DRAINAGE REPORT FOR HOFFMANTOWN

OCTOBER 2022

Prepared for:

PULTE DEVELOPMENT OF NEW MEXICO, INC

7601 JEFFERSON ST NE, SUITE 320

ALBUQUERQUE, NM 87109

Prepared by:

City of Albuquerque
Planning Department
Development Review Services
HYDROLOGY SECTION
PRELIMINARY APPROVED
DATE: 11/16/22
BY: Renée C. Brissette
HydroTrans # E20D020B

THESE PLANS AND/OR REPORT ARE CONCEPTUAL ONLY. MORE INFORMATION MAY BE NEEDED IN THEM AND SUBMITTED TO HYDROLOGY FOR BUILDING PERMIT APPROVAL.

Bohannan Huston

Engineering
Spatial Data
Advanced Technologies

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FOR
HOFFMANTOWN SUBDIVISION
ALBUQUERQUE, NM

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7601 JEFFERSON ST NE, SUITE 320
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Prepared by:

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Yolanda Padilla Moyer, PE   Date   Craig W. Hoover, PE   Date

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APPENDICES

EXHIBITS

I. INTRODUCTION

Hoffmantown Subdivision is a gated-private single-family residential development consisting of 39 lots on approximately 14 acres within IDO zoning RC-1. The site is located on Tract A-2 of the Hoffmantown Baptist Church Site, south of Harper Road, west of Ventura Street, and across from Red Sky intersection. The proposed development will occur in a single phase. The site currently drains from northeast to southwest. In the proposed conditions the site will discharge to the South Pino Arroyo located south of the property. The South Pinon Arroyo ultimately drains to the pond upstream of Wyoming Blvd and then west through existing CBCs under Wyoming Blvd. In the ultimate condition the drainage pattern will remain the same as existing. Storm runoff will be conveyed by the internal street network and collected by an internal storm drain network, which will ultimately outfall to the South Pino Arroyo.

II. PURPOSE OF REPORT

The purpose of this report is to provide site-specific drainage analysis for existing and ultimate conditions for the subdivision development referred to as Hoffmantown. This plan is prepared and submitted to support design and grading of the subdivision and internal streets for preliminary, final plat, and construction plan approvals.

III. METHODOLOGY AND REFERENCES

All analysis was completed for the offsite and fully developed conditions. The runoff flow rates and volumes for the onsite basins were computed for the 100 year – 6 hour storm in accordance with the City of Albuquerque Development Manual (DPM), Chapter 6, dated June 15, 2020. Rational Method is used in this report for the hydrology analysis to size storm and inlet capacity. The storm drain system hydraulic grade line (HGL) has been computed using the software Stormwater Studio. Street hydraulic capacities were computed in accordance with the COA DPM and using 8” standard curb & gutter for the subdivision.

IV. SITE LOCATION AND CHARACTERISTICS

The site is approximately 14 acres, located south of Harper Rd, east of Tract B-1 and west of Tract A-1 Hoffmantown Church (see EXHIBIT A– Subdivision Location Map and Preliminary Plat). Tract B-1 is a drainage tract owned and maintained by the city. There are also existing utility and drainage easements within the proposed site boundary, which leaves approximately 12 acres of the site for this subdivision development.

The site consists primarily of small shrubs, weeds, cacti, and sparse native grasses. The site currently drains from northeast to southwest and consist of slopes steeper than 20% in some places, with the majority of the project sloping at 2% to 10%. Soils at the site consist of well graded sand with silt, silty sand with varying amounts of gravel, silty, clayey sand, silty clay with sand, and sandy lean clay. The surface of this site is undulating.

V. EXISTING CONDITIONS

Based on the existing topography, the site is broken into four offsite and six onsite basins. The existing basin and drainage patterns are shown graphically on the Existing Drainage Conditions Map in ‘EXHIBIT B– Existing Conditions Basin Map’. The site consists of undeveloped land and currently drains from northeast to southwest towards the South Pino Arroyo located along the southern boundary of the site.

Offsite basins are designated as OS-B1, OS-B2, OS-B2a, OS-B3, and onsite basins are designated as EX-B1, EX-B2, EX-B2a, EX-B3, EX-B4, EX-B5 for this report. Offsite basin OS-B1 consists of steeper slopes and flows northwest toward Harper Rd. Basin EX-B3 is similar to OS-B1 and also flows northwest toward Harper Rd.

Offsite flow from basin OS-B2 enters the proposed site from the east and combines with onsite existing basin EX-B2. The existing slopes of basin EX-B2 ranges between 2% to 20% and drains southeast. The runoff ultimately enters the existing South Pino Arroyo.

Similarly, offsite flow from basin OS-B2a enters the proposed site from the east and combines with onsite existing basin EX-B2a. The runoff ultimately enters existing basin EX-B3 and flows northwest toward Harper Rd.

Offsite basin OS-B3 flows southwest and discharges to the South Pino Arroyo. Basin EX-B1 is similar to basin OS-B3 and consists of steeper slopes and also flows southwest toward the South Pino Arroyo.

Onsite existing basin EX-B4 is located at the northwest corner of the property and flows west. Runoff from this basin enters Tract B-1 and follows the natural topography that flows south and ultimately discharges to the existing South Pino Arroyo.

Onsite basin EX-B5 is located at southwest corner of the site. The runoff from this basin flows south and leaves the site from the southwest corner of the property boundary and ultimately discharges to the existing South Pino Arroyo.

Existing conditions for the proposed site show the total existing discharge is 16.4 cfs to the arroyo and 7.0 cfs at Harper Rd.

VI. DEVELOPED CONDITIONS

A. ALLOWABLE

In the proposed conditions, the site has free discharge of the developed flow to the South Pino Arroyo. However, the allowable discharge to Harper Rd from the proposed site is assumed to be the historic flow of 7.0 cfs leaving the site in existing undeveloped condition. Existing inlets on Harper Rd located west of the site boundary, collects the drainage from Harper Rd and discharges into the existing drainage swale on Tract B-1. The flow will then continue south to follow the existing runoff pattern and ultimately to the South Pino Arroyo

B. OFFSITE FLOW MANAGEMENT

As mentioned in the Existing Conditions, the total offsite flow of 0.5 cfs enters the proposed site on its eastern boundary. Ultimately, these flows will be mitigated by installing a lined swale along the eastern property line within the Hoffmantown Park tract. The swale will have a high point which is the same as existing condition and follow the existing drainage pattern which results in directing the entire runoff from OS-B1 and runoff of 0.23 cfs from OS-B2a north towards Harper Rd, and the remaining runoff from OS-B2a, runoff from OS-B2 and OS-B3 south towards the existing South Pino Arroyo. See ‘APPENDIX D-Offsite Swale Calculations’ for additional information.

C. ONSITE

Hoffmantown is a proposed gated-private single-family residential development with 39 single family residential lots on approximately 12 acres. The proposed development will occur in one phase. Using Section 6-1(A)(2) of the City’s DPM, a land treatment was assigned to each onsite basin. Since the number of residential units per acre is less than 6, the percent D land treatment area was determined by “Single Family Residential” equation listed in City’s DPM Table 6.2.10. The remaining area was split between land treatments B and C.

Developed flows are calculated for the 100 year – 6 hour storm event and are shown in ‘APPENDIX A-Basin Analysis and Summary of Land Treatments’. The developed flows from the subdivision will be conveyed by the internal private streets and proposed private storm drain networks to the existing arroyo and will have free discharge. The private storm drain system will utilize a stormwater quality inlet\manhole to collect any debris prior to discharging into the South Pino Arroyo. The Onsite Proposed Basin Map, EXHIBIT C, illustrates the basin locations and flow directions for the proposed development as well as the proposed street configurations for the subdivision.

In the developed condition, the entire subdivision is divided into eight onsite basins, Basin-B1 to Basin-B8. The proposed grading has two waterblocks, one at the northeast corner of the subdivision between Lots 10-11 and the other one at the middle of the entrance road to ensure the offsite flow from Harper Rd does not enter the subdivision and goes to the designated existing inlet located north of Tract B-1.

There is a proposed low point located south of Lot 30. The runoff from Basin-B1 flows southwest through the street network toward the low point.

Proposed Basin-B2 consists of lots that drain back towards the back boundary along Harper Rd. A 5' swale is proposed that is designed to carry the developed flow west and daylights west of Lot 1.

The runoff from Basin-B2 enters into Basin-B3. The combined runoff from these two basins flow to the proposed low point through the street network. Two inlets have been proposed in the sump condition to capture the entire developed flow from Basin-B1, Basin-B2, and Basin-B3, and free discharge to the existing South Pino Arroyo.

Basin-B4 consists of 4 lots that drain back to the west and free discharges to the existing drainage swale located in Tract B-1. Turnblocks and cobble rundowns have been proposed for safe discharge of the developed flow to the existing drainage swale.

Basin-B5 and Basin-B6 drain north to Harper Rd. The total runoff from these two basins is 1.0 cfs which is less than the historic flow of 3.5 cfs from the site. Therefore, the runoff from the developed site to the Harper Rd will have no negative impact to downstream infrastructure. The flow will ultimately be collected by existing inlets just west of our entrance road and discharge to the South Pino Arroyo via drainage swale located in Tract B-1.

Basin-B6 and Basin-B7 drain south. The runoff from these two basins will follow the existing terrain and free discharge to South Pino Arroyo.

"EXHIBIT D- Inlet and Storm Drain Network Plan', shows the flow, street grade, water depth, flow captured, and type of each inlet and the size, slope, flow, and capacity of the storm drain system. All upstream flows were within the depth of flow in the street and does not exceed the curb height nor the energy grade line does not exceed at the right of way (ROW) of any street. At the downstream end, an inlet in sump condition that captures all the developed flows. See 'APPENDIX B- Inlet/Street Hydraulics' and 'APPENDIX C- Stormdrain Pipe Analysis' for additional information.

VII. STORMWATER QUALITY REQUIRMENTS

This project is required to meet the stormwater quality requirements of the new City Drainage Ordinance. The stormwater quality requirement will be met via a cash in-lieu payment. Per the DPM Article 6-12- Stormwater Quality and Low-Impact Development, the required storage is calculated as 0.42" times the subdivision acreage times the percent impervious area (37%) *(11.73 acres), and is equal to $V_{Required} =$ 6618 cf. The payment is computed as the storage volume times $6 per cubic foot of storage and is equal to $39,708 for this subdivision.

VIII. SOUTH PINO ARROYO FLOODPLAIN

As part of the drainage analysis for the Hoffmantown development, potential impacts to the South Pino Arroyo and surrounding properties were evaluated in a separate memorandum. Since the South Pino Arroyo abuts and encroaches on the south side of the site, the proposed grading for the development will impact the arroyo. The South Pino Arroyo is delineated as a FEMA Zone AO in the area. Impacts were analyzed through a two-dimensional hydraulic model. Multiple potential configurations were evaluated. The South Pino Arroyo floodplain delineation will need to be amended to reflect changes along the south boundary of the property, which will be accomplished by following FEMA's CLOMR/LOMR process. Impacts on other properties adjacent to the arroyo will be negligible. Refer to APPENDIX E for the Offsite Analysis Memorandum.

To protect the site from the encroaching arroyo tinted shotcrete bank protection is proposed along the southern subdivision boundary of the site, located within the existing public drainage easement along the south side of the project site. The bank protection will extend from just inside the east site boundary to just inside the west site boundary. At each end, the bank protection will be keyed into the north bank of the arroyo and backfilled by the new north arroyo bank grading. The bank protection will be placed at a 2:1 slope and will extend down below the existing bed of the arroyo to the calculated scour depth. A 30” storm drain that conveys runoff from the subdivision to the arroyo will penetrate the bank protection near the west end. The pipe penetration will be per the AMAFCA standard details for a channel wall pipe penetration. Erosion protection at the outlet of the pipe in the bottom or the arroyo will be provided as part of the design. See APPENDIX F for Bank Protection Layout and Details. Additional details for the bank protection will be provided with the subdivision design plans.

IX. GRADING PLAN

The grading plan for Hoffmantown Subdivision is included in ‘Exhibit E– Grading Plan’ of this report.

X. CONCLUSION

This drainage report summarizes the hydrologic and hydraulic analysis for the new subdivision. With the proposed stormdrain network there is no adverse effects anticipated to the existing infrastructure. The proposed stormdrain infrastructure and drainage management schemes allow for the safe management of storm runoff. The implementation of these concepts would result in the safe passage of the 100 year - 6 hour storm event.

APPENDICES

APPENDIX A:	**BASIN ANALYSIS AND SUMMARY OF LAND TREATMENTS**
APPENDIX B:	**INLET/STREET HYDRAULICS**
APPENDIX C:	**STORM DRAIN PIPE ANALYSIS**
APPENDIX D:	**SWALE CALCULATIONS**
APPENDIX E:	**OFFSITE ANALYSIS MEMORANDUM**
APPENDIX F:	**BANK PROTECTION LAYOUT AND DETAILS**

APPENDIX A:

BASIN ANALYSIS AND SUMMARY OF LAND TREATMENTS

EXISTING CONDITIONS

BASIN I.D.	AREA (AC)	% LAND TREATMENT A	B	C	D	DISCHARGE (CFS) 10 YR	100YR
EX-B1	0.5	10.0%	90.0%	0.0%	0.0%	0.5	1.3
EX-B2	6.9	80.0%	20.0%	0.0%	0.0%	4.2	13.6
EX-B2a	1.6	80.0%	20.0%	0.0%	0.0%	1.0	3.2
EX-B3	1.3	10.0%	90.0%	0.0%	0.0%	1.3	3.1
EX-B4	1.0	90.0%	10.0%	0.0%	0.0%	0.5	1.8
EX-B5	0.5	90.0%	10.0%	0.0%	0.0%	0.3	1.0
OS-B1	0.1	10.0%	90.0%	0.0%	0.0%	0.1	0.4
OS-B2	0.1	90.0%	10.0%	0.0%	0.0%	0.1	0.2
OS-B2a	0.2	90.0%	10.0%	0.0%	0.0%	0.1	0.3
OS-B3	0.1	10.0%	90.0%	0.0%	0.0%	0.1	0.3
TOTAL	12.4					8.3	25.2

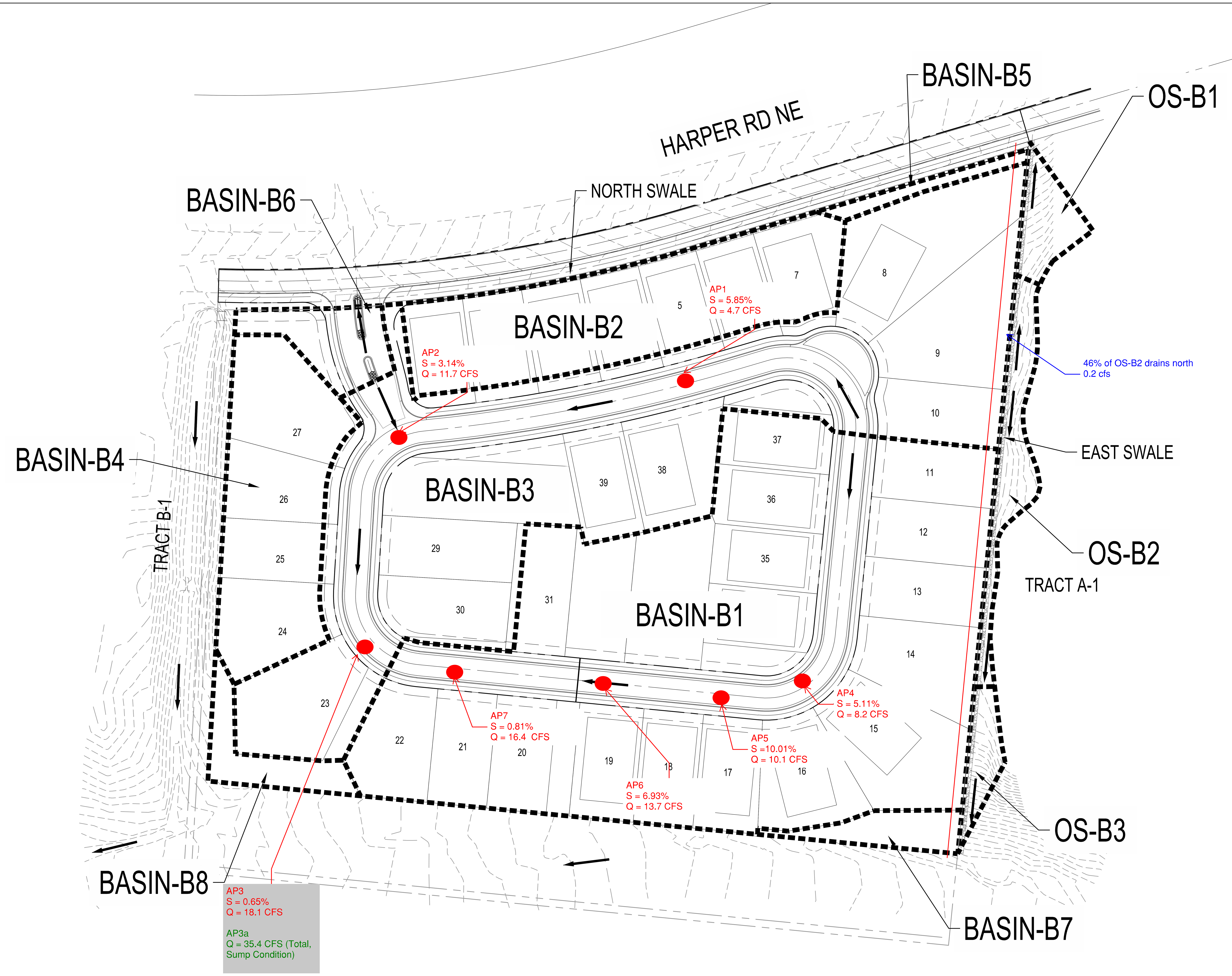
PROPOSED CONDITIONS

BASIN I.D.	AREA (AC)	UNITS #	% LAND TREATMENT				DISCHARGE (CFS)	
			A	B	C	D	10 YR	100YR
Basin B1	5.0	19	0.0%	31.0%	31.0%	38.0%	9.6	17.3
Basin B2	1.1	7	0.0%	31.0%	31.0%	38.0%	2.2	3.9
Basin B3	4.1	9	0.0%	31.0%	31.0%	38.0%	7.9	14.2
Basin B4	0.9	4	0.0%	31.0%	31.0%	38.0%	1.7	3.1
Basin B5	0.1	0	0.0%	50.0%	50.0%	0.0%	0.1	0.2
Basin B6	0.2	0	0.0%	25.0%	25.0%	50.0%	0.5	0.8
Basin B7	0.1	0	0.0%	50.0%	50.0%	0.0%	0.2	0.4
Basin B8	0.2	0	0.0%	50.0%	50.0%	0.0%	0.2	0.5
OS-B1	0.1	0	10.0%	90.0%	0.0%	0.0%	0.1	0.4
OS-B2	0.1	0	90.0%	10.0%	0.0%	0.0%	0.1	0.2
OS-B2a	0.2	0	90.0%	10.0%	0.0%	0.0%	0.1	0.3
OS-B3	0.1	0	10.0%	90.0%	0.0%	0.0%	0.1	0.3
TOTAL	12.2	39					22.7	41.6

Only Basin-B1, Basin-B2, Basin-B3 and Basin-B4 is considered in calculating %D

APPENDIX B:

INLET/STREET HYDRAULICS



LEGEND

PROPOSED BASIN BOUNDARY

FLOW ARROW

PROPOSED CONDITIONS

BASIN I.D.	AREA (AC)	UNITS #	% LAND TREATMENT A	B	C	D	DISCHARGE (CFS) 10 YR	100YR
Basin B1	5.0	19	0.0%	31.0%	31.0%	38.0%	**9.6**	**17.3**
Basin B2	1.1	7	0.0%	31.0%	31.0%	38.0%	**2.2**	**3.9**
Basin B3	4.1	9	0.0%	31.0%	31.0%	38.0%	**7.9**	**14.2**
Basin B4	0.9	4	0.0%	31.0%	31.0%	38.0%	**1.7**	**3.1**
Basin B5	0.1	0	0.0%	50.0%	50.0%	0.0%	**0.1**	**0.2**
Basin B6	0.2	0	0.0%	25.0%	25.0%	50.0%	**0.5**	**0.8**
Basin B7	0.1	0	0.0%	50.0%	50.0%	0.0%	**0.2**	**0.4**
Basin B8	0.2	0	0.0%	50.0%	50.0%	0.0%	**0.2**	**0.5**
OS-B1	0.1	0	10.0%	90.0%	0.0%	0.0%	**0.1**	**0.4**
OS-B2	0.2	0	90.0%	10.0%	0.0%	0.0%	**0.1**	**0.5**
OS-B3	0.1	0	10.0%	90.0%	0.0%	0.0%	**0.1**	**0.3**
TOTAL	**12.2**	**39**					22.7	41.6

Only Basin-B1, Basin-B2, Basin-B3 and Basin-B4 is considered in calculating %D

N

60 30 0 60

1" = 60'

Bohannan Huston
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ANALYSIS POINTS EXHIBIT

HOFFMANTOWN

DRAWN BY: SS	DATE: 08/31/2022	
CHECKED BY: YPM	BHI PROJECT NO. 20220092	SHEET NO. 1

S = 5.85%

MANNING'S N = 0.017   SLOPE = 0.059

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	0.9	5.0	12.0	0.1	9.0	38.2	0.7
2.0	9.4	0.7	6.0	24.0	0.2	10.0	38.6	0.7
3.0	9.8	0.7	7.0	36.0	0.1	11.0	48.0	0.9
4.0	10.0	0.0	8.0	38.0	0.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.010	0.010	0.002	0.001	0.329	0.598	1.213	0.313	0.016	1.490
0.020	0.020	0.006	0.006	0.658	0.949	1.526	0.626	0.034	1.673
0.030	0.030	0.014	0.017	0.987	1.243	1.838	0.938	0.054	1.790
0.040	0.040	0.025	0.038	1.316	1.506	2.151	1.251	0.075	1.878
0.050	0.050	0.039	0.068	1.645	1.748	2.464	1.564	0.098	1.949
0.060	0.060	0.056	0.111	1.974	1.974	2.777	1.877	0.121	2.009
0.070	0.070	0.077	0.168	2.303	2.187	3.089	2.189	0.144	2.061
0.080	0.080	0.100	0.239	2.632	2.391	3.402	2.502	0.169	2.108
0.090	0.090	0.127	0.328	2.961	2.586	3.715	2.815	0.194	2.149
0.100	0.100	0.156	0.434	3.290	2.774	4.028	3.128	0.220	2.187
0.110	0.110	0.189	0.559	3.619	2.956	4.340	3.440	0.246	2.222
0.120	0.120	0.225	0.706	3.948	3.133	4.653	3.753	0.273	2.255
0.130	0.130	0.264	0.873	4.277	3.305	4.966	4.066	0.300	2.285
0.140	0.140	0.316	0.891	6.479			6.253	0.264	2.213
0.150	0.150	0.389	1.039	8.682			8.440	0.261	2.191
0.160	0.160	0.485	1.287	10.884			10.627	0.270	2.193
0.170	0.170	0.602	1.633	13.087			12.814	0.285	2.208
0.180	0.180	0.741	2.082	15.289			15.000	0.303	2.229
0.190	0.190	0.902	2.641	17.492	2.929	18.087	17.187	0.323	2.254
0.200	0.200	1.085	3.320	19.694	3.060	20.274	19.374	0.346	2.280
0.210	0.210	1.289	4.126	21.897	3.200	22.461	21.561	0.369	2.307
0.220	0.220	1.516	5.069	24.100	3.344	24.648	23.748	0.394	2.333
0.230	0.230	1.764	6.158	26.302	3.490	26.835	25.935	0.419	2.359
0.240	0.240	2.035	7.402	28.505	3.638	29.022	28.122	0.446	2.384

AP1
Q = 4.7 CFS
d = 0.21'
E = 0.36'

0.250	0.250	2.316	9.180	28.525	3.964	29.027	28.127	0.494	2.435
0.260	0.260	2.597	11.107	28.546	4.277	29.032	28.132	0.544	2.482
0.270	0.270	2.878	13.178	28.567	4.578	29.037	28.137	0.596	2.523
0.280	0.280	3.160	15.387	28.587	4.869	29.042	28.142	0.649	2.562
0.290	0.290	3.441	17.730	28.608	5.152	29.047	28.147	0.703	2.598
0.300	0.300	3.723	20.203	28.628	5.427	29.052	28.152	0.758	2.631
0.310	0.310	4.004	22.802	28.649	5.694	29.057	28.157	0.814	2.662
0.320	0.320	4.286	25.524	28.670	5.955	29.062	28.162	0.872	2.691
0.330	0.330	4.568	28.367	28.690	6.210	29.067	28.167	0.930	2.719
0.340	0.340	4.849	31.327	28.711	6.460	29.073	28.173	0.989	2.745
0.350	0.350	5.131	34.402	28.732	6.705	29.078	28.178	1.049	2.770
0.360	0.360	5.413	37.591	28.752	6.945	29.083	28.183	1.110	2.794
0.370	0.370	5.695	40.890	28.773	7.180	29.088	28.188	1.172	2.816
0.380	0.380	5.977	44.298	28.794	7.412	29.093	28.193	1.234	2.838
0.390	0.390	6.259	47.812	28.814	7.639	29.098	28.198	1.298	2.859
0.400	0.400	6.541	51.432	28.835	7.863	29.103	28.203	1.362	2.879
0.410	0.410	6.823	55.155	28.855	8.084	29.108	28.208	1.426	2.898
0.420	0.420	7.105	58.980	28.876	8.301	29.113	28.213	1.492	2.916
0.430	0.430	7.387	62.905	28.897	8.516	29.118	28.218	1.558	2.934
0.440	0.440	7.669	66.930	28.917	8.727	29.123	28.223	1.625	2.952
0.450	0.450	7.951	71.052	28.938	8.936	29.128	28.228	1.692	2.968
0.460	0.460	8.234	75.270	28.959	9.142	29.133	28.233	1.760	2.984
0.470	0.470	8.516	79.583	28.979	9.345	29.139	28.239	1.828	3.000
0.480	0.480	8.798	83.990	29.000	9.546	29.144	28.244	1.897	3.015
WSEL	DEPTH	FLOW	FLOW	WETTED	FLOW	TOPWID	TOPWID	TOTAL	FROUDE
	INC	AREA	RATE	PER	VEL	PLUS	WATER	ENERGY	NO.
FT.		SQ.FT.	(CFS)	(FT)	(FPS)	OBSTRUCTIONS		(FT)	
0.490	0.490	9.081	88.490	29.021	9.745	29.149	28.249	1.967	3.030
0.500	0.500	9.363	93.082	29.041	9.941	29.154	28.254	2.037	3.044
0.510	0.510	9.646	97.764	29.062	10.135	29.159	28.259	2.108	3.058
0.520	0.520	9.929	102.536	29.082	10.327	29.164	28.264	2.179	3.072
0.530	0.530	10.211	107.396	29.103	10.517	29.169	28.269	2.251	3.085
0.540	0.540	10.494	112.344	29.124	10.706	29.174	28.274	2.323	3.098
0.550	0.550	10.777	117.379	29.144	10.892	29.179	28.279	2.395	3.111
0.560	0.560	11.060	122.500	29.165	11.076	29.184	28.284	2.468	3.123
0.570	0.570	11.342	127.706	29.186	11.259	29.189	28.289	2.542	3.135
0.580	0.580	11.625	132.997	29.206	11.440	29.194	28.294	2.616	3.147
0.590	0.590	11.908	138.371	29.227	11.620	29.199	28.299	2.690	3.158

