

## **Appendix E – Timing of Beals Slough Improvements TM**

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## TECHNICAL MEMORANDUM

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**To:** Brian Kramer, City of Lincoln, NE  
**From:** Brian Clow, Carollo Engineers  
**Date:** October 20, 2014 **Project No.:** 7498B.00  
**Subject:** Timing of Beals Slough Improvements

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### Estimate for the Timing of Future Phases of Beals Slough Relief Sewer

The timing of the installation of the Beal Slough parallel pipe between manholes C1-569 (27th Street) and DO-168 (Pine Lake Road) was estimated using the updated collection system hydraulic model. The pipe segment between manholes C1-569 and C1-188, (from 27th Street to 33rd Street) has already been paralleled. The analysis was conducted by assuming that the annual growth rate in the Beals Slough Basin is about 1.2 percent. Using this annual growth rate, a series of model runs were performed to estimate the approximate timing for the installation.

The dry weather flow and parameters for the wet weather flow unit hydrograph were estimated based on the annual growth rate to simulate the hydraulic conditions of the Beals system. All flows upstream of C1-188 (33rd Street) were conveyed through the existing pipe (called the north pipe). For each model run, the  $d/D$ , flow and the planning period were recorded for the critical section of the north pipe. The critical section of the north pipe is located between manholes C1-42 and C1-43 (40th Street).

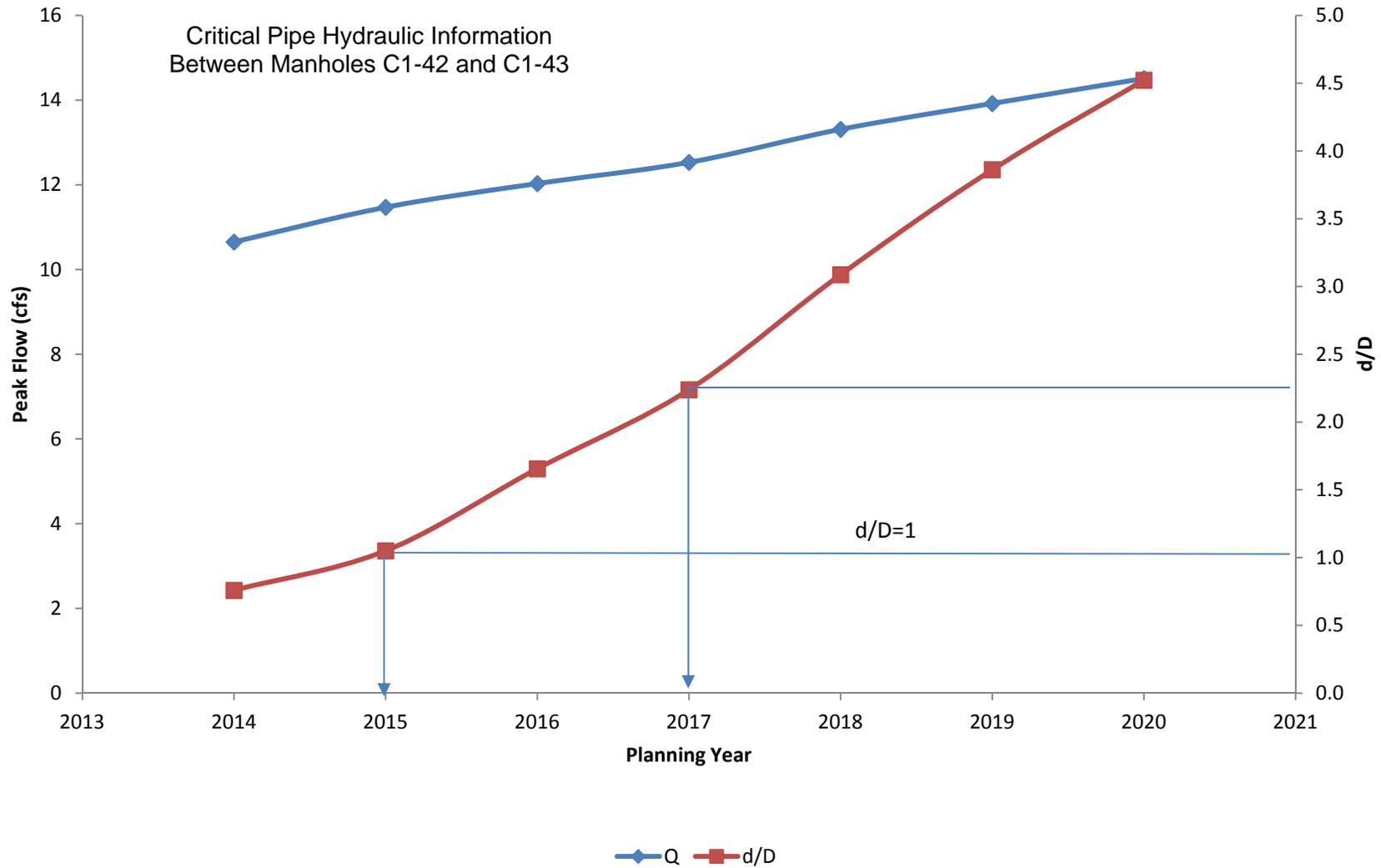
The results for the critical pipe were plotted and results shown on the attached Figure 1. The main criteria used is  $d/D$  in the critical pipe. If the  $d/D$  in the critical is greater or equal to 1, then the installation of the parallel pipe should be considered. The results show that,  $d/D$  in the critical pipe segment reaches 1 at a peak flow of 11.47 cfs in 2015, and is approaching a  $d/D$  of 2.5 in 2017.

