

APPENDIX K – Drainage Study

Storm Drainage Study

For

Project 65

Sacramento, California

Prepared for:

Capital Station 65, LLC

Prepared by:

Nolte Associates, Inc.
2495 Natomas Park Drive, Fourth Floor
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September 2006

Introduction

Project 65 is an approximately 65-acre commercial development located north of Richards Boulevard between 5th Street and 7th Street and south of the American River. The site is located in Drainage Basin 111 next to the Sump 111 pump station for the shed. Topography of the site slopes gradually from the American River levee down to Richards Boulevard. The existing City drainage system around the project conveys drainage south on 7th Street to Richards Boulevard, west to 5th Street and north on 5th to the Pump Station. Drainage from the site will be conveyed through a piping system and connect to the existing City system at multiple connection points within 5th Street, 7th Street and Richards Boulevard. A map of the on-site system and the area to be connected is attached in Appendix A.

Calculations and analysis are prepared in accordance with the requirements of the City of Sacramento Department of Utilities Section 11 – Storm Drainage Design Standards (Section 11) dated August 30, 2000 from the City’s website.

Site Drainage System

The City of Sacramento has not prepared a Master Drainage Plan for Basin 111, so information on the existing system is minimal. Per direction by the Department of Utilities, the hydraulic grade line (HGL) for the existing system was assumed to be 6-inches higher than the existing gutter flow line. Since the slope of the existing piping system is adverse to the slope of street grades in the area, the lowest gutter adjacent to the site (at the intersection of 5th Street and Richards Boulevard) was used as a basis for the starting HGL elevation of 18.69.

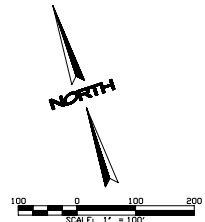
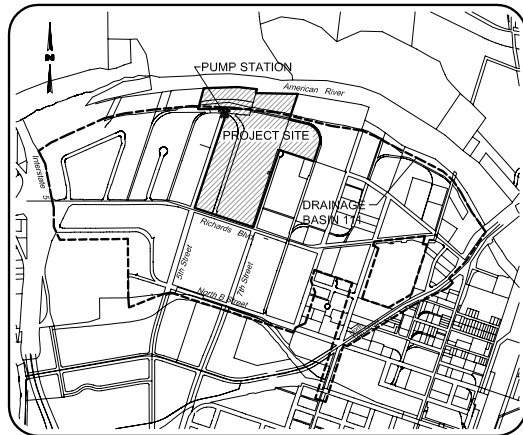
The StormCAD software program was used to model the onsite drainage system for the proposed project improvements. Design flows were calculated using 0.5 cfs per acre per section 11.732 of the City Design Standards. The on-site system is shown on the map attached in Appendix B. Results of the StormCAD model including flows and HGL’s are attached in Appendix C.

Onsite Storage

A majority of the project site currently consists of impervious surfaces such as buildings and pavement. Redevelopment of the site is not expected to significantly impact the existing drainage system since the proposed site plan increases the impervious surface by 5.3 acres across the entire 65 acre site from the existing condition. Based on Figure 11.7.3.2(a) of the City Design Standards, 7,950 cubic feet of storage will be required for the project to mitigate the increased impervious area.. On-site detention in landscape areas, parking lots, pipes or underground vaults will be used to mitigate the additional impervious area for the project. Figure 11.7.3.2(a) and maps of the pervious areas are attached in Appendix D.

