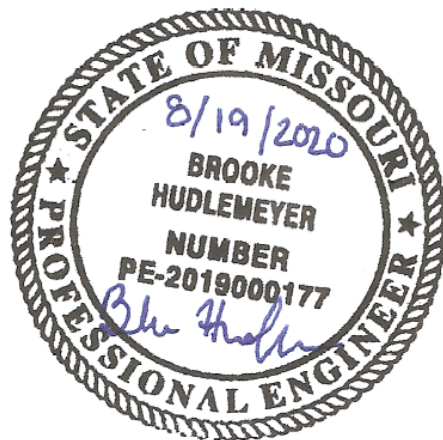


# **SANITARY SEWER CAPACITY ANALYSIS: MIDDLE SCHOOL 4**

**Prepared for:**

Lee's Summit School District R-7

Lee's Summit, Missouri



August 2020

Olsson Project No. 020-0103

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# 1. BACKGROUND

Lee's Summit R-7 School District has proposed the development of a new middle school on a 52 acre (ac) site located on the south side of Bailey Road at the intersection of Country Lane and SE Bailey Road in Lee's Summit, Missouri (City). This development includes the school and an athletic complex. A capacity analysis was performed on the City's existing Big Creek Interceptor sewer from the proposed connection point to an interceptor downstream. The purpose of this analysis was to determine if the existing sanitary sewer could accommodate future flows following the completion of the proposed development of the middle school.

The proposed development will tie into the existing sanitary sewer manhole (MH) 47-019. For the proposed connection, the following three (3) analyses were performed:

- Existing Conditions – Estimated sanitary sewer design flow generated by land within the drainage basin that currently has sanitary service. Sheet 1 of Appendix A shows the existing drainage areas and land uses for this condition.
- Proposed Conditions – Estimated sanitary sewer design flow generated by the existing conditions (above) and the proposed development. Sheet 2 of Appendix A shows the anticipated drainage areas and land uses for this condition.
- Ultimate Basin Build-Out Conditions – Estimated sanitary sewer design flow generated by the entire drainage basin. Sheet 3 of Appendix A shows the anticipated drainage areas for this condition.

The analysis presented here considers the capacity of sewer from the proposed connection point at MH 47-019 to MH 54-002. The impact of flow through the Big Creek Interceptor on the condition of the Big Creek Business Sewer shown in Appendix A was also considered.

## 2. METHODOLOGY

Wastewater flows were estimated and modeled for the existing, proposed, and ultimate build-out conditions of the sanitary sewer system from MH 47-019 to MH 54-002. Maps of the sub-basin areas and sewer network analyzed are shown in Appendix A. The City's Design Criteria Section 6501.C.1 was used to assign flows to residential areas and non-residential areas less than eight (8) acres or greater than 100 acres. In the existing and proposed conditions, areas 100 feet on either side of the sewer main through undeveloped areas were treated as vacant land to account for inflow and infiltration. Peak base flow for the Lee's Summit Fleet Operations and Lee's Summit Animal Control buildings (Area 7) were estimated using the equivalent dwelling unit (EDU) methodology of section 6501.C.2. Design peak infiltration and inflow rates for these parcels were estimated per section 6501.C.1 for non-residential areas. Flows from Summit Waste Systems (Area 8) and the Lee's Summit Sanitary Landfill leachate system (Area 11) were determined from flow monitoring performed from May 15, 2020 to July 9, 2020 by GBA. The peak flows were assumed to be the maximum observed flow rates at MH 47-023 and 54-009, respectively.

Based on conversation with the City, the inflow k-factor of 0.006 for residential and 0.003 for non-residential land prescribed in section 6501.C.1.c.ii. does not accurately reflect existing conditions in either the Big Creek Interceptor or the Big Creek Business Sewer. The City's recommended k-factor of 0.002 was applied to all residential and non-residential areas in the basin studied. Table 1 shows the projected sanitary sewer flow calculations for the existing conditions.

**Table 1. Projected Sanitary Sewer Flow for Existing Conditions.**

Existing Conditions – Current Basin Build-Out						
Sub-Basin	Area (ac)	Base Flow (gpd)	Peak Infiltration (gpd)	Peak Inflow (cfs*)	Design Flow Rate (MGD**)	Design Flow Rate (cfs*)
<b>AREA 1</b>	158.7	238,050	79,350	0.99	0.96	1.48
<b>AREA 2</b>	28.6	42,900	14,300	0.24	0.21	0.33
<b>AREA 3</b>	158.0	237,000	39,500	0.99	0.91	1.41
<b>AREA 4</b>	6.3	9,450	1,575	0.06	0.05	0.08
<b>AREA 5</b>	5.7	8,550	1,425	0.06	0.05	0.07
<b>AREA 6</b>	6.8	10,200	1,700	0.07	0.06	0.09
<b>AREA 7</b>	27.2	8,100	6,800	0.23	0.16	0.25
<b>AREA 8</b>	11.2	-	-	-	0.10	0.15
<b>AREA 9</b>	7.3	10,950	1,825	0.07	0.06	0.09
<b>AREA 10</b>	9.8	8,820	2,450	0.09	0.07	0.11

Existing Conditions – Current Basin Build-Out (Cont.)						
Sub-Basin	Area (ac)	Base Flow (gpd)	Peak Infiltration (gpd)	Peak Inflow (cfs*)	Design Flow Rate (MGD**)	Design Flow Rate (cfs*)
AREA 11	134.3	-	-	-	0.45	0.70
AREA 12	5.5	8,250	1,375	0.06	0.05	0.07
AREA 13	360.2	540,300	90,050	2.01	1.93	2.99
AREA 14	17.7	26,550	8,850	0.16	0.14	0.21
					<b>Total</b>	<b>8.03</b>

\*cfs = cubic feet per second; \*\*MGD = million gallons per day

The proposed development consists of a middle school main building, athletic complex, and the surrounding area. Design flow peak base flow was estimated in accordance with the EDU methodology of section 6501.C.2. The first and second floors of the middle school were considered separately because the second floor will have a lower occupied area. Design peak infiltration and inflow rates were estimated per section 6501.C.1 for non-residential areas. Table 2 shows the projected sanitary sewer flow calculations for the proposed development.

Table 2. Projected Sanitary Sewer Flow for Proposed Development.

Proposed Middle School					
Building	Area (sq. ft.)	EDU	Parameter	Stories	Base Flow (gpd)
Main Building First Floor	129.7	1	per 1,000 sq. ft.	1	38,920
Main Building Second Floor	60.3	1	per 1,000 sq. ft.	1	18,080
Athletics Building	5.0	1	per 1,000 sq. ft.	1	1,500
<b>Total Base Flow (gpd)</b>					58,500
<b>Total Area (Ac)</b>					52.6
<b>Peak Infiltration (gpd)</b>					13,150
<b>Peak Inflow (cfs)</b>					0.40
<b>Design Flow (cfs)</b>					0.51

The ultimate basin build-out condition estimates the impact on the sanitary system when all land in the drainage basin upstream of MH 54-002 is developed in accordance with the Lee's Summit, Missouri Wastewater Master Plan dated November 2006. Flow from the Lee's Summit Sanitary Landfill leachate system (Area 11) was assumed to be the same in the ultimate build-out condition

as in the existing condition. Area 10 was considered vacant land to account for inflow and infiltration not otherwise included in the landfill leachate system area. Flows from the Grove development (Area 15) were calculated from the basin build-out conditions described in BHC Rhodes' Grove Sanitary Sewer Design Memorandum from 2016. Flows from the non-residential parcel east of the Lee's Summit Sanitary Landfill (Area 17) were determined assuming residential peak base flow in the absence of further information about the intended development. Table 3 shows the projected sanitary sewer flow calculations for the ultimate build-out condition.

**Table 3. Projected Sanitary Sewer Flow for Ultimate Basin Build-out Condition.**

Ultimate Conditions - Basin Build-Out						
Sub-Basin	Area (ac)	Base Flow (gpd)	Peak Infiltration (gpd)	Peak Inflow (cfs*)	Design Flow Rate (MGD**)	Design Flow Rate (cfs*)
<b>DEVELOPMENT AREA</b>	52.6	58,500	13,150	0.40	0.33	0.51
<b>AREA 1</b>	158.7	238,050	79,350	0.99	0.96	1.48
<b>AREA 2</b>	28.6	42,900	14,300	0.24	0.21	0.33
<b>AREA 3</b>	347.9	521,850	86,975	1.95	1.87	2.89
<b>AREA 4</b>	153.1	229,650	76,550	0.96	0.93	1.43
<b>AREA 5</b>	78.1	117,150	39,050	0.55	0.51	0.79
<b>AREA 6</b>	6.8	10,200	1,700	0.07	0.06	0.09
<b>AREA 7</b>	60.5	8,100	15,125	0.45	0.31	0.48
<b>AREA 8</b>	21.7	50	5,425	0.19	0.13	0.20
<b>AREA 9</b>	23.5	35,250	11,750	0.20	0.18	0.28
<b>AREA 10</b>	17.5	15,750	4,375	0.16	0.12	0.19
<b>AREA 11</b>	133.9	-	-	-	0.45	0.70
<b>AREA 12</b>	46.8	70,200	23,400	0.36	0.33	0.51
<b>AREA 13</b>	1,187.9	1,781,850	296,975	5.17	5.42	8.39
<b>AREA 14</b>	390.8	586,200	195,400	2.15	2.17	3.36
<b>AREA 15</b>	131.2	-	-	-	0.92	1.42
<b>AREA 16</b>	115.9	173,850	57,950	0.75	0.72	1.11
<b>AREA 17</b>	39.4	59,100	9,850	0.32	0.27	0.42
<b>AREA 18</b>	25.4	38,100	12,700	0.22	0.19	0.30
					<b>Total</b>	<b>24.88</b>

\* cfs = cubic feet per second; \*\* MGD = million gallons per day

### **3. ANALYSIS**

Information for the existing sanitary sewer system was taken from the City's GIS data and record drawings. Where the GIS data and record drawings conflicted, the data from the record drawings was used. The slope of each pipe segment was calculated using the upstream and downstream inverts and the length of pipe listed in the record drawings. Existing sub-basin boundaries were determined using the current sanitary sewer layout and parcel maps. Ultimate condition sub-basin boundaries were determined using area contours. Sub-basin areas for each condition are shown in Appendix A. Per the Lee's Summit design criteria, flows were estimated based on drainage area and time of concentration. Manning's equation was used to determine current pipe flow capacities. The Manning's  $n$  roughness coefficient used was 0.014 for PVC pipe. Only PVC pipe was present in the area studied. The calculations and results of the analyses are shown in Appendices B and D.

Hydraulic grade lines (HGL) were also calculated for each analysis using a flow modeling extension in AutoCAD Civil 3D. For the model, it was assumed that the flow at the downstream end discharged to open air with a starting HGL equal to the normal depth. A line is considered inadequate if the HGL is higher than the pipe crown. The HGL models for each analysis are shown in Appendices C and E.

## 4. RESULTS

Pipe capacity calculations and hydraulic modeling of the existing conditions indicate that the HGL is above the crown of the pipe in the 15-inch mains from MH 47-023 to MH 54-002. The record drawings show segments of pipe at or below the minimum slope listed in the city specs which contribute to the surcharged condition. The pipe capacity calculations can be found in Table 1 of Appendix B. Profiles of the existing condition HGLs for the Big Creek Interceptor and Big Creek Business Sewer are shown in Appendix C.

Pipe capacity calculations and hydraulic modeling of the proposed conditions indicate that the HGL is at or above the manhole rim elevation at MH 54-015, MH 47-023, and MH 47-022. The pipe capacity calculations can be found in Table 2 of Appendix B. Profiles of the proposed condition HGLs for the Big Creek Interceptor and Big Creek Business Sewer are shown in Appendix C.

Estimated flows from the ultimate build-out condition will exceed the capacity of all segments of the Big Creek Interceptor and Big Creek Business Sewer studied. The ultimate build-out condition reflects the design flow generated by complete build-out of the basin in accordance with the Lee's Summit, Missouri Wastewater Master Plan. Hydraulic analysis of the ultimate build-out conditions indicates surcharging of all pipe segments studied. The pipe capacity calculations can be found in Table 3 of Appendix B. Profiles of the ultimate build-out condition HGLs for the Big Creek Interceptor and Big Creek Business Sewer are shown in Appendix C.

