

EXPIRES 03-31-2020



CITY OF BUCKEYE

**ROOSEVELT STREET SEWER
IMPROVEMENT DISTRICT**

**DESIGN MEMORANDUM
SEWER IMPROVEMENTS**

**THIRD SUBMITTAL
December 2017**

DISCLAIMER:

THE CITY APPROVES THIS REPORT FOR CONCEPT ONLY AND ACCEPTS NO LIABILITY FOR ERRORS OR OMISSIONS

BY: _____

BUCKEYE CITY ENGINEER

DATE _____

CITY OF BUCKEYE
ROOSEVELT STREET SEWER IMPROVEMENT DISTRICT

DESIGN MEMORANDUM
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1.0 INTRODUCTION

Carollo Engineers, Inc. (Carollo) was tasked with determining the appropriate sizing and depth of the proposed sewers along Roosevelt Street and 215th Avenue. Table 1 shows the design parameters that were used to design the sewer pipelines for the Roosevelt Street Sewer Improvement District (RSID). These are the Design Criteria standards prescribed by the City of Buckeye (COB).

Table 1 City of Buckeye Design Criteria Roosevelt Street Sewer Improvement District City of Buckeye		
Parameters	Value	Unit
Hydraulic Criteria		
Capacity of Pipe (maximum depth ratio)	0.75	
Manning's "n" Value	0.013	
Minimum Cover Top of Pipe	6	ft
Velocity		
Minimum Velocity	2.00	fps
Maximum Velocity	9.00	fps
Slope of Pipe		
Minimum Slope for 8-inch Pipe	0.004	ft/ft
Minimum Slope for 10-inch Pipe	0.0024	ft/ft
Minimum Slope for 12-inch Pipe	0.0019	ft/ft
Minimum Slope for 15-inch Pipe	0.0014	ft/ft
Peaking Factors		
For pipes less than 12-inch diameter	4	
For pipes with 12-inch or higher diameter	2	Minimum ⁽¹⁾
<u>Note:</u>		
(1) As per ADEQ R18-9-E301, with a minimum peaking factor of 2, for pipes with 12-inch or higher diameter.		
<u>Abbreviations:</u>		
ft = feet; fps = feet per second; ft/ft = feet per feet		

As per City of Buckeye Wastewater Design Standards (COB EDS):

- Land used for commercial as well as mixed use purposes produce an average daily flow of 1,500 gallons/acre/day.
- Medium High density residential areas produce 2,240 gallons/acre/day (Max of 7 dwelling units/acre x 3.2 persons/dwelling unit x 100 gallons/person/day)
- High density residential areas produce 4,500 gallons/acre/day (18 dwelling units/acre x 2.5 persons/dwelling unit x 100 gallons/person/day).

The land uses for the area served by the proposed sewer pipelines and estimated dwelling units per acre are defined by the Water Report (issued by RPA). Areas not defined were assumed to be used for Commercial/Mixed Use. The COB EDS has designated the average daily flow based on the land use as shown above. This was used to estimate the total flow that the pipe would drain, and consequently determine the size and depth of the pipe.

1.1 Project Location

The proposed service area is located within Section 1 of Township 1 North, Range 3 West, and Section 6 of Township 1 North, Range 2 West of the Gila and Salt River Base and Meridian, City of Buckeye, Maricopa County, Arizona. The service area bounds are Interstate 10 (I-10) and McDowell Road on the North, Dean Road on the West, Jackrabbit Trail on the East and Van Buren Street on the South. Figure 1 shows all the proposed sewer piped under this Improvement District Project. Details on the service areas are shown on Figures 2 and 3.

1.2 Topographic Conditions

The proposed service area consists of undeveloped land. The maximum elevation is approximately 1210 feet at the northwest corner and a minimum of approximately 1080 feet at the southeast corner. The ground gradually slopes downwards towards the Southeast at approximately 0.009 ft/ft.



OVERALL MAP

FIGURE 1

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2.0 ROOSEVELT STREET SEWER TO VERRADO WAY INTERCEPTOR

2.1 Pipe Size

The proposed 8-inch sewer runs east-west along the north edge of the Roosevelt Street. This sewer pipe will drain into the Verrado Way interceptor on the 12-inch sewer running north south on Verrado Way. Figure 2 shows the area that would be served by the proposed 8-inch sewer is 74 acres used for commercial purposes, as per the Water Report. As per the COB EDS, a daily average flow of 1,500 gallons/acre is to be utilized, with a peaking factor of 4, the estimated average flow is 77.08 gpm and a maximum flow is 308.33 gpm. As can be seen in Table 2, the design criteria mentioned in Table 1 are all met by the 8-inch diameter pipe.