APPENDIX A

CONNECTING AREA



PROJECT 65 DRAINAGE STUDY MAP

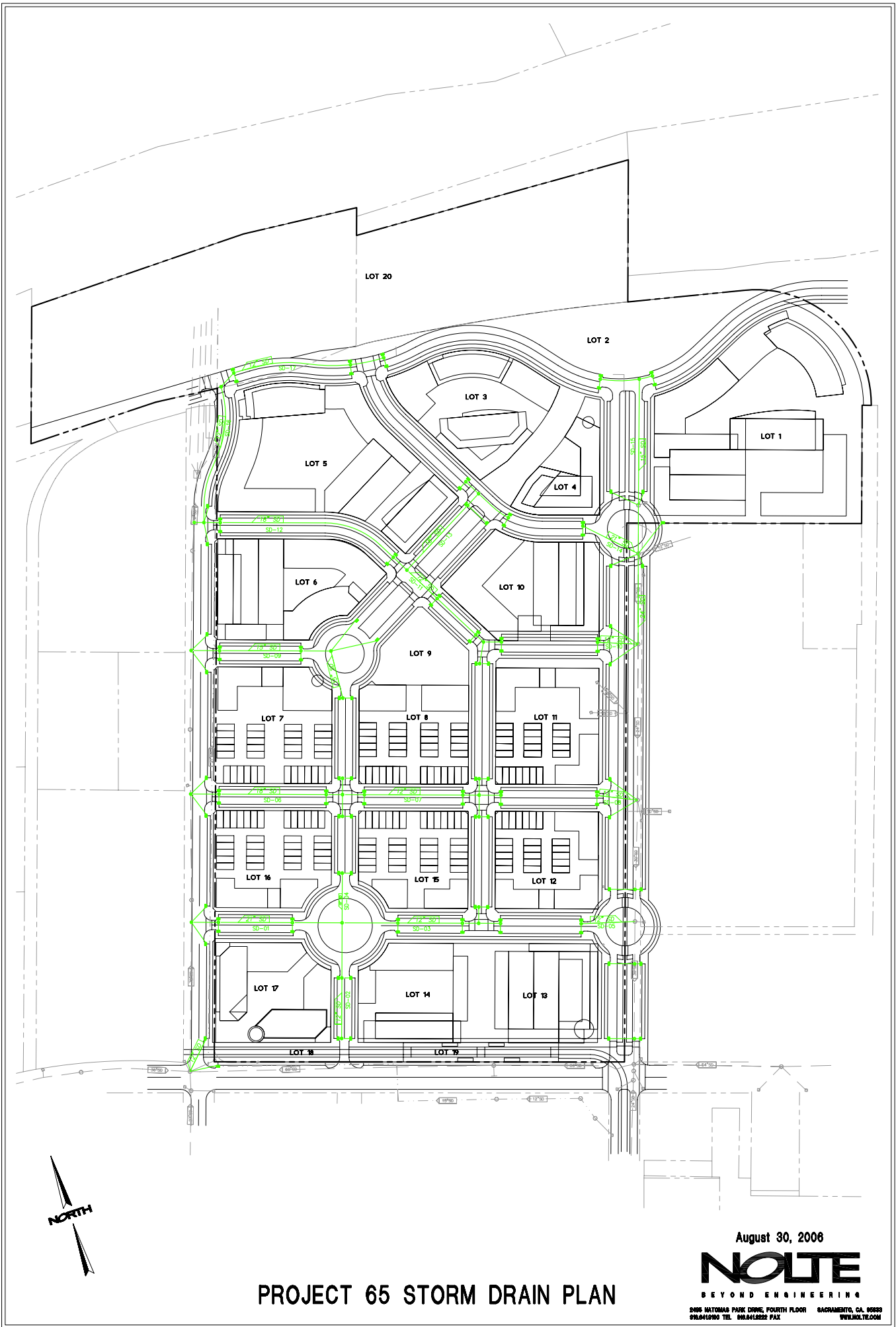
September 8, 2006

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APPENDIX B

ON-SITE SYSTEM



