SANITARY SEWER CAPACITY ANALYSIS: PERGOLA PARK DEVELOPMENT

Prepared for:

NLV Pergola Park, LLC

DRAFT

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Olsson Project No. 019-2074

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1. BACKGROUND

The proposed development is located on undeveloped land west of Old Longview Lake (Appendix A) in Lee's Summit, Missouri (City). The site will consist of approximately 20 acres of single-family residential properties. A capacity analysis was performed on the portion of the City's existing sanitary sewer downstream of the proposed development under both existing conditions and full build-out conditions. The purpose of the analyses is to determine if the existing downstream sanitary sewer can accommodate the anticipated future flows following completion of the proposed residential development.

The proposed development is in the Mouse Creek watershed. It will tie into the existing sanitary sewer at Manhole (MH) #42-005 and flow through approximately 1,760 linear feet of existing main to MH #42-083 (Appendix A). Based on the city's as-built plans, the existing main is constructed of 12" PVC pipe and was built in the mid-1980s. There are no services on this section of sewer main.

The outfall location was chosen because it is the end of the City-owned sewer main. At MH #42-083 the City's public main ends and transitions to the Little Blue Valley Sewer District (LBVSD) collection system. The sewer main downstream of MH #42-083 is approximately 570 linear feet of 12" DIP. This section of main ties into a 42-inch RCP main owned by LBVSD under Longview Lake.

Flows from existing developments are conveyed to MH #42-005 through sewer main north and east of Old Longview Lake. Collectively, these areas comprise Basin A (Appendix A). Undeveloped land exists within Basin A. Flows from future developments in this basin would be conveyed to MH #42-005 through the existing sewer main north and east of the lake.

Flows from the proposed development would flow to MH #42-005 through sewer main installed west and south of the lake. The proposed development will be the only contributing source to this sewer main. Accordingly, the area within the proposed development comprises Basin B (Appendix A).

2. METHODOLOGY

Design flows for the existing and proposed developments were calculated per Section 6501 of the City of Lee's Summit's, Missouri Design Criteria (2016). The existing development consists of single-family residential properties (117 acres), an elementary school (8.6 acres), a vacant commercial property (11.5 acres), and a park (7.5 acres). The K Vale Method, as described in Section 6501.C.1 of the design criteria, was used to estimate the design flow rate for the residential development. As directed in the design criteria, a K value of 0.006 was used in the calculations. Due to the size of the existing park, the K Value Method was also used to estimate its design flow rate. The EDU Method, as described in Section 6501.C.2 of the design criteria, was used to estimate the design flow rate for the remaining non-residential developments.

Under full build-out conditions, the sewershed will include additional single-family residential properties in the proposed development (20 acres), in an undeveloped area at the corner of SW Longview Blvd and SW Longview Rd (11.4 acres), and in an undeveloped area north of the lake (14.6 acres). The proposed development is not currently sewered. Approximately 4.9 acres of the undeveloped area north of the lake is proposed park land. The K Value Method was used to estimate design flow rates for each of these properties. All remaining undeveloped land in the sewershed is owned by the United States Army Corp of Engineers and it is assumed that it will not be developed.

3. ANALYSIS

All information used for the existing sanitary sewer system was taken from the City's GIS maps and as-built plans. Existing and ultimate sub-basin boundaries were determined using the current sanitary sewer layout and Jackson County, MO parcel maps. Sub-basin areas for each condition are shown on the maps in Appendix A.

For the analysis, flows were assigned based on drainage area and design flow rates based on the city's design criteria. Manning's equation was used to determine current pipe flow capacities. Per the City's design criteria, the Manning's n roughness coefficient is 0.014 for PVC pipe. The calculations and results of the analyses are shown in Appendix B.