### 4.1 Interceptor Upsizing

Pipe capacity calculations and hydraulic modeling indicate that there are segments of pipe over capacity in the existing, proposed, and ultimate build-out conditions. Therefore, analysis was performed to determine the necessary size of sewer mains to convey the estimated flows from the proposed and ultimate build-out conditions. This analysis extended from MH 47-019 to MH 54-002 only and assumed the same inverts and pipe lengths as the current pipe network. The pipe upsizing requirements are shown in Appendix A. The pipe capacity calculations can be found in Appendix D. Profiles of the proposed and ultimate build-out condition HGLs are shown in Appendix E. Table 4 shows the approximate lengths and necessary diameters of pipe segments from MH 47-019 to MH 54-002 to be upsized.



Table 4. Big Creek Interceptor Pipe Upsizing.

Necessary Pipe Diameter (in)	Approximate Total Length (ft)
<b>Proposed Conditions</b>	
<b>18"</b>	4,400
<b>21"</b>	1,750
<b>Ultimate Build-Out Conditions</b>	
<b>21"</b>	3,290
<b>24"</b>	2,510
<b>27"</b>	1,750

## 4.2 Main Extension Sizing

The main extension to serve the proposed middle school was sized to accommodate flows from the ultimate build-out condition. The design flow included the proposed development and 153 acres of residential development to the east. To convey the design flow rate, the main extension must be at least 15-inch diameter with a minimum slope of 0.70 percent. The pipe capacity calculations for the main extension can be found in Tables 2 and 3 of Appendix B. A representative pipe segment was included in the hydraulic analysis of the proposed and ultimate build-out conditions and profiles of the HGL are included in Appendices C and E. In Appendix C, the HGL is above the crown of the pipe for the representative pipe segment shown because of the surcharged condition of the downstream interceptor sewer. Modeling shown in Appendix E indicates that the main extension HGL will remain in the pipe if the downstream sewer is not surcharged.

## 5. CONCLUSION

Based on the City's Wastewater Master Plan and design criteria, flows from the existing, proposed, and ultimate build-out conditions for the areas served by the sewer from MH 47-019 to MH 54-002 were estimated. Pipe capacity calculations and hydraulic modeling indicated that in the existing condition, the 15-inch mains of the Big Creek Interceptor are over capacity. The addition of flows from the proposed middle school would cause the HGL to be at or above the rim elevation of MH 54-015, MH 47-023, and MH 47-022. In the ultimate build-out condition, all pipes studied were over capacity.

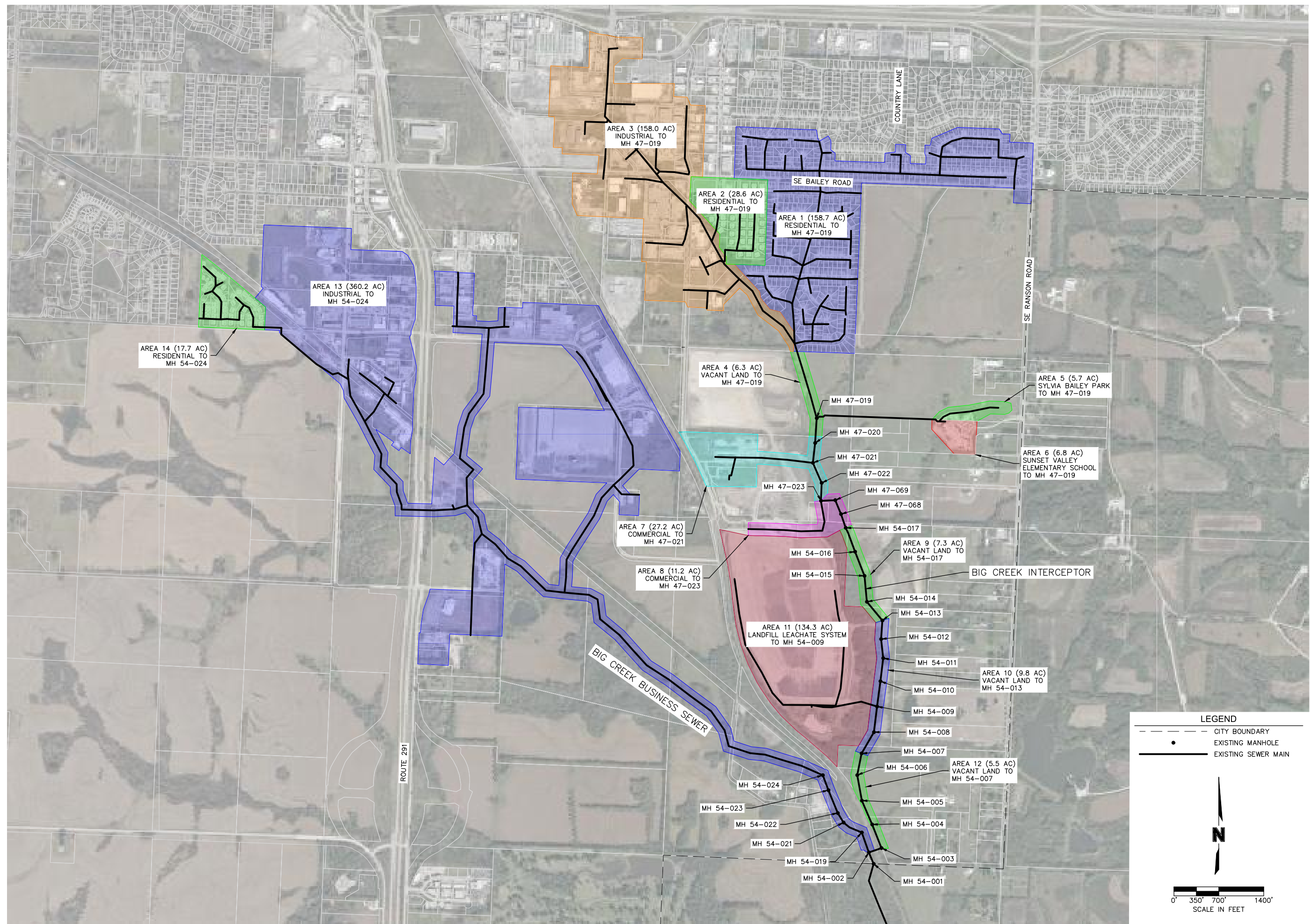
Analysis was performed to make recommendations for upsizing pipe from MH 47-019 to MH 54-002 only. Pipe inverts and lengths were assumed to be the same as the existing pipe network. To accommodate flows from the proposed condition, it would be necessary to install approximately 4,400 feet of 18-inch pipe and 1,750 feet of 21-inch pipe. To accommodate estimated flows from the ultimate build-out condition, it would be necessary to install approximately 3,290 feet of 21-inch pipe; 2,510 feet of 24-inch pipe; and 1,750 feet of 27-inch pipe. Further analysis should be performed to determine whether alternative approaches such as parallel relief mains, excess flow holding basins, or reductions of inflow would be more cost-effective means of increasing the capacity of the Big Creek Interceptor or reducing the flow through the system. Detailed flow and rainfall analysis should be performed to confirm flows for the design storm event in this basin.

The main extension serving the proposed middle school will connect to the existing sanitary sewer system at MH 47-019. The extension will be 15-inch diameter with a minimum slope of 0.70 percent to handle flows from the proposed middle school and future residential development to the east.

It is Olsson's understanding that the City is in the process of analyzing this basin for potential capacity improvements. Olsson recommends that the Lee's Summit School District 7 continue to coordinate their proposed improvements with the City's efforts in this basin.

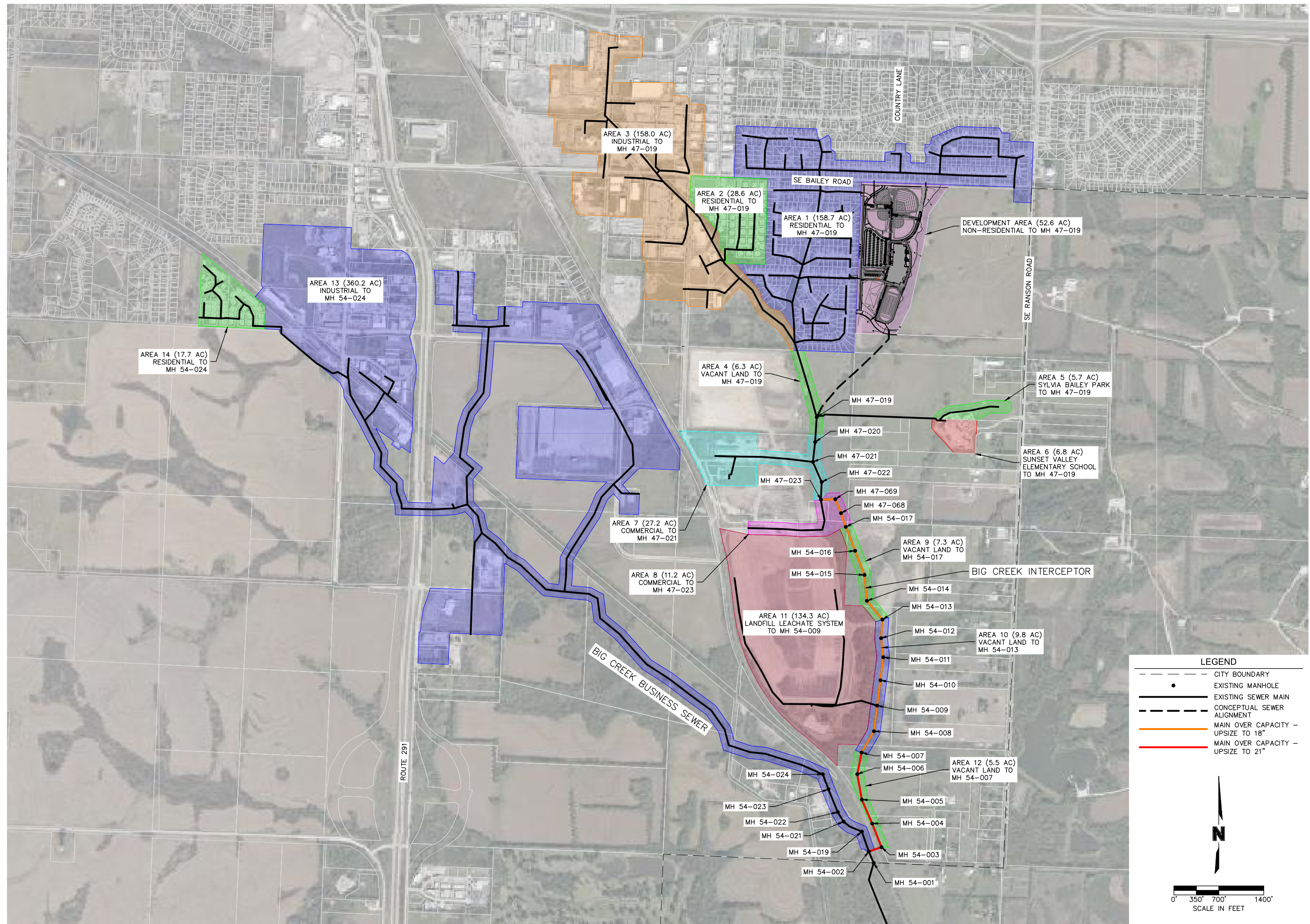
# **APPENDIX A**

## Sub-Basin Maps



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 DATE: Aug 17, 2020 2:14pm  
 USER: ngroff



**LEGEND**

- CITY BOUNDARY
- EXISTING MANHOLE
- EXISTING SEWER MAIN
- - - CONCEPTUAL SEWER ALIGNMENT
- MAIN OVER CAPACITY - UPSIZE TO 18"
- MAIN OVER CAPACITY - UPSIZE TO 21"