PROJECT 65 STORM DRAIN PLAN

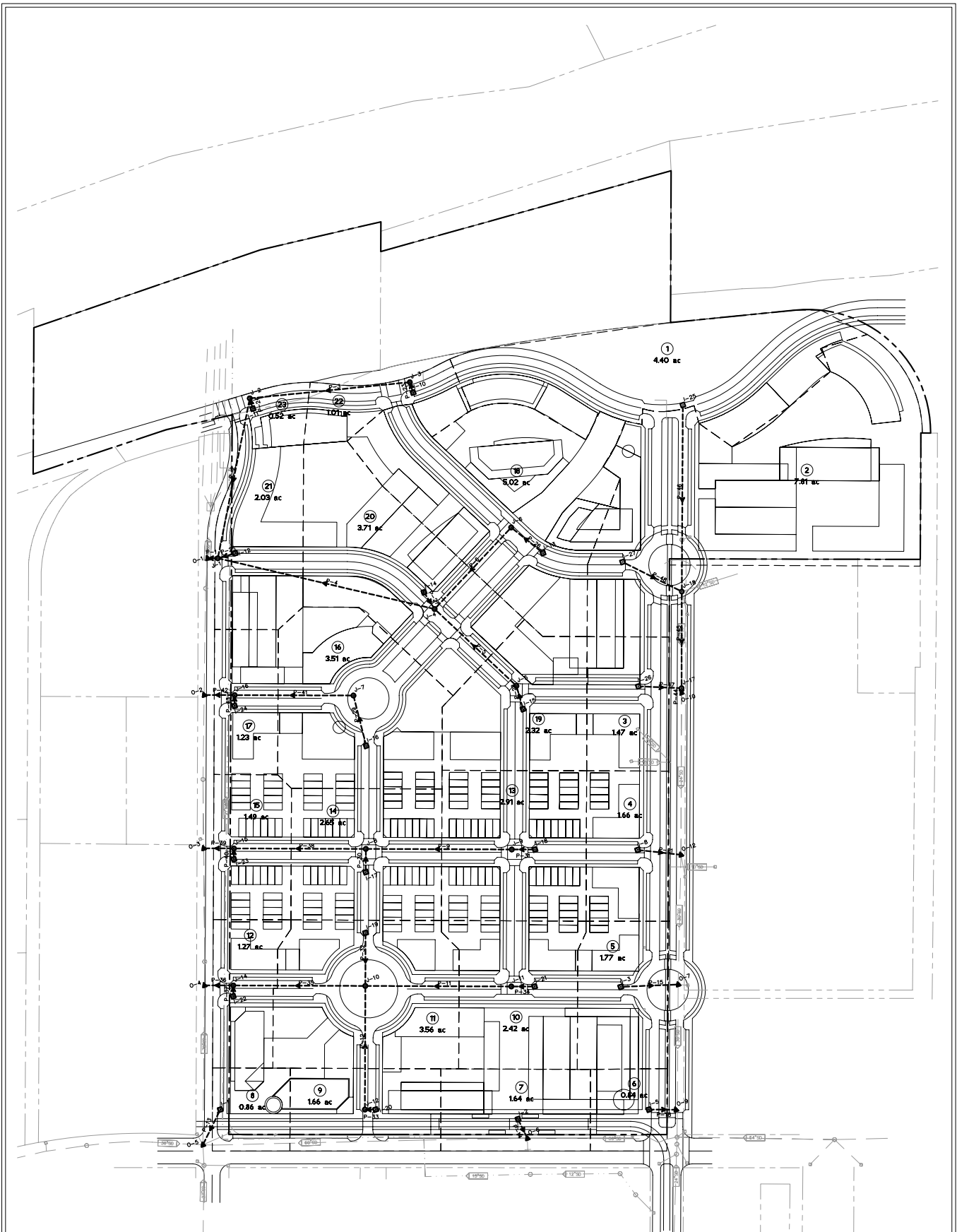
August 30, 2006

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APPENDIX C

DRAINAGE SYSTEM MODELING OUTPUT



100 0 100 200
SCALE: 1" = 100'