0.600	0.600	12.191	143.827	29.247	11.797	29.204	28.304	2.765	3.169
0.610	0.610	12.474	149.366	29.268	11.974	29.210	28.310	2.840	3.180
0.620	0.620	12.758	154.986	29.289	12.149	29.215	28.315	2.916	3.191
0.630	0.630	13.041	160.686	29.309	12.322	29.220	28.320	2.992	3.201
0.640	0.640	13.324	166.466	29.330	12.494	29.225	28.325	3.068	3.212
0.650	0.650	13.607	172.326	29.351	12.664	29.230	28.330	3.145	3.222
0.660	0.660	13.891	178.264	29.371	12.833	29.235	28.335	3.222	3.231
0.670	0.670	14.174	184.280	29.392	13.001	29.240	28.340	3.299	3.241
0.680	0.680	14.463	186.199	30.434	12.875	30.282	29.382	3.258	3.235
0.690	0.690	14.780	185.251	32.377	12.534	31.324	31.324	3.134	3.217
0.700	0.700	15.098	187.939	33.419	12.448	32.367	32.367	3.110	3.213
0.710	0.710	15.427	190.863	34.462	12.372	33.409	33.409	3.091	3.210
0.720	0.720	15.766	194.017	35.504	12.306	34.451	34.451	3.075	3.207
0.730	0.730	16.116	197.398	36.546	12.249	35.493	35.493	3.064	3.205
0.740	0.740	16.476	201.000	37.589	12.200	36.536	36.536	3.055	3.203
0.750	0.750	16.847	204.822	38.631	12.158	37.578	37.578	3.049	3.201
0.760	0.760	17.228	208.860	39.674	12.124	38.620	38.620	3.046	3.200
0.770	0.770	17.619	213.111	40.716	12.096	39.662	39.662	3.046	3.199
0.780	0.780	18.021	217.576	41.758	12.074	40.704	40.704	3.047	3.199
0.790	0.790	18.433	222.251	42.801	12.057	41.747	41.747	3.051	3.199
0.800	0.800	18.856	227.136	43.843	12.046	42.789	42.789	3.057	3.199
0.810	0.810	19.289	232.231	44.886	12.040	43.831	43.831	3.065	3.200
0.820	0.820	19.732	237.536	45.928	12.038	44.873	44.873	3.074	3.200
0.830	0.830	20.186	243.049	46.971	12.040	45.916	45.916	3.085	3.201
0.840	0.840	20.651	248.771	48.013	12.047	46.958	46.958	3.097	3.203

S = 3.14%

MANNING'S N = 0.017   SLOPE = 0.031

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	0.9	5.0	12.0	0.1	9.0	38.2	0.7
2.0	9.4	0.7	6.0	24.0	0.2	10.0	38.6	0.7
3.0	9.8	0.7	7.0	36.0	0.1	11.0	48.0	0.9
4.0	10.0	0.0	8.0	38.0	0.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.010	0.010	0.002	0.001	0.329	0.438	1.213	0.313	0.013	1.092
0.020	0.020	0.006	0.004	0.658	0.695	1.526	0.626	0.028	1.226
0.030	0.030	0.014	0.013	0.987	0.911	1.838	0.938	0.043	1.311
0.040	0.040	0.025	0.028	1.316	1.103	2.151	1.251	0.059	1.376
0.050	0.050	0.039	0.050	1.645	1.280	2.464	1.564	0.076	1.428
0.060	0.060	0.056	0.081	1.974	1.446	2.777	1.877	0.093	1.472
0.070	0.070	0.077	0.123	2.303	1.602	3.089	2.189	0.110	1.510
0.080	0.080	0.100	0.175	2.632	1.752	3.402	2.502	0.128	1.544
0.090	0.090	0.127	0.240	2.961	1.895	3.715	2.815	0.146	1.575
0.100	0.100	0.156	0.318	3.290	2.033	4.028	3.128	0.164	1.603
0.110	0.110	0.189	0.410	3.619	2.166	4.340	3.440	0.183	1.628
0.120	0.120	0.225	0.517	3.948	2.295	4.653	3.753	0.202	1.652
0.130	0.130	0.264	0.640	4.277	2.421	4.966	4.066	0.221	1.674
0.140	0.140	0.316	0.653	6.479	2.067	7.153	6.253	0.206	1.621
0.150	0.150	0.389	0.761	8.682	1.955	9.340	8.440	0.209	1.605
0.160	0.160	0.485	0.943	10.884	1.946	11.527	10.627	0.219	1.606
0.170	0.170	0.602	1.197	13.087	1.988	13.714	12.814	0.231	1.617
0.180	0.180	0.741	1.526	15.289	2.059	15.900	15.000	0.246	1.633
0.190	0.190	0.902	1.935	17.492	2.146	18.087	17.187	0.262	1.651
0.200	0.200	1.085	2.432	19.694	2.242	20.274	19.374	0.278	1.671
0.210	0.210	1.289	3.023	21.897	2.344	22.461	21.561	0.295	1.690
0.220	0.220	1.516	3.714	24.100	2.450	24.648	23.748	0.313	1.709
0.230	0.230	1.764	4.512	26.302	2.557	26.835	25.935	0.332	1.728
0.240	0.240	2.035	5.423	28.505	2.665	29.022	28.122	0.350	1.747

AP2
Q = 11.7 CFS
d = 0.28'
E = 0.47'

0.250	0.250	2.316	6.726	28.525	2.904	29.027	28.127	0.381	1.784
0.260	0.260	2.597	8.138	28.546	3.133	29.032	28.132	0.413	1.818
0.270	0.270	2.878	9.655	28.567	3.354	29.037	28.137	0.445	1.849
0.280	0.280	3.160	11.273	28.587	3.568	29.042	28.142	0.478	1.877
0.290	0.290	3.441	12.989	28.608	3.775	29.047	28.147	0.512	1.903
0.300	0.300	3.723	14.801	28.628	3.976	29.052	28.152	0.546	1.927
0.310	0.310	4.004	16.705	28.649	4.172	29.057	28.157	0.581	1.950
0.320	0.320	4.286	18.700	28.670	4.363	29.062	28.162	0.616	1.972
0.330	[illegible]	[illegible]	[illegible]2	28.690	4.550	29.067	28.167	0.652	1.992
0.340	[illegible]	[illegible]	[illegible]1	28.711	4.733	29.073	28.173	0.688	2.011
0.350	[illegible]	[illegible]	[illegible]4	28.732	4.912	29.078	28.178	0.725	2.029
0.360	[illegible]	[illegible]	[illegible]0	28.752	5.088	29.083	28.183	0.763	2.047
0.370	[illegible]	[illegible]	[illegible]7	28.773	5.261	29.088	28.188	0.800	2.063
0.380	[illegible]	[illegible]	[illegible]4	28.794	5.430	29.093	28.193	0.839	2.079
0.390	0.390	6.259	35.029	28.814	5.597	29.098	28.198	0.877	2.094
0.400	0.400	6.541	37.681	28.835	5.761	29.103	28.203	0.916	2.109
0.410	0.410	6.823	40.408	28.855	5.923	29.108	28.208	0.956	2.123
0.420	0.420	7.105	43.211	28.876	6.082	29.113	28.213	0.995	2.137
0.430	0.430	7.387	46.087	28.897	6.239	29.118	28.218	1.035	2.150
0.440	0.440	7.669	49.035	28.917	6.394	29.123	28.223	1.076	2.162
0.450	0.450	7.951	52.055	28.938	6.547	29.128	28.228	1.117	2.175
0.460	0.460	8.234	55.145	28.959	6.697	29.133	28.233	1.158	2.186
0.470	0.470	8.516	58.305	28.979	6.847	29.139	28.239	1.199	2.198
0.480	0.480	8.798	61.534	29.000	6.994	29.144	28.244	1.241	2.209
WSEL	DEPTH	FLOW	FLOW	WETTED	FLOW	TOPWID	TOPWID	TOTAL	FROUDE
	INC	AREA	RATE	PER	VEL	PLUS	WATER	ENERGY	NO.
FT.		SQ.FT.	(CFS)	(FT)	(FPS)	OBSTRUCTIONS		(FT)	
0.490	0.490	9.081	64.831	29.021	7.139	29.149	28.249	1.283	2.220
0.500	0.500	9.363	68.195	29.041	7.283	29.154	28.254	1.325	2.230
0.510	0.510	9.646	71.625	29.062	7.425	29.159	28.259	1.368	2.241
0.520	0.520	9.929	75.121	29.082	7.566	29.164	28.264	1.410	2.251
0.530	0.530	10.211	78.682	29.103	7.705	29.169	28.269	1.453	2.260
0.540	0.540	10.494	82.307	29.124	7.843	29.174	28.274	1.497	2.270
0.550	0.550	10.777	85.996	29.144	7.980	29.179	28.279	1.540	2.279
0.560	0.560	11.060	89.748	29.165	8.115	29.184	28.284	1.584	2.288
0.570	0.570	11.342	93.562	29.186	8.249	29.189	28.289	1.628	2.297
0.580	0.580	11.625	97.438	29.206	8.382	29.194	28.294	1.673	2.305
0.590	0.590	11.908	101.375	29.227	8.513	29.199	28.299	1.717	2.314

0.600	0.600	12.191	105.373	29.247	8.643	29.204	28.304	1.762	2.322
0.610	0.610	12.474	109.431	29.268	8.772	29.210	28.310	1.807	2.330
0.620	0.620	12.758	113.548	29.289	8.900	29.215	28.315	1.852	2.338
0.630	0.630	13.041	117.724	29.309	9.027	29.220	28.320	1.898	2.345
0.640	0.640	13.324	121.959	29.330	9.153	29.225	28.325	1.943	2.353
0.650	0.650	13.607	126.252	29.351	9.278	29.230	28.330	1.989	2.360
0.660	0.660	13.891	130.602	29.371	9.402	29.235	28.335	2.035	2.367
0.670	0.670	14.174	135.010	29.392	9.525	29.240	28.340	2.081	2.375
0.680	0.680	14.463	136.416	30.434	9.432	30.282	29.382	2.064	2.370
0.690	0.690	14.780	135.721	32.377	9.183	31.324	31.324	2.002	2.357
0.700	0.700	15.098	137.690	33.419	9.120	32.367	32.367	1.994	2.354
0.710	0.710	15.427	139.832	34.462	9.064	33.409	33.409	1.988	2.352
0.720	0.720	15.766	142.144	35.504	9.016	34.451	34.451	1.984	2.350
0.730	0.730	16.116	144.620	36.546	8.974	35.493	35.493	1.983	2.348
0.740	0.740	16.476	147.260	37.589	8.938	36.536	36.536	1.983	2.346
0.750	0.750	16.847	150.059	38.631	8.907	37.578	37.578	1.984	2.345
0.760	0.760	17.228	153.018	39.674	8.882	38.620	38.620	1.987	2.345
0.770	0.770	17.619	156.133	40.716	8.862	39.662	39.662	1.991	2.344
0.780	0.780	18.021	159.403	41.758	8.845	40.704	40.704	1.997	2.344
0.790	0.790	18.433	162.828	42.801	8.833	41.747	41.747	2.004	2.344
0.800	0.800	18.856	166.408	43.843	8.825	42.789	42.789	2.011	2.344
0.810	0.810	19.289	170.140	44.886	8.821	43.831	43.831	2.020	2.344
0.820	0.820	19.732	174.027	45.928	8.819	44.873	44.873	2.030	2.345
0.830	0.830	20.186	178.066	46.971	8.821	45.916	45.916	2.040	2.345
0.840	0.840	20.651	182.258	48.013	8.826	46.958	46.958	2.052	2.346

S = 0.65%

MANNING'S N = 0.017   SLOPE = 0.007

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	0.9	5.0	12.0	0.1	9.0	38.2	0.7
2.0	9.4	0.7	6.0	24.0	0.2	10.0	38.6	0.7
3.0	9.8	0.7	7.0	36.0	0.1	11.0	48.0	0.9
4.0	10.0	0.0	8.0	38.0	0.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.010	0.010	0.002	0.000	0.329	0.199	1.213	0.313	0.011	0.497
0.020	0.020	0.006	0.002	0.658	0.316	1.526	0.626	0.022	0.558
0.030	0.030	0.014	0.006	0.987	0.414	1.838	0.938	0.033	0.597
0.040	0.040	0.025	0.013	1.316	0.502	2.151	1.251	0.044	0.626
0.050	0.050	0.039	0.023	1.645	0.583	2.464	1.564	0.055	0.650
0.060	0.060	0.056	0.037	1.974	0.658	2.777	1.877	0.067	0.670
0.070	0.070	0.077	0.056	2.303	0.729	3.089	2.189	0.078	0.687
0.080	0.080	0.100	0.080	2.632	0.797	3.402	2.502	0.090	0.703
0.090	0.090	0.127	0.109	2.961	0.862	3.715	2.815	0.102	0.716
0.100	0.100	0.156	0.145	3.290	0.925	4.028	3.128	0.113	0.729
0.110	0.110	0.189	0.186	3.619	0.985	4.340	3.440	0.125	0.741
0.120	0.120	0.225	0.235	3.948	1.044	4.653	3.753	0.137	0.752
0.130	0.130	0.264	0.291	4.277	1.102	4.966	4.066	0.149	0.762
0.140	0.140	0.316	0.297	6.479	0.941	7.153	6.253	0.154	0.738
0.150	0.150	0.389	0.346	8.682	0.890	9.340	8.440	0.162	0.730
0.160	0.160	0.485	0.429	10.884	0.885	11.527	10.627	0.172	0.731
0.170	0.170	0.602	0.544	13.087	0.905	13.714	12.814	0.183	0.736
0.180	0.180	0.741	0.694	15.289	0.937	15.900	15.000	0.194	0.743
0.190	0.190	0.902	0.880	17.492	0.976	18.087	17.187	0.205	0.751
0.200	0.200	1.085	1.107	19.694	1.020	20.274	19.374	0.216	0.760
0.210	0.210	1.289	1.375	21.897	1.067	22.461	21.561	0.228	0.769
0.220	0.220	1.516	1.690	24.100	1.115	24.648	23.748	0.239	0.778
0.230	0.230	1.764	2.053	26.302	1.163	26.835	25.935	0.251	0.786
0.240	0.240	2.035	2.467	28.505	1.213	29.022	28.122	0.263	0.795

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.250	0.250	2.316	3.060	28.525	1.321	29.027	28.127	0.277	0.812
0.260	0.260	2.597	3.702	28.546	1.426	29.032	28.132	0.292	0.827
0.270	0.270	2.878	4.393	28.567	1.526	29.037	28.137	0.306	0.841
0.280	0.280	3.160	5.129	28.587	1.623	29.042	28.142	0.321	0.854
0.290	0.290	3.441	5.910	28.608	1.717	29.047	28.147	0.336	0.866
0.300	0.300	3.723	6.734	28.628	1.809	29.052	28.152	0.351	0.877
0.310	[illegible]	[illegible]	[illegible]01	28.649	1.898	29.057	28.157	0.366	0.887
0.320	[illegible]	[illegible]	[illegible]08	28.670	1.985	29.062	28.162	0.381	0.897
0.330	[illegible]	[illegible]	[illegible]56	28.690	2.070	29.067	28.167	0.397	0.906
0.340	[illegible]	[illegible]	[illegible]42	28.711	2.153	29.073	28.173	0.412	0.915
0.350	[illegible]	[illegible]	[illegible]67	28.732	2.235	29.078	28.178	0.428	0.923
0.360	[illegible]	[illegible]	[illegible]30	28.752	2.315	29.083	28.183	0.443	0.931
0.370	0.370	5.695	13.630	28.773	2.393	29.088	28.188	0.459	0.939
0.380	0.380	5.977	14.766	28.794	2.471	29.093	28.193	0.475	0.946
0.390	0.390	6.259	15.937	28.814	2.546	29.098	28.198	0.491	0.953
0.400	0.400	6.541	17.144	28.835	2.621	29.103	28.203	0.507	0.960
0.410	0.410	6.823	18.385	28.855	2.695	29.108	28.208	0.523	0.966
0.420	0.420	7.105	19.660	28.876	2.767	29.113	28.213	0.539	0.972
0.430	0.430	7.387	20.968	28.897	2.839	29.118	28.218	0.555	0.978
0.440	0.440	7.669	22.310	28.917	2.909	29.123	28.223	0.572	0.984
0.450	0.450	7.951	23.684	28.938	2.979	29.128	28.228	0.588	0.989
0.460	0.460	8.234	25.090	28.959	3.047	29.133	28.233	0.604	0.995
0.470	0.470	8.516	26.528	28.979	3.115	29.139	28.239	0.621	1.000
0.480	0.480	8.798	27.997	29.000	3.182	29.144	28.244	0.637	1.005
0.490	0.490	9.081	29.497	29.021	3.248	29.149	28.249	0.654	1.010
0.500	0.500	9.363	31.027	29.041	3.314	29.154	28.254	0.671	1.015
0.510	0.510	9.646	32.588	29.062	3.378	29.159	28.259	0.688	1.019
0.520	0.520	9.929	34.179	29.082	3.442	29.164	28.264	0.704	1.024
0.530	0.530	10.211	35.799	29.103	3.506	29.169	28.269	0.721	1.028
0.540	0.540	10.494	37.448	29.124	3.569	29.174	28.274	0.738	1.033
0.550	0.550	10.777	39.126	29.144	3.631	29.179	28.279	0.755	1.037
0.560	0.560	11.060	40.833	29.165	3.692	29.184			
0.570	0.570	11.342	42.569	29.186	3.753	29.189			
0.580	0.580	11.625	44.332	29.206	3.813	29.194			
0.590	0.590	11.908	46.124	29.227	3.873	29.199			

AP3 - Basin-B2 & Basin-B3
Q = 18.1 CFS
d = 0.41'
E = 0.52'

AP3a (Sump)
Q = 35.4 CFS
d = 0.53'
E = 0.72'

0.600	0.600	12.191	47.942	29.247	3.932	29.204	28.304	0.841	1.056
0.610	0.610	12.474	49.789	29.268	3.991	29.210	28.310	0.858	1.060
0.620	0.620	12.758	51.662	29.289	4.050	29.215	28.315	0.875	1.064
0.630	0.630	13.041	53.562	29.309	4.107	29.220	28.320	0.892	1.067
0.640	0.640	13.324	55.489	29.330	4.165	29.225	28.325	0.910	1.071
0.650	0.650	13.607	57.442	29.351	4.221	29.230	28.330	0.927	1.074
0.660	0.660	13.891	59.421	29.371	4.278	29.235	28.335	0.945	1.077
0.670	0.670	14.174	61.427	29.392	4.334	29.240	28.340	0.962	1.080
0.680	0.680	14.463	62.066	30.434	4.292	30.282	29.382	0.966	1.078
0.690	0.690	14.780	61.750	32.377	4.178	31.324	31.324	0.962	1.072
0.700	0.700	15.098	62.646	33.419	4.149	32.367	32.367	0.968	1.071
0.710	0.710	15.427	63.621	34.462	4.124	33.409	33.409	0.975	1.070
0.720	0.720	15.766	64.672	35.504	4.102	34.451	34.451	0.982	1.069
0.730	0.730	16.116	65.799	36.546	4.083	35.493	35.493	0.989	1.068
0.740	0.740	16.476	67.000	37.589	4.067	36.536	36.536	0.997	1.068
0.750	0.750	16.847	68.274	38.631	4.053	37.578	37.578	1.005	1.067
0.760	0.760	17.228	69.620	39.674	4.041	38.620	38.620	1.014	1.067
0.770	0.770	17.619	71.037	40.716	4.032	39.662	39.662	1.023	1.066
0.780	0.780	18.021	72.525	41.758	4.025	40.704	40.704	1.032	1.066
0.790	0.790	18.433	74.084	42.801	4.019	41.747	41.747	1.041	1.066
0.800	0.800	18.856	75.712	43.843	4.015	42.789	42.789	1.051	1.066
0.810	0.810	19.289	77.410	44.886	4.013	43.831	43.831	1.061	1.067
0.820	0.820	19.732	79.179	45.928	4.013	44.873	44.873	1.070	1.067
0.830	0.830	20.186	81.016	46.971	4.013	45.916	45.916	1.081	1.067
0.840	0.840	20.651	82.924	48.013	4.016	46.958	46.958	1.091	1.068

S = 5.11%

MANNING'S N = 0.017   SLOPE = 0.051

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	0.9	5.0	12.0	0.1	9.0	38.2	0.7
2.0	9.4	0.7	6.0	24.0	0.2	10.0	38.6	0.7
3.0	9.8	0.7	7.0	36.0	0.1	11.0	48.0	0.9
4.0	10.0	0.0	8.0	38.0	0.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.010	0.010	0.002	0.001	0.329	0.559	1.213	0.313	0.015	1.393
0.020	0.020	0.006	0.006	0.658	0.887	1.526	0.626	0.032	1.563
0.030	0.030	0.014	0.016	0.987	1.162	1.838	0.938	0.051	1.673
0.040	0.040	0.025	0.035	1.316	1.408	2.151	1.251	0.071	1.755
0.050	0.050	0.039	0.064	1.645	1.633	2.464	1.564	0.092	1.821
0.060	0.060	0.056	0.104	1.974	1.845	2.777	1.877	0.113	1.878
0.070	0.070	0.077	0.157	2.303	2.044	3.089	2.189	0.135	1.926
0.080	0.080	0.100	0.224	2.632	2.235	3.402	2.502	0.158	1.970
0.090	0.090	0.127	0.306	2.961	2.417	3.715	2.815	0.181	2.009
0.100	0.100	0.156	0.405	3.290	2.593	4.028	3.128	0.205	2.044
0.110	0.110	0.189	0.523	3.619	2.763	4.340	3.440	0.229	2.077
0.120	0.120	0.225	0.659	3.948	2.928	4.653	3.753	0.253	2.107
0.130	0.130	0.264	0.816	4.277	3.089	4.966	4.066	0.278	2.136
0.140	0.140	0.316	0.833	6.479	2.637	7.153	6.253	0.248	2.068
0.150	0.150	0.389	0.971	8.682	2.494	9.340	8.440	0.247	2.047
0.160	0.160	0.485	1.203	10.884	2.482	11.527	10.627	0.256	2.049
0.170	0.170	0.602	1.527	13.087	2.536	13.714	12.814	0.270	2.063
0.180	0.180	0.741	1.946	15.289	2.627	15.900	15.000	0.287	2.083
0.190	0.190	0.902	2.469	17.492	2.737	18.087	17.187	0.307	2.107
0.200	0.200	1.085	3.103	19.694	2.860	20.274	19.374	0.327	2.131
0.210	0.210	1.289	3.856	21.897	2.991	22.461	21.561	0.349	2.156
0.220	0.220	1.516	4.738	24.100	3.125	24.648	23.748	0.372	2.181
0.230	0.230	1.764	5.756	26.302	3.262	26.835	25.935	0.396	2.205
0.240	0.240	2.035	6.918	28.505	3.400	29.022	28.122	0.420	2.229

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.250	0.250	2.316	8.580	28.525	3.705	29.027	28.127	0.463	2.276
0.260	0.260	2.597	10.381	28.546	3.997	29.032	28.132	0.509	2.319
0.270	0.270	2.878	12.316	28.567	4.279	29.037	28.137	0.555	2.358
0.280	0.280	3.160	14.381	28.587	4.551			0.602	2.394
0.290	0.290	3.441	16.571	28.608	4.815			0.651	2.428
0.300	0.300	3.723	18.882	28.628	5.072			0.700	2.459
0.310	0.310	4.004	21.311	28.649	5.322			0.751	2.488
0.320	0.320	4.286	23.855	28.670	5.566			0.802	2.515
0.330	0.330	4.568	26.512	28.690	5.804			0.854	2.541
0.340	0.340	4.849	29.279	28.711	6.038	29.073	28.173	0.907	2.566
0.350	0.350	5.131	32.153	28.732	6.266	29.078	28.178	0.961	2.589
0.360	0.360	5.413	35.133	28.752	6.491	29.083	28.183	1.015	2.611
0.370	0.370	5.695	38.216	28.773	6.711	29.088	28.188	1.070	2.632
0.380	0.380	5.977	41.401	28.794	6.927	29.093	28.193	1.126	2.652
0.390	0.390	6.259	44.686	28.814	7.140	29.098	28.198	1.183	2.672
0.400	0.400	6.541	48.069	28.835	7.349	29.103	28.203	1.240	2.691
0.410	0.410	6.823	51.549	28.855	7.556	29.108	28.208	1.298	2.708
0.420	0.420	7.105	55.124	28.876	7.759	29.113	28.213	1.356	2.726
0.430	0.430	7.387	58.792	28.897	7.959	29.118	28.218	1.415	2.742
0.440	0.440	7.669	62.553	28.917	8.157	29.123	28.223	1.475	2.759
0.450	0.450	7.951	66.406	28.938	8.351	29.128	28.228	1.535	2.774
0.460	0.460	8.234	70.348	28.959	8.544	29.133	28.233	1.595	2.789
0.470	0.470	8.516	74.379	28.979	8.734	29.139	28.239	1.657	2.804
0.480	0.480	8.798	78.498	29.000	8.922	29.144	28.244	1.718	2.818
0.490	0.490	9.081	82.704	29.021	9.107	29.149	28.249	1.780	2.832
0.500	0.500	9.363	86.995	29.041	9.291	29.154	28.254	1.843	2.845
0.510	0.510	9.646	91.371	29.062	9.472	29.159	28.259	1.906	2.858
0.520	0.520	9.929	95.831	29.082	9.652	29.164	28.264	1.969	2.871
0.530	0.530	10.211	100.374	29.103	9.830	29.169	28.269	2.033	2.883
0.540	0.540	10.494	104.999	29.124	10.006	29.174	28.274	2.097	2.895
0.550	0.550	10.777	109.705	29.144	10.180	29.179	28.279	2.162	2.907
0.560	0.560	11.060	114.491	29.165	10.352	29.184	28.284	2.227	2.919
0.570	0.570	11.342	119.356	29.186	10.523	29.189	28.289	2.292	2.930
0.580	0.580	11.625	124.301	29.206	10.692	29.194	28.294	2.358	2.941
0.590	0.590	11.908	129.323	29.227	10.860	29.199	28.299	2.424	2.951