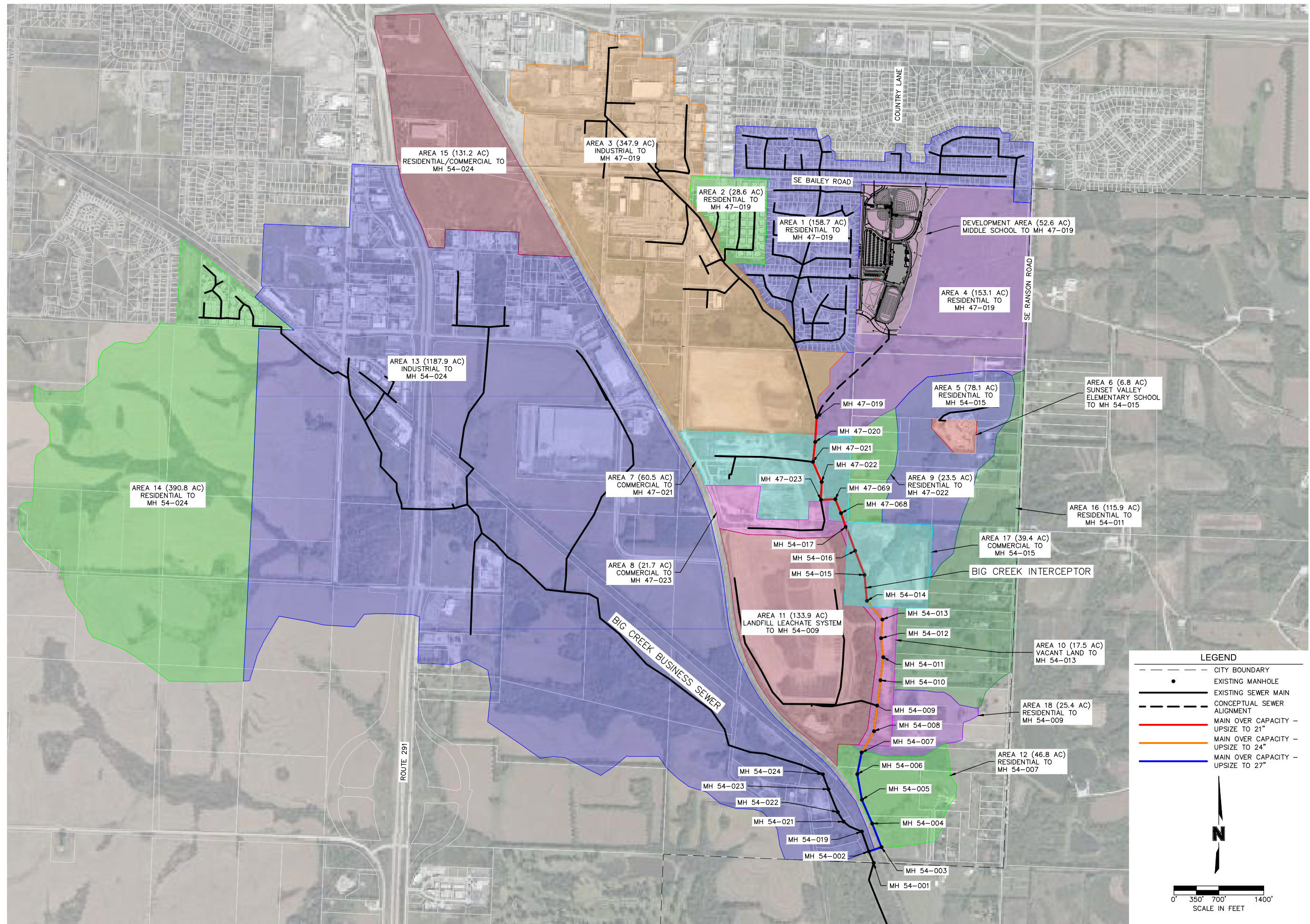
**SCALE IN FEET**

0' 350' 700' 1400'

**N**

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

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## **APPENDIX B**

### Sanitary Sewer Analysis Calculations

Table 1 - Existing Conditions

US MH	DS MH	Pipe No.	Sub-basin	Drainage Area (acre)	Cumulative Drainage Area (acre)	Design Flow Rate (cfs/acre)	Design Flow Rate (cfs)	Design Flow Rate (gpd)	US Invert	DS Invert	US MH Rim Elev.	Slope (%)	Pipe Diam. (in)	Pipe Length (ft)	Pipe Capacity (cfs)	Pipe Capacity (gpd)	Percent Pipe Capacity (%)	US HGL Elev.
54-002	54-001	P-56580			937.3	0.0086	8.04	5,199,511	920.64	920.26	933.00	0.20%	24.00	190.5	10.12	6,541,620	79.5%	922.06
<b>Big Creek Business Sewer</b>																		
54-019	54-002	P-56638			377.9	0.0085	3.20	2,068,093	921.33	920.79	931.14	0.16%	21.00	329.3	6.43	4,153,871	49.8%	922.44
54-021	54-019	P-56639			377.9	0.0085	3.20	2,068,093	922.07	921.53	931.32	0.16%	21.00	328.2	6.44	4,160,637	49.7%	922.98
54-022	54-021	P-56641			377.9	0.0085	3.20	2,068,093	922.73	922.27	932.09	0.27%	21.00	173.4	8.18	5,283,763	39.1%	923.53
54-023	54-022	P-56642			377.9	0.0085	3.20	2,068,093	923.70	922.91	935.82	0.21%	21.00	384.9	7.19	4,646,941	44.5%	924.55
54-024	54-023	P-56643	Area 13 & 14	377.9	377.9	0.0085	3.20	2,068,093	924.31	923.89	934.90	0.17%	21.00	247.3	6.54	4,227,016	48.9%	925.21
<b>Big Creek Interceptor</b>																		
54-003	54-002	P-56581			559.4	0.0087	4.85	3,131,418	921.28	920.84	945.00	0.22%	15.00	200.9	3.03	1,957,238	160.0%	923.55*
54-004	54-003	P-56582			559.4	0.0087	4.85	3,131,418	922.52	921.48	937.78	0.26%	15.00	400.0	3.30	2,132,312	146.9%	926.40*
54-005	54-004	P-56583			559.4	0.0087	4.85	3,131,418	923.76	922.72	941.77	0.26%	15.00	399.9	3.30	2,132,499	146.8%	929.05*
54-006	54-005	P-56584			559.4	0.0087	4.85	3,131,418	925.00	923.96	945.00	0.26%	15.00	400.0	3.30	2,132,419	146.8%	931.73*
54-007	54-006	P-56585	Area 12	5.5	559.4	0.0087	4.85	3,131,418	926.10	925.20	940.00	0.26%	15.00	348.2	3.29	2,126,007	147.3%	934.10*
54-008	54-007	P-56586			553.9	0.0086	4.77	3,085,058	930.00	926.30	944.75	0.97%	15.00	383.3	6.36	4,108,455	75.1%	936.62*
54-009	54-008	P-56587	Area 11	134.3	553.9	0.0086	4.77	3,085,058	931.76	930.20	944.00	0.39%	15.00	400.0	4.04	2,611,538	118.1%	939.26*
54-010	54-009	P-56589			419.6	0.0097	4.07	2,632,106	933.00	931.96	946.00	0.26%	15.00	400.0	3.30	2,132,312	123.4%	941.34*
54-011	54-010	P-56590			419.6	0.0097	4.07	2,632,106	934.00	933.20	949.00	0.22%	15.00	362.0	3.04	1,965,979	133.9%	943.04*
54-012	54-011	P-56591			419.6	0.0097	4.07	2,632,106	940.01	938.38	951.08	0.55%	15.00	297.1	4.79	3,097,362	85.0%	944.45*
54-013	54-012	P-56592	Area 10	9.8	419.6	0.0097	4.07	2,632,106	940.80	940.21	955.00	0.20%	15.00	291.1	2.91	1,882,647	139.8%	945.83*
54-014	54-013	P-56593			409.8	0.0097	3.96	2,559,958	941.65	940.90	954.00	0.20%	15.00	378.9	2.88	1,860,634	137.6%	947.61*
54-015	54-014	P-56594			409.8	0.0097	3.96	2,559,958	943.24	941.85	956.00	0.34%	15.00	407.9	3.78	2,441,241	104.9%	949.49*
54-016	54-015	P-56595			409.8	0.0097	3.96	2,559,958	945.84	943.44	960.37	0.60%	15.00	400.0	5.01	3,239,295	79.0%	951.28*
54-017	54-016	P-56596	Area 9	7.3	409.8	0.0097	3.96	2,559,958	947.00	946.04	962.46	0.24%	15.00	400.0	3.17	2,048,633	125.0%	953.05*
47-068	54-017	P-56597			402.5	0.0096	3.87	2,500,543	948.00	947.20	963.00	0.35%	15.00	230.0	3.82	2,466,349	101.4%	954.04*
47-069	47-068	P-56598			402.5	0.0096	3.87	2,500,543	949.00	948.20	964.00	0.35%	15.00	230.0	3.82	2,466,188	101.4%	955.02*
47-023	47-069	P-56599	Area 8	11.2	402.5	0.0096	3.87	2,500,543	950.00	949.20	963.77	0.37%	15.00	218.8	3.91	2,528,573	98.9%	956.07*
47-022	47-023	P-56546			391.3	0.0095	3.72	2,403,522	956.68	955.43	964.50	0.35%	18.00	357.0	6.23	4,023,787	59.7%	957.55
47-021	47-022	P-56545	Area 7	27.2	391.3	0.0095	3.72	2,403,522	958.05	956.88	966.50	0.35%	18.00	334.4	6.22	4,022,475	59.8%	958.92
47-020	47-021	P-56544			364.1	0.0095	3.46	2,239,179	959.35	958.25	968.00	0.35%	18.00	313.3	6.23	4,029,627	55.6%	960.18
47-019	47-020	P-56543	Area 1, 2, 3, 4, 5, & 6	364.1	364.1	0.0095	3.46	2,239,179	960.95	959.55	970.00	0.35%	18.00	400.0	6.22	4,022,982	55.7%	961.79