Table 2 Velocity and Flow through 8" Pipe Roosevelt Street Sewer Improvement District City of Buckeye	
Parameter	Value
Design Criteria	
Nominal Diameter (in)	D = 8
Pipe Material	VCP
Manning's n Value	n = 0.013
Pipe Slope (ft/ft)	S = 0.0075
Assumed Peaking Factor	4
Max Depth Ratio (d/D)	d/D = 0.75
Average Flow Rate (gpm)	Q _{avg} = 77.08
Required Max Flow Rate (gpm)	Q _{reqd} = 308.33
Calculated Values	
Flow Area (sq ft)	A = 0.28
Wetted Perimeter (ft)	P = 1.40
Hydraulic Radius (ft)	R = 0.2
Velocity (ft/sec)	V = 3.41
Design Flow Rate (gpm)	Q = 429



ROOSEVELT STREET SEWER TO VERRADO WAY INTERCEPTOR

FIGURE 2

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2.2 Pipe Depth

As shown in Figure 2, the assumed longest run of pipe upstream of the sewer is 700 feet long and 8 inches in diameter. This upstream sewer pipe has a minimum cover of 6 feet and is assumed to have the minimum slope required. The topography of the area is such that it slopes in the direction of the general flow of the sewer pipe. The pipes are designed to run deep to allow for future service connections. The proposed pipe has a slope of 0.0075 ft/ft to allow for a flow velocity of 3.4 fps.

Table 3 shows Manhole #1 and Manhole #2, which are existing manholes. The proposed slope of the 8-inch sewer pipe has been adjusted to match the existing inverts on Manhole #2. The Pipe Design Summary (Appendix A) shows the depth of the pipe from the proposed elevation of the rim of the manholes.

Table 3 Invert Elevations for Roosevelt Sewer to Match Existing Verrado Way Interceptor (8" VCP) Roosevelt Street Sewer Improvement District City of Buckeye						
Station	Begin Invert	Distance	Slope (Down)	Entrance Inv.	Drop Across MH	Exit Invert
MH 9	–	–	–	1072.78	0.1	1072.68
MH 8	1072.68	400	0.0075	1069.68	0.1	1069.58
MH 7	1069.58	400	0.0075	1066.58	0.1	1066.48
MH 6	1066.48	400	0.0075	1063.48	0.1	1063.38
MH 5	1063.38	400	0.0075	1060.38	0.1	1060.28
MH 4	1060.28	290	0.0075	1058.11	0.1	1058.01
MH 3	1058.01	160	0.0075	1056.81	0.2	1056.61
MH 2	1056.61	66	0.0253	1054.94	0.1	1054.84
Exist. MH 1	1054.84	74	0.0067	1054.31	–	–

