Inlet and Gutter Spread Analysis – Structures 16 and 17

The city of Lee's Summit has requested that additional analysis be provided regarding the design storm gutter spread as well as analysis regarding the capacity of structures 16 and 17 during a 100-year storm event.

Per APWA 5604.2 it has been determined that the maximum allowable spread of the design storm within a 28' wide roadway is 12.0'. This is measured from the back of the curb. This section of APWA also denotes that spread may exceed these limits within 50' of a sump inlet. Therefore, this document will analyze gutter spread of the design storm at a point 50' upstream of structures 16 and 17. Per APWA 5601.8.B.2.b, the 100-year water surface shall not exceed 14" in depth at the lowest point in the roadway and shall not exceed 7" at the highest point within the roadway. This document will also determine the ponding depth during a 100-year storm event and if that ponding is allowable.

The gutter spread calculations provided on sheet 19 of the plan set show that during the design storm, structure 30 will receive 5.05 cfs. The inlet will capture 1.80 cfs and 3.25 cfs will bypass the structure. Water that bypasses structure 30 will be received by structure 17.

The gutter spread calculations provided on sheet 19 of the plan set show that during the design storm, structure 15 will receive 2.16 cfs. The inlet will capture 1.51 cfs and 0.65 cfs will bypass the structure. Water that bypasses structure 15 will be received by structure 16.

The gutter spread within the roadway 50' upstream of structures 16 and 17 has also been analyzed. From the previous paragraph it was determined that 3.25 cfs will bypass structure 30 and 0.65 cfs will bypass structure 15. It has been determined that the direct drainage area to the point 50' upstream of structure 17 is 0.80 acres (See Drainage Map provided with this document). The Rational Method was used to determine the direct flow to the point of analysis upstream of structure 17 is 2.90 cfs. This results in a total runoff to the point of 6.15 cfs. Due to the location of structure 15 it has been determined that there will not be any direct flow to the point 50' upstream of structure 16. Therefore, the total runoff to the point 50' upstream of structure 16 is 0.65 cfs. The roadway slope at both points is 1.84%. This information was used to create a model of the gutter section for both locations. The model report of this analysis has been provided within this document. The results of the models have determined that the gutter spread at the point upstream of structure 17 is 11.09' and the gutter spread at the point upstream of structure 16 is 3.92'. Thus, complying with the gutter spread requirements found in APWA 5600.

The final analysis performed was conducted on the capacity of both sump inlets, structures 16 and 17, during a 100-year storm event. Using figure 5604-21 found in APWA 5600 it has been determined that both inlets are considered Type 1 curb inlets. Also, within the figure, it was determined that the effective capacity of a Type 1 sump curb inlet is 3.1*length of opening. It should be noted that effective capacity is dependent on the head. This calculation assumes that the water surface is equal to the top of the structure. Therefore, the effective capacity of structure 17 is 21.7 cfs and the effective capacity of structure 16 is 18.6 cfs. This capacity occurs at a depth of 3". Therefore, the inlets will have adequate

capacity. A table outlining the capacity calculations as well as figure 5604-21 have been provided on the next sheet.



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Drainage Calculations

Analysis Point	Storm Event	"K" Value	"C" Value	Тс	Intensity	Area	Q
50' Upstream of #17	10-Year	1.00	0.51	5.80	7.11	0.80	2.90
Structure #17	100-Year	1.25	0.51	6.10	9.88	1.73	10.90
Structure #16	100-Year	1.25	0.51	6.10	9.88	1.36	8.57

Sump Inlet Capacity Calculations

Structure	Storm Event	Direct Discharge	Upstream Bypass	Total	Allowable	Design Check
Structure	Storm Event	(cfs)	(cfs)	(cfs)	(cfs)	Design Check
16	100-Year	8.57	0.87	9.44	18.6	GOOD
17	100-Year	10.9	5.14	16.04	21.7	GOOD