PROJECT 65
ON-SITE DRAINAGE SYSTEM

September 9, 2006

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Scenario: Base

Drainage Report

Label	-Node- Upstream Downstream	-Ground- Upstream Downstream (ft)	-Invert- Upstream Downstream (ft)	-Depth- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	Mannings n	Constructed Slope (ft/ft)	Section Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Total System Flow (cfs)
P-13	I-1	19.00	14.69	4.02	18.71	0.015	0.002632	0.40	Circular	95.00	0.51	0.40
	O-5	19.80	14.44	4.25	18.69			1.58	12 inch			
P-14	I-2	23.00	18.00	0.70	18.70	0.015	0.069231	0.40	Circular	52.00	5.37	0.40
	O-6	22.30	14.40	4.29	18.69			8.12	12 inch			
P-15	I-3	20.50	16.66	2.15	18.81	0.015	0.002590	0.90	Circular	139.00	1.15	0.90
	O-7	22.90	16.30	2.39	18.69			1.57	12 inch			
P-18	I-5	22.20	16.17	2.53	18.70	0.015	0.002615	0.40	Circular	65.00	0.51	0.40
	O-9	22.50	16.00	2.69	18.69			1.58	12 inch			
P-21	I-8	21.50	15.76	3.00	18.76	0.015	0.002571	0.80	Circular	105.00	1.02	0.80
	O-12	23.20	15.49	3.20	18.69			1.57	12 inch			
P-1	J-1	25.00	11.75	7.10	18.85	0.015	0.010000	7.30	Circular	25.00	4.13	7.30
	O-1	25.00	11.50	7.19	18.69			9.10	18 inch			
P-2	J-2	40.00	31.00	0.37	31.37	0.015	0.032917	0.80	Circular	408.00	5.06	0.80
	J-1	25.00	17.57	1.28	18.85			5.60	12 inch			
P-3	J-3	39.00	33.93	0.29	34.22	0.015	0.007474	0.50	Circular	392.00	2.60	0.50
	J-2	40.00	31.00	0.37	31.37			2.67	12 inch			
P-4	J-4	24.50	17.15	3.76	20.91	0.015	0.009574	5.50	Circular	564.00	3.11	5.50
	J-1	25.00	11.75	7.10	18.85			8.91	18 inch			
P-5	J-5	24.50	18.85	2.40	21.25	0.015	0.002583	1.10	Circular	271.00	1.40	1.10
	J-4	24.50	18.15	2.76	20.91			1.57	12 inch			
P-6	J-6	26.00	19.85	1.24	21.09	0.015	0.001481	2.50	Circular	270.00	2.15	2.50
	J-4	24.50	19.45	1.46	20.91			3.50	18 inch			
P-23	I-10	39.00	34.00	0.37	34.37	0.015	0.002692	0.50	Circular	26.00	1.80	0.50
	J-3	39.00	33.93	0.29	34.22			1.60	12 inch			
P-24	I-11	37.00	32.00	0.23	32.23	0.015	0.038462	0.30	Circular	26.00	4.01	0.30
	J-2	40.00	31.00	0.37	31.37			6.06	12 inch			
P-25	I-12	25.00	20.00	0.42	20.42	0.015	0.055227	1.00	Circular	44.00	6.48	1.00
	J-1	25.00	17.57	1.28	18.85			7.26	12 inch			
P-26	I-13	25.00	20.00	1.16	21.16	0.015	0.001531	2.50	Circular	98.00	2.18	2.50
	J-6	26.00	19.85	1.24	21.09			3.56	18 inch			
P-27	I-14	25.00	20.00	0.97	20.97	0.015	0.001875	1.90	Circular	48.00	2.19	1.90
	J-4	24.50	19.91	1.00	20.91			2.42	15 inch			
P-28	I-15	24.00	19.01	2.32	21.33	0.015	0.002759	1.10	Circular	58.00	1.40	1.10
	J-5	24.50	18.85	2.40	21.25			1.62	12 inch			
P-11	J-11	20.00	15.46	4.08	19.54	0.015	0.002614	1.20	Circular	352.00	1.53	1.20
	J-10	20.00	14.54	4.47	19.01			1.58	12 inch			
P-12	J-12	20.20	15.31	3.90	19.21	0.015	0.002584	0.80	Circular	298.00	1.02	0.80