AP4
Q = 8.1 CFS
d = 0.25'
E = 0.46'

0.600	0.600	12.191	134.423	29.247	11.026	29.204	28.304	2.491	2.962
0.610	0.610	12.474	139.600	29.268	11.191	29.210	28.310	2.558	2.972
0.620	0.620	12.758	144.852	29.289	11.354	29.215	28.315	2.625	2.982
0.630	0.630	13.041	150.180	29.309	11.516	29.220	28.320	2.693	2.992
0.640	0.640	13.324	155.582	29.330	11.677	29.225	28.325	2.761	3.002
0.650	0.650	13.607	161.058	29.351	11.836	29.230	28.330	2.829	3.011
0.660	0.660	13.891	166.608	29.371	11.994	29.235	28.335	2.898	3.020
0.670	0.670	14.174	172.231	29.392	12.151	29.240	28.340	2.967	3.029
0.680	0.680	14.463	174.025	30.434	12.033	30.282	29.382	2.932	3.024
0.690	0.690	14.780	173.138	32.377	11.715	31.324	31.324	2.825	3.007
0.700	0.700	15.098	175.650	33.419	11.634	32.367	32.367	2.805	3.003
0.710	0.710	15.427	178.383	34.462	11.563	33.409	33.409	2.790	3.000
0.720	0.720	15.766	181.331	35.504	11.501	34.451	34.451	2.777	2.997
0.730	0.730	16.116	184.491	36.546	11.448	35.493	35.493	2.768	2.995
0.740	0.740	16.476	187.858	37.589	11.402	36.536	36.536	2.762	2.993
0.750	0.750	16.847	191.430	38.631	11.363	37.578	37.578	2.758	2.992
0.760	0.760	17.228	195.203	39.674	11.331	38.620	38.620	2.757	2.991
0.770	0.770	17.619	199.177	40.716	11.305	39.662	39.662	2.758	2.990
0.780	0.780	18.021	203.349	41.758	11.284	40.704	40.704	2.761	2.990
0.790	0.790	18.433	207.719	42.801	11.269	41.747	41.747	2.765	2.990
0.800	0.800	18.856	212.285	43.843	11.258	42.789	42.789	2.771	2.990
0.810	0.810	19.289	217.047	44.886	11.252	43.831	43.831	2.779	2.990
0.820	0.820	19.732	222.004	45.928	11.251	44.873	44.873	2.789	2.991
0.830	0.830	20.186	227.157	46.971	11.253	45.916	45.916	2.800	2.992
0.840	0.840	20.651	232.505	48.013	11.259	46.958	46.958	2.812	2.993

S = 10.01%

MANNING'S N = 0.017   SLOPE = 0.100

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	0.9	5.0	12.0	0.1	9.0	38.2	0.7
2.0	9.4	0.7	6.0	24.0	0.2	10.0	38.6	0.7
3.0	9.8	0.7	7.0	36.0	0.1	11.0	48.0	0.9
4.0	10.0	0.0	8.0	38.0	0.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.010	0.010	0.002	0.001	0.329	0.782	1.213	0.313	0.020	1.949
0.020	0.020	0.006	0.008	0.658	1.241	1.526	0.626	0.044	2.188
0.030	0.030	0.014	0.023	0.987	1.626	1.838	0.938	0.071	2.341
0.040	0.040	0.025	0.049	1.316	1.970	2.151	1.251	0.100	2.456
0.050	0.050	0.039	0.089	1.645	2.286	2.464	1.564	0.131	2.549
0.060	0.060	0.056	0.145	1.974	2.582	2.777	1.877	0.164	2.628
0.070	0.070	0.077	0.219	2.303	2.861	3.089	2.189	0.197	2.696
0.080	0.080	0.100	0.313	2.632	3.128	3.402	2.502	0.232	2.757
0.090	0.090	0.127	0.429	2.961	3.383	3.715	2.815	0.268	2.812
0.100	0.100	0.156	0.568	3.290	3.629	4.028	3.128	0.305	2.861
0.110	0.110	0.189	0.732	3.619	3.867	4.340	3.440	0.343	2.907
0.120	0.120	0.225	0.923	3.948	4.098	4.653	3.753	0.381	2.950
0.130	0.130	0.264	1.142	4.277	4.323	4.966	4.066	0.421	2.989
0.140	0.140	0.316	1.166	6.479	3.691	7.153	6.253	0.352	2.895
0.150	0.150	0.389	1.359				8.440	0.340	2.865
0.160	0.160	0.485	1.684				10.627	0.348	2.868
0.170	0.170	0.602	2.137				12.814	0.366	2.888
0.180	0.180	0.741	2.724				15.000	0.390	2.916
0.190	0.190	0.902	3.455				17.187	0.418	2.949
0.200	0.200	1.085	4.342				19.374	0.449	2.983
0.210	0.210	1.289	5.397	21.897	4.186	22.461	21.561	0.483	3.018
0.220	0.220	1.516	6.631	24.100	4.374	24.648	23.748	0.518	3.052
0.230	0.230	1.764	8.056	26.302	4.566	26.835	25.935	0.554	3.086
0.240	0.240	2.035	9.682	28.505	4.759	29.022	28.122	0.592	3.119

AP5
Q = 10.1 CFS
d = 0.24'
E = 0.63'

0.250	0.250	2.316	12.008	28.525	5.185	29.027	28.127	0.668	3.186
0.260	0.260	2.597	14.530	28.546	5.594	29.032	28.132	0.747	3.246
0.270	0.270	2.878	17.238	28.567	5.989	29.037	28.137	0.828	3.301
0.280	0.280	3.160	20.128	28.587	6.370	29.042	28.142	0.911	3.351
0.290	0.290	3.441	23.192	28.608	6.739	29.047	28.147	0.996	3.398
0.300	0.300	3.723	26.427	28.628	7.099	29.052	28.152	1.084	3.441
0.310	0.310	4.004	29.827	28.649	7.449	29.057	28.157	1.173	3.482
0.320	0.320	4.286	33.388	28.670	7.790	29.062	28.162	1.264	3.520
0.330	0.330	4.568	37.106	28.690	8.124	29.067	28.167	1.356	3.557
0.340	0.340	4.849	40.979	28.711	8.450	29.073	28.173	1.451	3.591
0.350	0.350	5.131	45.002	28.732	8.770	29.078	28.178	1.546	3.623
0.360	0.360	5.413	49.172	28.752	9.084	29.083	28.183	1.644	3.654
0.370	0.370	5.695	53.488	28.773	9.392	29.088	28.188	1.742	3.684
0.380	0.380	5.977	57.945	28.794	9.695	29.093	28.193	1.842	3.712
0.390	0.390	6.259	62.543	28.814	9.993	29.098	28.198	1.943	3.740
0.400	0.400	6.541	67.278	28.835	10.286	29.103	28.203	2.046	3.766
0.410	0.410	6.823	72.148	28.855	10.575	29.108	28.208	2.149	3.791
0.420	0.420	7.105	77.151	28.876	10.859	29.113	28.213	2.254	3.815
0.430	0.430	7.387	82.286	28.897	11.139	29.118	28.218	2.360	3.838
0.440	0.440	7.669	87.550	28.917	11.416	29.123	28.223	2.467	3.861
0.450	0.450	7.951	92.942	28.938	11.689	29.128	28.228	2.575	3.883
0.460	0.460	8.234	98.460	28.959	11.958	29.133	28.233	2.684	3.904
0.470	0.470	8.516	104.102	28.979	12.224	29.139	28.239	2.794	3.924
0.480	0.480	8.798	109.867	29.000	12.487	29.144	28.244	2.905	3.944
WSEL	DEPTH	FLOW	FLOW	WETTED	FLOW	TOPWID	TOPWID	TOTAL	FROUDE
	INC	AREA	RATE	PER	VEL	PLUS	WATER	ENERGY	NO.
FT.		SQ.FT.	(CFS)	(FT)	(FPS)	OBSTRUCTIONS		(FT)	
0.490	0.490	9.081	115.753	29.021	12.747	29.149	28.249	3.017	3.964
0.500	0.500	9.363	121.760	29.041	13.004	29.154	28.254	3.130	3.982
0.510	0.510	9.646	127.884	29.062	13.258	29.159	28.259	3.244	4.001
0.520	0.520	9.929	134.126	29.082	13.509	29.164	28.264	3.359	4.018
0.530	0.530	10.211	140.484	29.103	13.758	29.169	28.269	3.474	4.036
0.540	0.540	10.494	146.957	29.124	14.004	29.174	28.274	3.590	4.052
0.550	0.550	10.777	153.543	29.144	14.248	29.179	28.279	3.707	4.069
0.560	0.560	11.060	160.242	29.165	14.489	29.184	28.284	3.825	4.085
0.570	0.570	11.342	167.052	29.186	14.728	29.189	28.289	3.944	4.101
0.580	0.580	11.625	173.972	29.206	14.965	29.194	28.294	4.063	4.116
0.590	0.590	11.908	181.002	29.227	15.200	29.199	28.299	4.183	4.131

0.600	0.600	12.191	188.140	29.247	15.432	29.204	28.304	4.304	4.146
0.610	0.610	12.474	195.385	29.268	15.663	29.210	28.310	4.426	4.160
0.620	0.620	12.758	202.736	29.289	15.891	29.215	28.315	4.548	4.174
0.630	0.630	13.041	210.193	29.309	16.118	29.220	28.320	4.671	4.188
0.640	0.640	13.324	217.754	29.330	16.343	29.225	28.325	4.794	4.201
0.650	0.650	13.607	225.419	29.351	16.566	29.230	28.330	4.919	4.214
0.660	0.660	13.891	233.186	29.371	16.787	29.235	28.335	5.043	4.227
0.670	0.670	14.174	241.056	29.392	17.007	29.240	28.340	5.169	4.240
0.680	0.680	14.463	243.566	30.434	16.841	30.282	29.382	5.092	4.232
0.690	0.690	14.780	242.326	32.377	16.396	31.324	31.324	4.871	4.208
0.700	0.700	15.098	245.842	33.419	16.283	32.367	32.367	4.824	4.203
0.710	0.710	15.427	249.667	34.462	16.184	33.409	33.409	4.784	4.199
0.720	0.720	15.766	253.793	35.504	16.097	34.451	34.451	4.750	4.195
0.730	0.730	16.116	258.215	36.546	16.022	35.493	35.493	4.723	4.192
0.740	0.740	16.476	262.928	37.589	15.958	36.536	36.536	4.701	4.189
0.750	0.750	16.847	267.926	38.631	15.904	37.578	37.578	4.684	4.188
0.760	0.760	17.228	273.208	39.674	15.859	38.620	38.620	4.672	4.186
0.770	0.770	17.619	278.770	40.716	15.822	39.662	39.662	4.664	4.185
0.780	0.780	18.021	284.609	41.758	15.793	40.704	40.704	4.660	4.185
0.790	0.790	18.433	290.725	42.801	15.772	41.747	41.747	4.659	4.184
0.800	0.800	18.856	297.116	43.843	15.757	42.789	42.789	4.662	4.185
0.810	0.810	19.289	303.780	44.886	15.749	43.831	43.831	4.668	4.185
0.820	0.820	19.732	310.719	45.928	15.747	44.873	44.873	4.677	4.186
0.830	0.830	20.186	317.931	46.971	15.750	45.916	45.916	4.688	4.188
0.840	0.840	20.651	325.417	48.013	15.758	46.958	46.958	4.702	4.189

S = 6.93%

MANNING'S N = 0.017   SLOPE = 0.069

POINT	DIST	ELEV
1.0	0.0	0.9
2.0	9.4	0.7
3.0	9.8	0.7
4.0	10.0	0.0
5.0	12.0	0.1
6.0	24.0	0.2
7.0	36.0	0.1
8.0	38.0	0.0
9.0	38.2	0.7
10.0	38.6	0.7
11.0	48.0	0.9

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.010	0.010	0.002	0.001	0.329	0.651	1.213	0.313	0.017	1.622
0.020	0.020	0.006	0.006	0.658	1.033	1.526	0.626	0.037	1.821
0.030	0.030	0.014	0.019	0.987	1.353	1.838	0.938	0.058	1.948
0.040	0.040	0.025	0.041	1.316	1.639	2.151	1.251	0.082	2.044
0.050	0.050	0.039	0.074	1.645	1.902	2.464	1.564	0.106	2.121
0.060	0.060	0.056	0.121	1.974	2.148	2.777	1.877	0.132	2.186
0.070	0.070	0.077	0.182	2.303	2.381	3.089	2.189	0.158	2.243
0.080	0.080	0.100	0.260	2.632	2.602	3.402	2.502	0.185	2.294
0.090	0.090	0.127	0.357	2.961	2.815	3.715	2.815	0.213	2.339
0.100	0.100	0.156	0.472	3.290	3.020	4.028	3.128	0.242	2.381
0.110	0.110	0.189	0.609	3.619	3.218	4.340	3.440	0.271	2.419
0.120	0.120	0.225	0.768	3.948	3.410	4.653	3.753	0.301	2.454
0.130	0.130	0.264	0.951	4.277	3.597	4.966	4.066	0.331	2.487
0.140	0.140	0.316	0.970	6.479	3.071	7.153	6.253	0.287	2.409
0.150	0.150	0.389	1.131	8.682	2.905	9.340	8.440	0.281	2.384
0.160	0.160	0.485	1.401	10.884	2.891	11.527	10.627	0.290	2.386
0.170	0.170	0.602	1.778	13.087	2.954	13.714	12.814	0.306	2.403
0.180	0.180	0.741	2.266	15.289	3.059	15.900	15.000	0.326	2.426
0.190	0.190	0.902	2.875	17.492	3.188	18.087	17.187	0.348	2.453
0.200	0.200	1.085	3.613	19.694	3.331	20.274	19.374	0.373	2.482
0.210	0.210	1.289	4.491	21.897	3.483	22.461	21.561	0.399	2.511
0.220	0.220	1.516	5.517	24.100	3.640	24.648	23.748	0.426	2.540
0.230	0.230	1.764	6.703	26.302	3.799	26.835	25.935	0.454	2.568
0.240	0.240	2.035	8.056	28.505	3.960	29.022	28.122	0.484	2.595

0.250	0.250	2.316	9.992	28.525	4.314	29.027	28.127	0.540	2.651
0.260	0.260	2.597	12.089	28.546	4.655	29.032	28.132	0.597	2.701
0.270	0.270	2.878	14.343	28.567	4.983	29.037	28.137	0.656	2.746
0.280	0.280	3.160	16.747	28.587	5.300	29.042	28.142	0.717	2.788
0.290	0.290	3.441	19.297	28.608	5.607	29.047	28.147	0.779	2.827
0.300	0.300	3.723	21.988	28.628	5.906			.843	2.863
0.310	0.310	4.004	24.817	28.649	6.198			.907	2.897
0.320	0.320	4.286	27.780	28.670	6.482			.973	2.929
0.330	0.330	4.568	30.874	28.690	6.759			.041	2.959
0.340	0.340	4.849	34.096	28.711	7.031			.109	2.988
0.350	0.350	5.131	37.444	28.732	7.297			.178	3.015
0.360	0.360	5.413	40.914	28.752	7.559	29.083	28.183	1.249	3.041
0.370	0.370	5.695	44.504	28.773	7.815	29.088	28.188	1.320	3.065
0.380	0.380	5.977	48.213	28.794	8.067	29.093	28.193	1.392	3.089
0.390	0.390	6.259	52.039	28.814	8.315	29.098	28.198	1.465	3.111
0.400	0.400	6.541	55.978	28.835	8.559	29.103	28.203	1.539	3.133
0.410	0.410	6.823	60.031	28.855	8.799	29.108	28.208	1.614	3.154
0.420	0.420	7.105	64.194	28.876	9.035	29.113	28.213	1.690	3.174
0.430	0.430	7.387	68.466	28.897	9.269	29.118	28.218	1.766	3.194
0.440	0.440	7.669	72.846	28.917	9.499	29.123	28.223	1.843	3.212
0.450	0.450	7.951	77.332	28.938	9.726	29.128	28.228	1.921	3.231
0.460	0.460	8.234	81.924	28.959	9.950	29.133	28.233	2.000	3.248
0.470	0.470	8.516	86.618	28.979	10.171	29.139	28.239	2.079	3.265
0.480	0.480	8.798	91.415	29.000	10.390	29.144	28.244	2.159	3.282
WSEL	DEPTH	FLOW	FLOW	WETTED	FLOW	TOPWID	TOPWID	TOTAL	FROUDE
	INC	AREA	RATE	PER	VEL	PLUS	WATER	ENERGY	NO.
FT.		SQ.FT.	(CFS)	(FT)	(FPS)	OBSTRUCTIONS		(FT)	
0.490	0.490	9.081	96.313	29.021	10.606	29.149	28.249	2.240	3.298
0.500	0.500	9.363	101.310	29.041	10.820	29.154	28.254	2.321	3.313
0.510	0.510	9.646	106.406	29.062	11.031	29.159	28.259	2.403	3.329
0.520	0.520	9.929	111.600	29.082	11.240	29.164	28.264	2.485	3.343
0.530	0.530	10.211	116.890	29.103	11.447	29.169	28.269	2.568	3.358
0.540	0.540	10.494	122.276	29.124	11.652	29.174	28.274	2.652	3.372
0.550	0.550	10.777	127.756	29.144	11.855	29.179	28.279	2.736	3.386
0.560	0.560	11.060	133.329	29.165	12.056	29.184	28.284	2.821	3.399
0.570	0.570	11.342	138.996	29.186	12.254	29.189	28.289	2.906	3.412
0.580	0.580	11.625	144.754	29.206	12.452	29.194	28.294	2.992	3.425
0.590	0.590	11.908	150.603	29.227	12.647	29.199	28.299	3.078	3.437

AP6
Q = 13.7 CFS
d = 0.27'
E = 0.65'

0.600	0.600	12.191	156.542	29.247	12.840	29.204	28.304	3.164	3.449
0.610	0.610	12.474	162.570	29.268	13.032	29.210	28.310	3.252	3.461
0.620	0.620	12.758	168.687	29.289	13.223	29.215	28.315	3.339	3.473
0.630	0.630	13.041	174.891	29.309	13.411	29.220	28.320	3.428	3.484
0.640	0.640	13.324	181.182	29.330	13.598	29.225	28.325	3.516	3.495
0.650	0.650	13.607	187.560	29.351	13.784	29.230	28.330	3.605	3.506
0.660	0.660	13.891	194.023	29.371	13.968	29.235	28.335	3.695	3.517
0.670	0.670	14.174	200.570	29.392	14.151	29.240	28.340	3.785	3.528
0.680	0.680	14.463	202.659	30.434	14.013	30.282	29.382	3.734	3.521
0.690	0.690	14.780	201.627	32.377	13.642	31.324	31.324	3.585	3.501
0.700	0.700	15.098	204.553	33.419	13.548	32.367	32.367	3.555	3.497
0.710	0.710	15.427	207.735	34.462	13.466	33.409	33.409	3.530	3.494
0.720	0.720	15.766	211.169	35.504	13.394	34.451	34.451	3.510	3.491
0.730	0.730	16.116	214.848	36.546	13.331	35.493	35.493	3.494	3.488
0.740	0.740	16.476	218.769	37.589	13.278	36.536	36.536	3.482	3.486
0.750	0.750	16.847	222.928	38.631	13.233	37.578	37.578	3.474	3.484
0.760	0.760	17.228	227.323	39.674	13.195	38.620	38.620	3.468	3.483
0.770	0.770	17.619	231.950	40.716	13.165	39.662	39.662	3.466	3.482
0.780	0.780	18.021	236.809	41.758	13.141	40.704	40.704	3.466	3.482
0.790	0.790	18.433	241.898	42.801	13.123	41.747	41.747	3.469	3.482
0.800	0.800	18.856	247.215	43.843	13.111	42.789	42.789	3.474	3.482
0.810	0.810	19.289	252.761	44.886	13.104	43.831	43.831	3.481	3.482
0.820	0.820	19.732	258.534	45.928	13.102	44.873	44.873	3.490	3.483
0.830	0.830	20.186	264.534	46.971	13.105	45.916	45.916	3.501	3.484
0.840	0.840	20.651	270.763	48.013	13.112	46.958	46.958	3.514	3.486

S = 0.81%

MANNING'S N = 0.017   SLOPE = 0.008

POINT	DIST	ELEV	POINT	DIST	ELEV	POINT	DIST	ELEV
1.0	0.0	0.9	5.0	12.0	0.1	9.0	38.2	0.7
2.0	9.4	0.7	6.0	24.0	0.2	10.0	38.6	0.7
3.0	9.8	0.7	7.0	36.0	0.1	11.0	48.0	0.9
4.0	10.0	0.0	8.0	38.0	0.0			

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.010	0.010	0.002	0.000	0.329	0.222	1.213	0.313	0.011	0.555
0.020	0.020	0.006	0.002	0.658	0.353	1.526	0.626	0.022	0.622
0.030	0.030	0.014	0.007	0.987	0.463	1.838	0.938	0.033	0.666
0.040	0.040	0.025	0.014	1.316	0.560	2.151	1.251	0.045	0.699
0.050	0.050	0.039	0.025	1.645	0.650	2.464	1.564	0.057	0.725
0.060	0.060	0.056	0.041	1.974	0.734	2.777	1.877	0.068	0.748
0.070	0.070	0.077	0.062	2.303	0.814	3.089	2.189	0.080	0.767
0.080	0.080	0.100	0.089	2.632	0.890	3.402	2.502	0.092	0.784
0.090	0.090	0.127	0.122	2.961	0.962	3.715	2.815	0.104	0.800
0.100	0.100	0.156	0.161	3.290	1.032	4.028	3.128	0.117	0.814
0.110	0.110	0.189	0.208	3.619	1.100	4.340	3.440	0.129	0.827
0.120	0.120	0.225	0.263	3.948	1.166	4.653	3.753	0.141	0.839
0.130	0.130	0.264	0.325	4.277	1.230	4.966	4.066	0.154	0.850
0.140	0.140	0.316	0.332	6.479	1.050	7.153	6.253	0.157	0.824
0.150	0.150	0.389	0.387	8.682	0.993	9.340	8.440	0.165	0.815
0.160	0.160	0.485	0.479	10.884	0.988	11.527	10.627	0.175	0.816
0.170	0.170	0.602	0.608	13.087	1.010	13.714	12.814	0.186	0.821
0.180	0.180	0.741	0.775	15.289	1.046	15.900	15.000	0.197	0.829
0.190	0.190	0.902	0.983	17.492	1.090	18.087	17.187	0.208	0.839
0.200	0.200	1.085	1.235	19.694	1.139	20.274	19.374	0.220	0.849
0.210	0.210	1.289	1.535	21.897	1.191	22.461	21.561	0.232	0.858
0.220	0.220	1.516	1.886	24.100	1.244	24.648	23.748	0.244	0.868
0.230	0.230	1.764	2.291	26.302	1.299	26.835	25.935	0.256	0.878
0.240	0.240	2.035	2.754	28.505	1.354	29.022	28.122	0.269	0.887

WSEL FT.	DEPTH INC	FLOW AREA SQ.FT.	FLOW RATE (CFS)	WETTED PER (FT)	FLOW VEL (FPS)	TOPWID PLUS OBSTRUCTIONS	TOPWID WATER	TOTAL ENERGY (FT)	FROUDE NO.
0.250	0.250	2.316	3.416	28.525	1.475	29.027	28.127	0.284	0.906
0.260	0.260	2.597	4.133	28.546	1.591	29.032	28.132	0.299	0.923
0.270	0.270	2.878	4.904	28.567	1.704	29.037	28.137	0.315	0.939
0.280	0.280	3.160	5.726	28.587	1.812	29.042	28.142	0.331	0.953
0.290	0.290	3.441	6.597	28.608	1.917	29.047	28.147	0.347	0.967
0.300	0.300	3.723	7.517	28.628	2.019	29.052	28.152	0.363	0.979
0.310	0.310	4.004	8.485	28.649	2.119	29.057	28.157	0.380	0.991
0.320	0.320	4.286	9.498	28.670	2.216	29.062	28.162	0.396	1.001
0.330	0.330	4.568	10.555	28.690	2.311	29.067	28.167	0.413	1.012
0.340	0.340	4.849	11.657	28.711	2.404	29.073	28.173	0.430	1.021
0.350	0.350	5.131	12.801	28.732	2.495	29.078	28.178	0.447	1.031
0.360	0.360	5.413	13.988	28.752	2.584	29.083	28.183	0.464	1.040
0.370	0.370	5.695	15.215	28.773	2.672	29.088	28.188	0.481	1.048
0.380	0.380	5.977	16.483	28.794	2.758	29.093	28.193	0.498	1.056
0.390	0.390	6.259	17.791	28.814	2.843	29.098	28.198	0.516	1.064
0.400	0.400	6.541	19.138	28.835	2.926	29.103	28.203	0.533	1.071
0.410	0.410	6.823	20.523	28.855	3.008	[illegible]	[illegible]	551	1.078
0.420	0.420	7.105	21.947	28.876	3.089	[illegible]	[illegible]	568	1.085
0.430	0.430	7.387	23.407	28.897	3.169	[illegible]	[illegible]	586	1.092
0.440	0.440	7.669	24.905	28.917	3.247	[illegible]	[illegible]	604	1.098
0.450	0.450	7.951	26.439	28.938	3.325	[illegible]	[illegible]	622	1.104
0.460	0.460	8.234	28.008	28.959	3.402	[illegible]	[illegible]	640	1.111
0.470	0.470	8.516	29.613	28.979	3.477	29.139	28.239	0.658	1.116
0.480	0.480	8.798	31.253	29.000	3.552	29.144	28.244	0.676	1.122
0.490	0.490	9.081	32.928	29.021	3.626	29.149	28.249	0.695	1.127
0.500	0.500	9.363	34.636	29.041	3.699	29.154	28.254	0.713	1.133
0.510	0.510	9.646	36.378	29.062	3.771	29.159	28.259	0.731	1.138
0.520	0.520	9.929	38.154	29.082	3.843	29.164	28.264	0.750	1.143
0.530	0.530	10.211	39.963	29.103	3.914	29.169	28.269	0.768	1.148
0.540	0.540	10.494	41.804	29.124	3.984	29.174	28.274	0.787	1.153
0.550	0.550	10.777	43.677	29.144	4.053	29.179	28.279	0.805	1.157
0.560	0.560	11.060	45.583	29.165	4.122	29.184	28.284	0.824	1.162
0.570	0.570	11.342	47.520	29.186	4.190	29.189	28.289	0.843	1.166
0.580	0.580	11.625	49.489	29.206	4.257	29.194	28.294	0.862	1.171
0.590	0.590	11.908	51.488	29.227	4.324	29.199	28.299	0.881	1.175

AP7
Q = 16.4 CFS
d = 0.38'
E = 0.49'

0.600	0.600	12.191	53.519	29.247	4.390	29.204	28.304	0.900	1.179
0.610	0.610	12.474	55.580	29.268	4.455	29.210	28.310	0.919	1.183
0.620	0.620	12.758	57.671	29.289	4.521	29.215	28.315	0.938	1.187
0.630	0.630	13.041	59.792	29.309	4.585	29.220	28.320	0.957	1.191
0.640	0.640	13.324	61.943	29.330	4.649	29.225	28.325	0.976	1.195
0.650	0.650	13.607	64.123	29.351	4.712	29.230	28.330	0.995	1.199
0.660	0.660	13.891	66.333	29.371	4.775	29.235	28.335	1.015	1.202
0.670	0.670	14.174	68.571	29.392	4.838	29.240	28.340	1.034	1.206
0.680	0.680	14.463	69.286	30.434	4.791	30.282	29.382	1.037	1.204
0.690	0.690	14.780	68.933	32.377	4.664	31.324	31.324	1.028	1.197
0.700	0.700	15.098	69.933	33.419	4.632	32.367	32.367	1.034	1.196
0.710	0.710	15.427	71.021	34.462	4.604	33.409	33.409	1.040	1.194
0.720	0.720	15.766	72.195	35.504	4.579	34.451	34.451	1.046	1.193
0.730	0.730	16.116	73.453	36.546	4.558	35.493	35.493	1.053	1.192
0.740	0.740	16.476	74.793	37.589	4.540	36.536	36.536	1.061	1.192
0.750	0.750	16.847	76.215	38.631	4.524	37.578	37.578	1.068	1.191
0.760	0.760	17.228	77.718	39.674	4.511	38.620	38.620	1.077	1.191
0.770	0.770	17.619	79.300	40.716	4.501	39.662	39.662	1.085	1.191
0.780	0.780	18.021	80.961	41.758	4.493	40.704	40.704	1.094	1.190
0.790	0.790	18.433	82.700	42.801	4.487	41.747	41.747	1.103	1.190
0.800	0.800	18.856	84.518	43.843	4.482	42.789	42.789	1.113	1.190
0.810	0.810	19.289	86.414	44.886	4.480	43.831	43.831	1.122	1.191
0.820	0.820	19.732	88.388	45.928	4.479	44.873	44.873	1.132	1.191
0.830	0.830	20.186	90.440	46.971	4.480	45.916	45.916	1.142	1.191
0.840	0.840	20.651	92.569	48.013	4.483	46.958	46.958	1.153	1.192

ANALYSIS OF AN INLET IN A SUMP CONDITION - **IN 1 & IN 2**

INLET TYPE: Double Grate Type "A" with curb opening wings on both sides on inlet.