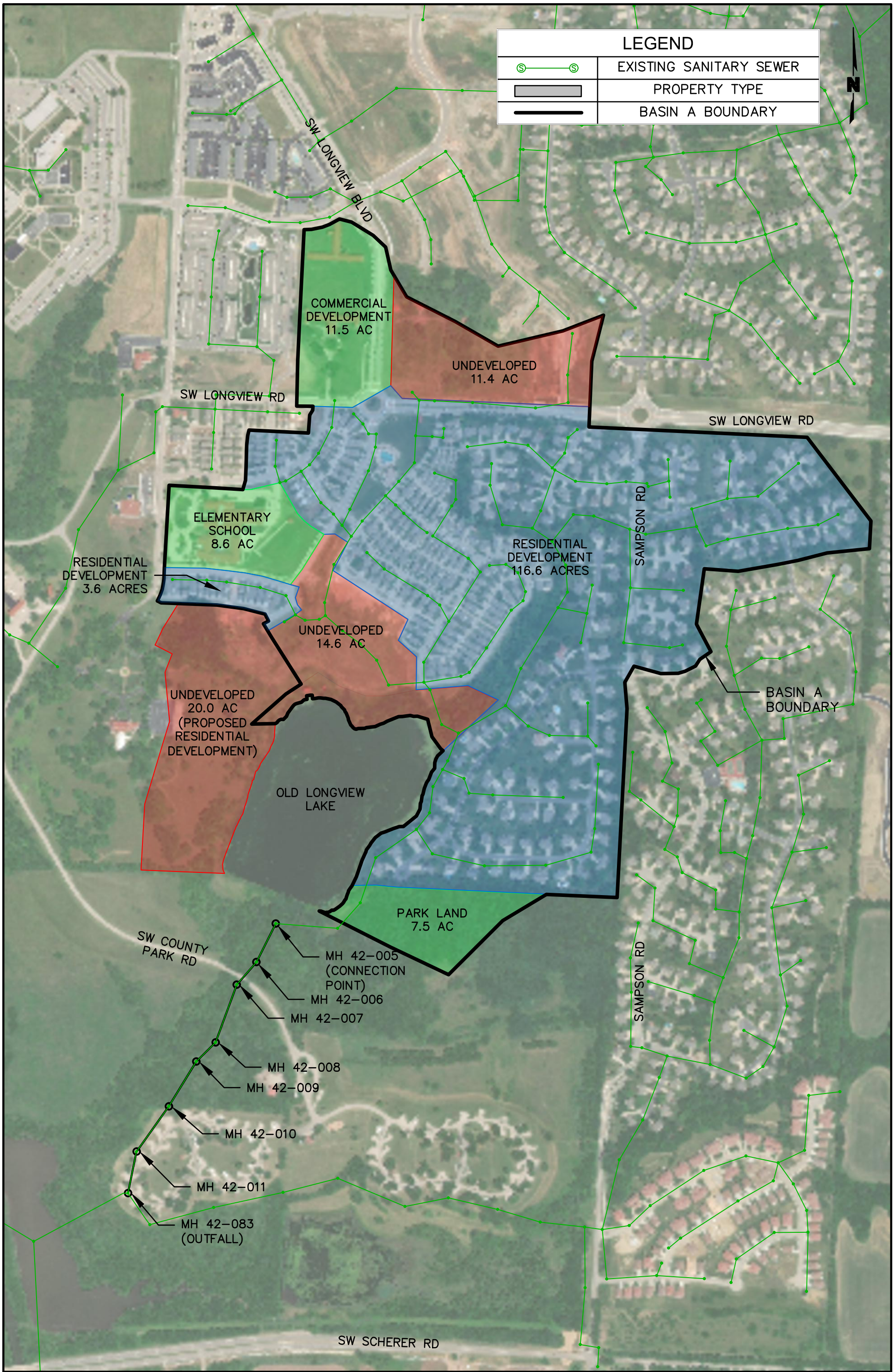
Hydraulic Grade Lines (HGL) were also calculated for each analysis using a flow modeling extension in AutoCAD Civil 3D. For the model, it was assumed that the flow at the downstream end of the existing sewer main discharges to open air. A line is considered inadequate if the HGL elevation is higher than the top of pipe elevation, per Section 6501.D.2.a of the design criteria. The HGL models for both existing and full-build out conditions are shown in Appendix C.

4. RESULTS

[TO BE COMPLETED]