=HGL above crown



Table 2 - Proposed Conditions

US MH	DS MH	Pipe No.	Sub-basin	Drainage Area (acre)	Cumulative Drainage Area (acre)	Design Flow Rate (cfs/acre)	Design Flow Rate (cfs)	Design Flow Rate (gpd)	US Invert	DS Invert	US MH Rim Elev.	Slope (%)	Pipe Diam. (in)	Pipe Length (ft)	Pipe Capacity (cfs)	Pipe Capacity (gpd)	Percent Pipe Capacity (%)	US HGL Elev.
54-002	54-001	P-56580			989.9	0.0086	8.56	5,530,002	920.64	920.26	933.00	0.20%	24.00	190.5	10.12	6,541,620	84.5%	922.14
<b>Big Creek Business Sewer</b>																		
54-019	54-002	P-56638			377.9	0.0085	3.20	2,068,093	921.33	920.79	931.14	0.16%	21.00	329.3	6.43	4,153,871	49.8%	922.49
54-021	54-019	P-56639			377.9	0.0085	3.20	2,068,093	922.07	921.53	931.32	0.16%	21.00	328.2	6.44	4,160,637	49.7%	922.98
54-022	54-021	P-56641			377.9	0.0085	3.20	2,068,093	922.73	922.27	932.09	0.27%	21.00	173.4	8.18	5,283,763	39.1%	923.53
54-023	54-022	P-56642			377.9	0.0085	3.20	2,068,093	923.70	922.91	935.82	0.21%	21.00	384.9	7.19	4,646,941	44.5%	924.55
54-024	54-023	P-56643	Area 13 & 14	377.9	377.9	0.0085	3.20	2,068,093	924.31	923.89	934.90	0.17%	21.00	247.3	6.54	4,227,016	48.9%	925.21
<b>Big Creek Interceptor</b>																		
54-003	54-002	P-56581			612.0	0.0088	5.36	3,461,910	921.28	920.84	945.00	0.22%	15.00	200.9	3.03	1,957,238	176.9%	923.91*
54-004	54-003	P-56582			612.0	0.0088	5.36	3,461,910	922.52	921.48	937.78	0.26%	15.00	400.0	3.30	2,132,312	162.4%	927.38*
54-005	54-004	P-56583			612.0	0.0088	5.36	3,461,910	923.76	922.72	941.77	0.26%	15.00	399.9	3.30	2,132,499	162.3%	930.60*
54-006	54-005	P-56584			612.0	0.0088	5.36	3,461,910	925.00	923.96	945.00	0.26%	15.00	400.0	3.30	2,132,419	162.3%	933.85*
54-007	54-006	P-56585	Area 12	5.5	612.0	0.0088	5.36	3,461,910	926.10	925.20	940.00	0.26%	15.00	348.2	3.29	2,126,007	162.8%	936.74*
54-008	54-007	P-56586			606.5	0.0087	5.28	3,415,541	930.00	926.30	944.75	0.97%	15.00	383.3	6.36	4,108,455	83.1%	939.81*
54-009	54-008	P-56587	Area 11	134.3	606.5	0.0087	5.28	3,415,541	931.76	930.20	944.00	0.39%	15.00	400.0	4.04	2,611,538	130.8%	943.03*
54-010	54-009	P-56589			472.2	0.0097	4.58	2,962,604	933.00	931.96	946.00	0.26%	15.00	400.0	3.30	2,132,312	138.9%	945.64*
54-011	54-010	P-56590			472.2	0.0097	4.58	2,962,604	934.00	933.20	949.00	0.22%	15.00	362.0	3.04	1,965,979	150.7%	947.78*
54-012	54-011	P-56591			472.2	0.0097	4.58	2,962,604	940.01	938.38	951.08	0.55%	15.00	297.1	4.79	3,097,362	95.6%	949.56*
54-013	54-012	P-56592	Area 10	9.8	472.2	0.0097	4.58	2,962,604	940.80	940.21	955.00	0.20%	15.00	291.1	2.91	1,882,647	157.4%	951.30*
54-014	54-013	P-56593			462.4	0.0097	4.47	2,890,440	941.65	940.90	954.00	0.20%	15.00	378.9	2.88	1,860,634	155.3%	953.55*
54-015	54-014	P-56594			462.4	0.0097	4.47	2,890,440	943.24	941.85	956.00	0.34%	15.00	407.9	3.78	2,441,241	118.4%	955.93*
54-016	54-015	P-56595			462.4	0.0097	4.47	2,890,440	945.84	943.44	960.37	0.60%	15.00	400.0	5.01	3,239,295	89.2%	958.21*
54-017	54-016	P-56596	Area 9	7.3	462.4	0.0097	4.47	2,890,440	947.00	946.04	962.46	0.24%	15.00	400.0	3.17	2,048,633	141.1%	960.46*
47-068	54-017	P-56597			455.1	0.0096	4.38	2,831,025	948.00	947.20	963.00	0.35%	15.00	230.0	3.82	2,466,349	114.8%	961.71*
47-069	47-068	P-56598			455.1	0.0096	4.38	2,831,025	949.00	948.20	964.00	0.35%	15.00	230.0	3.82	2,466,188	114.8%	962.97*
47-023	47-069	P-56599	Area 8	11.2	455.1	0.0096	4.38	2,831,025	950.00	949.20	963.77	0.37%	15.00	218.8	3.91	2,528,573	112.0%	964.31*
47-022	47-023	P-56546			443.9	0.0095	4.23	2,734,012	956.68	955.43	964.50	0.35%	18.00	357.0	6.23	4,023,787	67.9%	965.18*
47-021	47-022	P-56545	Area 7	27.2	443.9	0.0095	4.23	2,734,012	958.05	956.88	966.50	0.35%	18.00	334.4	6.22	4,022,475	68.0%	965.85*
47-020	47-021	P-56544			416.7	0.0095	3.98	2,569,666	959.35	958.25	968.00	0.35%	18.00	313.3	6.23	4,029,627	63.8%	966.45*
47-019	47-020	P-56543	Area 1, 2, 3, 4, 5, & 6	364.1	416.7	0.0095	3.98	2,569,666	960.95	959.55	970.00	0.35%	18.00	400.0	6.22	4,022,982	63.9%	967.12*
Future	47-019	Future	Development Area	52.6	52.6	0.0097	0.51	330,495	964.20	961.40	Future	0.70%	15.00	400.0	5.41	3,498,751	9.4%	

=HGL above crown

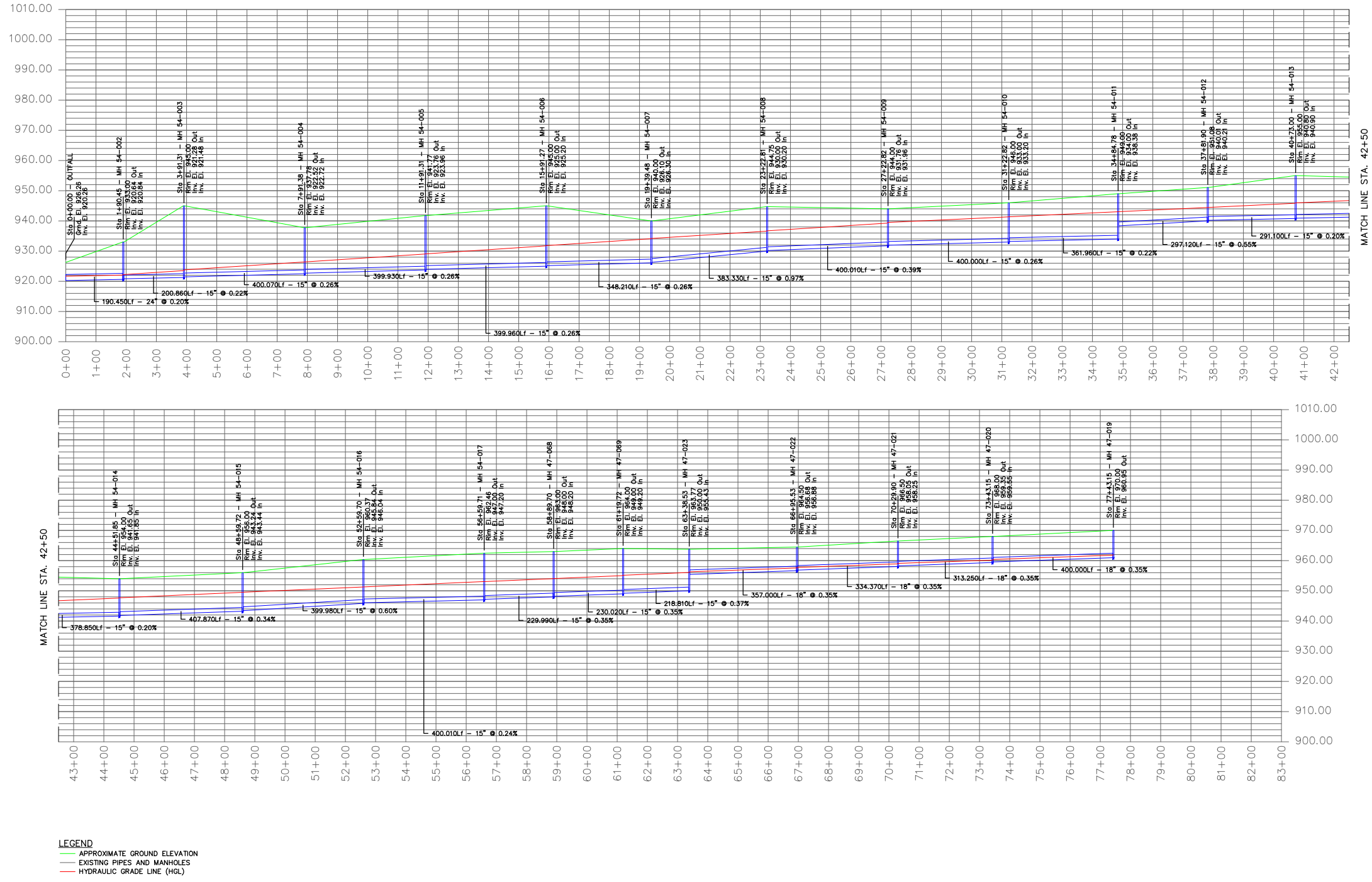
**Table 3 - Ultimate Build-Out Conditions**

US MH	DS MH	Pipe No.	Sub-basin	Drainage Area (acre)	Cumulative Drainage Area (acre)	Design Flow Rate (cfs/acre)	Design Flow Rate (cfs)	Design Flow Rate (gpd)	US Invert	DS Invert	US MH Rim Elev.	Slope (%)	Pipe Diam. (in)	Pipe Length (ft)	Pipe Capacity (cfs)	Pipe Capacity (gpd)	Percent Pipe Capacity (%)	US HGL Elev.
54-002	54-001	P-56580			3020.3	0.0082	24.87	16,075,014	920.64	920.26	933.00	0.20%	24.00	190.5	10.12	6,541,620	245.7%	924.93*
<b>Big Creek Business Sewer</b>																		
54-019	54-002	P-56638			1709.9	0.0077	13.16	8,508,191	921.33	920.79	931.14	0.16%	21.00	329.3	6.43	4,153,871	204.8%	928.54*
54-021	54-019	P-56639			1709.9	0.0077	13.16	8,508,191	922.07	921.53	931.32	0.16%	21.00	328.2	6.44	4,160,637	204.5%	931.51*
54-022	54-021	P-56641			1709.9	0.0077	13.16	8,508,191	922.73	922.27	932.09	0.27%	21.00	173.4	8.18	5,283,763	161.0%	933.16*
54-023	54-022	P-56642			1709.9	0.0077	13.16	8,508,191	923.70	922.91	935.82	0.21%	21.00	384.9	7.19	4,646,941	183.1%	936.33*
54-024	54-023	P-56643	Area 13, 14, & 15	1709.9	1709.9	0.0077	13.16	8,508,191	924.31	923.89	934.90	0.17%	21.00	247.3	6.54	4,227,016	201.3%	938.38*
<b>Big Creek Interceptor</b>																		
54-003	54-002	P-56581			1310.4	0.0089	11.71	7,566,822	921.28	920.84	945.00	0.22%	15.00	200.9	3.03	1,957,238	386.6%	933.57*
54-004	54-003	P-56582			1310.4	0.0089	11.71	7,566,822	922.52	921.48	937.78	0.26%	15.00	400.0	3.30	2,132,312	354.9%	950.24*
54-005	54-004	P-56583			1310.4	0.0089	11.71	7,566,822	923.76	922.72	941.77	0.26%	15.00	399.9	3.30	2,132,499	354.8%	965.70*
54-006	54-005	P-56584			1310.4	0.0089	11.71	7,566,822	925.00	923.96	945.00	0.26%	15.00	400.0	3.30	2,132,419	354.8%	981.33*
54-007	54-006	P-56585	Area 12	46.8	1310.4	0.0089	11.71	7,566,822	926.10	925.20	940.00	0.26%	15.00	348.2	3.29	2,126,007	355.9%	995.21*
54-008	54-007	P-56586			1263.6	0.0089	11.20	7,237,830	930.00	926.30	944.75	0.97%	15.00	383.3	6.36	4,108,455	176.2%	1009.10*
54-009	54-008	P-56587	Area 11 & 18	159.3	1263.6	0.0089	11.20	7,237,830	931.76	930.20	944.00	0.39%	15.00	400.0	4.04	2,611,538	277.1%	1023.63*
54-010	54-009	P-56589			1104.3	0.0092	10.20	6,593,088	933.00	931.96	946.00	0.26%	15.00	400.0	3.30	2,132,312	309.2%	1036.50*
54-011	54-010	P-56590	Area 16	115.9	1104.3	0.0092	10.20	6,593,088	934.00	933.20	949.00	0.22%	15.00	362.0	3.04	1,965,979	335.4%	1047.14*
54-012	54-011	P-56591			988.4	0.0092	9.09	5,877,971	940.01	938.38	951.08	0.55%	15.00	297.1	4.79	3,097,362	189.8%	1054.26*
54-013	54-012	P-56592	Area 10	17.5	988.4	0.0092	9.09	5,877,971	940.80	940.21	955.00	0.20%	15.00	291.1	2.91	1,882,647	312.2%	1061.13*
54-014	54-013	P-56593			970.9	0.0092	8.91	5,755,856	941.65	940.90	954.00	0.20%	15.00	378.9	2.88	1,860,634	309.3%	1070.11*
54-015	54-014	P-56594	Area 5, 6, & 17	124.3	970.9	0.0092	8.91	5,755,856	943.24	941.85	956.00	0.34%	15.00	407.9	3.78	2,441,241	235.8%	1079.61*
54-016	54-015	P-56595			846.6	0.0090	7.61	4,917,139	945.84	943.44	960.37	0.60%	15.00	400.0	5.01	3,239,295	151.8%	1086.31*
54-017	54-016	P-56596			846.6	0.0090	7.61	4,917,139	947.00	946.04	962.46	0.24%	15.00	400.0	3.17	2,048,633	240.0%	1092.84*
47-068	54-017	P-56597			846.6	0.0090	7.61	4,917,139	948.00	947.20	963.00	0.35%	15.00	230.0	3.82	2,466,349	199.4%	1096.64*
47-069	47-068	P-56598			846.6	0.0090	7.61	4,917,139	949.00	948.20	964.00	0.35%	15.00	230.0	3.82	2,466,188	199.4%	1100.43*
47-023	47-069	P-56599	Area 8	21.7	846.6	0.0090	7.61	4,917,139	950.00	949.20	963.77	0.37%	15.00	218.8	3.91	2,528,573	194.5%	1104.52*
47-022	47-023	P-56546	Area 9	23.5	824.9	0.0090	7.41	4,788,625	956.68	955.43	964.50	0.35%	18.00	357.0	6.23	4,023,787	119.0%	1107.17*
47-021	47-022	P-56545	Area 7	60.5	801.4	0.0089	7.13	4,609,807	958.05	956.88	966.50	0.35%	18.00	334.4	6.22	4,022,475	114.6%	1109.09*
47-020	47-021	P-56544			740.9	0.0090	6.65	4,296,998	959.35	958.25	968.00	0.35%	18.00	313.3	6.23	4,029,627	106.6%	1110.78*
47-019	47-020	P-56543	Area 1, 2, & 3	535.2	740.9	0.0090	6.65	4,296,998	960.95	959.55	970.00	0.35%	18.00	400.0	6.22	4,022,982	106.8%	1112.67*
Future	47-019	Future	Development Area and Area 4	205.7	205.7	0.0094	1.94	1,256,211	964.20	961.40	Future	0.70%	15.00	400.0	5.41	3,498,751	35.9%	