WEIR: Q=C*L*H^1.5

Wing opening
C= 3.0
L= 4.0 ft
Q=3.0(4.0')H^1.5= 12.0H^1.5

Grate opening
C=3.0
L(double grate)=[2(2.67')+2(1.8')]=8.94 ft
Q=3.0(8.94)H^1.5=26.82*H^1.5

ORIFICE: Q=C*A*(2*G*H)^0.5

Grate opening
C=0.6
A(double grate)=8.19 sf
Q=0.6(7.14)((64.4*H))^0.5

Wing opening*
C=0.6
A=2.0 sf
Q=1.2*(64.4*H)^0.5
*not included in the orifice calc

	WS ELEVATION	HEIGHT ABOVE INLET	Q (CFS) WEIR "A" OPENING	Q (CFS) WEIR DOUBLE GRATE	Q (CFS) ORIFICE DOUBLE GRATE	TOTAL Q (CFS)	Q=51.23 cfs/2 = 25.62 cfs per inlet **COMMENTS:**
~FL @ INLET	0.00	0.00	0.00	0.00	0.00	0.00	Flow at double "A" inlet w/ two wing openings
	0.10	0.10	0.38	0.85	12.47	1.61	Weir controls on grate analysis
	0.20	0.20	1.07	2.40	17.64	4.55	
	0.30	0.30	1.97	4.41	21.60	8.35	
	0.40	0.40	3.04	6.78	24.94	12.86	
	0.50	0.50	4.24	9.48	27.88	17.97	
	0.60	0.60	5.58	12.46	30.55	23.62	@ Q(100 yr) = 17.7 cfs
TOP OF CURB	0.70	0.70	7.03	15.71	32.99	29.76	
	0.80	0.80	8.59	19.19	35.27	36.36	@ Q(2 x100 yr) = 35.5 cfs
ROW LIMIT	0.86	0.86	9.52	21.28	36.51	40.32	
	0.90	0.90	10.25	22.90	37.41	43.39	
	1.00	1.00	12.00	26.82	39.43	50.82	
	1.10	1.10	13.84	30.94	41.36	58.63	

NOTE: The total runoff intercepted by the inlet at the low point in the road is:

Qr(100) = 2*[(runoff of the wing opening) + (the lesser of the weir or orifice amount taken by the double grate)].

APPENDIX C:

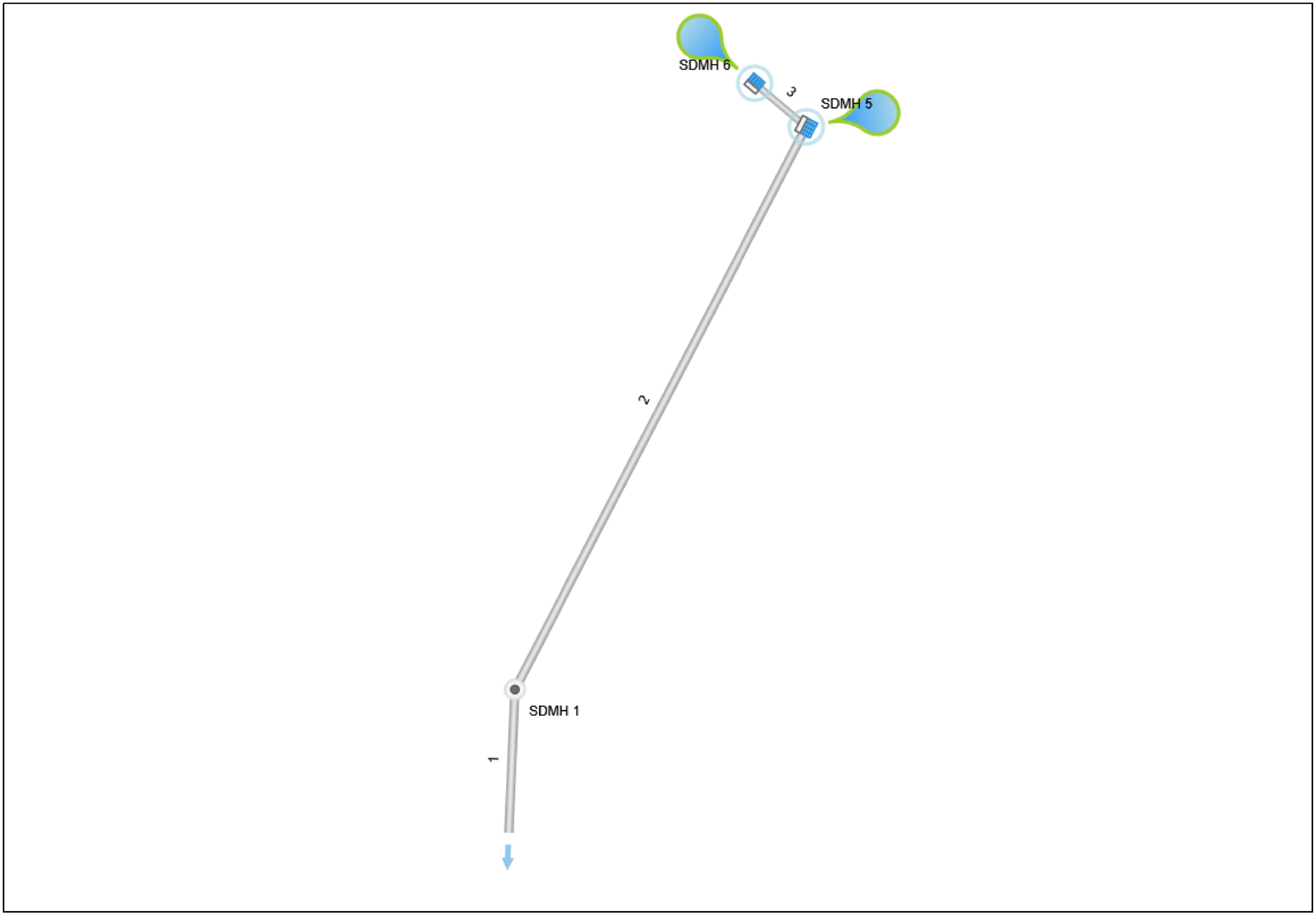
STORM DRAIN PIPE ANALYSIS

Plan View

Stormwater Studio 2022 v 3.0.0.29

Project Name: SD

10-13-2022



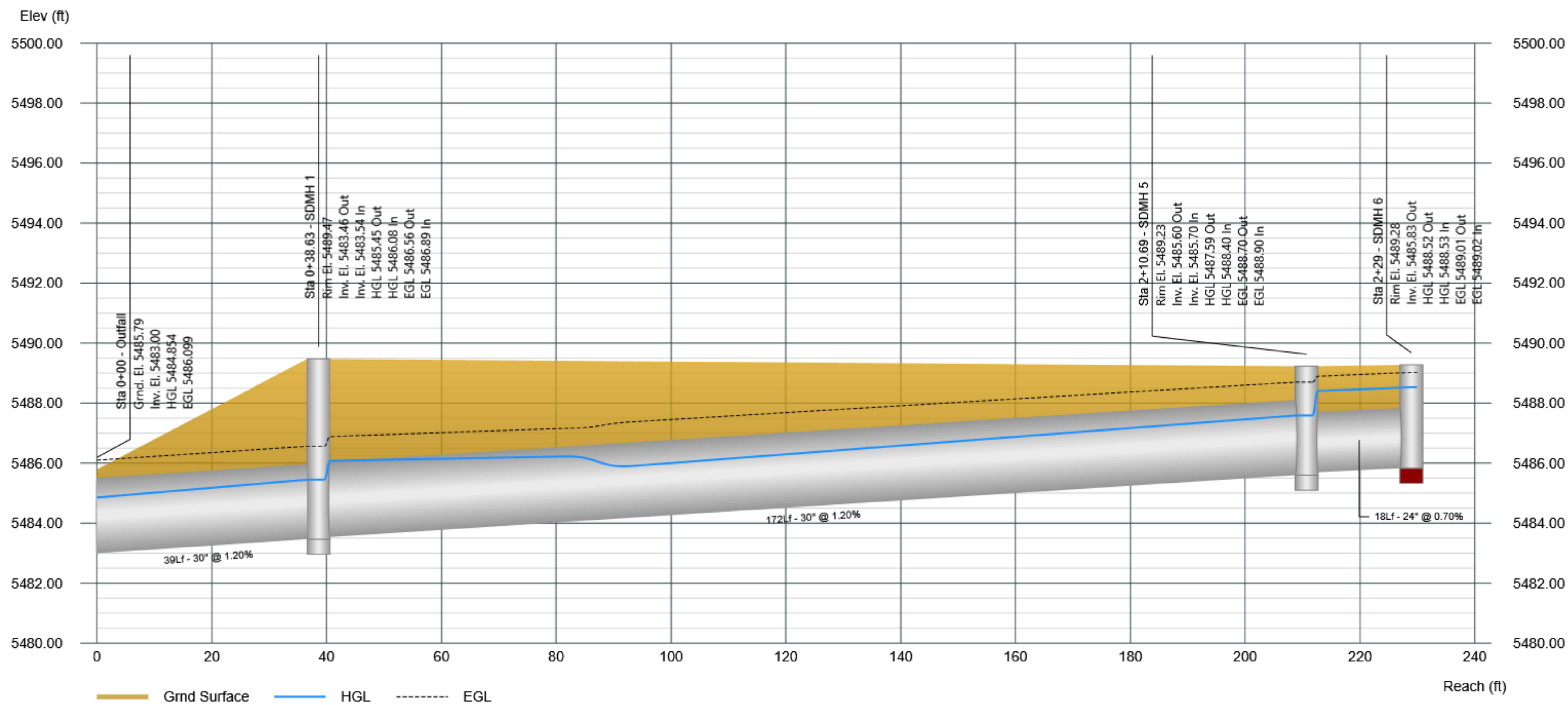
Project File: 20220092HGL Analysis_10-13-2022.sws

Profile View

Stormwater Studio 2022 v 3.0.0.29

Project Name: SD

10-13-2022



Project File: 20220092HGL Analysis_10-13-2022.sws

LineNo.	LineNo.	LineID	LineSize (in)	FlowRate (cfs)	VelAve (ft/s)	Grnd/RimE (ft)	HGLDn (ft)	Grnd/RimE (ft)	HGLUp (ft)	EGLDn (ft)	EGLUp (ft)	VelDn (ft/s)	VelUp (ft/s)
1	1	SDP 1	30	35.4	8.76	5485.79	5484.85	5489.47	5485.45	5486.1	5486.56	9.07	8.46
2	2	SDP 3	30	35.4	7.83	5489.47	5486.08	5489.23	5487.59	5486.89	5488.7	7.21	8.46
3	3	SDP 4	24	17.7	5.63	5489.23	5488.4	5489.28	5488.52	5488.9	5489.01	5.64	5.63

APPENDIX D:
SWALE CALCULATIONS

Channel Report

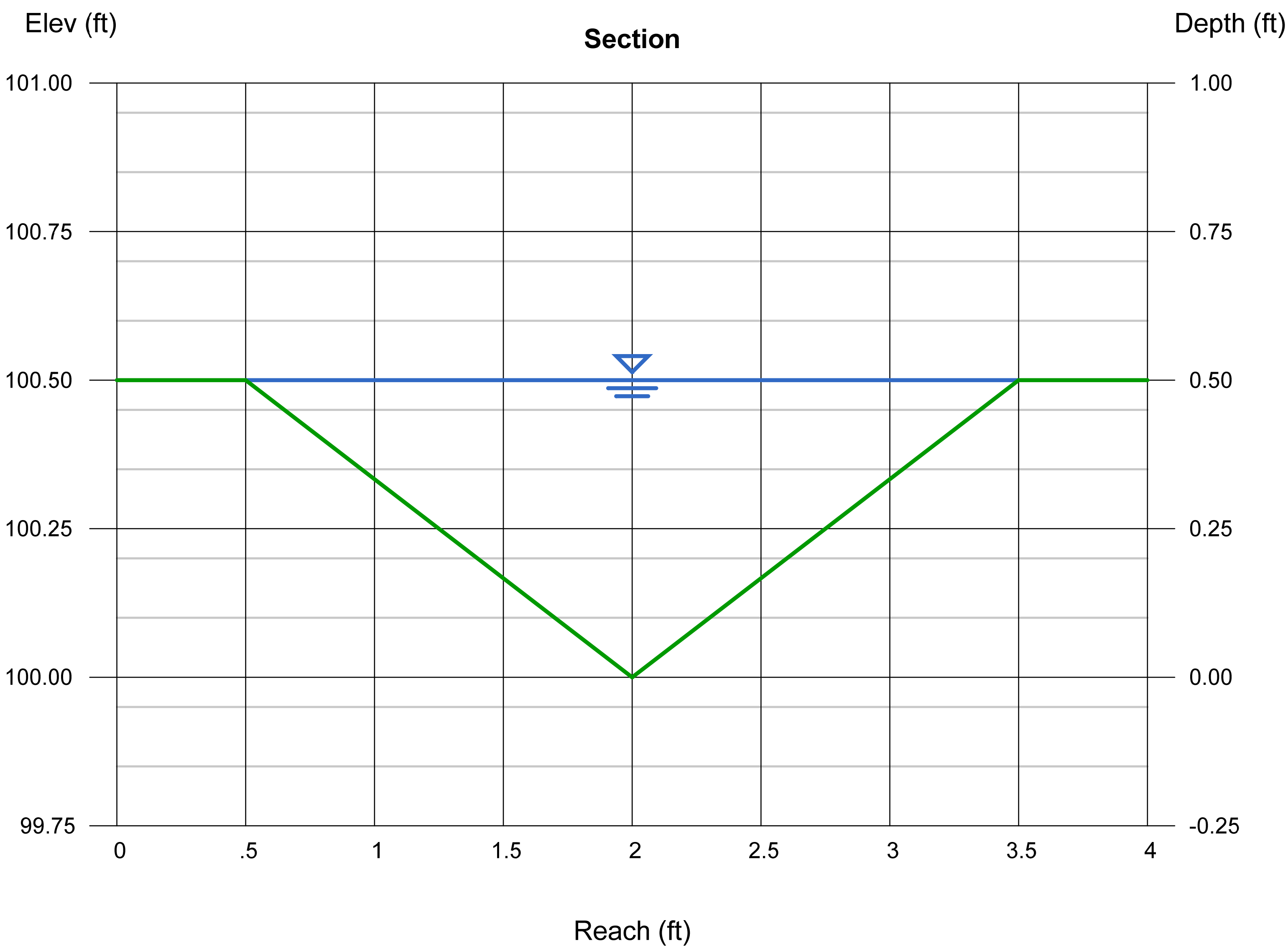
East Swale_S=1.14%

Triangular	
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.14
N-Value	= 0.035

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted	
Depth (ft)	= 0.50
Q (cfs)	= 1.302
Area (sqft)	= 0.75
Velocity (ft/s)	= 1.74
Wetted Perim (ft)	= 3.16
Crit Depth, Yc (ft)	= 0.42
Top Width (ft)	= 3.00
EGL (ft)	= 0.55



Channel Report

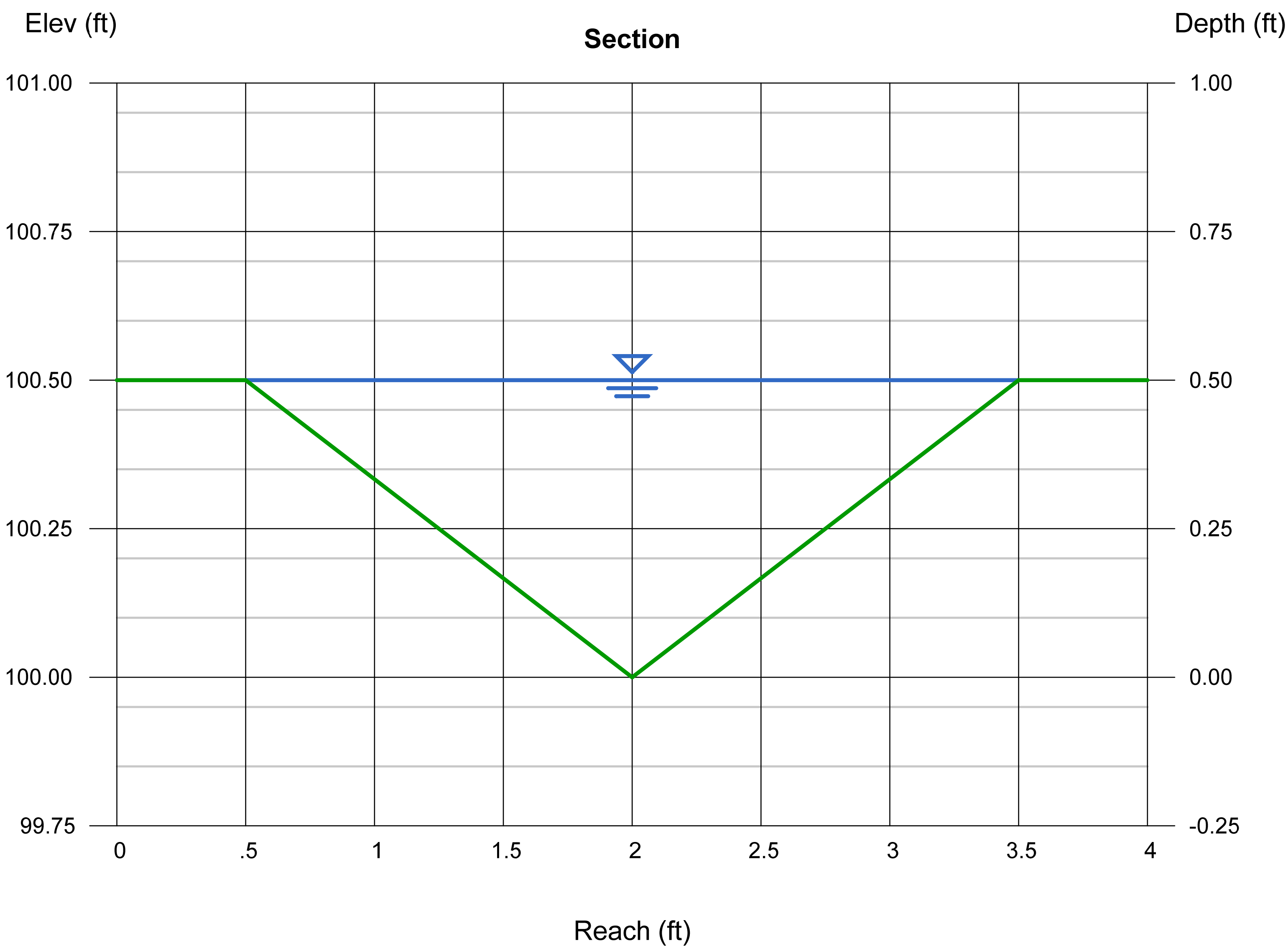
East Swale_S=2.51%

Triangular
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 100.00
Slope (%) = 2.51
N-Value = 0.035

Calculations
Compute by: Q vs Depth
No. Increments = 10

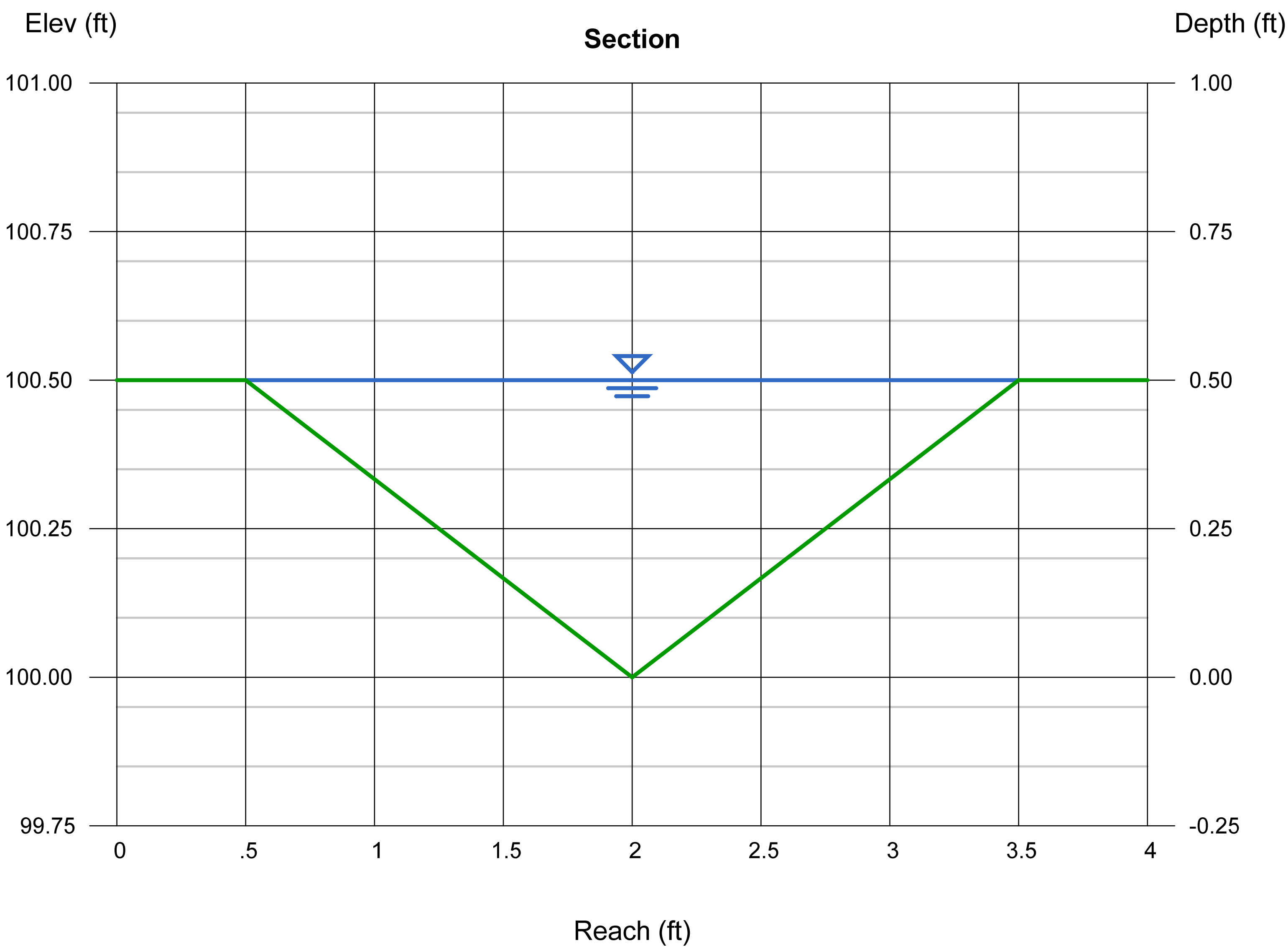
Highlighted
Depth (ft) = 0.50
Q (cfs) = 1.932
Area (sqft) = 0.75
Velocity (ft/s) = 2.58
Wetted Perim (ft) = 3.16
Crit Depth, Yc (ft) = 0.49
Top Width (ft) = 3.00
EGL (ft) = 0.60