APPENDIX A

Capacity Analysis Existing and Full Build-out Layouts



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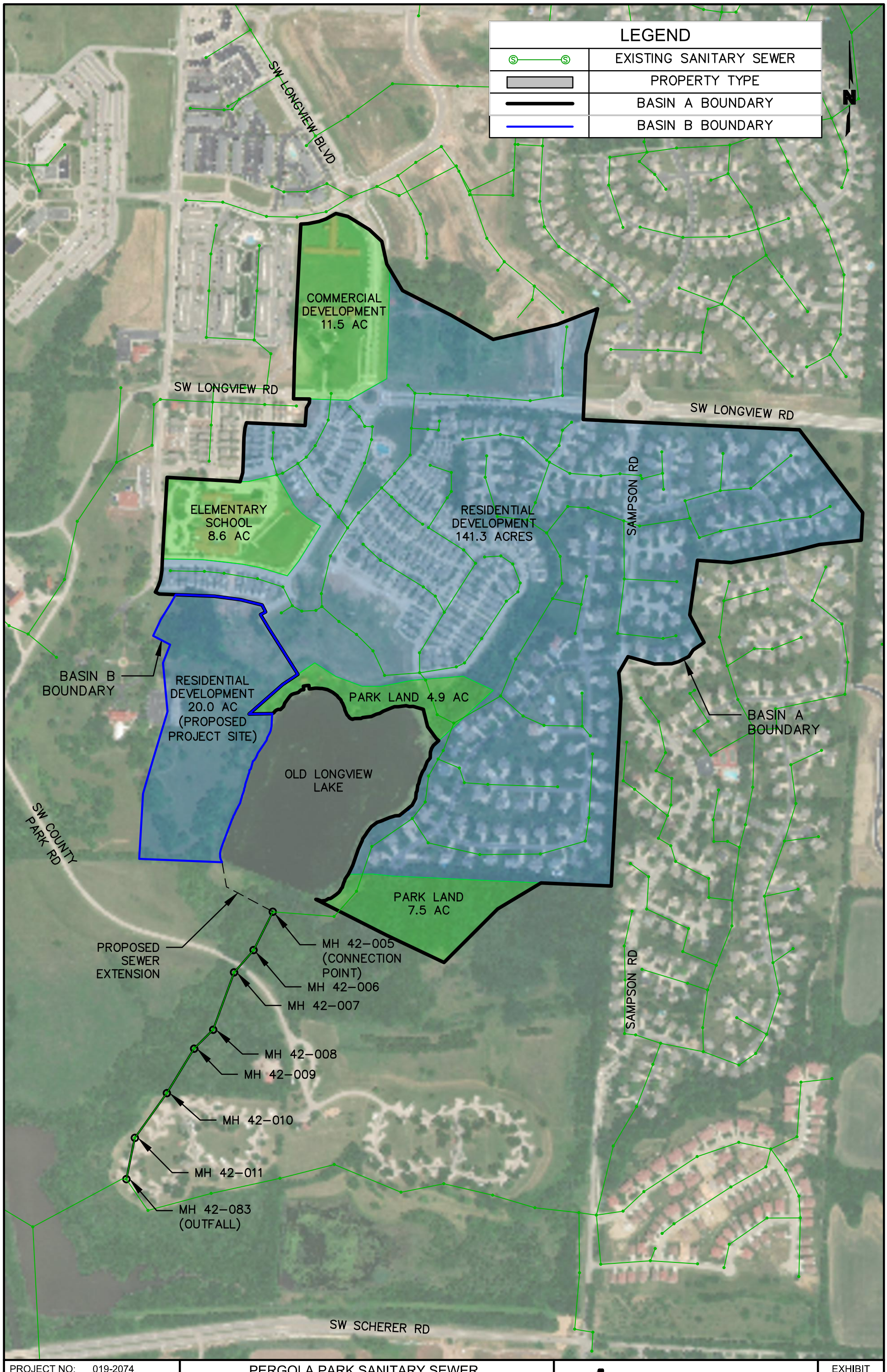

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APPENDIX B

Sanitary Sewer Capacity Analysis Results
for Existing and Full Build-Out Conditions

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APPENDIX B - SANITARY SEWER CAPACITY ANALYSIS RESULTS FOR EXISTING AND FULL BUILD-OUT CONDITIONS

EXISTING CONDITIONS

Existing Basin A Flows

Sub-Basin	Drainage Area (acre)	Design Flow Rate (cfs/acre)	Design Flow Rate (cfs)	Design Flow Rate (gpd)
Basin A Existing Commercial	11.5	0.0160	0.18	118,867
Basin A Existing School	8.6	0.0195	0.17	108,577
Basin A Existing Residential and Non-Residential < 8 acres	128.1	0.0223	2.85	1,843,860
Total Flow to MH 42-005	**148.2**	**0.0578**	**3.20**	**2,071,304**

