infrastructure and deliver a more constant flow to the WWTF's.

Table 10.8 Recommended Improvements - Salt Valley Trunk Sewer System
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

Tier (Timing)	ID	Description	Location	Parameters	Unit Price	Planning Cost [1]
I	SVT-1	Line existing 48-inch diameter corrugated metal piping	B4-60 to B5-57	5,700 lf	$4.00/in dia-ft	$1,100,000
I	SVT-2	Maximize Flow in the older 48-inch SVT Trunk Sewer	Varies	-	-	$200,000 [2]
I	SVT-3	Storage	Near Manhole B1-310	2,000,000 gal	$4.00/gal	$8,000,000
II	SVT-4	Additional Storage	Near Manhole B1-310	1,000,000 gal	$4.00/gal	$4,000,000
II	SVT-5	Storage	Near Manhole B2S-37	500,000 gal	$4.00/gal	$2,000,000

Notes:
1. ENR CCI for Kansas City = 8512. (July 2006).
2. Assumed values to modify existing structures.