Figure 5604-21



TYPE 1 CURB INLET

TYPE 2 CURB INLET

Туре	h	di	do	Qi	80% Qi
1	10"	14"	9"	3.9L	3.1L
2	6"	10"	7"	2.1L	1.7L

 $Q_i = Co h L (2 g d_o)^{0.5}$

- Co = orifice coefficient (0.67)
- du = effective head on the center of the
- orifice throat, ft
- L = length of orifice opening, ft
- di = depth at lip of curb opening, ft
- h = height of curb opening orifice, ft g = gravitational constant, 32.2 ft/sec²
- g = gravitational constant, 32.2 fi/sec
- Qi = theoretical inlet capacity (cfs)

Figure 5604-21: Capacity of Curb Opening Inlet at Sump



Friday, Jun 16 2023

Gutter Spread - 50' Upstream of Structure #17

Gutter		Highlighted	
Cross SI, Sx (ft/ft)	= 0.021	Depth (ft)	= 0.29
Cross SI, Sw (ft/ft)	= 0.052	Q (cfs)	= 6.150
Gutter Width (ft)	= 2.00	Area (sqft)	= 1.34
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.59
Slope (%)	= 1.84	Wetted Perim (ft)	= 11.38
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.40
		Spread Width (ft)	= 11.09
Calculations		EGL (ft)	= 0.62
Compute by:	Known Q		
Known Q (cfs)	= 6.15		



Thursday, Jun 15 2023

Gutter Spread - 50' Upstream of Structure 16

Gutter		Highlighted	
Cross SI, Sx (ft/ft)	= 0.021	Depth (ft)	= 0.14
Cross SI, Sw (ft/ft)	= 0.051	Q (cfs)	= 0.650
Gutter Width (ft)	= 2.00	Area (sqft)	= 0.22
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 2.95
Slope (%)	= 1.84	Wetted Perim (ft)	= 4.07
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.19
		Spread Width (ft)	= 3.92
Calculations		EGL (ft)	= 0.28
Compute by:	Known Q		
Known Q (cfs)	= 0.65		



= 0.013

Structure #30 - 100-Year Event

Curb Inlet

Location	= On grade
Curb Length (ft)	= 6.00
Throat Height (in)	= 1.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-
Gutter	
Gutter Slope, Sw (ft/ft)	= 0.052
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft)	= 0.052 = 0.021
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft) Local Depr (in)	= 0.052 = 0.021 = 7.88
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft) Local Depr (in) Gutter Width (ft)	= 0.052 = 0.021 = 7.88 = 3.00
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft) Local Depr (in) Gutter Width (ft) Gutter Slope (%)	= 0.052 = 0.021 = 7.88 = 3.00 = 8.00

Calculations Compute by: Q (cfs)	Known Q = 8.67
Highlighted	
Q Total (cfs)	= 8.67
Q Capt (cfs)	= 3.53
Q Bypass (cfs)	= 5.14
Depth at Inlet (in)	= 11.18
Efficiency (%)	= 41
Gutter Spread (ft)	= 8.67
Gutter Vel (ft/s)	= 9.34
Bypass Spread (ft)	= 6.63
Bypass Depth (in)	= 2.79

All dimensions in feet

Gutter n-value



= 0.013

Structure #15 - 100-Year Event

Curb Inlet

Location	= On grade
Curb Length (ft)	= 6.00
Throat Height (in)	= 1.00
Grate Area (sqft)	= -0-
Grate Width (ft)	= -0-
Grate Length (ft)	= -0-
Gutter	
Gutter Slope, Sw (ft/ft)	= 0.052
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft)	= 0.052 = 0.021
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft) Local Depr (in)	= 0.052 = 0.021 = 7.88
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft) Local Depr (in) Gutter Width (ft)	= 0.052 = 0.021 = 7.88 = 3.00
Gutter Slope, Sw (ft/ft) Slope, Sx (ft/ft) Local Depr (in) Gutter Width (ft) Gutter Slope (%)	= 0.052 = 0.021 = 7.88 = 3.00 = 1.84

Known Q = 3.82
= 3.82
= 2.95
= 0.87
= 11.09
= 77
= 8.31
= 4.41
= 3.28
= 1.94

All dimensions in feet

Gutter n-value