Existing Hydraulic Conditions

US MH	DS MH	Pipe No.	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 MH HGL Elev.
MH 42-011	Outfall	P-49569	900.82	900.30	907.00	0.22%	12	238.4	1.67	1,077,174	192.3%	903.57
MH 42-010	MH 42-011	P-49568	901.60	900.87	910.00	0.23%	12	312.9	1.72	1,114,028	185.9%	906.62
MH 42-009	MH 42-010	P-49567	902.37	901.65	913.00	0.24%	12	296.5	1.76	1,136,557	182.2%	909.44
MH 42-008	MH 42-009	P-49566	902.79	902.42	908.00	0.24%	12	152.8	1.76	1,134,950	182.5%	910.94
MH 42-007	MH 42-008	P-49565	903.73	902.89	912.00	0.24%	12	346.8	1.76	1,135,109	182.5%	914.31
MH 42-006	MH 42-007	P-49564	904.19	903.78	912.00	0.24%	12	168.3	1.76	1,138,380	182.0%	915.99
MH 42-005	MH 42-006	P-49563	904.86	904.29	916.50	0.23%	12	242.8	1.73	1,117,508	185.4%	918.34

FULL BUILD-OUT CONDITIONS

Full Build-Out Basin A and B Flows

Sub-Basin	Drainage Area (acre)	Design Flow Rate (cfs/acre)	Design Flow Rate (cfs)	Design Flow Rate (gpd)
Basin A Existing Commercial	11.5	0.0160	0.18	118,867
Basin A Existing School	8.6	0.0195	0.17	108,577
Basin A Ex. + Full Build-Out Residential and Non-Residential <8 acres	153.4	0.0219	3.36	2,169,955
Basin B Proposed Residential	20	0.0295	0.59	381,775
Total Flow to MH 42-005	**173.5**	**0.0869**	**4.30**	**2,779,174**

Full Build-Out Hydraulic Conditions

US MH	DS MH	Pipe No.	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 MH HGL Elev.
MH 42-011	Outfall	P-49569	900.82	900.30	907.00	0.22%	12	238.4	1.67	1,077,174	258.0%	905.10
MH 42-010	MH 42-011	P-49568	901.60	900.87	910.00	0.23%	12	312.9	1.72	1,114,028	249.5%	910.61
MH 42-009	MH 42-010	P-49567	902.37	901.65	913.00	0.24%	12	296.5	1.76	1,136,557	244.5%	915.69
MH 42-008	MH 42-009	P-49566	902.79	902.42	908.00	0.24%	12	152.8	1.76	1,134,950	244.9%	918.40
MH 42-007	MH 42-008	P-49565	903.73	902.89	912.00	0.24%	12	346.8	1.76	1,135,109	244.8%	924.49
MH 42-006	MH 42-007	P-49564	904.19	903.78	912.00	0.24%	12	168.3	1.76	1,138,380	244.1%	927.53
MH 42-005	MH 42-006	P-49563	904.86	904.29	916.50	0.23%	12	242.8	1.73	1,117,508	248.7%	931.78

=HGL elevation above top of pipe elevation

EXISTING BASIN A FLOWS CALCULATIONS

Existing Vacant Commercial Building

Flow Estimation Method:	EDU Method	
Land Area =	11.5	acres
EDU =	3	per acre
Peak Base Flow =	10,350	gpd
	0.0014	cfs/acre
Peak I/I Flow =	0.0146	cfs/acre
Peak Flow (Design Flow) =	**0.0160**	**cfs/acre**

Existing Elementary School

Flow Estimation Method:	EDU Method	
Land Area =	8.6	acres
Building Size =	70	1,000 sf
No. of Stories =	1.5	
EDU =	0.8	per 1,000 sf
Peak Base Flow =	25,200	gpd
	0.0045	cfs/acre
Peak I/I Flow =	0.0150	cfs/acre
Peak Flow (Design Flow) =	**0.0195**	**cfs/acre**

Existing Residential Properties and Non-Residential Properties < 8 Acres

Flow Estimation Method:	K Value Method	
Land Area =	128.1	acres
Peak Base Flow =	1,500	gpd/acre
	0.0023	cfs/acre
Peak Infiltration =	500	gpd/acre
	0.0008	cfs/acre
Inflow Factor (K) =	0.006	
Time of Concentration =	63	min
Design Year =	50	yr
Rainfall Intensity (i) =	3.20	in/hr
Peak Inflow =	0.0192	cfs/acre
Peak Flow (Design Flow) =	**0.0223**	**cfs/acre**

EXISTING BASIN A PEAK FLOW =	**0.0578**	**cfs/acre**

FULL BUILD-OUT BASIN A FLOW CALCULATIONS

Existing Vacant Commercial Building

Flow Estimation Method:	EDU Method	
Land Area =	11.5	acres
EDU =	3	per acre
Peak Base Flow =	10,350	gpd
	0.0014	cfs/acre
Peak I/I Flow =	0.0146	cfs/acre
Peak Flow (Design Flow) =	**0.0160**	**cfs/acre**