Scenario: Base

Drainage Report

Label	-Node- Upstream Downstream	-Ground- Upstream Downstream (ft)	-Invert- Upstream Downstream (ft)	-Depth- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	Mannings n	Constructed Slope (ft/ft)	Section Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Total System Flow (cfs)
P-32	J-10	20.00	14.54	4.47	19.01	0.015	0.001953	1.57	12 inch	128.00	1.47	1.80
	I-19	19.50	14.53	4.61	19.14			1.80	Circular			
P-33	J-10	20.00	14.28	4.73	19.01	0.015	0.002692	2.47	15 inch	26.00	1.02	0.80
	I-20	20.20	15.38	3.84	19.22			0.80	Circular			
P-34	J-12	20.20	15.31	3.90	19.21	0.015	0.002500	1.60	12 inch	56.00	1.53	1.20
	I-21	20.00	15.60	4.02	19.62			1.20	Circular			
P-35	J-11	20.00	15.46	4.08	19.54	0.015	0.001254	1.54	12 inch	319.00	1.58	3.80
	J-10	20.00	13.79	5.22	19.01			3.80	Circular			
P-36	J-14	20.00	13.39	5.37	18.76	0.015	0.001159	4.86	21 inch	69.00	1.83	4.40
	J-14	20.00	13.39	5.37	18.76			4.40	Circular			
P-37	O-4	20.00	13.31	5.38	18.69	0.015	0.002692	4.68	21 inch	26.00	0.76	0.60
	I-22	20.00	14.21	4.56	18.77			0.60	Circular			
P-9	J-14	20.00	14.14	4.62	18.76	0.015	0.002614	1.60	12 inch	352.00	1.91	1.50
	J-9	21.00	16.10	3.83	19.93			1.50	Circular			
P-30	J-8	21.00	15.18	3.92	19.10	0.015	0.002679	1.58	12 inch	56.00	1.66	1.30
	I-17	20.50	15.55	3.65	19.20			1.30	Circular			
P-31	J-8	21.00	15.40	3.70	19.10	0.015	0.002679	1.60	12 inch	56.00	1.91	1.50
	I-18	21.00	16.25	3.81	20.06			1.50	Circular			
P-38	J-9	21.00	16.10	3.83	19.93	0.015	0.001509	1.60	12 inch	318.00	1.58	2.80
	J-8	21.00	14.68	4.42	19.10			2.80	Circular			
P-39	J-15	21.00	14.20	4.60	18.80	0.015	0.012877	3.54	18 inch	73.00	1.98	3.50
	J-15	21.00	14.20	4.60	18.80			3.50	Circular			
P-40	O-3	21.40	13.26	5.43	18.69	0.015	0.002692	10.33	18 inch	26.00	0.89	0.70
	I-23	22.00	17.00	1.81	18.81			0.70	Circular			
P-29	J-15	21.00	16.93	1.87	18.80	0.015	0.001920	1.60	12 inch	125.00	1.47	1.80
	I-16	20.70	15.00	4.25	19.25			1.80	Circular			
P-41	J-7	23.50	14.76	4.36	19.12	0.015	0.001916	2.45	15 inch	287.00	1.47	1.80
	J-7	23.50	14.76	4.36	19.12			1.80	Circular			
P-42	J-16	21.00	14.21	4.61	18.82	0.015	0.014521	2.45	15 inch	73.00	1.96	2.40
	J-16	21.00	14.21	4.61	18.82			2.40	Circular			
P-43	O-2	23.00	13.15	5.54	18.69	0.015	0.002692	6.75	15 inch	26.00	0.76	0.60
	I-24	21.00	16.00	2.83	18.83			0.60	Circular			
P-44	J-16	21.00	15.93	2.89	18.82	0.015	0.000909	1.60	12 inch	11.00	2.16	6.80
	J-17	24.80	16.18	2.52	18.70			6.80	Circular			
P-45	O-10	24.80	16.17	2.52	18.69	0.015	0.001030	5.91	24 inch	233.00	1.94	6.10
	J-18	25.90	16.42	2.51	18.93			6.10	Circular			
	J-17	24.80	16.18	2.52	18.70			6.29	24 inch			