=HGL above crown

## **APPENDIX C**

### Sanitary Sewer Hydraulic Grade Line



**BIG CREEK INTERCEPTOR  
 EXISTING CONDITIONS HGL**

**SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4  
 SANITARY SEWER CAPACITY ANALYSIS**

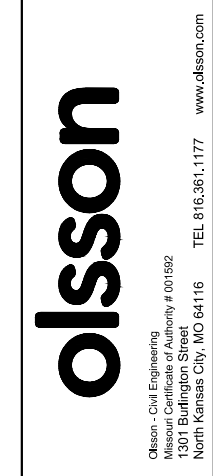
LEE'S SUMMIT, MISSOURI

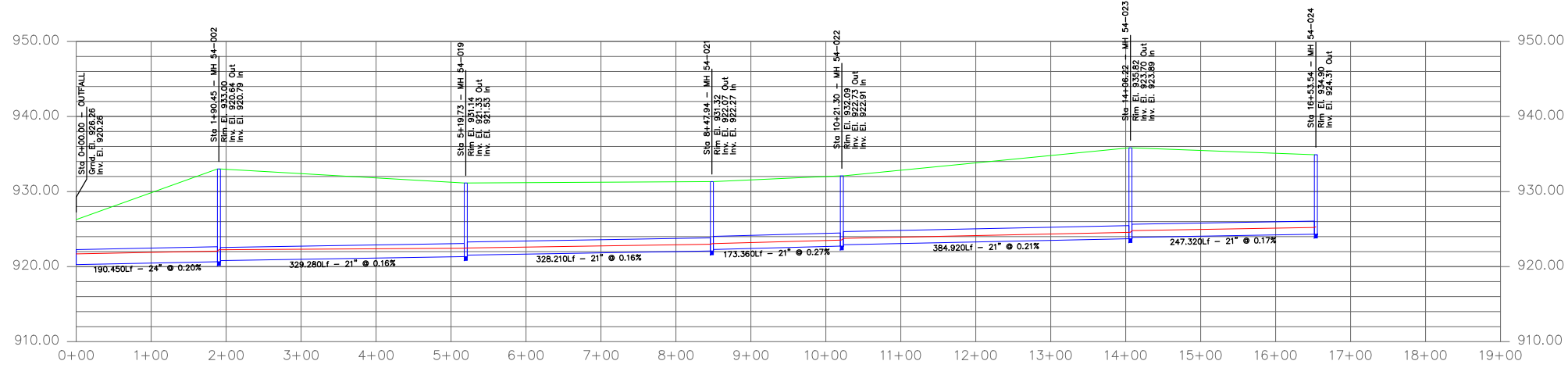
REV. NO.	DATE	REVISIONS DESCRIPTION	BY

2020

**REVISIONS**

drawn by: \_\_\_\_\_ NMG  
 checked by: \_\_\_\_\_  
 approved by: \_\_\_\_\_  
 project no.: 020-0103  
 drawing no.: \_\_\_\_\_  
 date: 08.17.20





**LEGEND**  
 — APPROXIMATE GROUND ELEVATION  
 — EXISTING PIPES AND MANHOLES  
 — HYDRAULIC GRADE LINE (HGL)

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

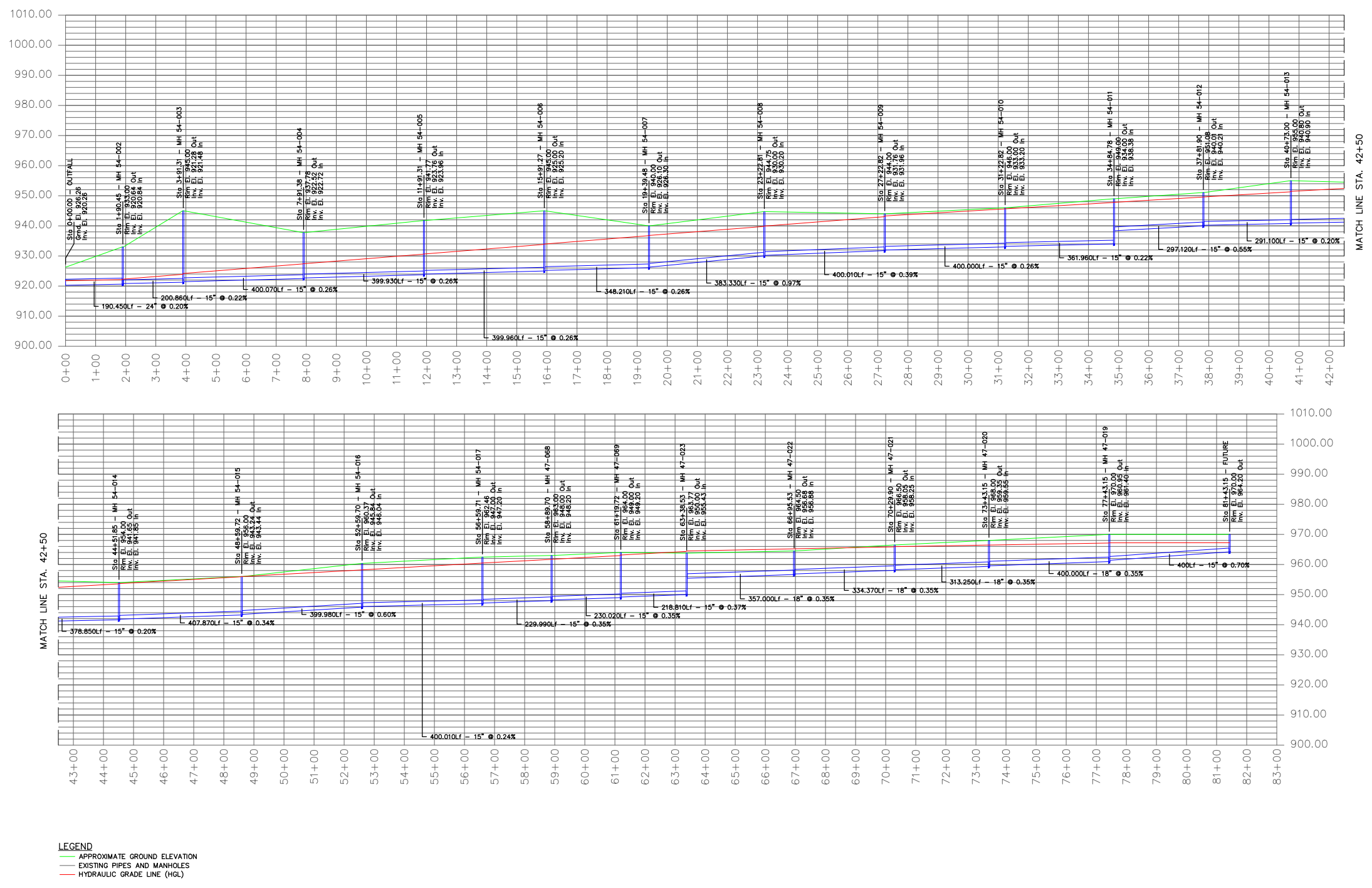
**BIG CREEK BUSINESS SEWER EXISTING CONDITIONS HGL**

**SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4 SANITARY SEWER CAPACITY ANALYSIS**

**LEE'S SUMMIT, MISSOURI**

2020

drawn by: NMG  
 checked by: \_\_\_\_\_  
 approved by: \_\_\_\_\_  
 QA/QC by: \_\_\_\_\_  
 project no.: 020-0103  
 drawing no.: \_\_\_\_\_  
 date: 08.17.20



**olsson**

Olsson - Civil Engineering  
 Missouri Certificate of Authority # 001592  
 1301 Burlington Street  
 North Kansas City, MO 64116  
 TEL 816.361.1177  
 www.olson.com