Channel Report

East Swale_S=10.27%

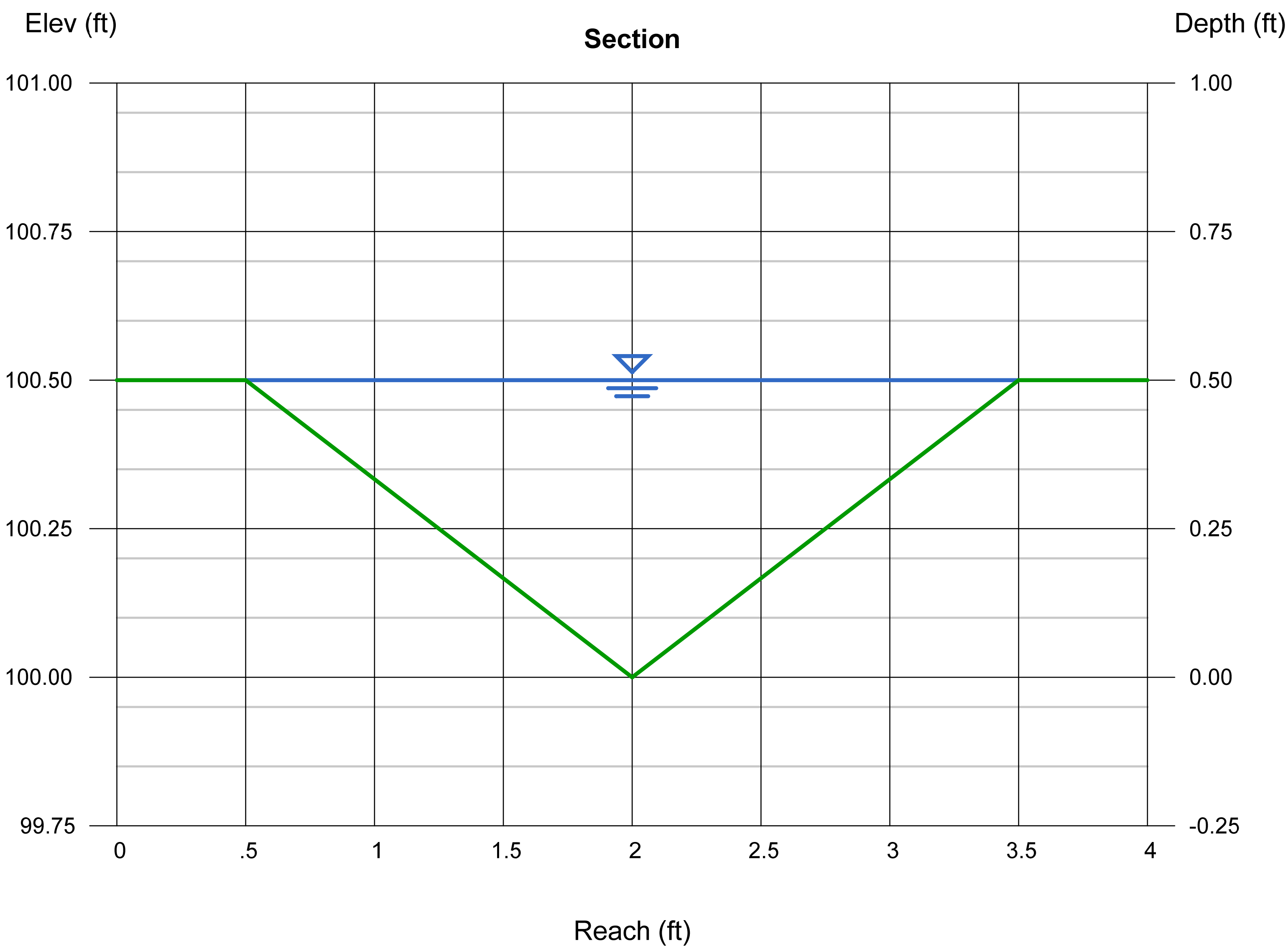
Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.00	Depth (ft)	= 0.50
Total Depth (ft)	= 0.50	Q (cfs)	= 3.908
		Area (sqft)	= 0.75
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 5.21
Slope (%)	= 10.27	Wetted Perim (ft)	= 3.16
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.50
		Top Width (ft)	= 3.00
Calculations		EGL (ft)	= 0.92
Compute by:	Q vs Depth		
No. Increments	= 10		



Channel Report

East Swale_S=17.01%

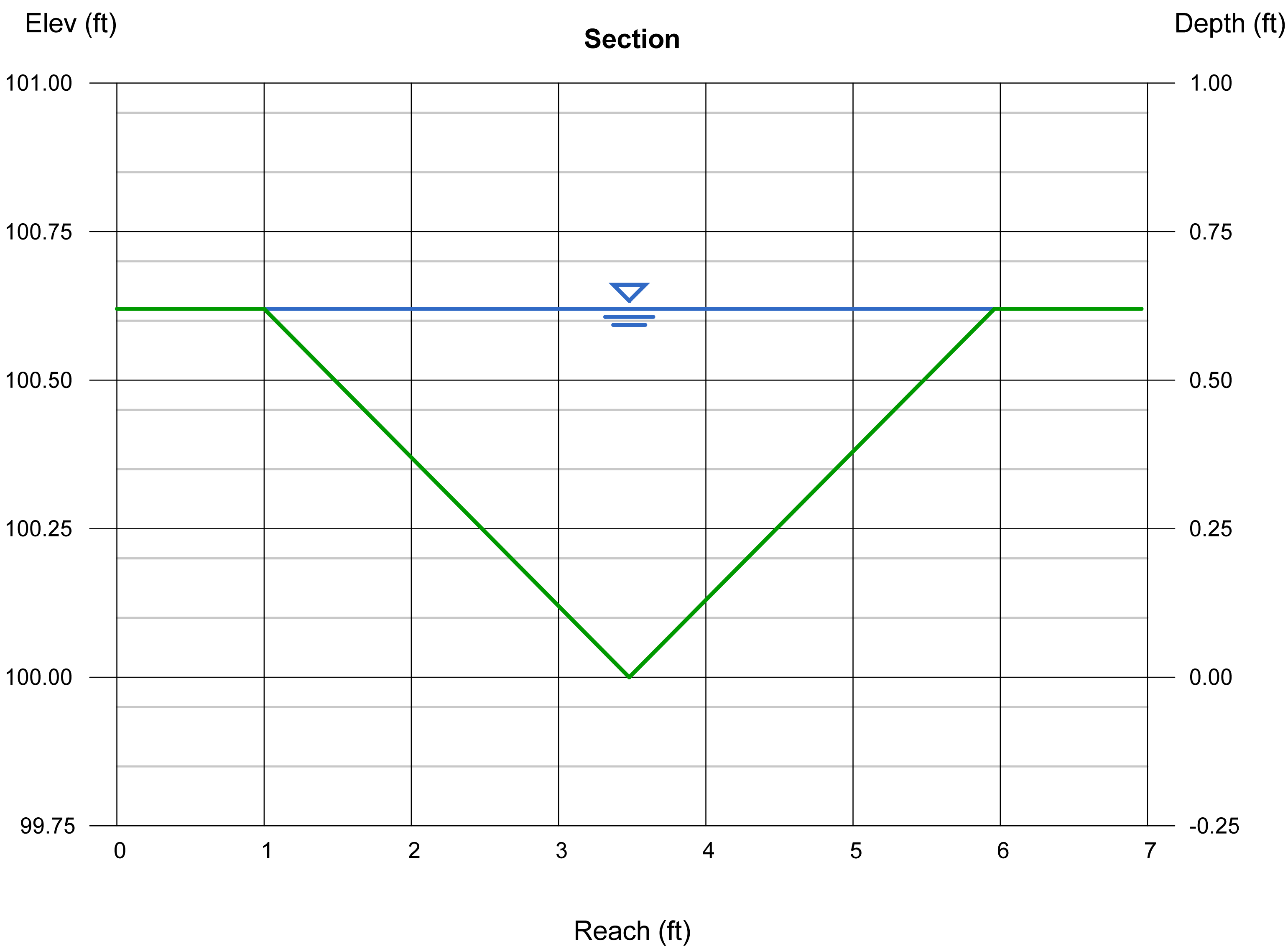
Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.00	Depth (ft)	= 0.50
Total Depth (ft)	= 0.50	Q (cfs)	= 5.030
		Area (sqft)	= 0.75
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 6.71
Slope (%)	= 17.01	Wetted Perim (ft)	= 3.16
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.50
		Top Width (ft)	= 3.00
Calculations		EGL (ft)	= 1.20
Compute by:	Q vs Depth		
No. Increments	= 10		



Channel Report

North Swale_S=1.03%

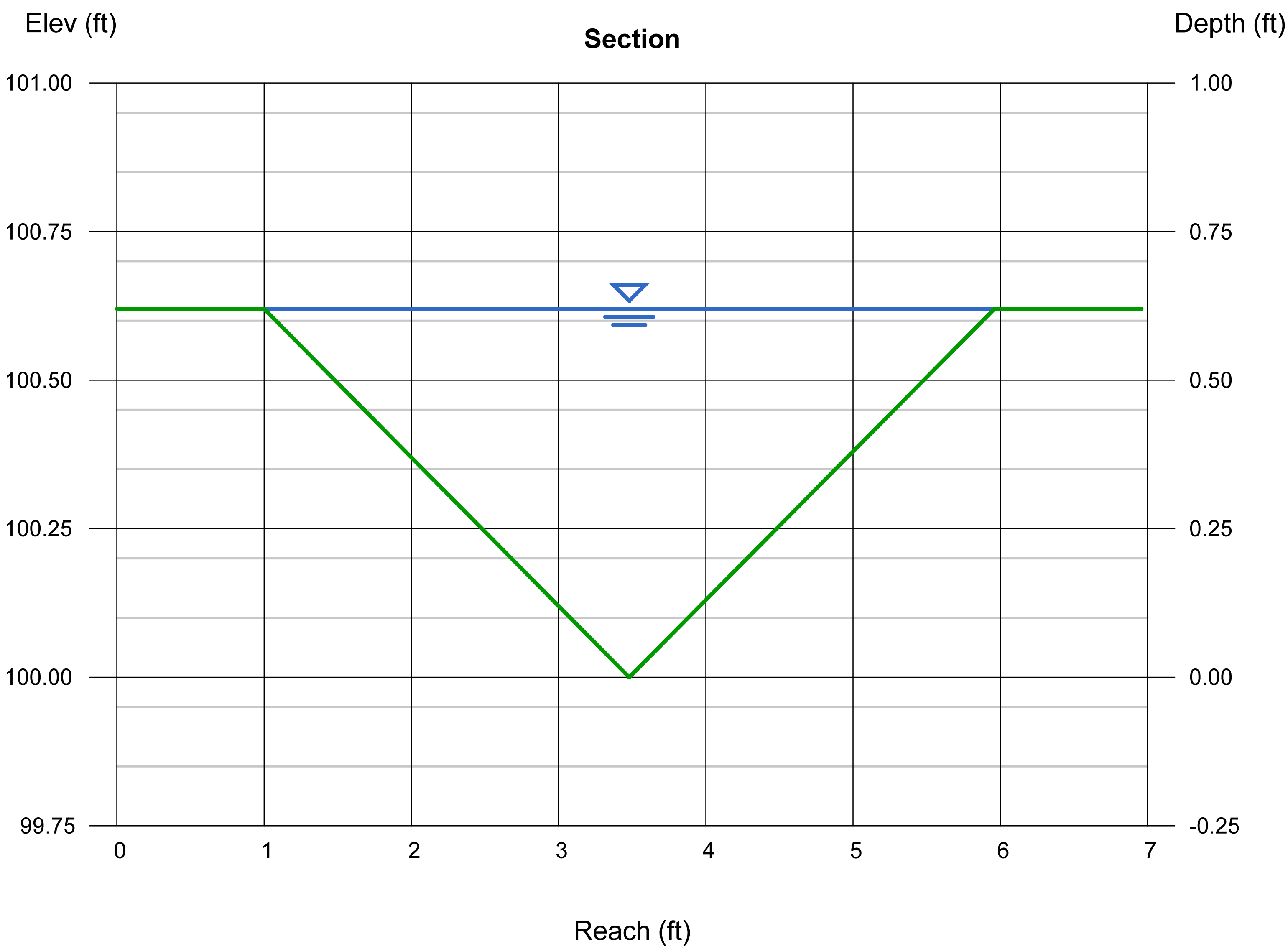
Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.62
Total Depth (ft)	= 0.62	Q (cfs)	= 2.973
		Area (sqft)	= 1.54
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 1.93
Slope (%)	= 1.03	Wetted Perim (ft)	= 5.11
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.51
		Top Width (ft)	= 4.96
Calculations		EGL (ft)	= 0.68
Compute by:	Q vs Depth		
No. Increments	= 10		



Channel Report

North Swale_S=2.68%

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.62
Total Depth (ft)	= 0.62	Q (cfs)	= 4.795
		Area (sqft)	= 1.54
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 3.12
Slope (%)	= 2.68	Wetted Perim (ft)	= 5.11
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.62
		Top Width (ft)	= 4.96
Calculations		EGL (ft)	= 0.77
Compute by:	Q vs Depth		
No. Increments	= 10		



Channel Report

North Swale_S=2.85%

Triangular

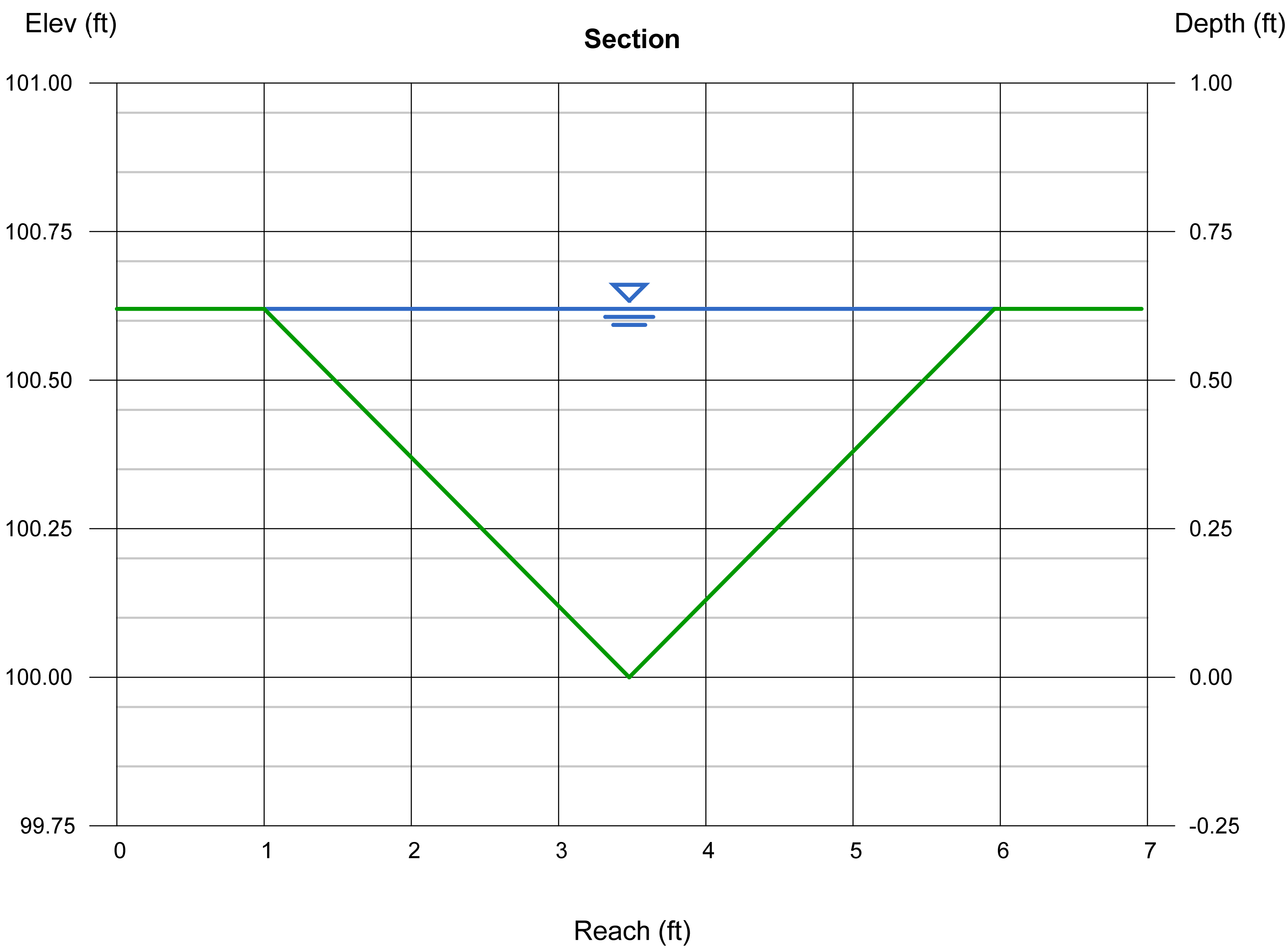
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 0.62
Invert Elev (ft)	= 100.00
Slope (%)	= 2.85
N-Value	= 0.035

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.62
Q (cfs)	= 4.945
Area (sqft)	= 1.54
Velocity (ft/s)	= 3.22
Wetted Perim (ft)	= 5.11
Crit Depth, Yc (ft)	= 0.62
Top Width (ft)	= 4.96
EGL (ft)	= 0.78



Channel Report

North Swale_S=3.78%

Triangular

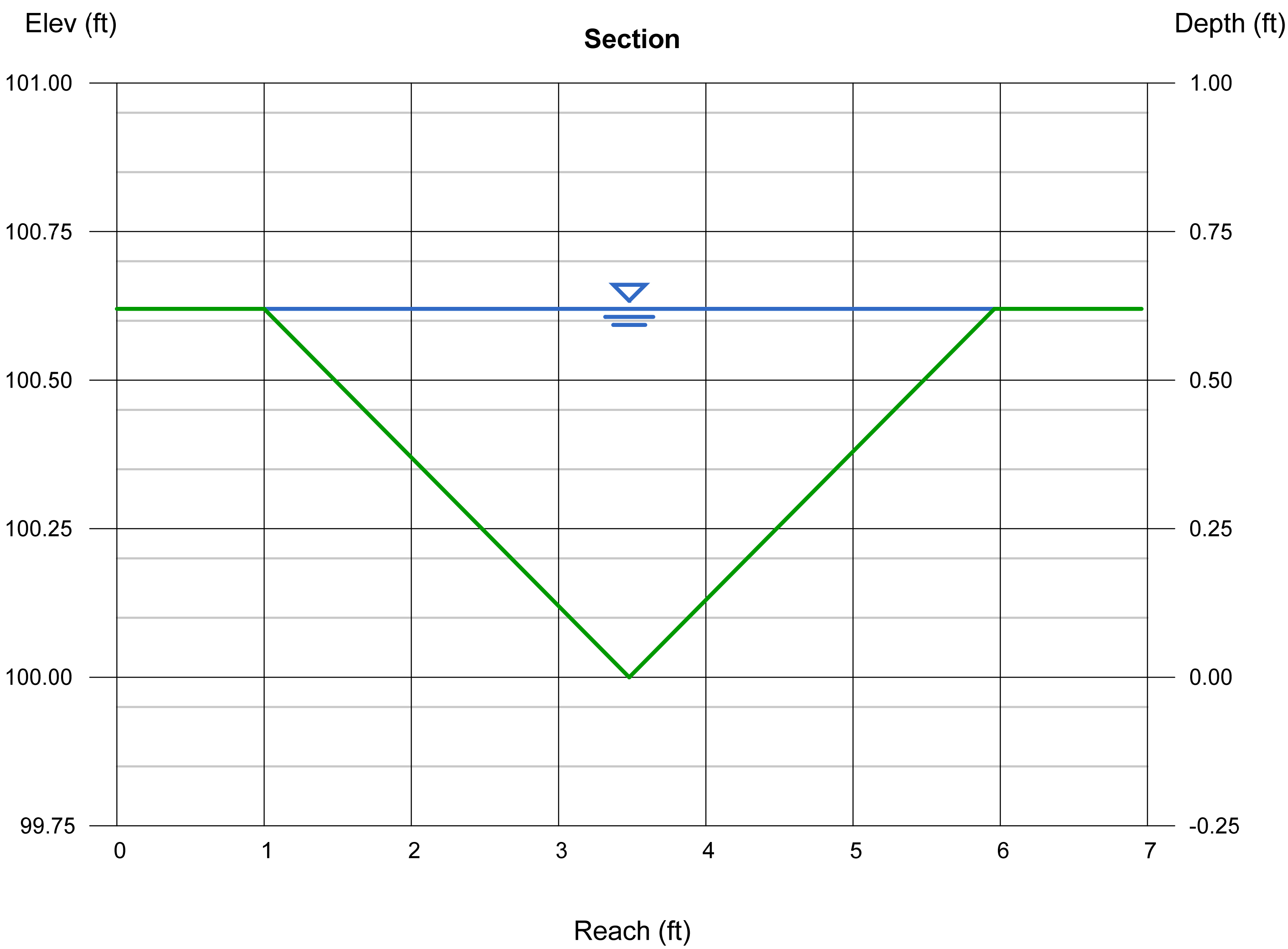
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 0.62
Invert Elev (ft)	= 100.00
Slope (%)	= 3.78
N-Value	= 0.035

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.62
Q (cfs)	= 5.695
Area (sqft)	= 1.54
Velocity (ft/s)	= 3.70
Wetted Perim (ft)	= 5.11
Crit Depth, Yc (ft)	= 0.62
Top Width (ft)	= 4.96
EGL (ft)	= 0.83



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Aug 11 2022

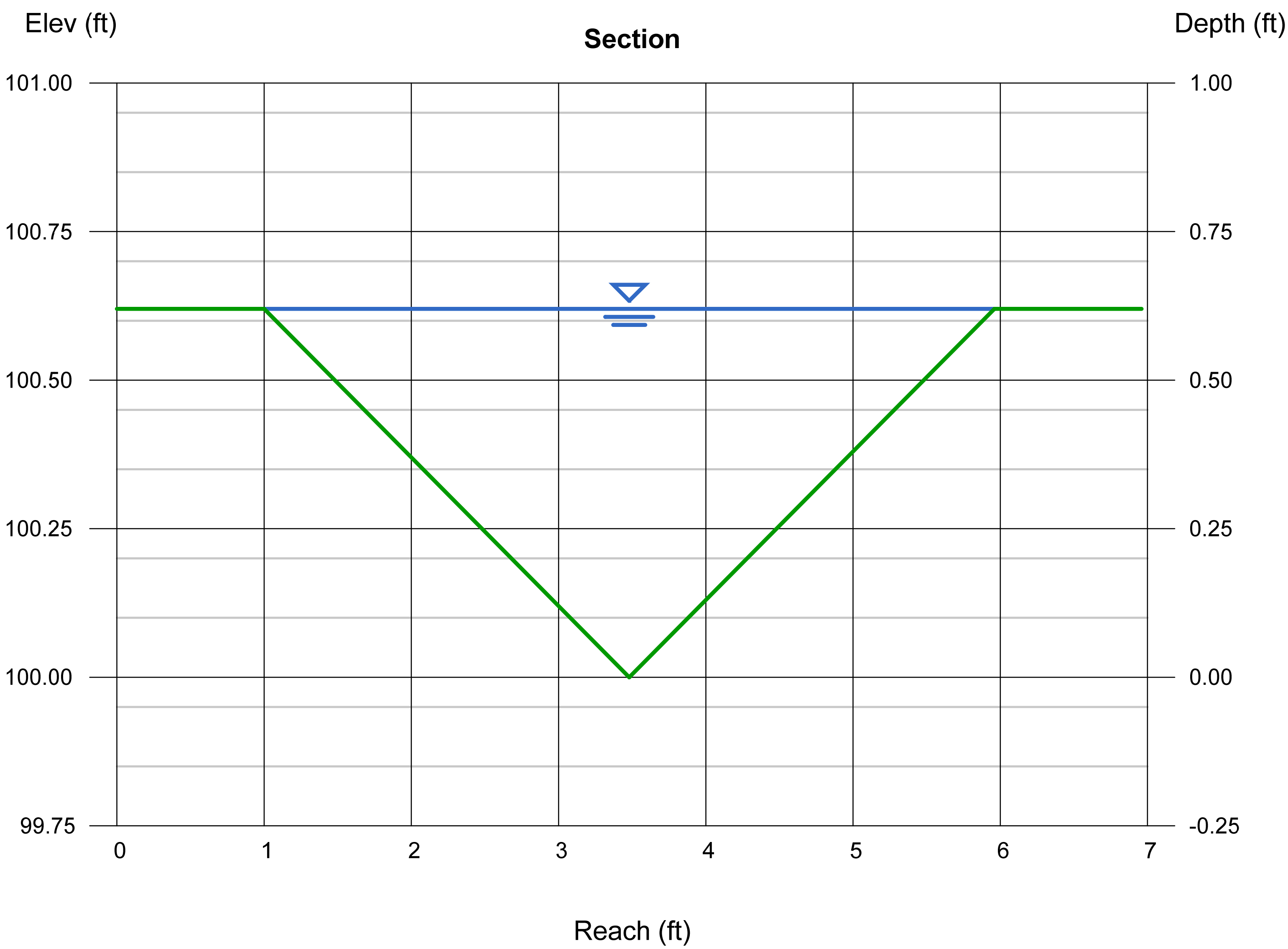
North Swale_S=5.11%

Triangular
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 0.62

Invert Elev (ft) = 100.00
Slope (%) = 5.11
N-Value = 0.035

Calculations
Compute by: Q vs Depth
No. Increments = 10

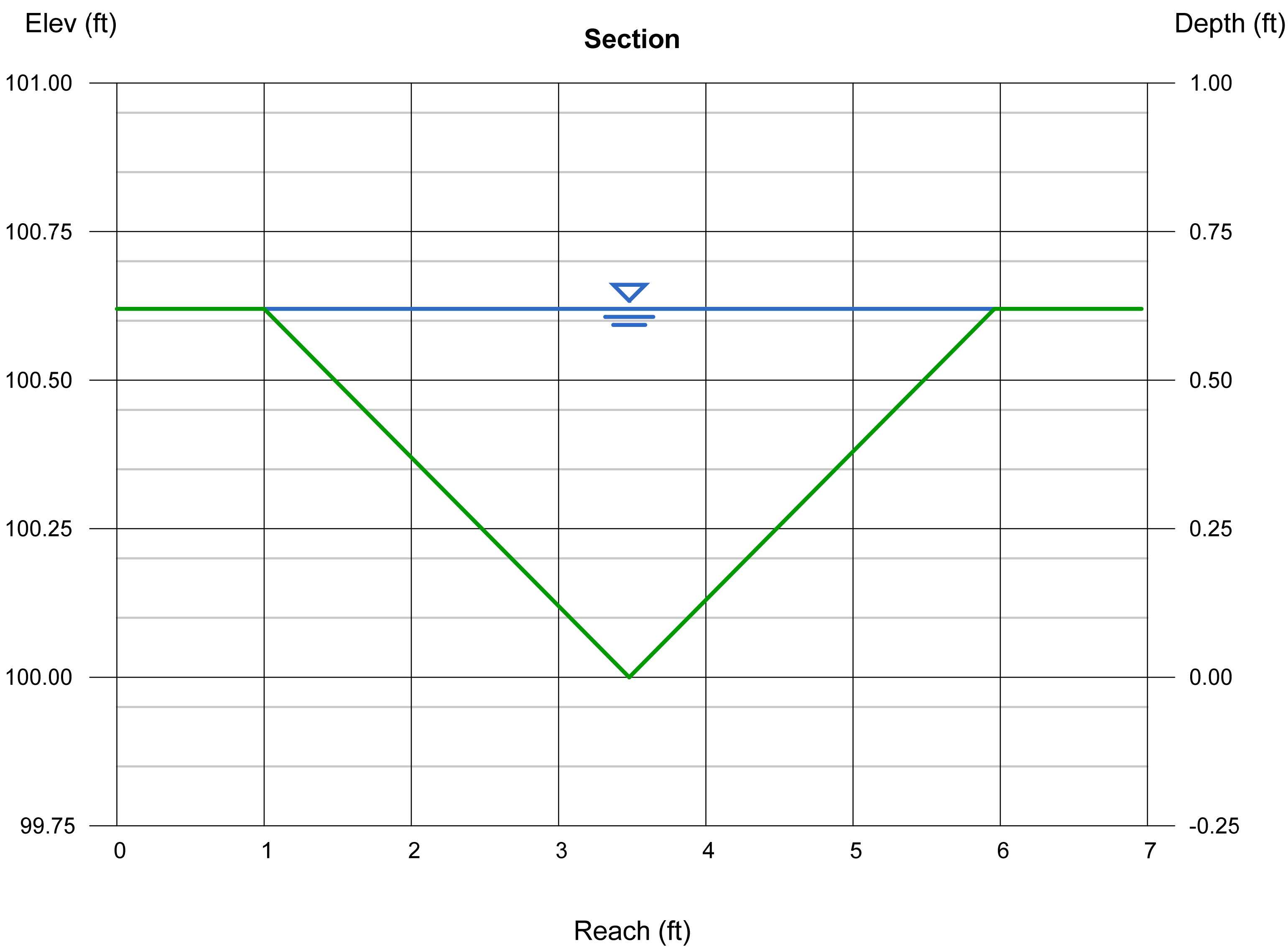
Highlighted
Depth (ft) = 0.62
Q (cfs) = 6.622
Area (sqft) = 1.54
Velocity (ft/s) = 4.31
Wetted Perim (ft) = 5.11
Crit Depth, Yc (ft) = 0.62
Top Width (ft) = 4.96
EGL (ft) = 0.91