### Performance of the Beals Slough Trunk Sewer South of 56th Street and Old Cheney Road

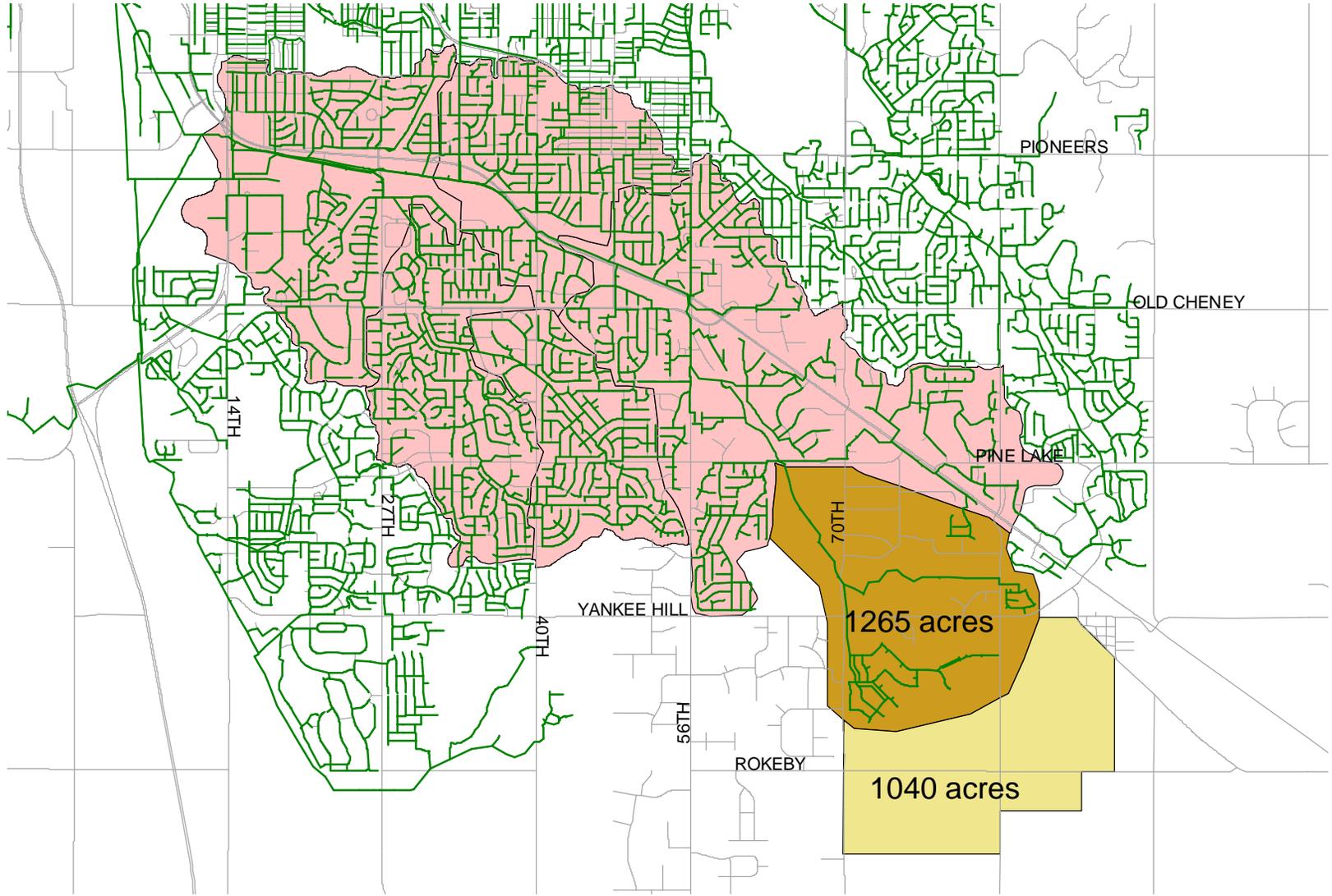
The reach of trunk sewer south of 56th street and Old Cheney Road is not planned to be paralleled in the future. Therefore, as part of this analysis the City wanted to further understand how the system will operate south of 56th street, and to confirm that there is adequate capacity to accommodate the existing and planned future development. The area served by Beals Slough Trunk Sewer is shown in Figure 2. The model was run at the Tier I (Buildout) condition using the 10 year, 24 hour type II storm. Figure 3 shows hydraulic profile on the reach of trunk sewer between 56th Street and Pine Lake Road, including the flows from the two highlighted areas. As shown there is minimal surcharging and no flooding at this model condition. Figure 4 shows the reach of sewer from Pine Lake Road to Manhole D2S-2 (Dempster Drive). As shown