Scenario: Base

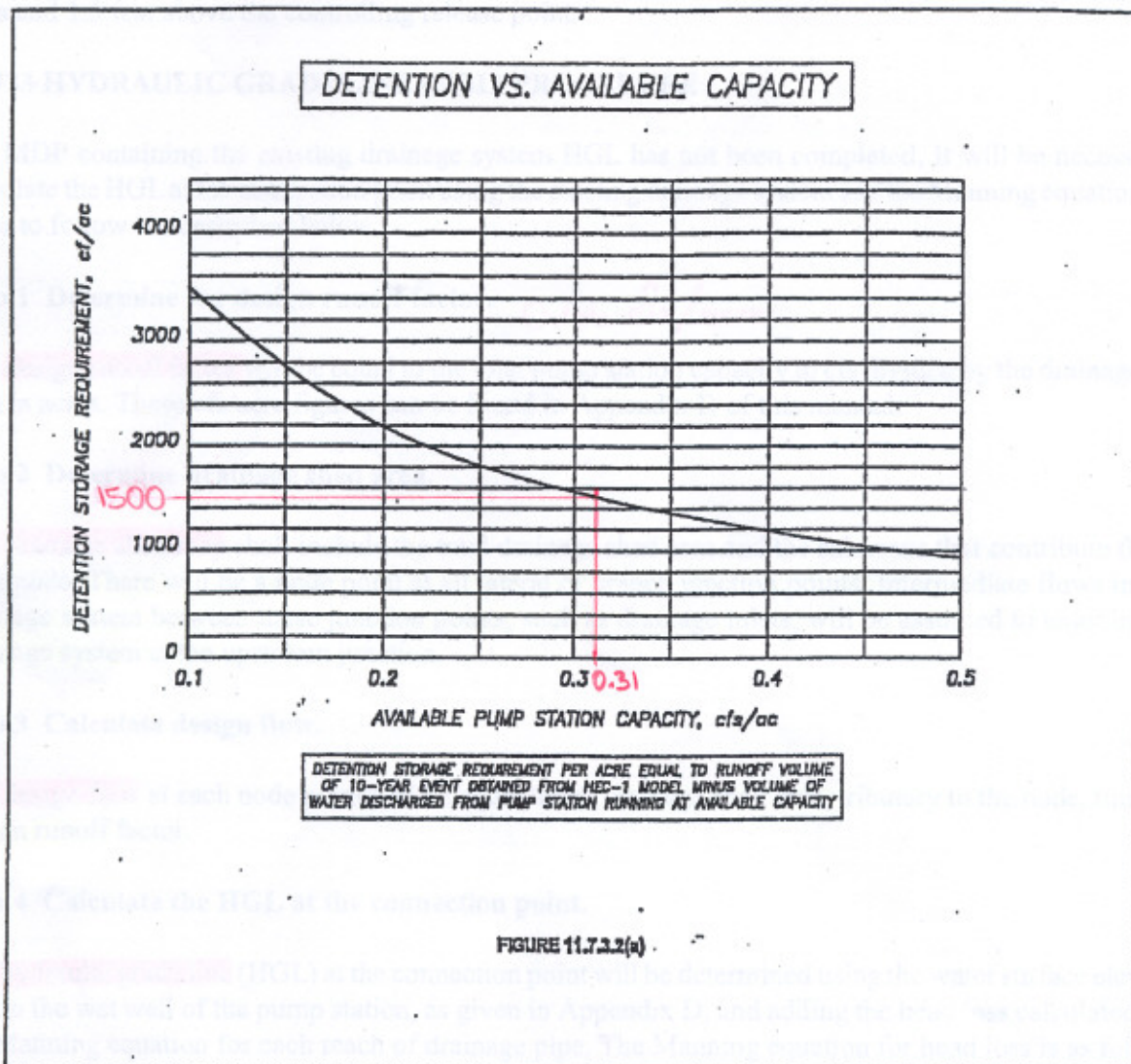
Drainage Report

Label	-Node- Upstream Downstream	-Ground- Upstream Downstream (ft)	-Invert- Upstream Downstream (ft)	-Depth- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	Mannings n	Constructed Slope (ft/ft)	Section Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Total System Flow (cfs)
P-46	I-25	37.00	32.00	0.59	32.59	0.015	0.032956	2.20	Circular	450.00	6.61	2.20
	J-18	25.90	17.17	1.76	18.93			10.16	15 inch			
P-47	I-26	24.30	19.30	0.35	19.65	0.015	0.020190	0.70	Circular	105.00	4.09	0.70
	J-17	24.80	17.18	1.52	18.70			4.39	12 inch			
P-48	I-27	25.30	20.30	0.72	21.02	0.015	0.022687	3.90	Circular	160.00	6.60	3.90
	J-18	25.90	16.67	2.26	18.93			20.68	21 inch			