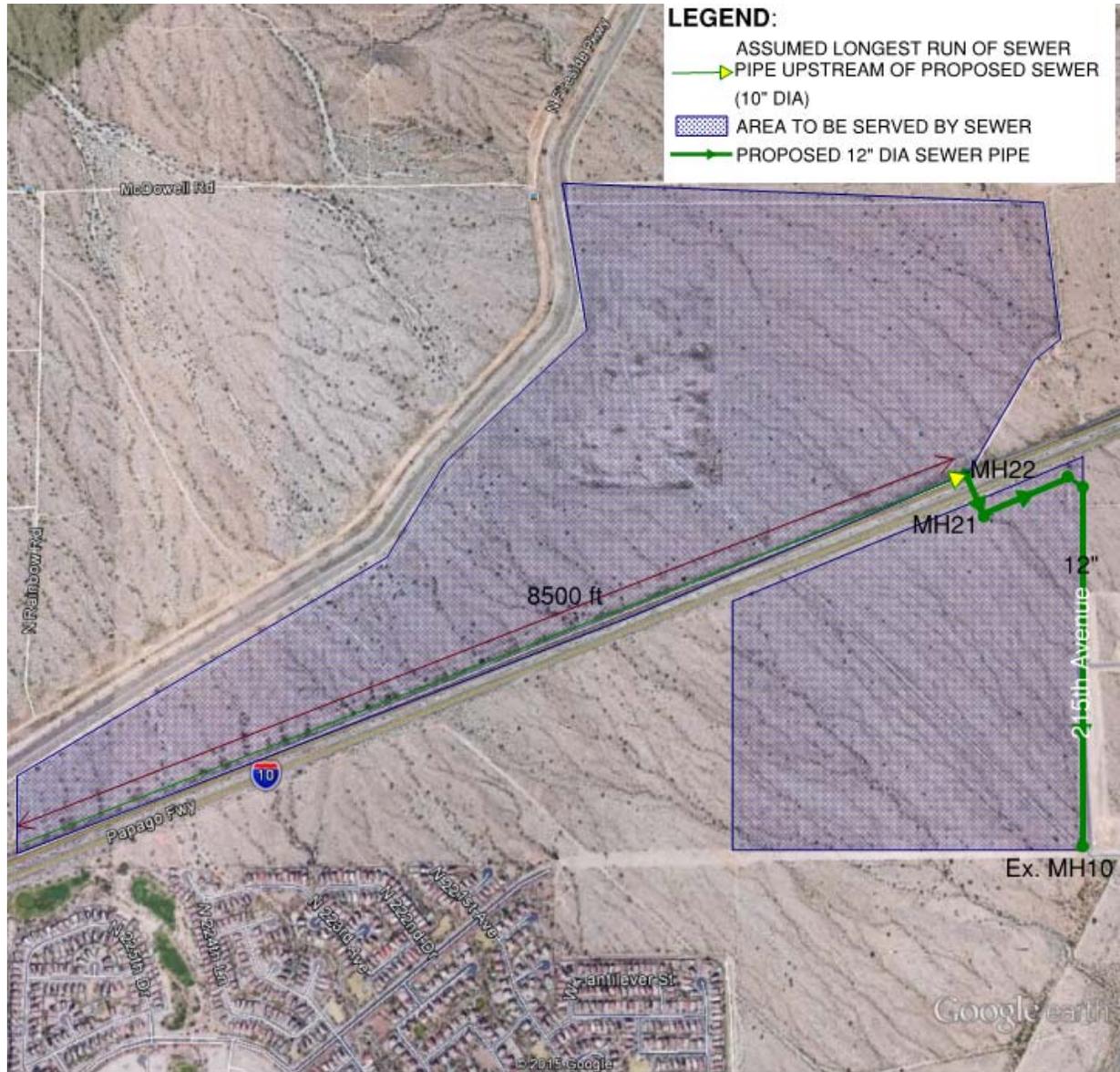
3.0 215TH AVENUE SEWER TO VAN BUREN STREET INTERCEPTOR

3.1 Pipe Size

The proposed sewer pipe running north-south along the west side of 215th Avenue, will drain into the existing 15-inch sewer that runs east-west on Van Buren Street. This sewer is determined to serve the area shown in Figure 3. This would account for a total of 440 acres. As per the Water Report, 110 acres is allotted for mixed uses, 60 acres for high density residential use (40 and 20 acres respectively in Areas 1 and 2), and 130 acres for commercial uses. Not accounted for in the Water Report is an area of 140 acres bound by the Freeside Parkway to the northwest, and Rainbow Road to the west, lying north of the I-10 highway. It is assumed that this area will be used for commercial/mixed uses and therefore have a production of 1,500 gpd/acre as per the COB EDS. Based on a flow generation of 1,500 gpd/acre for commercial, 1,500 gpd/acre for commercial/mixed, and 4,500 gpd/acre for high density residential land use, and a peaking factor of 2.0, the maximum daily flow through this pipe would be 1,167 gpm. As mentioned before, as per ADEQ A.A.C. R18-9E301, the peaking factor can be determined using an estimated 15 persons/acre for commercial and mixed uses and 45 persons/acre for high density residential uses (estimated based on 2.5 persons/EDU and approximately 18 EDUs/acre as per the Water Report). This equates to 19,800 persons for the 440 acres of land being served by this sanitary sewer. For 440 acres, the peaking factor using the formula as per ADEQ A.A.C. R18-9E301 (D), is 1.74. In accordance to COB Wastewater Design Standard Table 2, the flows were designed around a peaking factor of 2.0.