on this figure there is surcharging that is occurring on either side of Yankee Hill Road, but no loss of containment within the collection system.

It should be noted that the information that was used to generate this reach of sewer was based on the latest GIS data that we have received to date, It may be beneficial to verify this information, including the invert and ground elevations with record drawings when available. As the sewer system is extended southward, it is probable that the surcharging that the model shows in the Yankee Hill area will decrease. This is due to the fact that currently all of the modeled flows from the areas south of manhole D2S-2 are input into the model at this manhole. When the system is extended, the flow inputs will be distributed along the reach of new sewer. This will result in the peak flows being attenuated due to the time of travel.

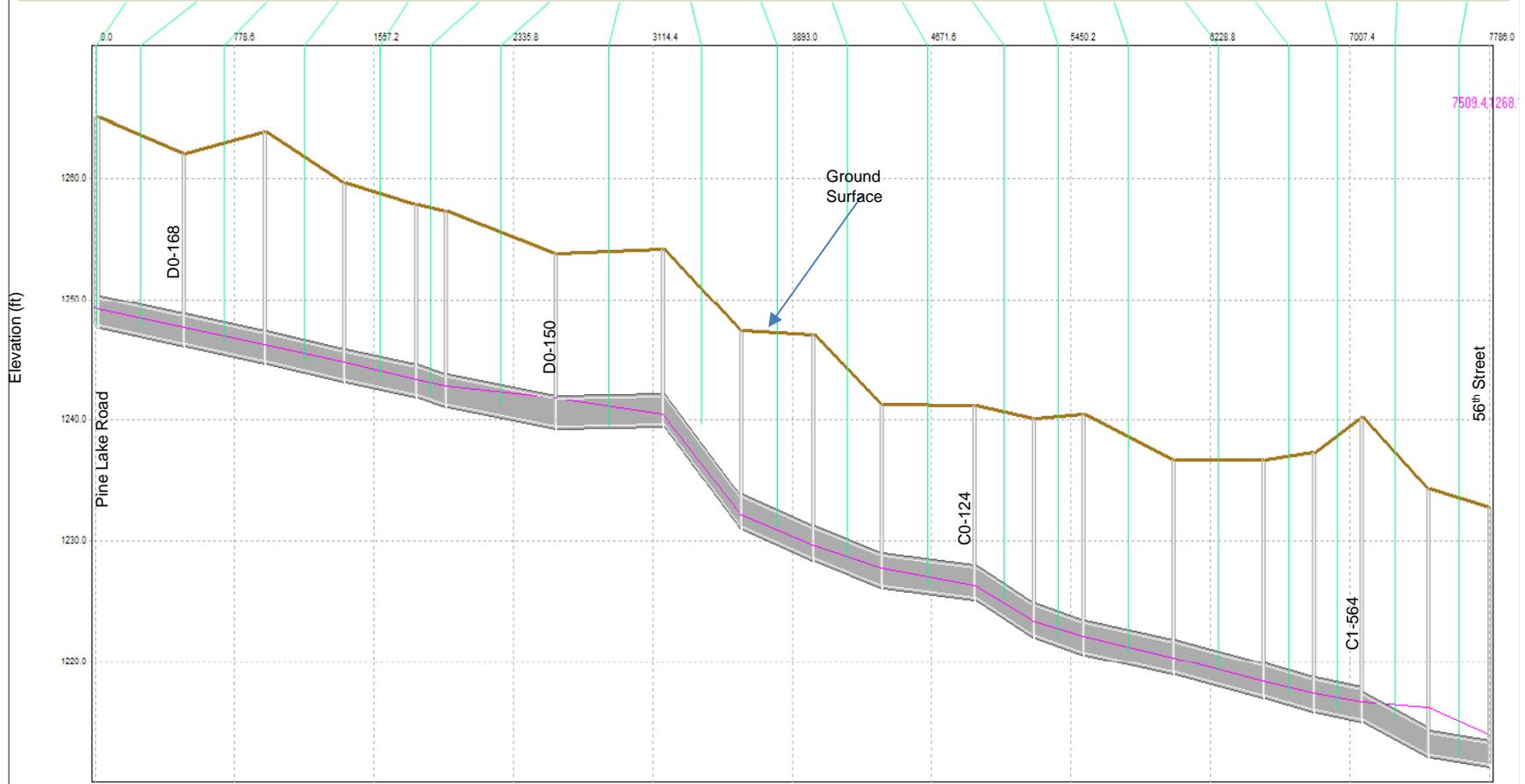


**FIGURE 1 – ESTIMATED TIMING FOR FUTURE PHASES  
OF BEALS SLOUGH RELIEF SEWER**  
BEALS SLOUGH ANALYSIS – 2014  
CITY OF LINCOLN, NEBRASKA