APPENDIX D

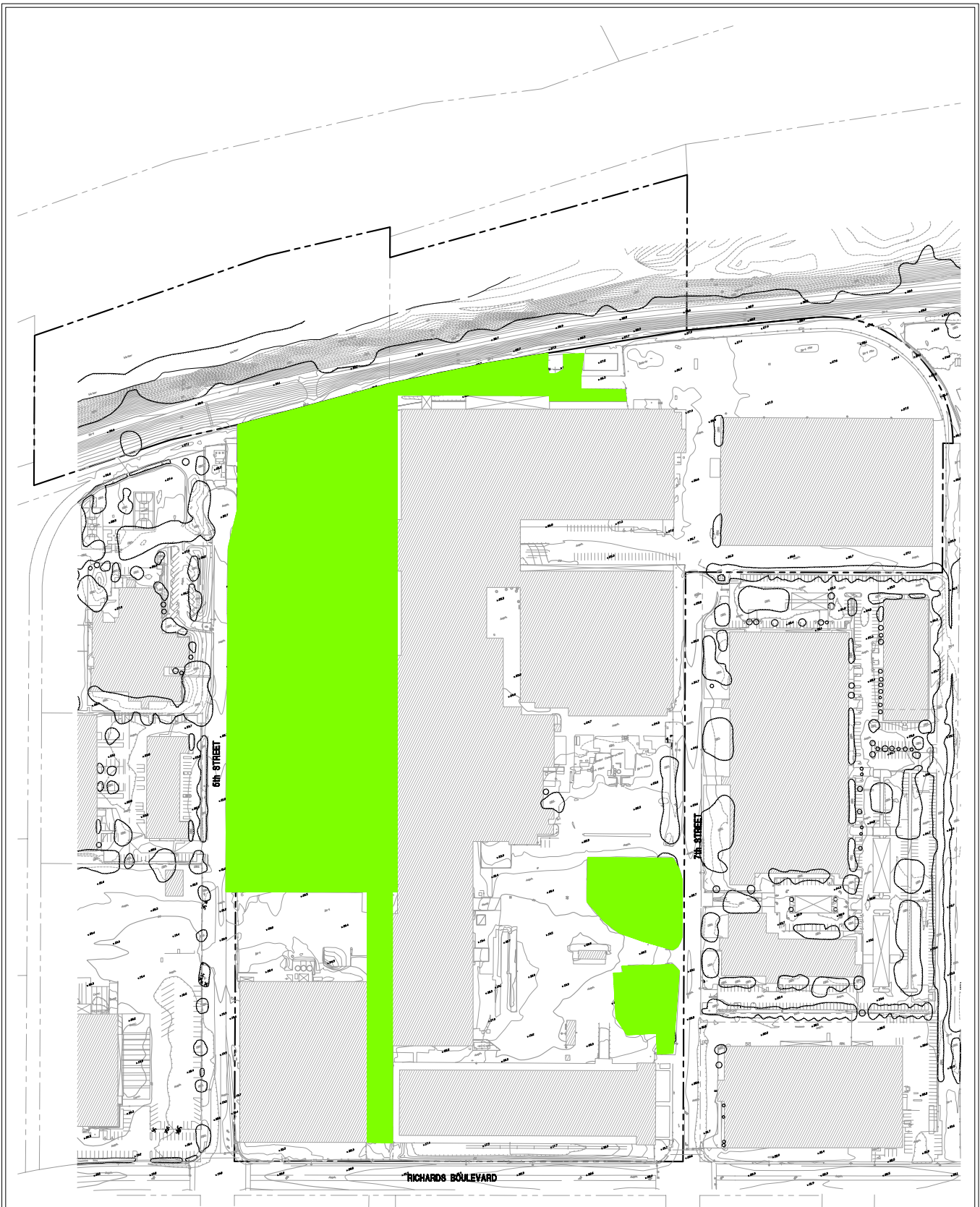
STORAGE

of service.

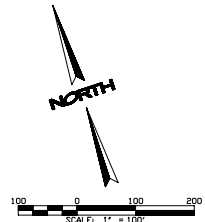


Runoff can be stored in the landscape areas, parking lots, pipes, or underground vaults. Maximum water depth shall not exceed 6 inches in the parking lots. Paved access within the development shall be as high as the overland release point.