Table 4 shows the pipe capacity of the proposed 12-inch at a slope of 0.007 ft/ft that would serve Area 1 outlined in the Water Report and the 140 acres between Freeside Parkway and Rainbow Road, north of the I-10 highway. This is the slope of pipe that runs below the I-10 highway, and bends before it connects to the sewer running north south along the 215th Avenue. Since the sewer is proposed to run north-south, only these two areas (north of the I-10 highway) are assumed to be serviced by the run of pipe at a slope of 0.007 ft/ft. The parcels south of the I-10 highway will be serviced by the pipe at a slope of 0.0085 ft/ft.

As seen in Table 5, due to the highly sloped grade, the proposed pipe would have a slope of 0.0085 ft/ft along the 215th Avenue alignment, which will serve Areas 1 and 2, as mentioned in the Water Report, as well as the 140 acres mentioned above.



215TH AVENUE SEWER TO VAN BUREN INTERCEPTOR

FIGURE 3

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Table 4 Velocity and Flow through 12" Pipe With S = 0.007 ft/ft Roosevelt Street Sewer Improvement District City of Buckeye	
Parameter	Value
Design Criteria	
Nominal Diameter (in)	D = 12
Pipe Material	VCP
Manning's n Value	n = 0.013
Pipe Slope (ft/ft)	S = 0.007
Assumed Peaking Factor	2.0
Max Depth Ratio (d/D)	d/D = 0.75
Average Flow Rate (gpm)	Q _{avg} = 385
Required Max Flow Rate (gpm)	Q _{reqd} = 771
Calculated Values	
Flow Area (sq ft)	A = 0.63
Wetted Perimeter (ft)	P = 2.09
Hydraulic Radius (ft)	R = 0.30
Velocity (ft/sec)	V = 4.31
Design Flow Rate (gpm)	Q = 1223

Table 5 Velocity and Flow through 12" Pipe With S = 0.0085 ft/ft Roosevelt Street Sewer Improvement District City of Buckeye	
Parameter	Value
Design Criteria	
Nominal Diameter (in)	D = 12
Pipe Material	VCP
Manning's n Value	n = 0.013
Pipe Slope (ft/ft)	S = 0.0085
Assumed Peaking Factor	2.0
Max Depth Ratio (d/D)	d/D = 0.75
Average Flow Rate (gpm)	Q _{avg} = 583
Required Max Flow Rate (gpm)	Q _{reqd} = 1167
Calculated Values	
Flow Area (sq ft)	A = 0.63
Wetted Perimeter (ft)	P = 2.09
Hydraulic Radius (ft)	R = 0.30
Velocity (ft/sec)	V = 4.75
Design Flow Rate (gpm)	Q = 1348

3.2 Pipe Depth

It was assumed that the longest run of pipe upstream of the sewer would be approximately 8,500 linear feet long with a minimum diameter of 10 inches. The naturally sloped grade works advantageously, allowing the pipe to be sloped steeply without going against the grade. There are however, channels on the east of the area served by this sewer. To avoid them, it was thus conservative to be at least 14 feet below grade before the sewer crosses the I-10 highway. The sewer then has been designed to maintain a depth of 10 feet - 12 feet below grade for ease of construction. This pipe will slope at 0.0085 and have a flow velocity of about 4.75 fps. The inverts for this pipe are shown in Table 6 and the depth of the pipe is summarized in the Pipe Design Summary (Appendix A).

Table 6 Invert Elevations for the 215th Avenue Sewer to Van Buren Interceptor (12" VCP) Roosevelt Street Sewer Improvement District City of Buckeye							
Station	Begin Invert	Distance	Slope (Down)	Entrance Inv.	Drop Across MH	Exit Invert	Pipe Capacity
MH 22				1090.20	0.2	1090.00	
MH 21	1089.80	417	0.0070	1087.09	0.2	1086.89	1,223 gpm
MH 20	1086.68	400	0.0070	1084.00	0.2	1083.80	
MH 19	1083.68	26	0.0070	1083.62	0.2	1083.42	
MH 18	1083.30	160	0.0085	1081.94	0.2	1081.74	
MH 17	1081.74	42	0.0085	1081.38	0.2	1081.18	
MH 16	1081.18	288	0.0085	1078.73	0.1	1078.63	
MH 15	1078.63	400	0.0085	1075.23	0.1	1075.13	
MH 14	1075.13	400	0.0085	1071.73	0.1	1071.63	1,348 gpm
MH 13	1071.63	400	0.0085	1068.23	0.1	1068.13	
MH 12	1068.13	400	0.0085	1064.73	0.1	1064.63	
MH 11	1064.63	400	0.0085	1061.23	10.68	1050.55	
Exist. MH 10	1050.55	299	0.0085	1048.01			

4.0 SUMMARY

The proposed Buckeye Roosevelt Street Sewer design can provide adequate and reliable service to the sewer service areas depicted in Figures 2 and 3. The sewer pipelines have been designed as per the City of Buckeye and ADEQ standards and requirements.