Existing Elementary School

Flow Estimation Method:	EDU Method	
Land Area =	8.6	acres
Building Size =	70	1,000 sf
No. of Stories =	1.5	
EDU =	0.8	per 1,000 sf
Peak Base Flow =	25,200	gpd
	0.0045	cfs/acre
Peak I/I Flow =	0.0150	cfs/acre
Peak Flow (Design Flow) =	**0.0195**	**cfs/acre**

Full Build-Out Residential Properties and Non-Residential Properties < 8 Acres

Flow Estimation Method:	K Value Method	
Land Area =	153.4	acres
Peak Base Flow =	1,500	gpd/acre
	0.0023	cfs/acre
Peak Infiltration =	500	gpd/acre
	0.0008	cfs/acre
Inflow Factor (K) =	0.006	
Time of Concentration =	66	min
Design Year =	50	yr
Rainfall Intensity (i) =	3.13	in/hr
Peak Inflow =	0.0188	cfs/acre
Peak Flow (Design Flow) =	**0.0219**	**cfs/acre**

FULL BUILD-OUT BASIN A PEAK FLOW =	**0.0574**	**cfs/acre**

FULL BUILD-OUT BASIN B FLOW CALCULATIONS

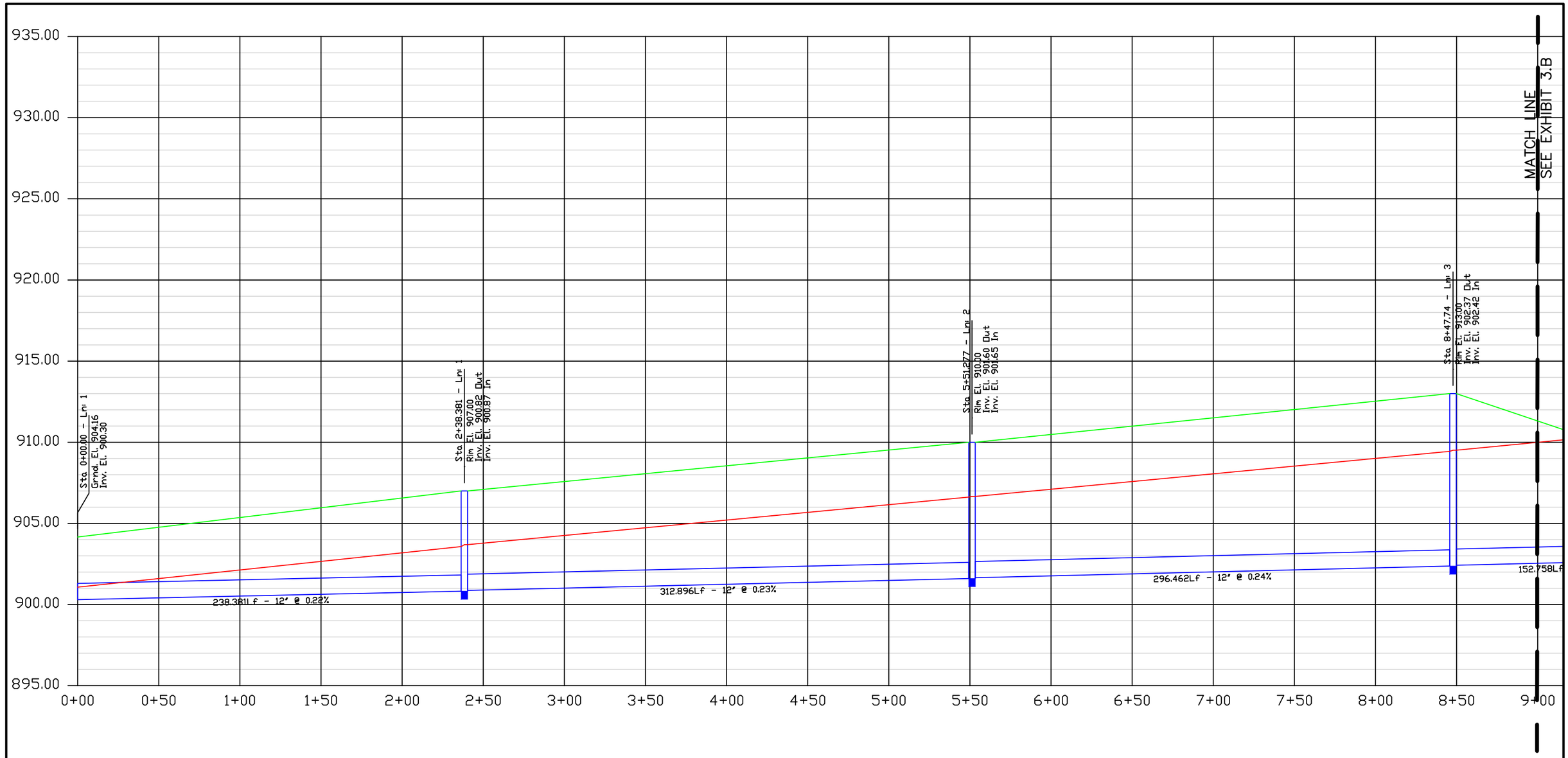
Full Build-Out Residential Properties

Flow Estimation Method:	K Value Method	
Land Area =	20	acres
Peak Base Flow =	1,500	gpd/acre
	0.0023	cfs/acre
Peak Infiltration =	500	gpd/acre
	0.0008	cfs/acre
Inflow Factor (K) =	0.006	
Time of Concentration =	40	min
Design Year =	50	yr
Rainfall Intensity (i) =	4.41	in/hr
Peak Inflow =	0.0264	cfs/acre

FULL BUILD-OUT BASIN B PEAK FLOW =	**0.0295**	**cfs/acre**

APPENDIX C

Hydraulic Grade Line Models
for Existing and Full Build-Out Conditions



LEGEND

- APPROX. GROUND ELEV.
- EXIST. PIPES AND MANHOLES
- HYDRAULIC GRADE LINE (HGL)

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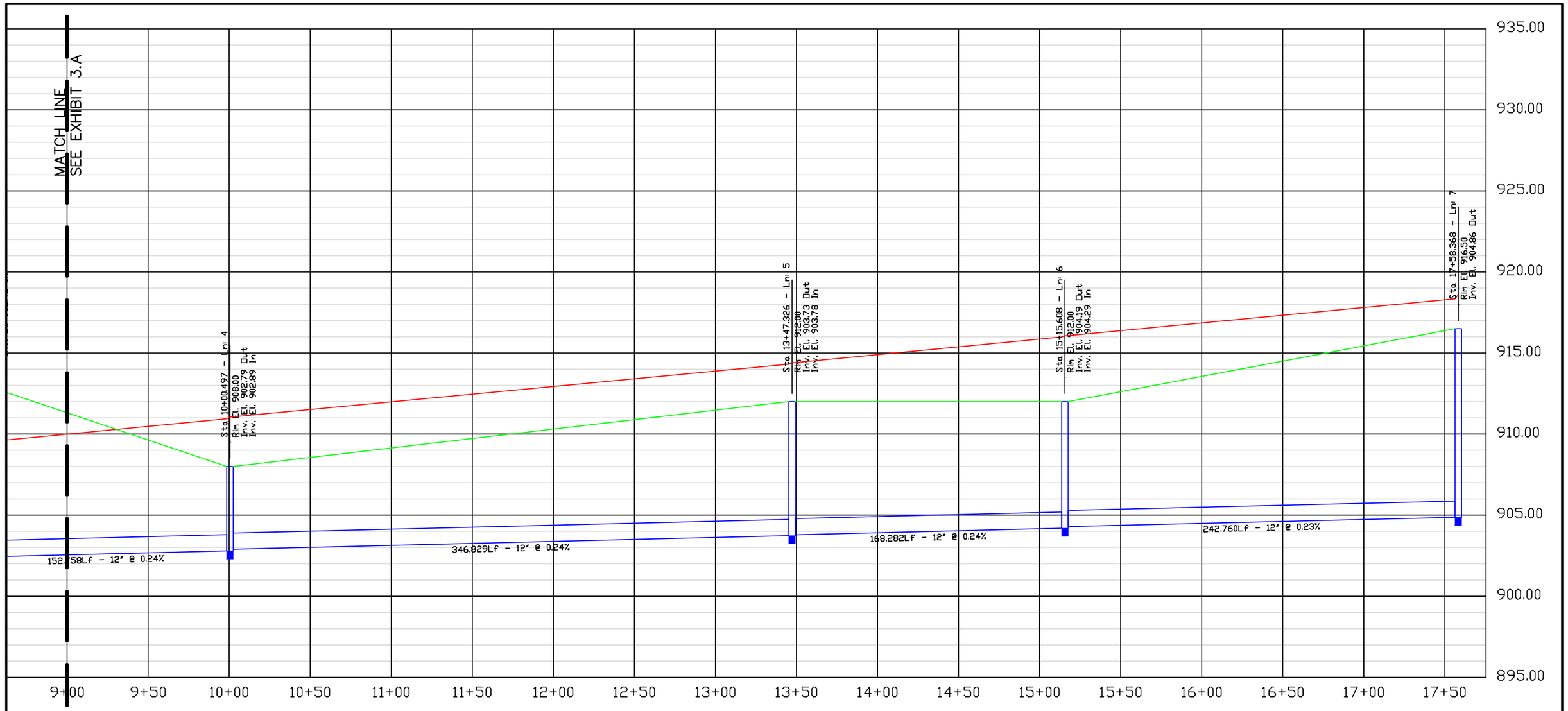
3.A