**REVISIONS**

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

**BIG CREEK INTERCEPTOR  
 PROPOSED CONDITIONS HGL**

**SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4  
 SANITARY SEWER CAPACITY ANALYSIS**

LEE'S SUMMIT, MISSOURI

drawn by: \_\_\_\_\_

checked by: \_\_\_\_\_

QA/QC by: \_\_\_\_\_

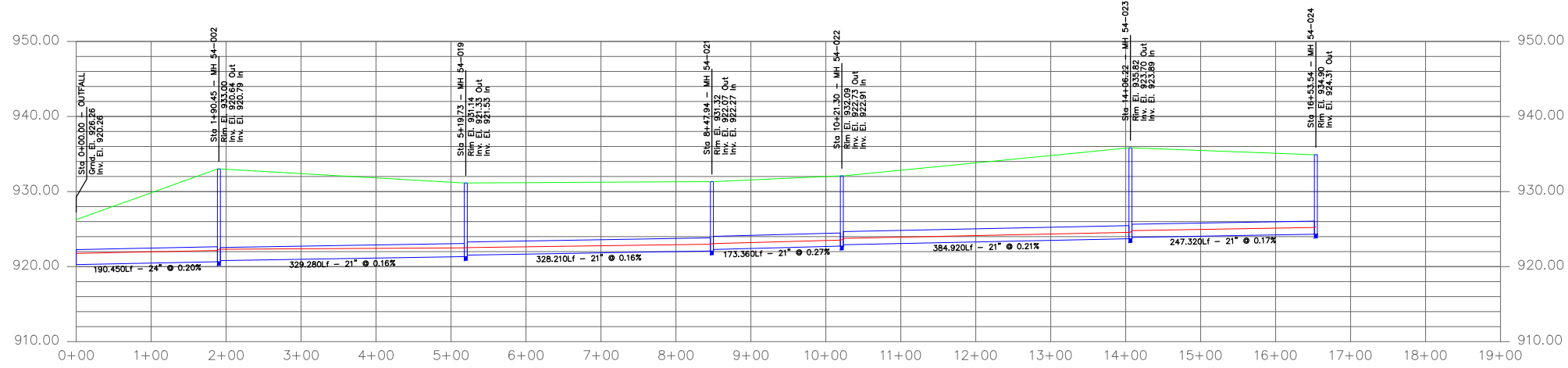
project no.: 020-0103

drawing no.: \_\_\_\_\_

date: 08.17.20

2020

**SHEET**  
3 of 6



**LEGEND**  
 — APPROXIMATE GROUND ELEVATION  
 — EXISTING PIPES AND MANHOLES  
 — HYDRAULIC GRADE LINE (HGL)

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

**BIG CREEK BUSINESS SEWER PROPOSED CONDITIONS HGL**

**SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4 SANITARY SEWER CAPACITY ANALYSIS**

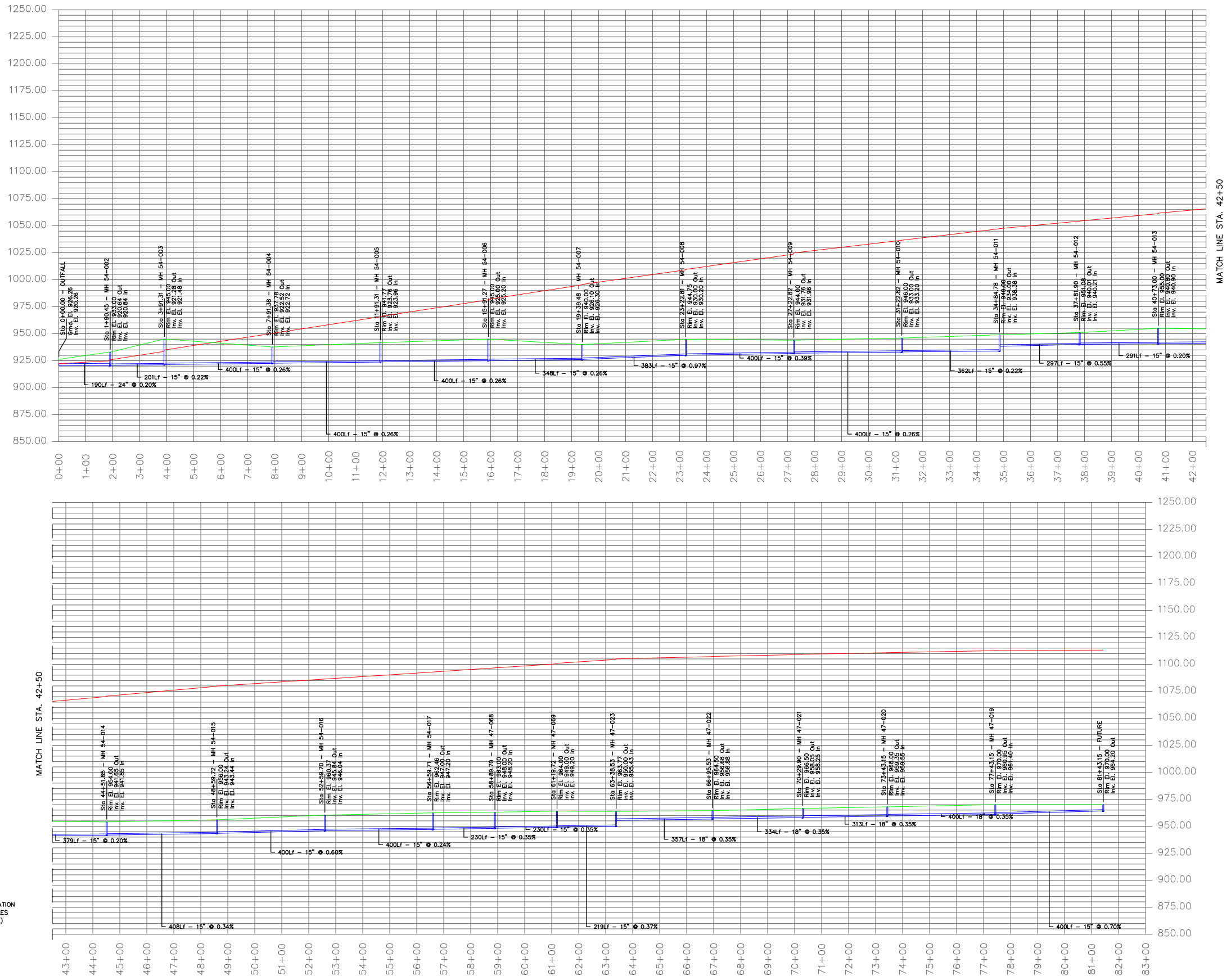
LEE'S SUMMIT, MISSOURI

2020

drawn by: \_\_\_\_\_ NMG  
 checked by: \_\_\_\_\_  
 approved by: \_\_\_\_\_  
 QA/QC by: \_\_\_\_\_  
 project no.: 020-0103  
 drawing no.: \_\_\_\_\_  
 date: 08.17.20

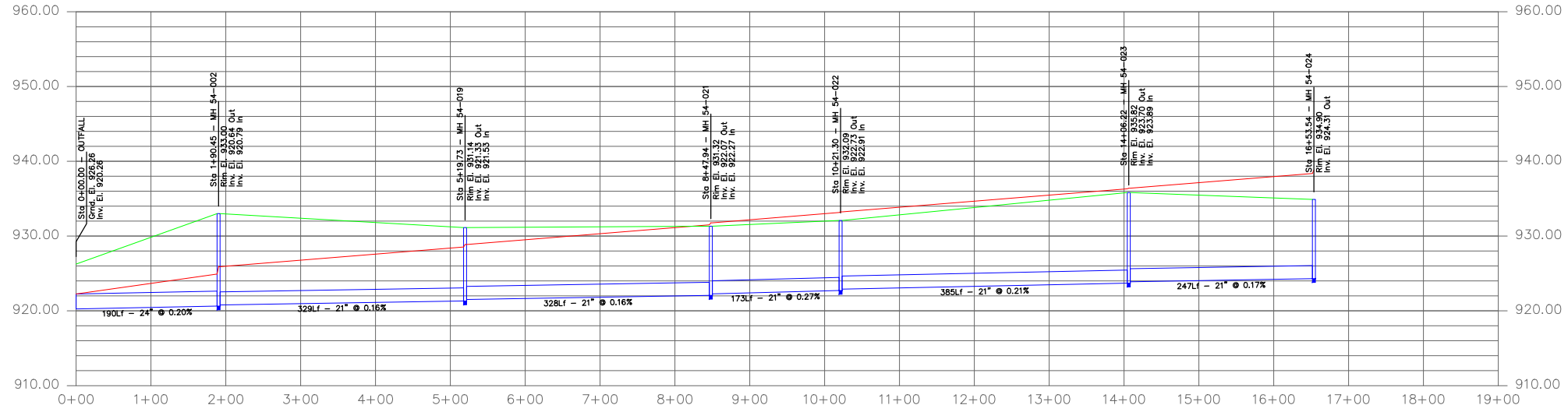
**SHEET**  
 4 of 6

**LEGEND**  
 - - - APPROXIMATE GROUND ELEVATION  
 - - - EXISTING PIPES AND MANHOLES  
 - - - HYDRAULIC GRADE LINE (HGL)



<b>olsson</b>			Olsson - Civil Engineering Missouri Certificate of Authority # 001592 1301 Burlington Street North Kansas City, MO 64116 TEL 816.361.1177 www.olsosn.com															
<b>BIG CREEK INTERCEPTOR          ULTIMATE BUILD-OUT CONDITIONS HGL</b>		BY  	REVISIONS <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">REV. NO.</th> <th style="width: 60%;">DATE</th> <th style="width: 30%;">REVISIONS DESCRIPTION</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	REV. NO.	DATE	REVISIONS DESCRIPTION												
REV. NO.	DATE	REVISIONS DESCRIPTION																
<b>SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4          SANITARY SEWER CAPACITY ANALYSIS</b>		2020																
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drawn by: _____ NMG checked by: _____ approved by: _____ QA/QC by: _____ project no.: 020-0103 drawing no.: _____ date: 08.17.20																		
<b>SHEET</b> 5 of 6																		





**LEGEND**  
 — APPROXIMATE GROUND ELEVATION  
 — EXISTING PIPES AND MANHOLES  
 — HYDRAULIC GRADE LINE (HGL)

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

**BIG CREEK BUSINESS SEWER  
 ULTIMATE BUILD-OUT CONDITIONS HGL**

**SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4  
 SANITARY SEWER CAPACITY ANALYSIS**

LEE'S SUMMIT, MISSOURI

2020

drawn by: NMG  
 checked by: \_\_\_\_\_  
 approved by: \_\_\_\_\_  
 QA/QC by: \_\_\_\_\_  
 project no.: 020-0103  
 drawing no.: \_\_\_\_\_  
 date: 08.17.20

**SHEET**  
 6 of 6

## **APPENDIX D**

### Sanitary Sewer Upsizing Analysis Calculations

**Table 1 - Proposed Conditions**

US MH	DS MH	Pipe No.	Sub-basin	Drainage Area (acre)	Cumulative Drainage Area (acre)	Design Flow Rate (cfs/acre)	Design Flow Rate (cfs)	Design Flow Rate (gpd)	US Invert	DS Invert	US MH Rim Elev.	Slope (%)	Pipe Diam. (in)	Pipe Length (ft)	Pipe Capacity (cfs)	Pipe Capacity (gpd)	Percent Pipe Capacity (%)	US HGL Elev.
54-002	54-001	P-56580			989.9	0.0086	8.56	5,530,002	920.64	920.26	933.00	0.20%	24.00	190.5	10.12	6,541,620.27	84.5%	922.14
<b>Big Creek Business Sewer</b>																		
54-019	54-002	P-56638			377.9	0.0085	3.20	2,068,093	921.33	920.79	931.14	0.16%	21.00	329.3	6.43	4,153,871.26	49.8%	922.49
54-021	54-019	P-56639			377.9	0.0085	3.20	2,068,093	922.07	921.53	931.32	0.16%	21.00	328.2	6.44	4,160,636.78	49.7%	922.98
54-022	54-021	P-56641			377.9	0.0085	3.20	2,068,093	922.73	922.27	932.09	0.27%	21.00	173.4	8.18	5,283,762.59	39.1%	923.53
54-023	54-022	P-56642			377.9	0.0085	3.20	2,068,093	923.70	922.91	935.82	0.21%	21.00	384.9	7.19	4,646,940.76	44.5%	924.55
54-024	54-023	P-56643	Area 13 & 14	377.9	377.9	0.0085	3.20	2,068,093	924.31	923.89	934.90	0.17%	21.00	247.3	6.54	4,227,015.64	48.9%	925.21
<b>Big Creek Interceptor</b>																		
54-003	54-002	P-56581			612.0	0.0088	5.36	3,461,910	921.28	920.84	945.00	0.22%	21.00	200.9	7.43	4,800,853.32	72.1%	922.58
54-004	54-003	P-56582			612.0	0.0088	5.36	3,461,910	922.52	921.48	937.78	0.26%	21.00	400.0	8.09	5,230,286.78	66.2%	923.59
54-005	54-004	P-56583			612.0	0.0088	5.36	3,461,910	923.76	922.72	941.77	0.26%	21.00	399.9	8.09	5,230,744.50	66.2%	924.85
54-006	54-005	P-56584			612.0	0.0088	5.36	3,461,910	925.00	923.96	945.00	0.26%	21.00	400.0	8.09	5,230,548.32	66.2%	926.09
54-007	54-006	P-56585	Area 12	5.5	612.0	0.0088	5.36	3,461,910	926.10	925.20	940.00	0.26%	21.00	348.2	8.07	5,214,821.70	66.4%	927.19
54-008	54-007	P-56586			606.5	0.0087	5.28	3,415,541	930.00	926.30	944.75	0.97%	18.00	383.3	10.34	6,680,800.66	51.1%	930.88
54-009	54-008	P-56587	Area 11	134.3	606.5	0.0087	5.28	3,415,541	931.76	930.20	944.00	0.39%	18.00	400.0	6.57	4,246,648.93	80.4%	932.84
54-010	54-009	P-56589			472.2	0.0097	4.58	2,962,604	933.00	931.96	946.00	0.26%	18.00	400.0	5.36	3,467,374.33	85.4%	934.13
54-011	54-010	P-56590			472.2	0.0097	4.58	2,962,604	934.00	933.20	949.00	0.22%	18.00	362.0	4.95	3,196,897.85	92.7%	935.23
54-012	54-011	P-56591			472.2	0.0097	4.58	2,962,604	940.01	938.38	951.08	0.55%	18.00	297.1	7.79	5,036,651.66	58.8%	940.87
54-013	54-012	P-56592	Area 10	9.8	472.2	0.0097	4.58	2,962,604	940.80	940.21	955.00	0.20%	18.00	291.1	4.74	3,061,392.12	96.8%	942.09
54-014	54-013	P-56593			462.4	0.0097	4.47	2,890,440	941.65	940.90	954.00	0.20%	18.00	378.9	4.68	3,025,596.73	95.5%	942.92
54-015	54-014	P-56594			462.4	0.0097	4.47	2,890,440	943.24	941.85	956.00	0.34%	18.00	407.9	6.14	3,969,726.39	72.8%	944.20
54-016	54-015	P-56595			462.4	0.0097	4.47	2,890,440	945.84	943.44	960.37	0.60%	18.00	400.0	8.15	5,267,451.42	54.9%	946.67
54-017	54-016	P-56596	Area 9	7.3	462.4	0.0097	4.47	2,890,440	947.00	946.04	962.46	0.24%	18.00	400.0	5.15	3,331,303.86	86.8%	948.15
47-068	54-017	P-56597			455.1	0.0096	4.38	2,831,025	948.00	947.20	963.00	0.35%	18.00	230.0	6.21	4,010,555.89	70.6%	948.98
47-069	47-068	P-56598			455.1	0.0096	4.38	2,831,025	949.00	948.20	964.00	0.35%	18.00	230.0	6.20	4,010,294.35	70.6%	949.98
47-023	47-069	P-56599	Area 8	11.2	455.1	0.0096	4.38	2,831,025	950.00	949.20	963.77	0.37%	18.00	218.8	6.36	4,111,738.31	68.9%	950.96
47-022	47-023	P-56546			443.9	0.0095	4.23	2,734,012	956.68	955.43	964.50	0.35%	18.00	357.0	6.23	4,023,786.74	67.9%	957.63
47-021	47-022	P-56545	Area 7	27.2	443.9	0.0095	4.23	2,734,012	958.05	956.88	966.50	0.35%	18.00	334.4	6.22	4,022,474.82	68.0%	959.00
47-020	47-021	P-56544			416.7	0.0095	3.98	2,569,666	959.35	958.25	968.00	0.35%	18.00	313.3	6.23	4,029,627.10	63.8%	960.25
47-019	47-020	P-56543	Area 1, 2, 3, 4, 5, & 6	364.1	416.7	0.0095	3.98	2,569,666	960.95	959.55	970.00	0.35%	18.00	400.0	6.22	4,022,981.90	63.9%	961.86
Future	47-019	Future	Development Area	52.6	52.6	0.0097	0.51	330,495	964.20	961.40	Future	0.70%	15.00	400.0	5.41	3,498,751.41	9.4%	