Channel Report

North Swale_S=8.04%

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.62
Total Depth (ft)	= 0.62	Q (cfs)	= 8.306
		Area (sqft)	= 1.54
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 5.40
Slope (%)	= 8.04	Wetted Perim (ft)	= 5.11
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.62
		Top Width (ft)	= 4.96
Calculations		EGL (ft)	= 1.07
Compute by:	Q vs Depth		
No. Increments	= 10		



APPENDIX E:
OFFSITE ANALYSIS MEMORANDUM

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M E M O R A N D U M

DATE: June 30, 2022

TO: Kevin Patton, Director of Land Planning and Entitlements, Pulte Group

FROM: Craig Hoover, PE
Caroline Ogg, PE
Stuart Trabant, PE

SUBJECT: **Drainage Recommendation Summary Memorandum - Hoffmantown Residential**

I. Project Background

A residential development (Site) is proposed in the City of Albuquerque (City) in Bernalillo County (County), north of and adjacent to the South Pino Arroyo (Arroyo), also referred to as the Arroyo del Pino. On the opposite bank of the Arroyo from the Site is Albuquerque Academy (Academy) and adjacent lands under their ownership. The southern edge of the Site is encumbered by the existing FEMA-delineated Special Flood Hazard Area (floodplain). The floodplain extends to the north outside of the existing drainage easement onto the Site, as shown in Figure 1. The proposed Site grading and lot layout would require a modification to this floodplain. Given this and the Site's proximity to the Arroyo, a preliminary hydraulic analysis of the Arroyo was performed to determine:

1) What impacts to the existing Arroyo and its FEMA-delineated floodplain will be caused by the proposed development.
2) What, if any, impacts to the Academy will be caused by the proposed development, including impacts to the existing solar array on Academy property.
3) What, if any, impacts to the Academy's entrance road that crosses the Arroyo west of the Site.
4) How best to mitigate any impacts identified in (1) – (3) above.

The hydraulic analysis focused on impacts to 100-year flood depths, flow patterns, flow velocities, scour depth, and sediment transport. In addition, as part of the entrance road analysis the average annual storm event, estimated as 20% of the 100-year flow rate, was also analyzed. Both existing conditions and proposed conditions (post project development) were evaluated. For proposed conditions a vertical wall located roughly 15 feet south of the south property line was included to initially represent the planned arroyo bank protection along the length of the proposed development. The wall location within the hydraulic models, being offset toward the arroyo from the proposed southern lot lines, provides a conservative assessment of Arroyo impacts.

Refinements to the configuration of bank protection (modeled by this wall) and the proposed conditions hydraulic model will be included as part of the project design phase.

II. FEMA Floodplain Analysis

The Arroyo, also referred to as the Arroyo del Pino, is currently delineated as a FEMA Zone AO, with average depths of one or two feet. Refer to Figure 2 for an excerpt from the FEMA Flood Insurance Rate Map (FIRM) panel. Zone AO is defined by FEMA as:

> *Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.*

The Arroyo does not exhibit characteristics of alluvial fan flooding. The average depths indicate areas where the flood depth is estimated to be 0.5-1.5 and 1.5-2.5 feet for the one-foot and two-foot depth delineation, respectively.

A. Existing Conditions Floodplain Analysis

For the purposes of a preliminary floodplain analysis, the existing berm around the Academy tennis courts was removed from the existing terrain model. No records are available to demonstrate that this is an engineered berm as defined by FEMA. Thus, FEMA will likely require it be assumed to fail in 100-year flood conditions (i.e., not contain Arroyo flows to the north). This is consistent with the FEMA FIRM which shows the extents of the 100-year floodplain extending south of the tennis court berm. The removal of the berm for floodplain analysis purposes and the respective changes to the floodplain delineation are not caused by the proposed development. The preliminary existing conditions floodplain delineation appears in Figure 3.

As demonstrated in Figure 3, the existing FEMA floodplain delineation does not accurately represent the existing 100-year floodplain limits. The existing floodplain limits as shown in Figure 3 is a more accurate representation of existing conditions.

B. Proposed Floodplain Impacts

The existing floodplain delineation will be impacted by the proposed development. As part of this impact, it is anticipated that FEMA will require the floodplain to be delineated as a Zone AE ,which is defined as “Base Flood Elevations Determined”.

A more detailed analysis will need to be performed with final design of the Site and any mitigation measures identified before submittal to FEMA in the form of a Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR). Based on future coordination with FEMA and the local floodplain manager, the CLOMR/LOMR process will be detailed and determination on the Special Flood Hazard Area (SFHA) Zone designation, including floodways, will be given at that time. Refer to Figure 4 for a preliminary analysis of the developed conditions floodplain limits. This preliminary floodplain delineation applies to several mitigation alternatives, discussed in further sections.

1. Existing Conditions Preliminary Analysis

Hydraulic modeling was completed to establish existing conditions within the Arroyo in the vicinity of the proposed development. Refer to Figure 5 and Figure 6 for a visualization of the existing conditions results.

2. Developed Conditions Preliminary Analysis

To estimate impacts to the existing Arroyo and adjacent Academy properties, several developed conditions analyses were performed. An initial proposed "Base Model", which only includes changes caused by the proposed development, was constructed. This Base Model and its results were used to evaluate alternatives to mitigate or improve different sections of the Arroyo to help protect the proposed development from Arroyo floodwaters and to enable the existing floodplain that encroaches on the project site to be removed. These alternatives include construction of a berm along the north and east limits of the solar farm and multiple configurations of culverts crossing the entrance road. Refer to the Methodology section for a description of the modeling methodology used.

III. Impacts to the Solar Farm

The solar farm, located on the south side of the arroyo, is impacted significantly by both the effective FEMA floodplain and the existing Arroyo 100-year inundation limits, as shown in Figure 3 and Figure 5, respectively.

With the proposed Site development (which includes grading and modifications to the existing Arroyo), it was acknowledged that the solar farm could be impacted and so hydraulic modeling included this area. Results from the Base Model indicate no increases in flood depths or velocities, within modeling tolerance, during the 100-year storm event. Refer to Figure 7 and Figure 8 for a visual representation of the Base Model impacts.

While this hydraulic analysis for the proposed development shows no increases in flood depths or velocities, within modeling tolerance, within the fenced limits of the solar farm during the 100-year storm event, Pulte requested an evaluation of an engineered berm along the south side of the arroyo adjacent to the solar farm in the event development of the Site raises concerns from adjacent property owners.

A. Proposed Berm Evaluation

As directed by Pulte, the construction of a berm or wall running along the north and east sides of the solar farm was analyzed. Such a berm or wall would narrow the Arroyo floodplain significantly and the resulting 100-year water surface elevation would be higher than the ground elevation along the south side of the berm/wall (the solar farm area that is generally within the existing 100-year floodplain). Based on an average flow depth along the berm/wall of approximately 2-feet, a minimum height of four feet would be required. This height includes two feet of freeboard as required by the *City's Development Process Manual,* Section 6-4(F) (2020). Refer to Figure 9, Figure 10, and Figure 11 for inundation, depth, and velocity impacts of the solar berm, respectively.

The proposed berm would constrict stormwater in the Arroyo, allowing the solar farm to not be inundated by Arroyo flows in a 100-year storm event. This berm would not be a FEMA or U.S. Army Corps of Engineers (USACE) certified levee. Therefore, the revised FEMA floodplain limits would not reflect it (i.e., the revised FEMA floodplain would be comparable as shown in Figure 4).

IV. Impacts to the Academy

Potential increases in depth, velocity, and floodplain extents were evaluated to determine if the Academy could be impacted by the proposed development because of the constriction of the Arroyo.

As illustrated by Figure 7 and Figure 8, the proposed site development and associated impacts to the Arroyo would cause increases in both depths and velocities along the berm around the tennis courts. However, these increases are generally limited to a reach across from and immediately downstream of the Site and are minor. The inundation limits will likely not be significantly impacted by the development.

As discussed above, changes to the FEMA floodplain delineation are expected on Academy property, but they are not a direct result of this development.

A. Impacts to the Academy Entrance Road

Impact to the existing entrance road to the Academy due to the proposed development was evaluated for both hydraulic and sediment-based conditions.

1. Hydraulic Analysis

From both a depth and velocity perspective, hydraulic impacts to the entrance road are minimal. As illustrated by Figure 7 and Figure 8, impacts from the development are generally limited to a reach upstream of the entrance road.

2. Sediment-transport Analysis

Deposition of sediment, often referred to as sedimentation, at the Academy entrance road low-water crossing of the Arroyo has been an ongoing problem for the Academy. The sedimentation occurs during relatively low-magnitude and frequently occurring storm events, resulting in temporary access closures and subsequent maintenance requirements. A sediment-transport analysis was conducted to assess the potential impacts of the proposed Site development and associated grading on the existing sedimentation issues. The analysis focused on determining the degree to which, if any, the proposed grading would worsen the sedimentation problems.

Development of a detailed, mobile boundary sediment-transport model was beyond the scope of this work. In lieu of the modeling, the analysis focused on estimating the amount of sediment (sediment load) delivered to the entrance road low-water crossing. Because the hydraulic conditions at the entrance road crossing would not change appreciably with the construction of the proposed project, the upstream sediment supply under existing and with-project conditions was computed and compared to quantify the anticipated changes in sediment delivery. To compute the sediment supply, sediment-transport capacity rating curves (sediment load versus water discharge) were computed using the results from the hydraulic modeling and geomorphic site reconnaissance, as discussed in the Methodology section.

The results of the sediment transport analysis show that in smaller more frequent storm events, as represented by the average annual storm event, which was estimated as 20% of the 100-year peak flow rate, the sediment transport and sedimentation at the entrance road will decrease slightly as a result of the proposed Site development. This is due to the reduction in the local sediment supply immediately upstream of the entrance road as a result of the proposed site grading, which reduces the arroyo floodplain width. In larger storm events, such as the 100-year storm, the increased energy in the flow resulting from the proposed Site grading, narrowing of the Arroyo more than offsets the reduction in available sediment resulting in an overall increase in sediment transport and sedimentation at the entrance road. The sediment transport analysis is described in more detail in the Methodology section.

B. Potential Entrance Road Improvements

At the request of Pulte, the option of including crossing culverts at the entrance road was preliminarily evaluated. Two options were considered: passing the average annual storm event (approximated as 20% of the 100-year peak flow) and passing the full 100-year flow.

Because of the known sedimentation issues at the entrance road in the existing condition, maintaining the existing roadway profile and constructing culverts below existing grade was determined to be an ineffective solution; the upstream end of the new culverts would likely become filled with sediment and return the crossing to a similar condition as it is today.

Using low-profile culverts and changing the profile of the entrance road was evaluated for both storm events. A summary of the number, size of culverts, analyzed flow rates, and the required length of the entrance road to be replaced appears below in Table 1.

Table 1. Academy Entrance Road Culvert Summary

Storm Analyzed	Culvert Size/Shape	Number of Barrels	Length of Road Replacement (feet)	Height Adjustment to Roadway Profile at Low-Water Crossing (feet)	Length of Grading Required in Arroyo (Upstream and Downstream of Crossing) (feet)
Average Annual	6 ft x 2 ft CBC	7	400	3.5	120
100-year Storm	10 ft x 3 ft CBC	13	400	4.5	350

Because of the existing grade of the entrance road south of the low water crossing, a large portion of the entrance road would need to be regraded to prevent flow from being directed into Academy parking lots. With the higher roadway profile, the existing parking lot entrances would also need to be raised. The existing grades in the area also limit how much headwater can be generated on the upstream side of the culvert, with a risk of runoff breaking out to the south and inundating Academy property. Because of the potential flood risks associated with raising the entrance road and the inefficiency of maintaining the existing roadway profile, it is recommended that no culvert be installed at the low water crossing.

V. Methodology

Two-dimensional (2D) hydraulic models were constructed using the USACE River Analysis System (HEC-RAS) version 6.1.0. No hydrologic analysis was performed.

A. Hydraulic Analysis

Quasi-steady models for both existing and proposed conditions were used to evaluate changes in depth, velocity, and floodplain extents.

B. Terrain

Field survey data prepared by Souder, Miller and Associates associated with the *AMAFCA South Pino Arroyo Study* (Bohannan Huston, Inc. (BHI), 2017) was used. Field survey data was combined with Middle Rio Grande Council of Governments (MRCOG) mapping data for the 2017 study.

C. Mesh Development

For the purposes of this preliminary study, A1 standard cell spacing of 15 feet was used for all models. Breaklines were included in each model for additional detail and cell orientation. The cell spacing on breaklines was set at a minimum of five feet and a maximum of 15 feet, with spacing for each line depending on its location.

D. Materials

Land cover types were determined from aerial imagery. To represent buildings near inundated areas, the roughness coefficient on buildings was set to 1.0. This high Manning's n value discourages runoff to move through buildings but does not prevent inundation up to building footprints. Manning's n values were determined based on the *HEC-RAS Hydraulic Reference Manual*, Table 3-1 and are summarized below:

Table 2. Summary of Roughness Coefficients

Land Cover Type	Manning's n
Main Channel	0.045
Channel Banks	0.050
Overbank – with trees	0.070
Overbank – brush only	0.050
Solar Farm	0.052
Concrete (includes Tennis Courts)	0.015
Lawn	0.030
Asphalt	0.013
Building	1.000
Dirt Parking Lots	0.025

E. Boundary Conditions

The inflow rate used for the quasi-steady analysis was taken from the FEMA Flood Insurance Study (FIS) for Bernalillo County, New Mexico. The 100-year storm event (or 1-percent Annual Chance) peak discharge is established at 2,432 cubic feet per second (cfs) for the 8.70 square mile drainage area. This peak discharge was determined just downstream of Wyoming Boulevard, which is downstream of the Site. The peak discharge was entered as the inflow for every time step throughout the model duration.

Outflow boundary conditions were set to normal depth in locations of approximately one-dimensional flow. For all outflow boundary conditions, the slope of the energy grade was assumed to be the same as the thalweg slope.

To represent additional runoff entering the Arroyo from the Site in the proposed condition, a boundary condition was added just downstream of the Site. The preliminary difference in pre- versus post-development discharge (14 cfs) from the Site was used as the inflow rate. Like the inflow condition at the upstream end of the Arroyo, this flow rate was entered as the inflow for every time step throughout the model duration.

This approach of adding the increase in discharge from the development to the Arroyo is conservative, as it is likely peak runoff from the Site will have flowed through the Arroyo before the larger, offsite peak discharge reaches the area. This results in a proposed 100-year peak flow of 2,446 cfs at the downstream end of the model.

F. Hydraulic Structures

The existing conditions analysis does not contain hydraulic structures. The culvert upstream of the model domain, crossing Ventura Avenue, was not included. This culvert is far enough upstream from the Site and the area of interest that hydraulic impacts caused by the Ventura Avenue culvert would be negligible.

The developed conditions model includes elevating the Site and bank protection along the tie-in slope to the arroyo, the design of which is preliminary and will be refined as the project progresses. Therefore, in this preliminary analysis, the increase in ground elevation was modeled as a vertical wall in HEC-RAS using an SA/2D Area Connection (which allows for modeling various hydraulic structures in HEC-RAS). The elevation of the top of the wall was set to generally represent the elevation of the proposed Site and ensure all stormwater remained contained in the Arroyo. The representation of the Site and slope protection in this area will be refined with the final design analysis.

An SA/2D Area Connection was also used to represent the option to construct a berm along the limits of the Solar Farm. The elevation was set to contain all stormwater to the Arroyo. If this option progresses forward, a more detailed inclusion of the proposed berm will be included with the final design analysis.

G. Model Control

The quasi-steady model used an evaluation time step of 0.5 seconds, and the model duration was set to 2 hours to achieve stable results. Diffusion-wave equation sets were used to improve the stability of this preliminary model. Full momentum equations should be investigated with modeling for final design.

VI. Sediment-Transport Analysis

A separate analysis involving site reconnaissance, additional hydraulic modeling, and sediment transport computations was performed to determine the changes to sediment transport capacity and prospective sediment loading in the Arroyo.

A. Geomorphic Site Reconnaissance

A geomorphic site reconnaissance of the project area was conducted on April 27, 2022 by BHI's Project Manager (Craig Hoover) and Senior Geomorphologist (Stu Trabant). The site reconnaissance involved documented observations of the general hydraulic, geomorphic, and sediment-transport conditions as well as collection of spatially located ground photography and sediment samples of the channel boundary materials.

The modeled reach of the South Pino Arroyo demonstrates three distinct geomorphic reaches with reach breaks (identified on Figure 12) that corresponds to 1) the approximate location of the Hoffmantown Church storm drain outfall/rock apron rundown on the north bank, and 2) the entrance road low-water crossing. The upstream reach of the arroyo between Ventura Avenue NE and the Hoffmantown Church outfall is a well-defined and relatively steep channel bounded by narrow, low-elevation floodplains that are constricted by higher, natural, or anthropogenic-fill terraces. Reduced terrace heights and wider terrace-to-terrace widths in the middle reach of the arroyo between the outfall and the road crossing, coupled with a lower channel gradient, results in much wider floodplains. Downstream from the low-water crossing, the Arroyo becomes anastomosed (multi-branched) due to progressive flattening of the channel gradient.

Two sediment samples were collected during the geomorphic site reconnaissance (Figure 12). Sample S1 was collected from the channel bed north of the Academy tennis courts. This sample is representative of the bed material that is being supplied to the low-water crossing, and is a sandy gravel with median diameter (D50) of about 2.1 mm. Sample S2 is a bed material sample that was collected from the more confined upper reach of the arroyo and represents the overall sediment supply from the watershed. The material in this sample is primarily sand and has a D50 of about 1.4 mm. It is likely that this sample contains locally finer material that was eroded from the north bank fill that was used for construction of the Hoffmantown Church.

B. Hydraulic Modeling for Sediment-Transport Analysis

The 2D hydraulic model discussed above was modified for the sediment-transport analysis by incorporating unsteady flow hydrographs at the upstream boundary condition. The unsteady flow hydrograph was incorporated to obtain results for a range of flow conditions in addition to the peak discharge condition described above. Although the shape and timing of the hydrograph are unimportant to the sediment-transport computations, the hydrographs were developed using a regionally representative hydrograph resulting from a 6-hour rainfall and adjusted to match the 100-year peak discharge of about 2,430 cfs.

The hydrographs were input into the existing and the proposed conditions models, and the models were executed using the same parameters and outflow boundary conditions as the steady-state models. Key hydraulic variables from the results of both models were extracted from a representative cross section adjacent to the proposed development (see Figure 12). Hydraulic variables of interest included depth, velocity, energy slope, and shear stress. To prepare the input for the sediment-transport calculations, the 2D model results were then converted to cross-sectionally averaged results on a depth-weighted basis.

C. Sediment-Transport Computations & Results

As discussed above, the sediment-transport analysis was conducted by preparing sediment-transport capacity rating curves at the representative cross section at the proposed development. The sediment-transport capacity was computed using an appropriate bed-material transport equation, with the predicted hydraulic conditions and sampled bed material information as input. Since Sample S2 appears to overestimate the amount of fine sand that is potentially sourced from local fill material, the gradation of Sample S1 was used in the computations.

Numerous bed-material transport equations are available in the literature. Each of these equations has been developed under a specific range of conditions, which include but are not limited to: sediment supply, sediment gradation, discharge ranges, channel types, and bed slopes. Due to the empirical nature of sediment-transport equations, there is no one equation that is universally suited to all situations. Of the sediment-transport equations available, the Meyer-Peter-Müller (1948) relation (MPM relation) was selected for the analysis because it was developed for conditions similar to those found in the Arroyo study reach.

The predicted sediment-transport capacity rating curves indicate that the proposed project would result in increased sediment supply to the low-water crossing at flows in excess of about 900 cfs, but would cause a decrease in sediment supply over the range of lower flows (Figure 13). These results are somewhat surprising in that, at first glance, one would expect the higher degree of flow constriction caused by the project to result in higher sediment-transport loads over the range of modeled discharges. However, closer inspection of the results at the lower discharges reveals that by eliminating flow conveyance and sediment-transport along the area of grading, the project would actually reduce the overall sediment load compared to existing conditions. In other words, the local sediment supply is reduced by narrowing of the Arroyo associated with the proposed site grading.

The reduction to sediment transport along the overall cross section is best represented by the flow energy, an example comparison of which is shown in Figure 14 at a discharge of about 335 cfs. With the proposed grading, modeled as a wall, the area to the right of the wall in Figure 14 no longer sees flow and thus does not contribute sediment. At flows in excess of about 900 cfs, the reduction in local sediment supply (from the area to the right of the wall in Figure 14) is more than offset by the increased energies, and thus sediment transport, along the remainder of the channel. Figure 15 illustrates this at a discharge of about 2,430 cfs.

Considering the full duration of the 100-year storm event, the total change in sediment supply to the low-water crossing can be estimated by integrating the sediment-transport capacity rating curves over the flow hydrographs. The results indicate that the total volume of sediment supply for the 100-year storm event under proposed conditions would increase by about 3% compared to the 100-year storm event under proposed conditions would increase by about 3% compared to existing conditions (Figure 16). The relatively small increase is because the duration of flows that exceed the 900 cfs threshold are much shorter than the duration of flows less than that threshold, even though the difference in sediment loading is much larger at flows in excess of the threshold flow (up to about 12%). Under average annual peak storm conditions, which can be represented by the dominant discharge that is about 20% of the 100-year peak discharge (Q ~ 500 cfs; MEI, 2007), it is reasonable to conclude that the project would result in a reduction to sediment supply over the entire storm hydrograph, since the peak discharge is less than the 900 cfs threshold.

VII. Conclusion and Recommendations

Pulte's proposed development adjacent to the South Pino Arroyo will cause hydraulic impacts to the Arroyo and its FEMA-delineated floodplain. A preliminary analysis of the existing and proposed hydraulic and sediment-transport conditions was completed to quantify these impacts and evaluate potential mitigation measures.

The FEMA floodplain delineation will need to be updated through the CLOMR/LOMR process. The Pulte development will be the impetus of these amendments, but the existing FEMA delineation does not accurately represent the existing condition of the South Pino Arroyo. The Pulte development will not significantly impact the floodplain limits outside of amendments to more accurately reflect the existing condition and the removal of the Pulte site from the floodplain. The solar farm located south of the Arroyo will not be negatively impacted by the proposed Pulte development. No changes to the water surface elevations or velocities of runoff reaching the solar farm, outside of modeling tolerance, are anticipated.

Albuquerque Academy will similarly not experience major impacts from this development. Velocities and depths will increase slightly near the proposed development, but inundation limits will not change significantly, and existing buildings will not be impacted.

The entrance road to Albuquerque Academy will also not be negatively affected by this development. Both the sediment transport and hydraulic analyses demonstrated negligible change or improved conditions for the entrance road during most flow conditions.

As this project moves forward, refinement of the hydraulic and sediment-transport analyses is recommended. Additional detail in the hydraulic analysis, coordination with FEMA and local floodplain managers, and input from adjacent property stakeholders may contribute to future changes in the overall design.

CO/ST/CH/ab

References

Meyer-Peter, E. and Müller, R. (1948). *Formulas for bed load transport.* In Proceedings of the 2nd Congress of the International Association for Hydraulic Research, Stockholm, 2: Paper No. 2, pp 39-64.

Mussetter Engineering, Inc. (2008). *SSCAFCA Sediment and Erosion Design Guide*. Rio Rancho: Mussetter Engineering, Inc.