LEGEND

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- HYDRAULIC GRADE LINE (HGL)

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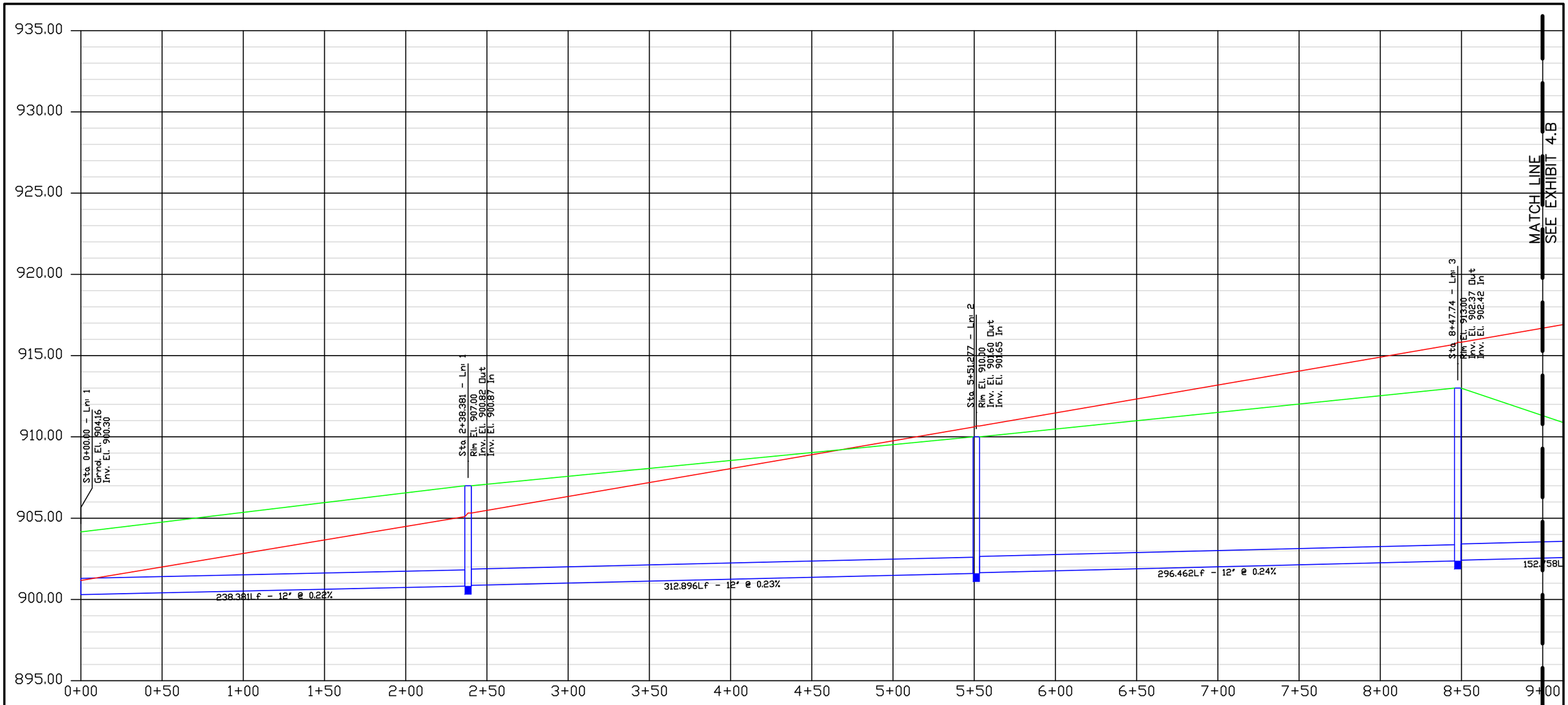