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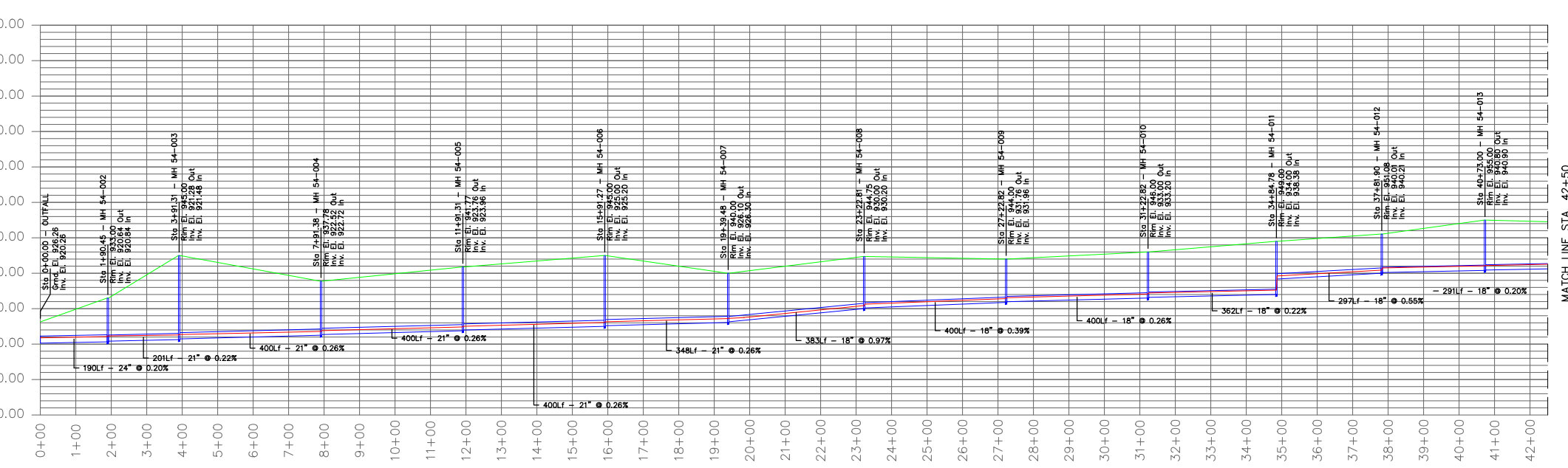
**Table 2 - Ultimate Build-Out Conditions**

US MH	DS MH	Pipe No.	Sub-basin	Drainage Area (acre)	Cumulative Drainage Area (acre)	Design Flow Rate (cfs/acre)	Design Flow Rate (cfs)	Design Flow Rate (gpd)	US Invert	DS Invert	US MH Rim Elev.	Slope (%)	Pipe Diam. (in)	Pipe Length (ft)	Pipe Capacity (cfs)	Pipe Capacity (gpd)	Percent Pipe Capacity (%)	US HGL Elev.
54-002	54-001	P-56580			3020.3	0.0082	24.87	16,075,014	920.64	920.26	933.00	0.20%	36.00	190.5	29.84	19,286,881.90	83.3%	922.86
<b>Big Creek Business Sewer</b>																		
54-019	54-002	P-56638			1709.9	0.0077	13.16	8,508,191	921.33	920.79	931.14	0.16%	30.00	329.3	16.64	10,752,883.12	79.1%	923.50
54-021	54-019	P-56639			1709.9	0.0077	13.16	8,508,191	922.07	921.53	931.32	0.16%	30.00	328.2	16.66	10,770,396.64	79.0%	923.99
54-022	54-021	P-56641			1709.9	0.0077	13.16	8,508,191	922.73	922.27	932.09	0.27%	30.00	173.4	21.16	13,677,766.60	62.2%	924.35
54-023	54-022	P-56642			1709.9	0.0077	13.16	8,508,191	923.70	922.91	935.82	0.21%	30.00	384.9	18.61	12,029,263.25	70.7%	925.34
54-024	54-023	P-56643	Area 13, 14, & 15	1709.9	1709.9	0.0077	13.16	8,508,191	924.31	923.89	934.90	0.17%	30.00	247.3	16.93	10,942,227.71	77.8%	926.06
<b>Big Creek Interceptor</b>																		
54-003	54-002	P-56581			1310.4	0.0089	11.71	7,566,822	921.28	920.84	945.00	0.22%	27.00	200.9	14.52	9,383,618.79	80.6%	923.48
54-004	54-003	P-56582			1310.4	0.0089	11.71	7,566,822	922.52	921.48	937.78	0.26%	27.00	400.0	15.82	10,222,977.88	74.0%	924.23
54-005	54-004	P-56583			1310.4	0.0089	11.71	7,566,822	923.76	922.72	941.77	0.26%	27.00	399.9	15.82	10,223,872.51	74.0%	925.28
54-006	54-005	P-56584			1310.4	0.0089	11.71	7,566,822	925.00	923.96	945.00	0.26%	27.00	400.0	15.82	10,223,489.07	74.0%	926.52
54-007	54-006	P-56585	Area 12	46.8	1310.4	0.0089	11.71	7,566,822	926.10	925.20	940.00	0.26%	27.00	348.2	15.77	10,192,750.23	74.2%	927.62
54-008	54-007	P-56586			1263.6	0.0089	11.20	7,237,830	930.00	926.30	944.75	0.97%	24.00	383.3	22.26	14,387,935.36	50.3%	931.20
54-009	54-008	P-56587	Area 11 & 18	159.3	1263.6	0.0089	11.20	7,237,830	931.76	930.20	944.00	0.39%	24.00	400.0	14.15	9,145,686.79	79.1%	933.18
54-010	54-009	P-56589			1104.3	0.0092	10.20	6,593,088	933.00	931.96	946.00	0.26%	24.00	400.0	11.55	7,467,421.99	88.3%	934.56
54-011	54-010	P-56590	Area 16	115.9	1104.3	0.0092	10.20	6,593,088	934.00	933.20	949.00	0.22%	24.00	362.0	10.65	6,884,917.24	95.8%	935.71
54-012	54-011	P-56591			988.4	0.0092	9.09	5,877,971	940.01	938.38	951.08	0.55%	24.00	297.1	16.78	10,847,055.93	54.2%	941.11
54-013	54-012	P-56592	Area 10	17.5	988.4	0.0092	9.09	5,877,971	940.80	940.21	955.00	0.20%	24.00	291.1	10.20	6,593,088.78	89.2%	942.37
54-014	54-013	P-56593			970.9	0.0092	8.91	5,755,856	941.65	940.90	954.00	0.20%	24.00	378.9	10.08	6,515,998.96	88.3%	943.22
54-015	54-014	P-56594	Area 5, 6, & 17	124.3	970.9	0.0092	8.91	5,755,856	943.24	941.85	956.00	0.34%	21.00	407.9	9.26	5,988,049.02	96.1%	944.74
54-016	54-015	P-56595			846.6	0.0090	7.61	4,917,139	945.84	943.44	960.37	0.60%	21.00	400.0	12.29	7,945,574.63	61.9%	946.86
54-017	54-016	P-56596			846.6	0.0090	7.61	4,917,139	947.00	946.04	962.46	0.24%	21.00	400.0	7.77	5,025,034.19	97.9%	948.54
47-068	54-017	P-56597			846.6	0.0090	7.61	4,917,139	948.00	947.20	963.00	0.35%	21.00	230.0	9.36	6,049,637.41	81.3%	949.27
47-069	47-068	P-56598			846.6	0.0090	7.61	4,917,139	949.00	948.20	964.00	0.35%	21.00	230.0	9.36	6,049,242.89	81.3%	950.23
47-023	47-069	P-56599	Area 8	21.7	846.6	0.0090	7.61	4,917,139	950.00	949.20	963.77	0.37%	21.00	218.8	9.60	6,202,263.87	79.3%	951.24
47-022	47-023	P-56546	Area 9	23.5	824.9	0.0090	7.41	4,788,625	956.68	955.43	964.50	0.35%	21.00	357.0	9.39	6,069,595.19	78.9%	957.92
47-021	47-022	P-56545	Area 7	60.5	801.4	0.0089	7.13	4,609,807	958.05	956.88	966.50	0.35%	21.00	334.4	9.39	6,067,616.27	76.0%	959.26
47-020	47-021	P-56544			740.9	0.0090	6.65	4,296,998	959.35	958.25	968.00	0.35%	21.00	313.3	9.40	6,078,404.97	70.7%	960.46
47-019	47-020	P-56543	Area 1, 2, & 3	535.2	740.9	0.0090	6.65	4,296,998	960.95	959.55	970.00	0.35%	21.00	400.0	9.39	6,068,381.15	70.8%	962.09
Future	47-019	Future	Development Area and Area 4	205.7	205.7	0.0094	1.94	1,256,211	964.20	961.40	Future	0.70%	15.00	400.0	5.41	3,498,751.41	35.9%	

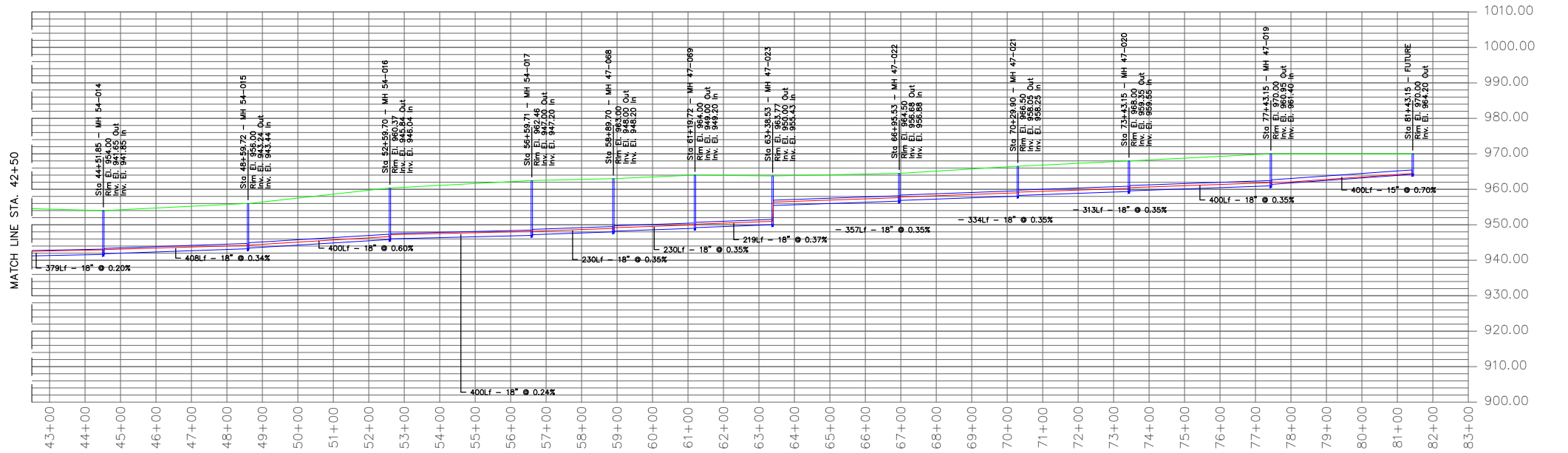
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## **APPENDIX E**