Attachments

Figure 1. Vicinity Map
Figure 2. FEMA FIRM
Figure 3. Preliminary FEMA Floodplain Limits - Corrected Existing Condition
Figure 4. Preliminary FEMA Floodplain Limits - Proposed Development Condition
Figure 5. Existing Conditions - Depth
Figure 6. Existing Conditions - Velocity
Figure 7. Preliminary Base Development Impacts – Change in Water Surface Elevations
Figure 8. Preliminary Base Development Impacts – Change in Velocity
Figure 9. Preliminary Solar Farm Berm Impacts – Inundation
Figure 10. Preliminary Solar Berm and Site Impacts – Change in Water Surface Elevations
Figure 11. Preliminary Solar Berm and Site Impacts – Change in Velocity
Figure 12. Sediment Transport Analysis Results
Figure 13. Computed Sediment-transport Capacity Rating Curves
Figure 14. Representative Sediment-transport Cross Section – 335 cfs
Figure 15. Representative Sediment-transport Cross Section – 2,330 cfs
Figure 16. Predicted Sediment Loads – 100-year Storm

Legend

- City of Albuquerque Parcels
- Site Property Boundary
- Existing Drainage and Utility Easement
- Academy Cross-Country Course

N
W E
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0 300 600 Feet

1 " = 300 feet

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Hoffmantown Residential Preliminary Drainage Analysis

Vicinity Map
Figure 1

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_1_PSFBI_I.mxd
Author: cogg

June 2022

National Flood Hazard Layer FIRMette

FEMA

106°33'14"W 35°9'32"N

106°32'37"W 35°9'3"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

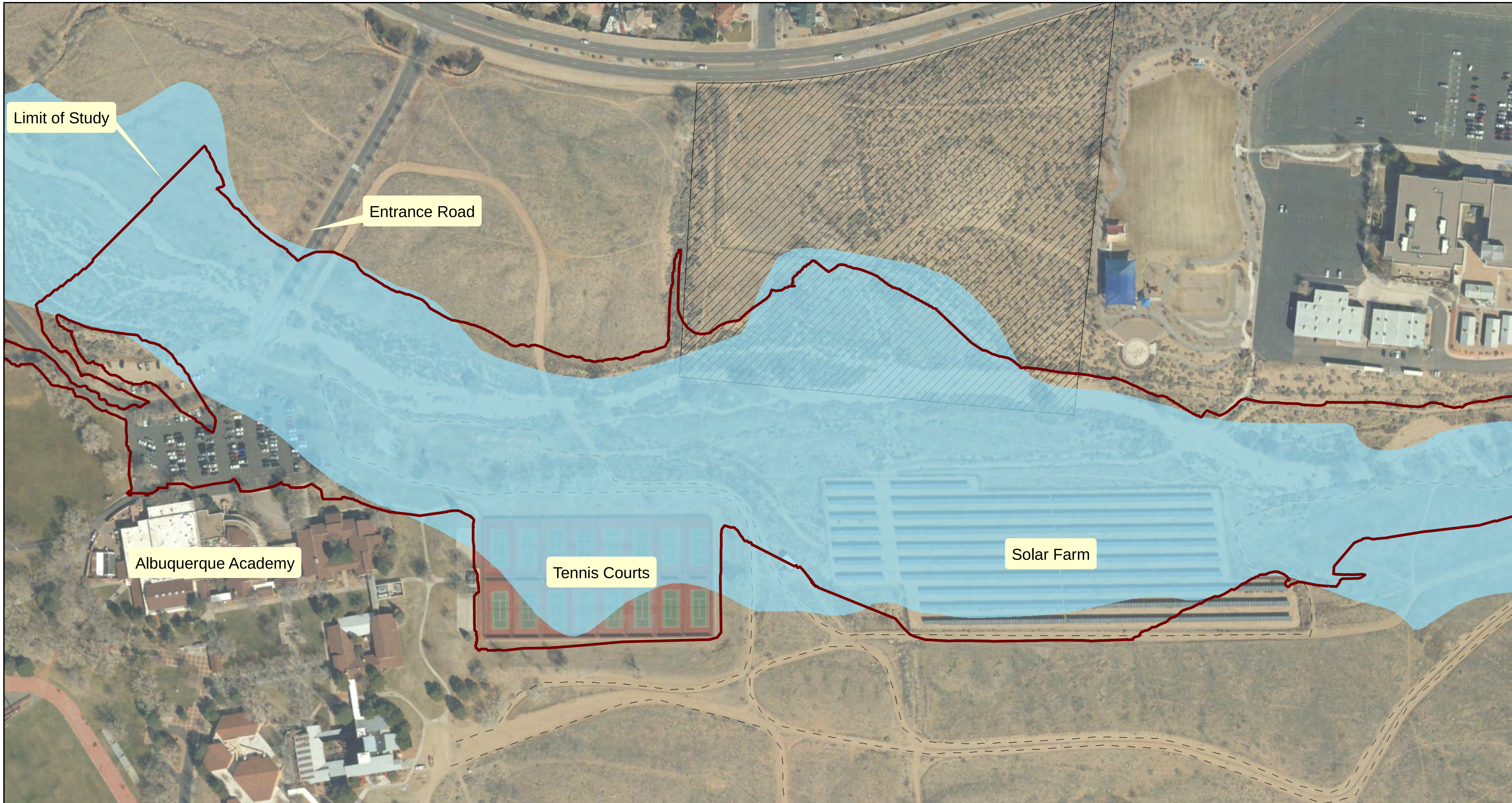
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/29/2022 at 11:00 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Figure 2



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Legend

- Existing Floodplain Extents
- FEMA SFHA (Zone AO)
- Site Boundary

N
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0 200 400 Feet

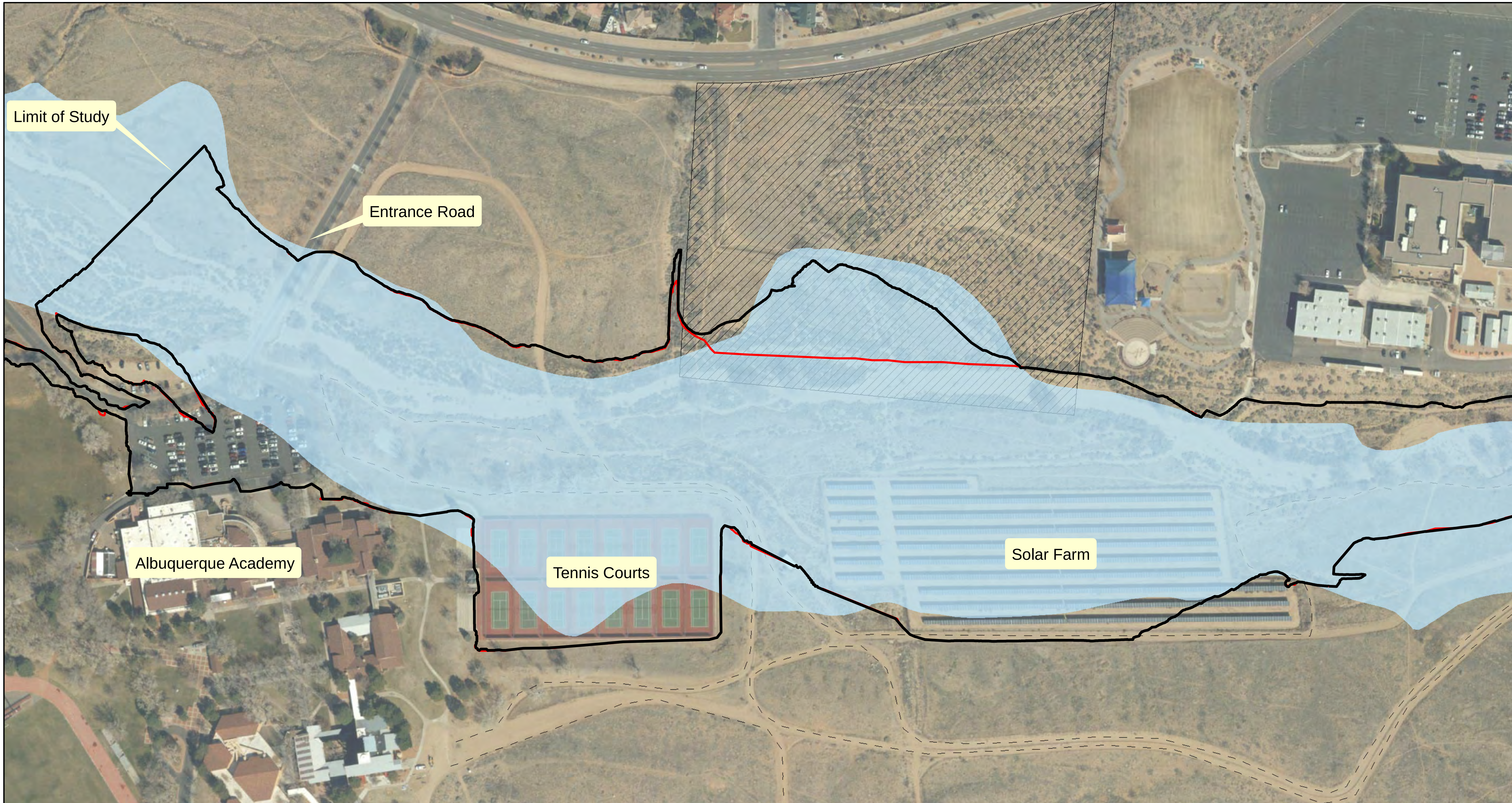
1 " = 200 feet

Hoffmantown Residential Preliminary Drainage Analysis

Preliminary Existing Floodplain Limits
Figure 3

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_3_FEMA_Exist.mxd
Author: cogg

June 2022



Legend

- Existing Floodplain Extents
- Floodplain Changes with Pulte Development
- FEMA SFHA (Zone AO)
- Site Boundary

N
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0 200 400 Feet
1 " = 200 feet

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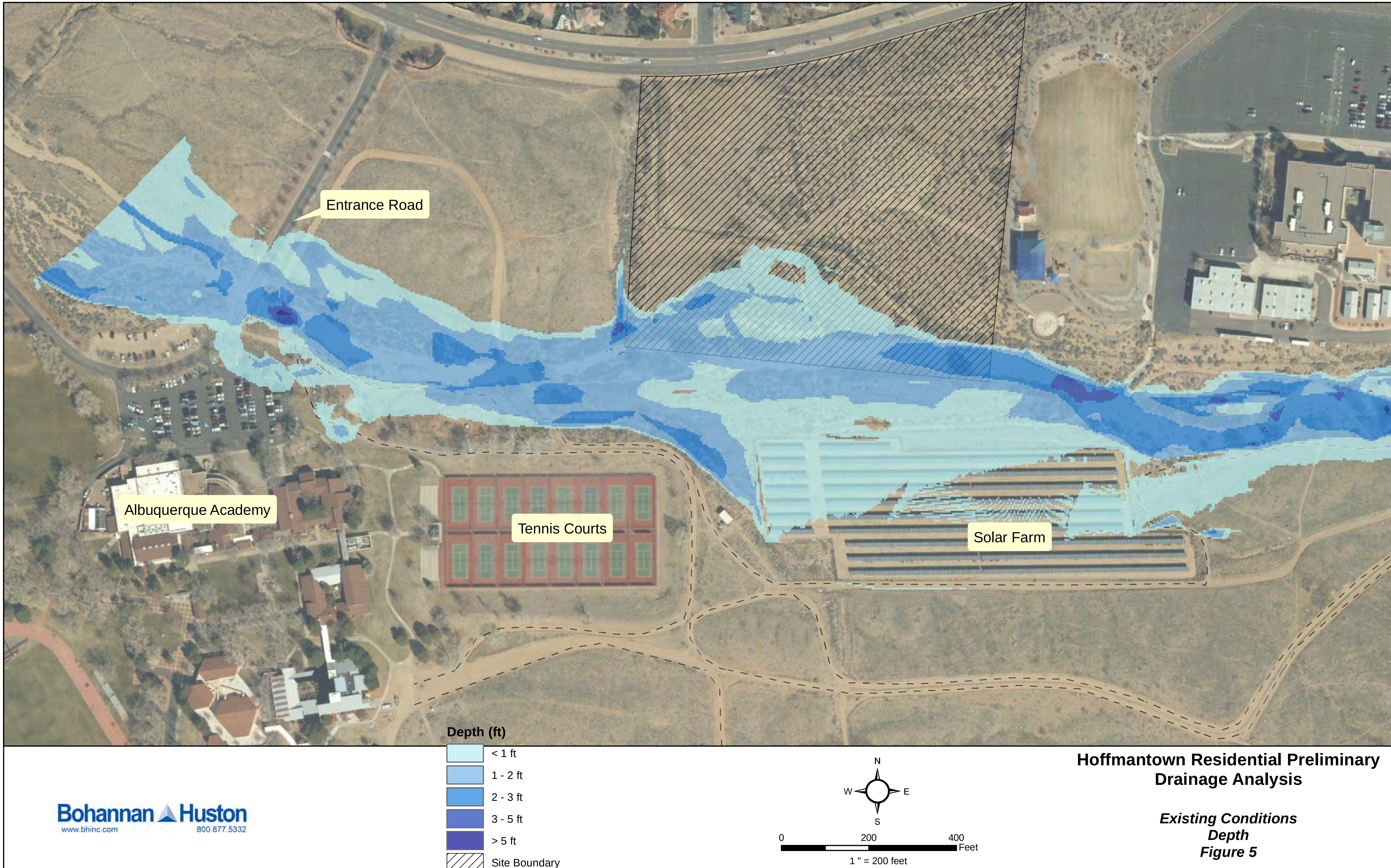
Hoffmantown Residential Preliminary Drainage Analysis

Preliminary Floodplain Limits
Proposed Development Condition
Figure 4

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_4_FEMA_Proposed.mxd
Author: cogg

June 2022



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Hoffmantown Residential Preliminary Drainage Analysis

Existing Conditions
Depth
Figure 5

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_5_EX_WSE.mxd
Author: snordquist

June 2022

Velocity (ft/sec)

- < 2 ft/sec
- 2 - 5 ft/sec
- 5 - 7 ft/sec
- 7 - 10 ft/sec
- > 10 ft/sec
- Site Boundary

N W E S

0 200 400 Feet

1 " = 200 feet

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Hoffmantown Residential Preliminary Drainage Analysis

Existing Conditions
Velocity
Figure 6

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_6_EX_V.mxd
Author: snordquist

June 2022

Change in Water Surface Elevation (ft)

- > 0.5 ft decrease
- 0.5 - 0.25 ft decrease
- < 0.25 ft decrease
- No Change (within modeling tolerance)
- < 0.25 ft increase
- 0.25 - 0.5 ft increase
- > 0.5 ft increase
- Site Boundary

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N
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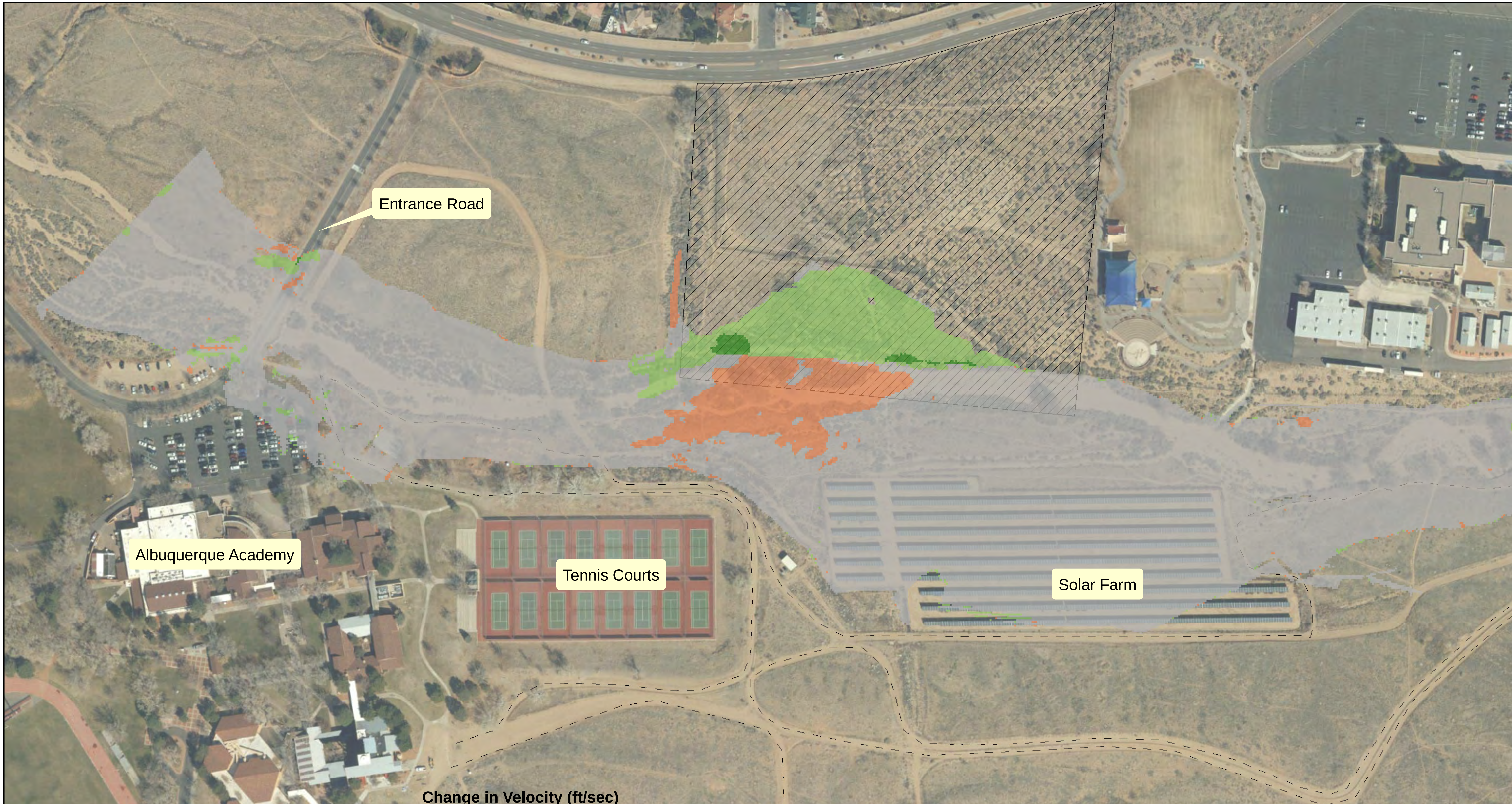
0 200 400 Feet
1 " = 200 feet

Hoffmantown Residential Preliminary Drainage Analysis

Preliminary Base Development Impacts
Change in Water Surface Elevations
Figure 7

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_7_PDI_WSE.mxd
Author: snordquist

June 2022



Change in Velocity (ft/sec)

- > 5 ft/sec decrease
- < 5 ft/sec decrease
- No Change (within modeling tolerances)
- < 5 ft/sec increase
- > 5 ft/sec increase
- Site Boundary

N
W E
S

0 200 400 Feet

1 " = 200 feet

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Hoffmantown Residential Preliminary Drainage Analysis

Preliminary Base Development Impacts
Change in Velocity
Figure 8

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_8_PDI_V.mxd
Author: snordquist

June 2022

Legend

- Existing 100-Year
- Proposed 100-Year with Pulte Project
- Proposed 100-Year with Solar Farm Berm
- Site Boundary

N
W E
S

0 200 400 Feet

1 " = 200 feet

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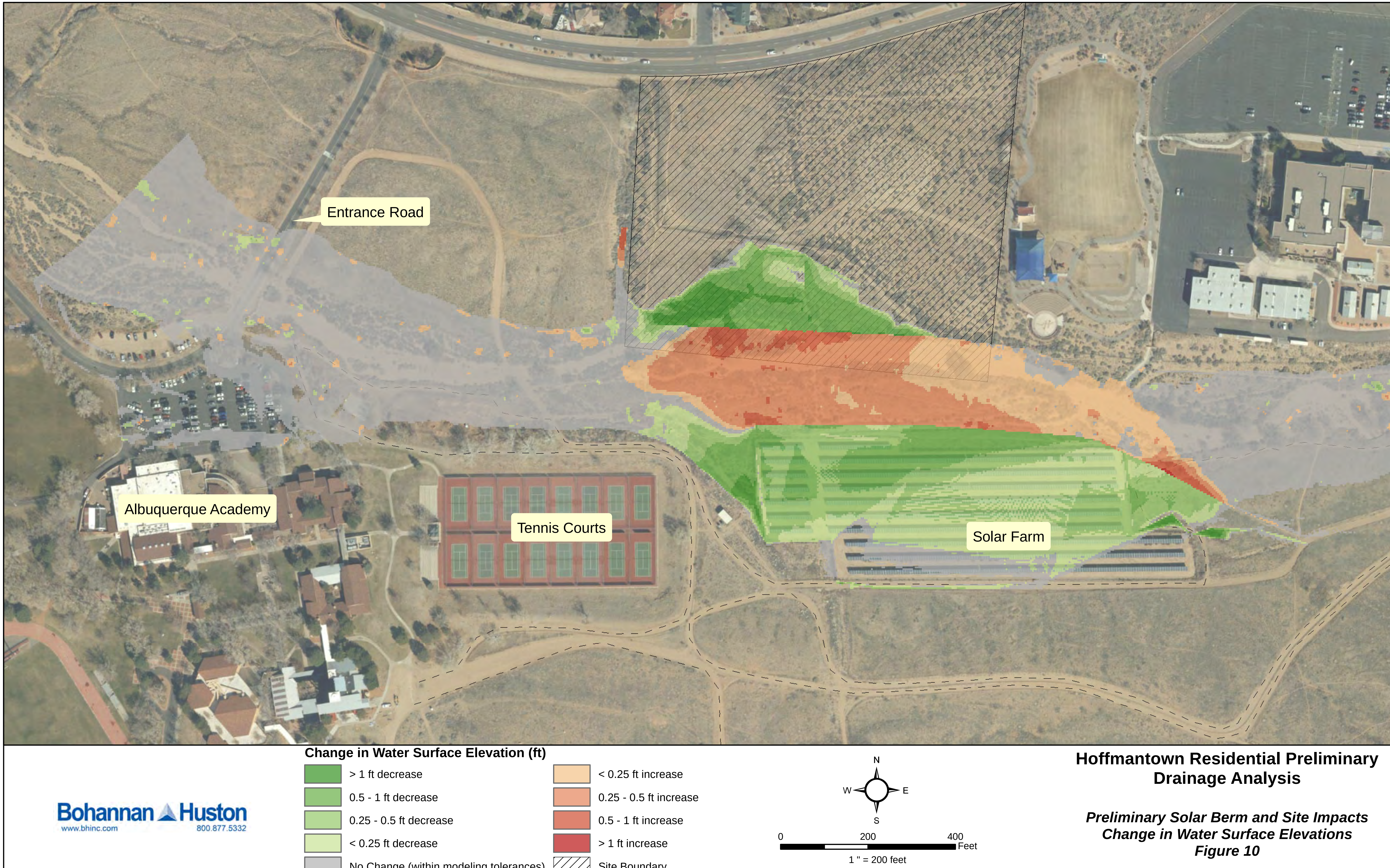
Hoffmantown Residential Preliminary Drainage Analysis

Preliminary Solar Farm Berm Impacts Inundation

Figure 9

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_9_PSFBI_I.mxd
Author: cogg

June 2022



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Hoffmantown Residential Preliminary Drainage Analysis

Preliminary Solar Berm and Site Impacts
Change in Water Surface Elevations
Figure 10

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_10_PSFBI_WSE.mxd
Author: snordquist

June 2022

Change in Velocity (ft/sec)

- > 5 ft/sec decrease
- < 5 ft/sec decrease
- No Change (within modeling tolerances)
- < 5 ft/sec increase
- > 5 ft/sec increase
- Site Boundary

N
W E
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0 200 400 Feet

1 " = 200 feet

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Hoffmantown Residential Preliminary Drainage Analysis

Preliminary Solar Berm and Site Impacts
Change in Velocity
Figure 11

\\A-ABQ-FS2\ABQ-Projects\20220291\WR\Reports\Final\Figures\MXDs\20220291_11_PSFBI_V.mxd
Author: snordquist

June 2022

Change in Velocity (ft/sec)

- > 5 ft/sec decrease
- < 5 ft/sec decrease
- No Change (within modeling tolerance)
- < 5 ft/sec increase
- > 5 ft/sec increase

N

0 300 600 Feet

1 in =300 ft

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Hoffmantown Residential Preliminary Drainage Analysis

Predicted Change in Velocity at Average Annual Peak Flow (Q~500 cfs) and Key Features Considered in the Sediment-transport Analysis

Figure 12

\\A-ABQ-FS2\ABQ-Projects\20220291\WRARCGIS\Maps\ArcPro\Pulte\Pulte.aprx
Author: cogg

June 2022

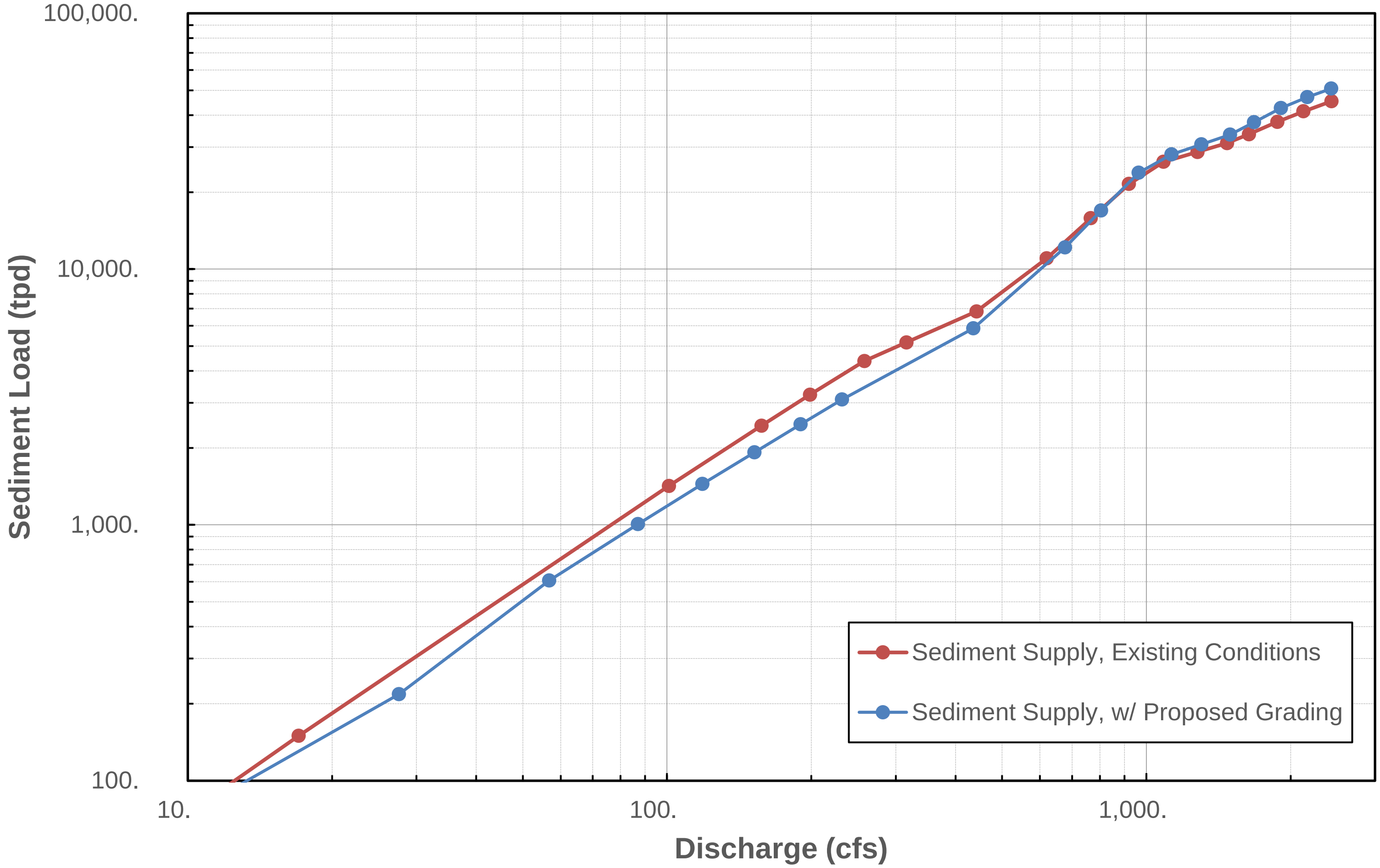


Figure 13. Computed sediment-transport capacity rating curves at the representative location of the proposed project that represent the estimated sediment supply to the low-water crossing.