APPENDIX A – PIPE DESIGN SUMMARY

Pipe Attributes							Design Flows				Rim and Pipe Invert Elevations						Pipe Design Requirements				
Pipe Label	Upstream Manhole Number	Downstream Manhole Number	Pipe Diameter (in.)	Pipe Length (ft.)	Pipe Slope (Down)	Pipe Mannings Value	Cumulative Average Daily Flow (gpd)	Peaking Factor	Total Peak Flow (gpd)	Design Pipe Capacity, Full (gpd)	Upstream Invert Elevation	Upstream Rim Elevation	Downstream Entrance Invert Elevation	Drop across Downstream Manhole (ft.)	Downstream Exit Invert Elevation	Downstream Rim Elevation	Upstream Pipe Cover (ft.)	Downstream Pipe Cover (ft.)	Q _{peak} / Q _{full} (Max=0.82)	d/D (Max= 0.75)	Flow Velocity (fps)
215th Avenue and Van Buren Road Sewer	MH 22	MH 21	12.00	417	0.0070	0.013	554,400	2	1,108,800	1,941,120	1089.80	1103.76	1086.88	0.20	1086.68	1099.44	12.96	11.56	0.57	0.75	4.31
	MH 21	MH 20		400	0.0070						1086.68	1099.44	1083.88	0.20	1083.68	1096.47	11.76	11.59			
	MH 20	MH 19		26	0.0070						1083.68	1096.47	1083.50	0.20	1083.30	1095.96	11.79	11.46			
	MH 19	MH 18		160	0.0085		839,520		2,128,700	1083.30	1095.96	1081.94	0.20	1081.74	1095.40	11.66	12.46	0.79	0.71	4.75	
	MH 18	MH 17		42	0.0085					1081.74	1095.40	1081.38	0.20	1081.18	1095.20	12.66	12.82				
	MH 17	MH 16		288	0.0085					1081.18	1095.20	1078.73	0.10	1078.63	1093.40	13.02	13.67				
	MH 16	MH 15		400	0.0085					1078.63	1093.40	1075.23	0.10	1075.13	1090.44	13.77	14.21				
	MH 15	MH 14		400	0.0085					1075.13	1090.44	1071.73	0.10	1071.63	1086.18	14.31	13.45				
	MH 14	MH 13		400	0.0085					1071.63	1086.18	1068.23	0.10	1068.13	1083.24	13.55	14.01				
	MH 13	MH 12		400	0.0085					1068.13	1083.24	1064.73	0.10	1064.63	1079.75	14.11	14.02				
	MH 12	MH 11		400	0.0085					1064.63	1079.75	1061.23	10.68	1050.55	1076.23	14.12	14.00				
	MH 11	Ex. MH 10		299	0.0085					1050.55	1076.23	1048.01	0.20	1047.81	1072.52	24.68	23.51				
	Roosevelt Road and Verrado Way Sewer	MH 9		MH 8	8.00					400	0.0075	0.013	110,880	4	443,520	676,800	1072.68				1090.98
MH 8		MH 7	400	0.0075		1069.58	1088.34	1066.58	0.10	1066.48	1085.68						18.09	18.43			
MH 7		MH 6	400	0.0075		1066.48	1085.68	1063.48	0.10	1063.38	1084.28						18.53	20.13			
MH 6		MH 5	400	0.0075		1063.38	1084.28	1060.38	0.10	1060.28	1083.32						20.23	22.27			
MH 5		MH 4	290	0.0075		1060.28	1083.32	1058.11	0.10	1058.01	1081.52						22.37	22.75			
MH 4		MH 3	160	0.0075		1058.01	1081.52	1056.81	0.20	1056.61	1080.47						22.85	23.00			
MH 3		MH 2	66	0.0253		1,242,720	1056.61	1080.47	1054.94	0.10	1054.84						1080.23	23.20	24.63	0.36	
MH 2		Ex. MH 1	74	0.0067		639,360	1054.84	1080.23	1054.31	0.17	1054.14					1080.14	24.73	25.16	0.69		