(e) Building pad requirement



TOTAL PERVIOUS AREA = 13.5 Acres

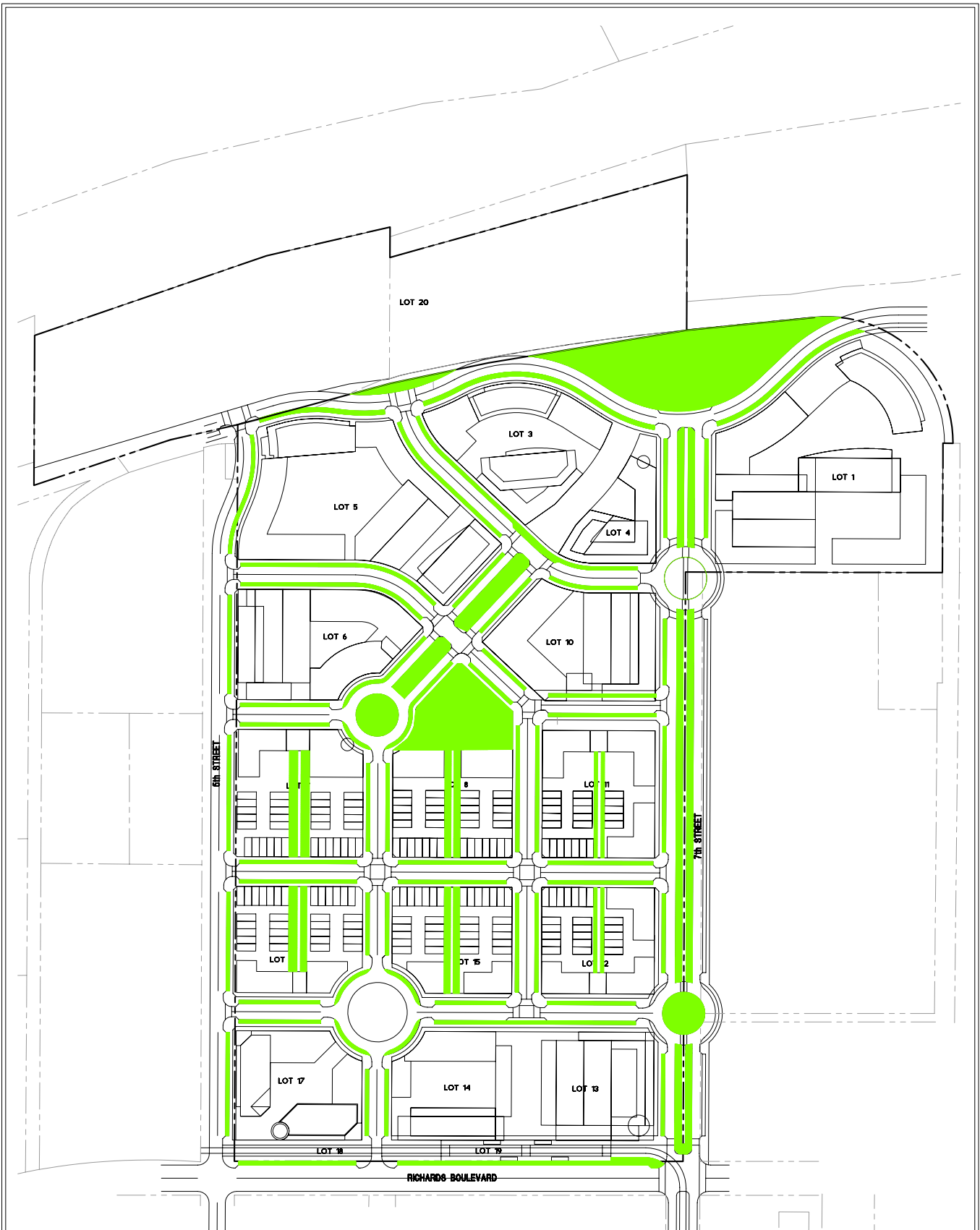


PROJECT 65
EXISTING PERVIOUS AREAS

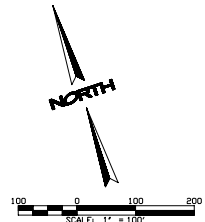
September 7, 2006

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TOTAL PERVIOUS AREA = 8.2 Acres



PROJECT 65
PROPOSED PERVIOUS AREAS

September 7, 2006

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