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- APPROX. GROUND ELEV.
- EXIST. PIPES AND MANHOLES
- HYDRAULIC GRADE LINE (HGL)

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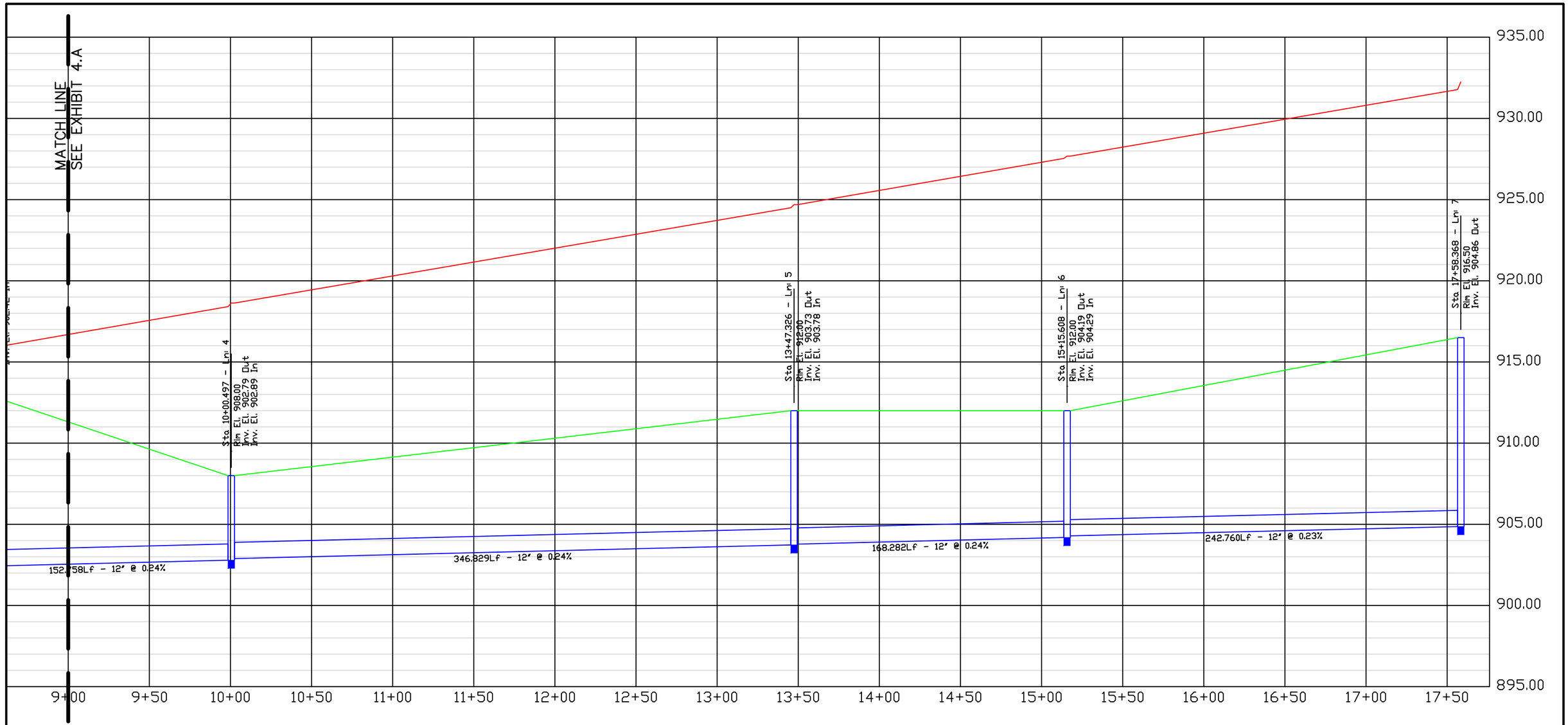
4.A



LEGEND

- APPROX. GROUND ELEV.
- EXIST. PIPES AND MANHOLES
- HYDRAULIC GRADE LINE (HGL)

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EXHIBIT
4.B

SANITARY SEWER CAPACITY ANALYSIS: PERGOLA PARK DEVELOPMENT

Lee’s Summit, Missouri - 2019

July 2019

Olsson Project No. 019-2074