### Sanitary Sewer Upsizing Hydraulic Grade Line



MATCH LINE STA. 42+50



MATCH LINE STA. 42+50

**LEGEND**  
 --- APPROXIMATE GROUND ELEVATION  
 --- EXISTING PIPES AND MANHOLES  
 --- HYDRAULIC GRADE LINE (HGL)

BIG CREEK INTERCEPTOR IMPROVEMENTS  
 PROPOSED CONDITIONS

SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4  
 SANITARY SEWER CAPACITY ANALYSIS

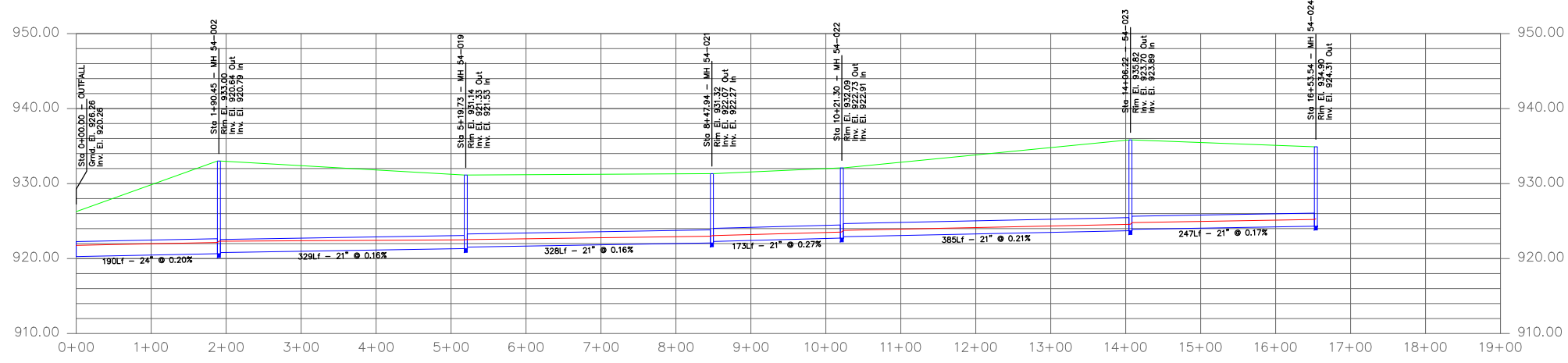
LEE'S SUMMIT, MISSOURI

2020

drawn by: NMG  
 checked by:  
 approved by:  
 QA/QC by:  
 project no.: 020-0103  
 drawing no.:  
 date: 08.17.20

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

Olsson - Civil Engineering  
 Missouri Certificate of Authority # 001592  
 1301 Burlington Street  
 North Kansas City, MO 64116  
 TEL 816.361.1177  
 www.olson.com



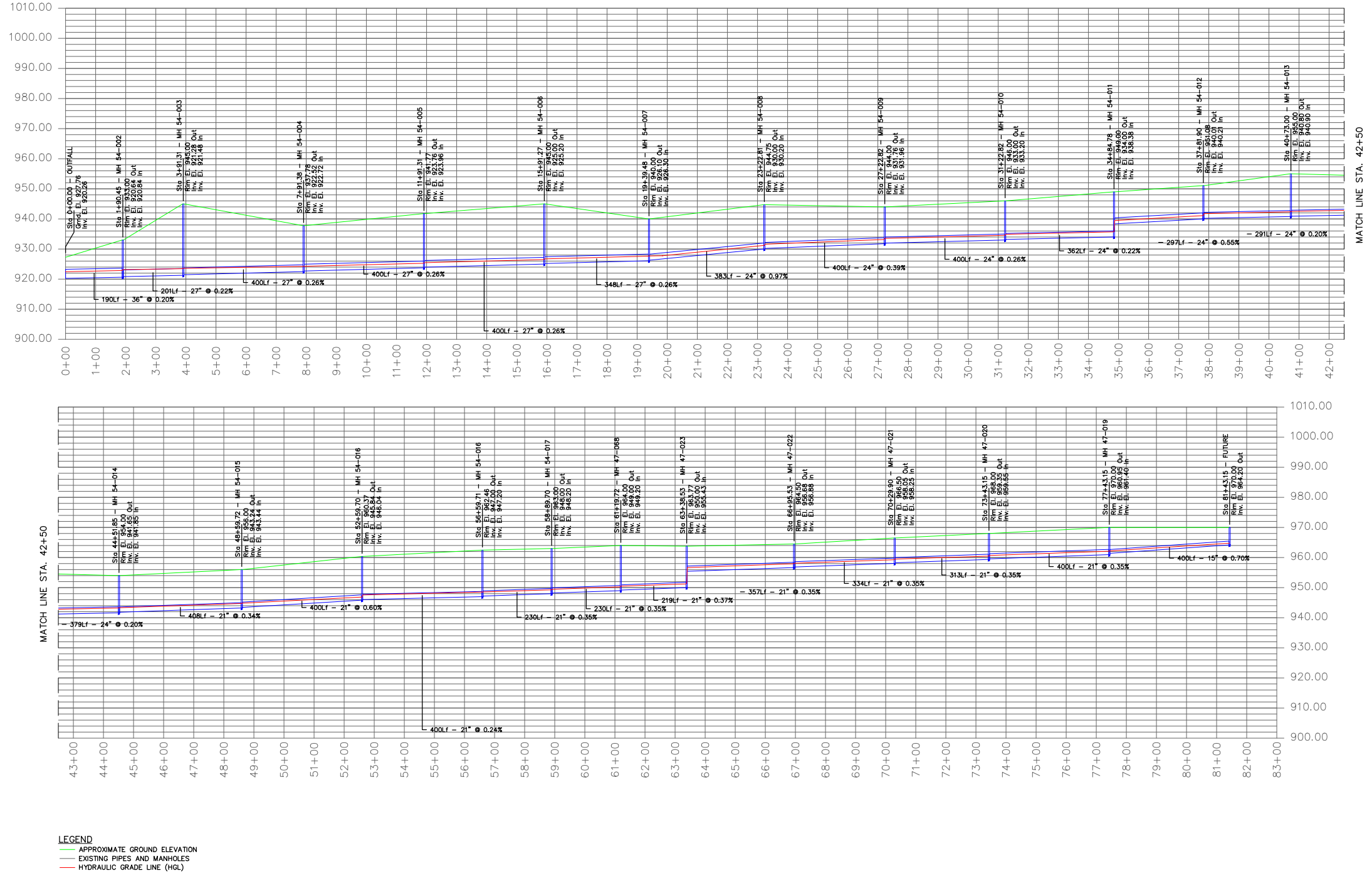
**LEGEND**  
 — APPROXIMATE GROUND ELEVATION  
 — EXISTING PIPES AND MANHOLES  
 — HYDRAULIC GRADE LINE (HGL)

**BIG CREEK BUSINESS SEWER IMPROVEMENTS  
 PROPOSED CONDITIONS**  
 SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4  
 SANITARY SEWER CAPACITY ANALYSIS  
 LEE'S SUMMIT, MISSOURI

drawn by: NMG  
 checked by:  
 approved by:  
 QA/QC by:  
 project no.: 020-0103  
 drawing no.:  
 date: 08.17.20

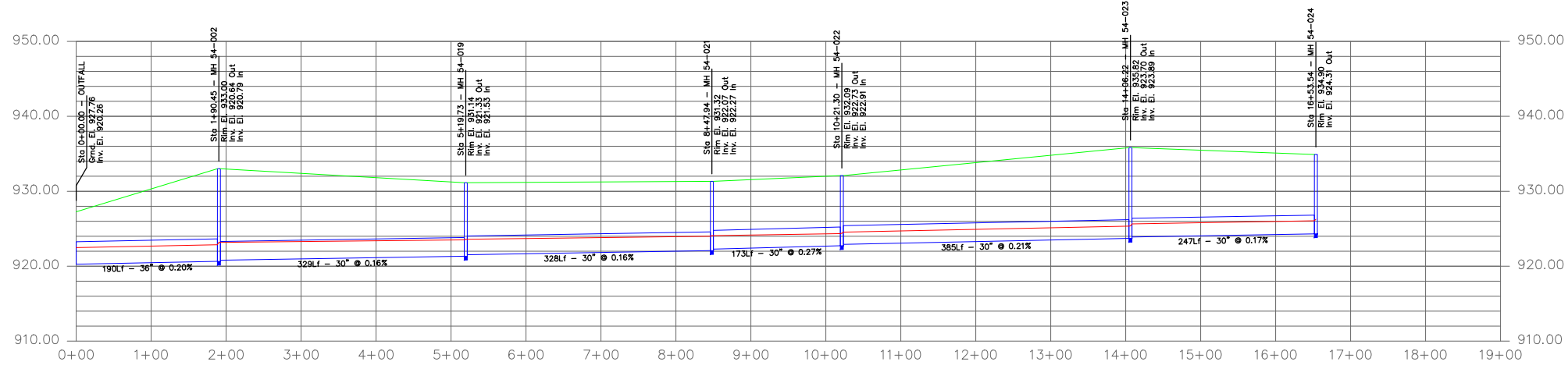
REV. NO.	DATE	REVISIONS DESCRIPTION	BY

**REVISIONS**

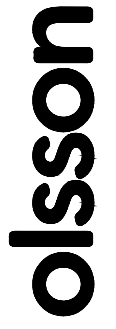


REV. NO.	DATE	REVISIONS DESCRIPTION	BY





**LEGEND**  
 — APPROXIMATE GROUND ELEVATION  
 — EXISTING PIPES AND MANHOLES  
 — HYDRAULIC GRADE LINE (HGL)

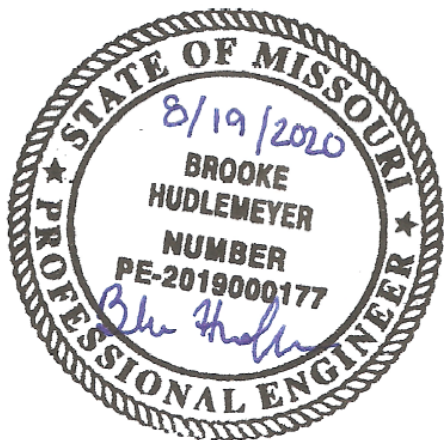


Olsson - Civil Engineering  
 Missouri Certificate of Authority # 001592  
 1301 Burlington Street  
 North Kansas City, MO 64116  
 TEL 816.361.1177 www.olsosn.com

REV. NO.	DATE	REVISIONS DESCRIPTION	BY

**BIG CREEK BUSINESS SEWER IMPROVEMENTS**  
**ULTIMATE BUILD-OUT CONDITIONS**  
**SCHOOL DISTRICT R-7 MIDDLE SCHOOL 4**  
**SANITARY SEWER CAPACITY ANALYSIS**  
 LEE'S SUMMIT, MISSOURI

drawn by: NMG  
 checked by: \_\_\_\_\_  
 approved by: \_\_\_\_\_  
 QA/QC by: \_\_\_\_\_  
 project no.: 020-0103  
 drawing no.: \_\_\_\_\_  
 date: 08.17.20



# **SANITARY SEWER CAPACITY ANALYSIS: MIDDLE SCHOOL 4**

Lee's Summit, Missouri - 2020

August 2020

Olsson Project No. 020-0103