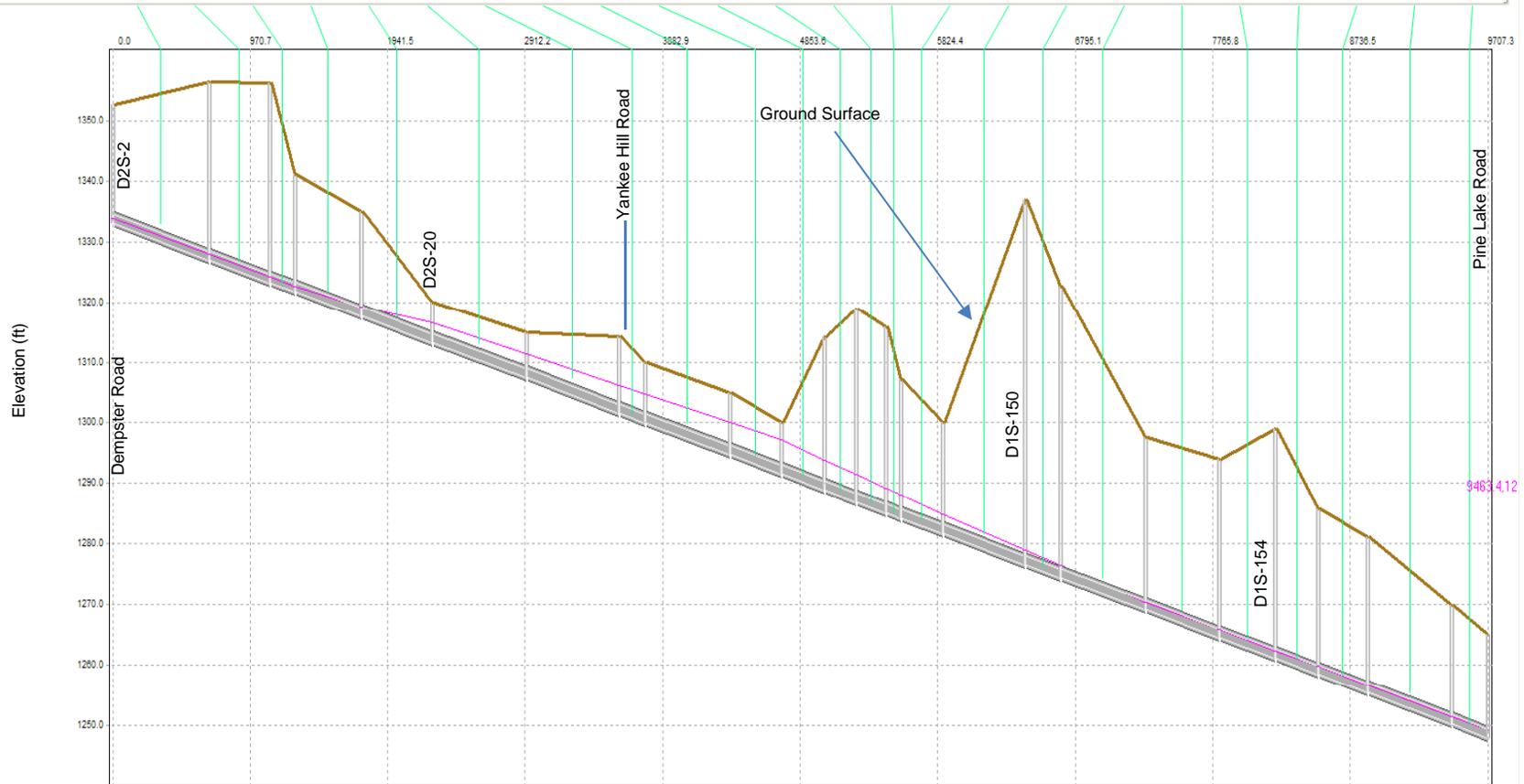
**FIGURE 2 – AREA SERVED BY TRUNK SEWER SOUTH  
OF PINE LAKE ROAD**  
BEALS SLOUGH ANALYSIS – 2014  
CITY OF LINCOLN, NEBRASKA

	L804	PP1	PP2	PP3	PP4	PP5	PP6	PP7	PP8	PP9	PP10	PP11	PP12	PP13	PP14	PP15	PP16	PP17	PP19	L759	
Shape	Circular																				
Max d/D (dept)	0.723	0.605	0.602	0.606	0.606	0.679	1.036	0.947	0.457	0.420	0.604	0.604	0.452	0.510	0.510	0.494	0.529	0.575	1.923	2.198	
Diameter (In)	2.000	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.250	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.000	1.750	



**FIGURE 3 – HYDRAULIC PROFILE BETWEEN 56<sup>TH</sup> STREET AND PINE LAKE ROAD**  
 BEALS SLOUGH ANALYSIS – 2014  
 CITY OF LINCOLN, NEBRASKA

	Link1782	Link1783	Link1784	Link1785	Link1786	Link1787	Link1788	Link1789	Link1790	Link1791	Link1792	Link1794	Link1795	Link1796	Link1797	Link1798	Link1799	Link1800	Link1801	Link1802	Link1803	Link1804	Link1805	Link1806
Shape	Circular																							
Max d/D (depth/diameter)	0.703	0.702	0.707	1.105	2.250	2.626	3.036	3.154	3.561	3.818	3.818	3.343	3.000	2.729	2.590	2.222	1.623	1.388	0.928	0.919	0.919	0.916	0.924	0.963
Diameter (Height)	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500



**FIGURE 4 – HYDRAULIC PROFILE BETWEEN  
PINE LAKE ROAD AND MANHOLE D2S-2  
BEALS SLOUGH ANALYSIS – 2014  
CITY OF LINCOLN, NEBRASKA**