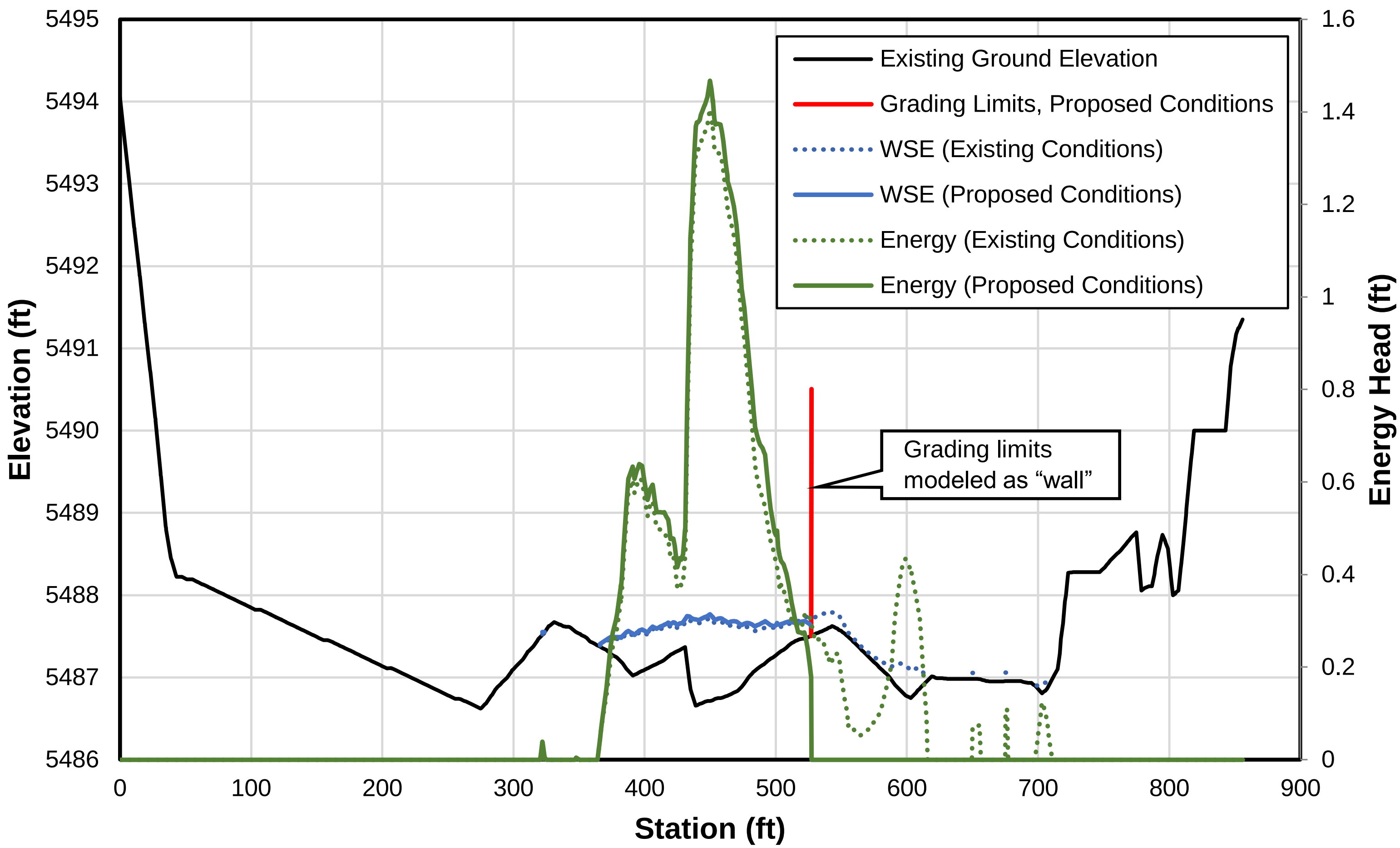


Figure 14. Representative cross section at proposed development showing the limits of the grading, predicted water-surface elevation, and predicted energy under existing and proposed conditions at about 335 cfs.

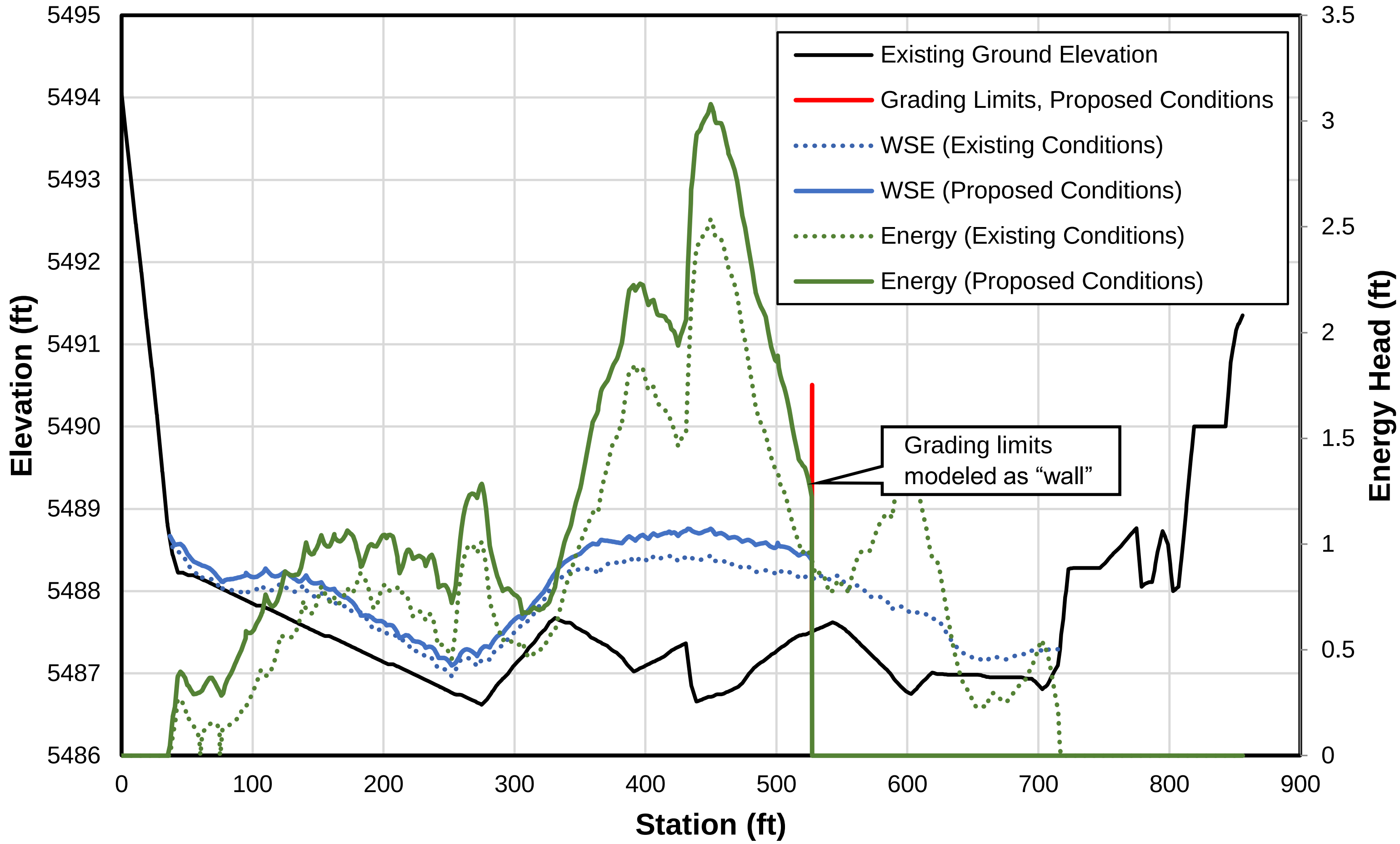


Figure 15. Representative cross section at proposed development showing the limits of the grading, predicted water-surface elevation and predicted energy under existing and proposed conditions at about 2,330 cfs.

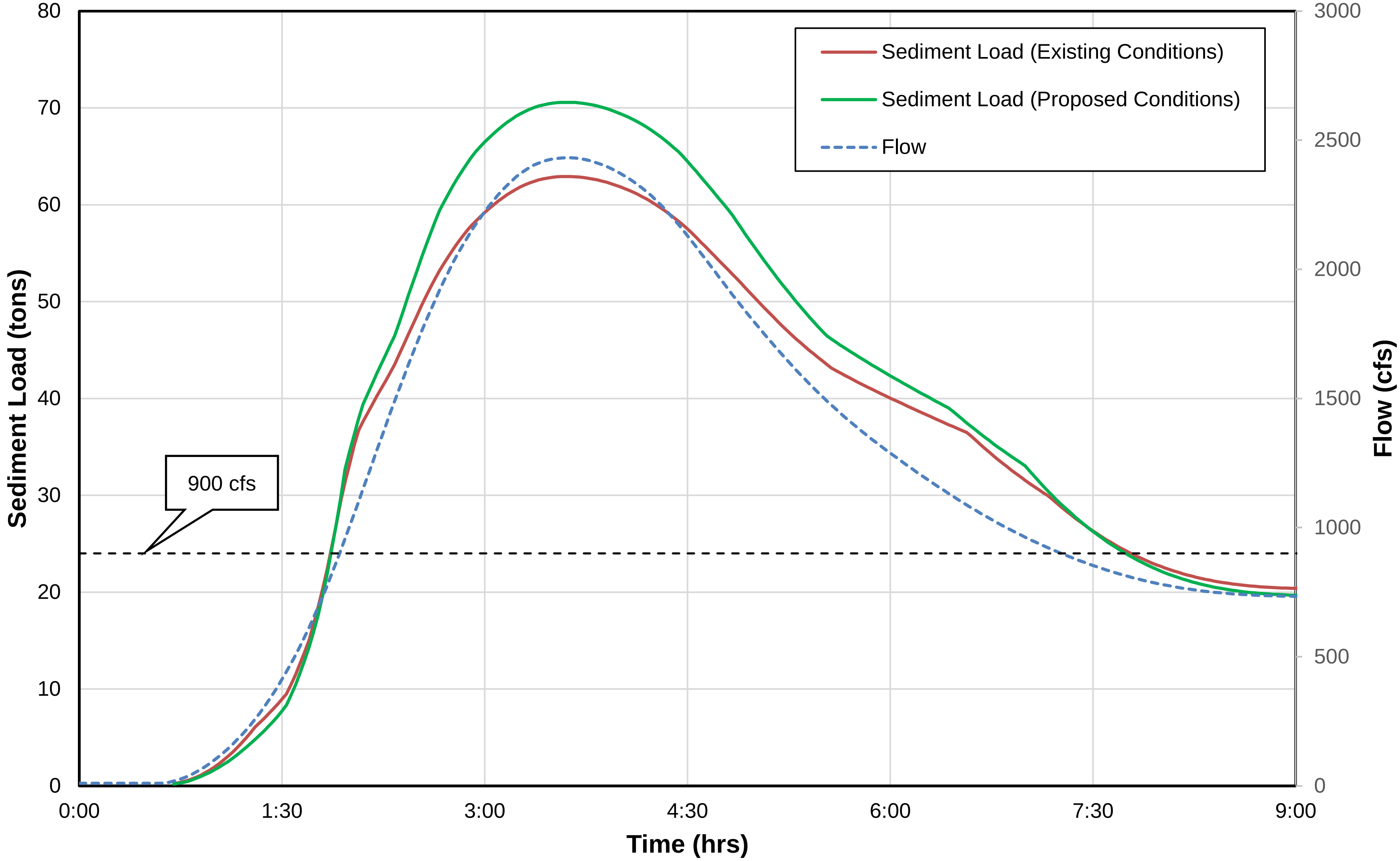
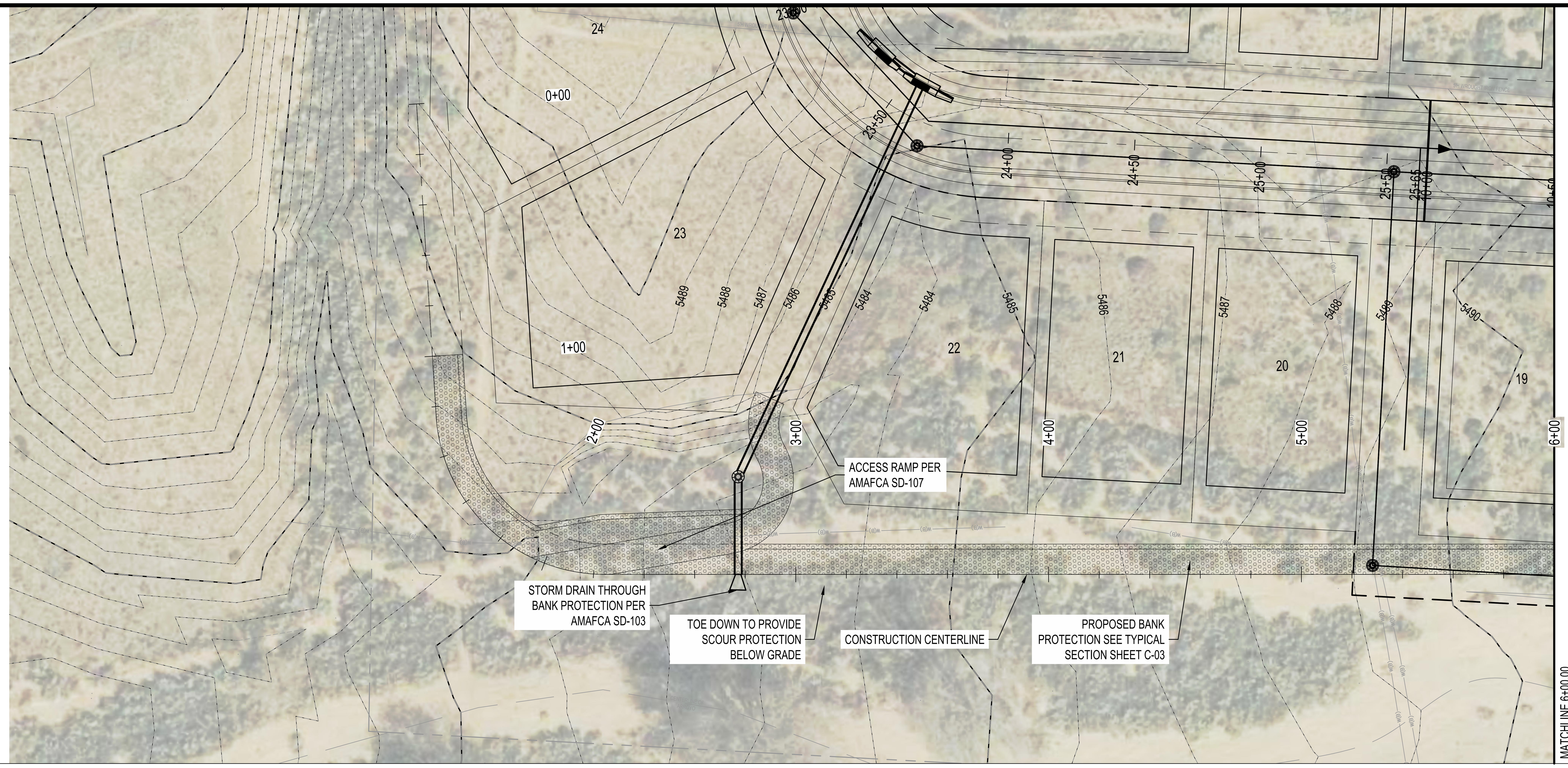
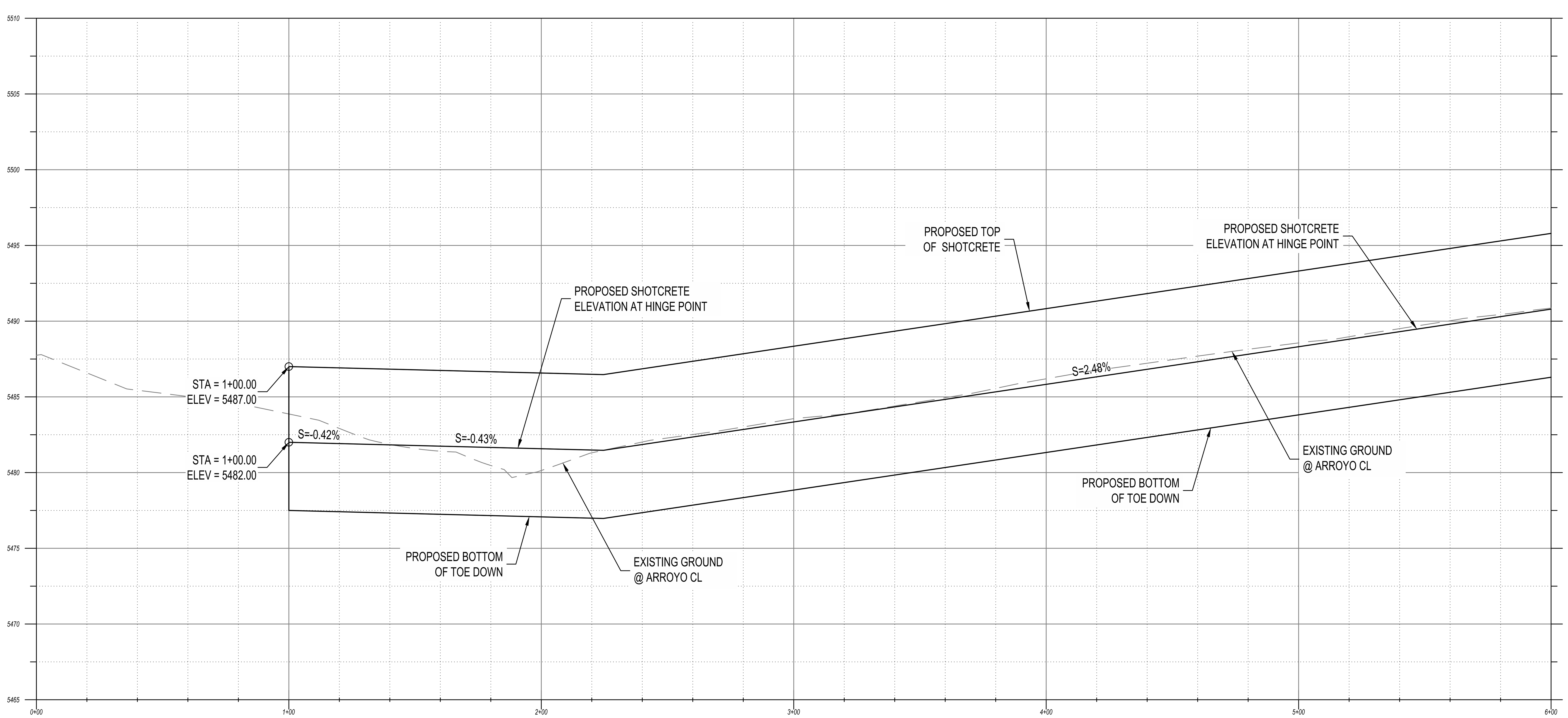


Figure 16. Predicted sediment loads under existing and proposed conditions over the simulated duration of the 100-year storm event. Also shown is the flow hydrograph and the 900 cfs threshold when sediment loading increases under proposed conditions.

APPENDIX F:
BANK PROTECTION LAYOUT AND DETAILS





Thu, 13-Oct-2022 - 4:39 pm, Plotted by: CHOESLY
P:\20220092\WR\Design\plans\20220092_C-01_Bank Protection PNP.dwg

BHI JOB NO. 20220092

GENERAL NOTES:

1. CONSTRUCTION CENTERLINE IS AT BANK PROTECTION HINGE POINT.
2. REFER TO SUBDIVISION GRADING PLAN FOR ADDITIONAL GRADING INFORMATION.
3. ORDINARY HIGH WATER MARK (OHWM) PER DELINEATION PREPARED BY MARRON & ASSOCIATES (AUGUST 2017).

LEGEND:

- DUMPED RIPRAP
- SHOTCRETE BANK PROTECTION (ABOVE GROUND)
- SHOTCRETE BANK PROTECTION (BELOW GROUND)

N

30 15 0 30
1"=30'

CALL NM ONE-CALL SYSTEM SEVEN (7) DAYS PRIOR TO ANY EXCAVATION

CONSULTANTS

Bohannan Huston
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800.877.5332

BENCH MARKS

ACS BRASS DISK STAMPED "13-E20"
GEOGRAPHIC POSITION (NAD 83)
NM STATE PLANE GRID COORDINATES (CENTRAL ZONE)
N = 1,511,612.268 (USFT), E = 1,550,598.401 (USFT)
GROUND TO GRID FACTOR = 0.999650558
DELTA ALPHA = -0°10'22.86"

SEAL

FOR REVIEW ONLY

October 13, 2022

NO.	DATE	DESCRIPTION	BY

AS-BUILT INFORMATION
CONTRACTOR: DATE:
WORK STAKED BY: DATE:
INSPECTOR'S ACCEPTANCE BY: DATE:
FIELD VERIFICATION BY: DATE:
DRAWINGS CORRECTED BY: DATE:

DESIGNED BY:	CH
DRAWN BY:	NEC
CHECKED BY:	VCS
DATE	10/13/22

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

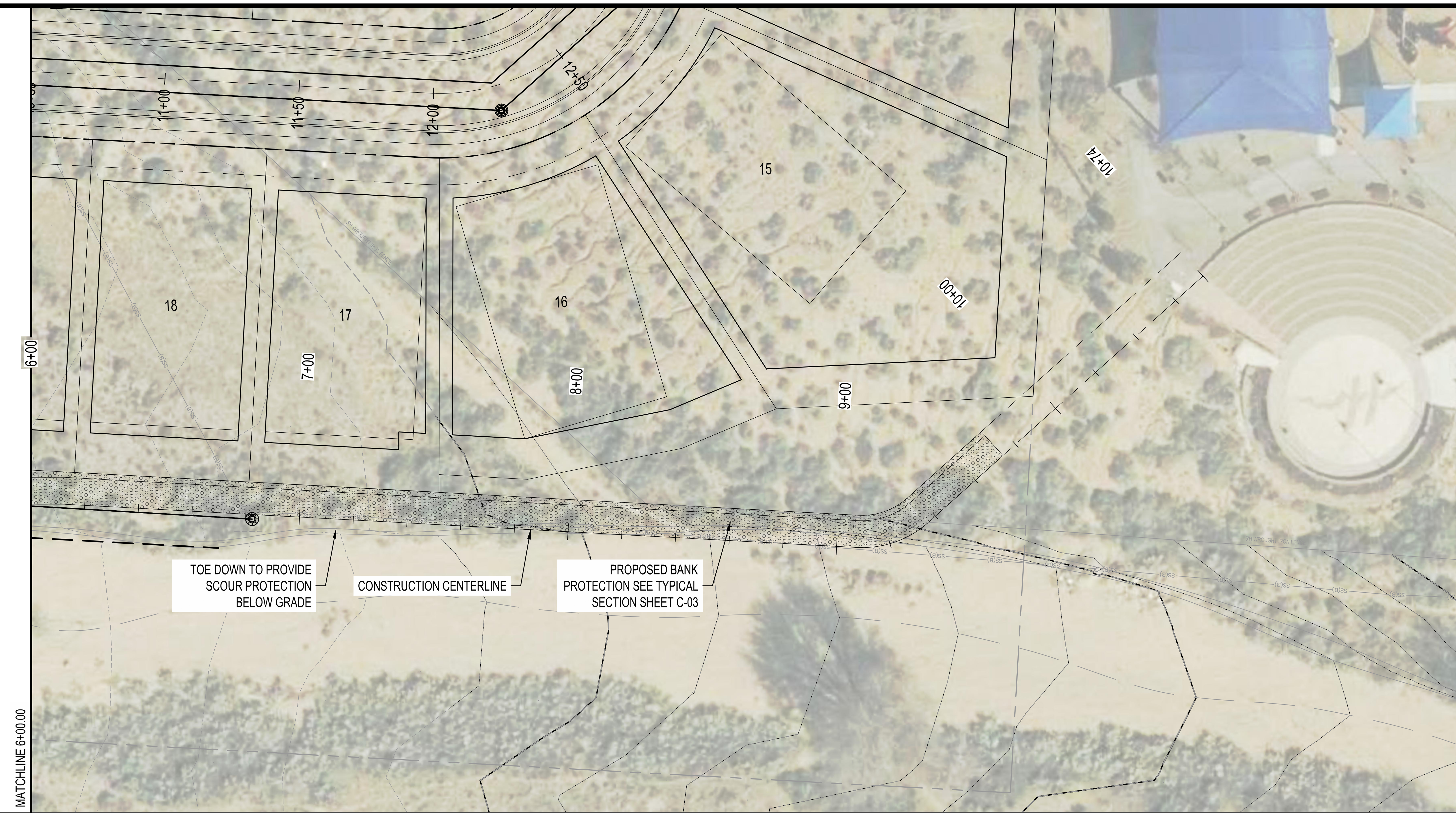
SOUTH PINO ARROYO
BANK PROTECTION
PLAN AND PROFILE
STA. 0+00.00 TO STA. 6+00.00

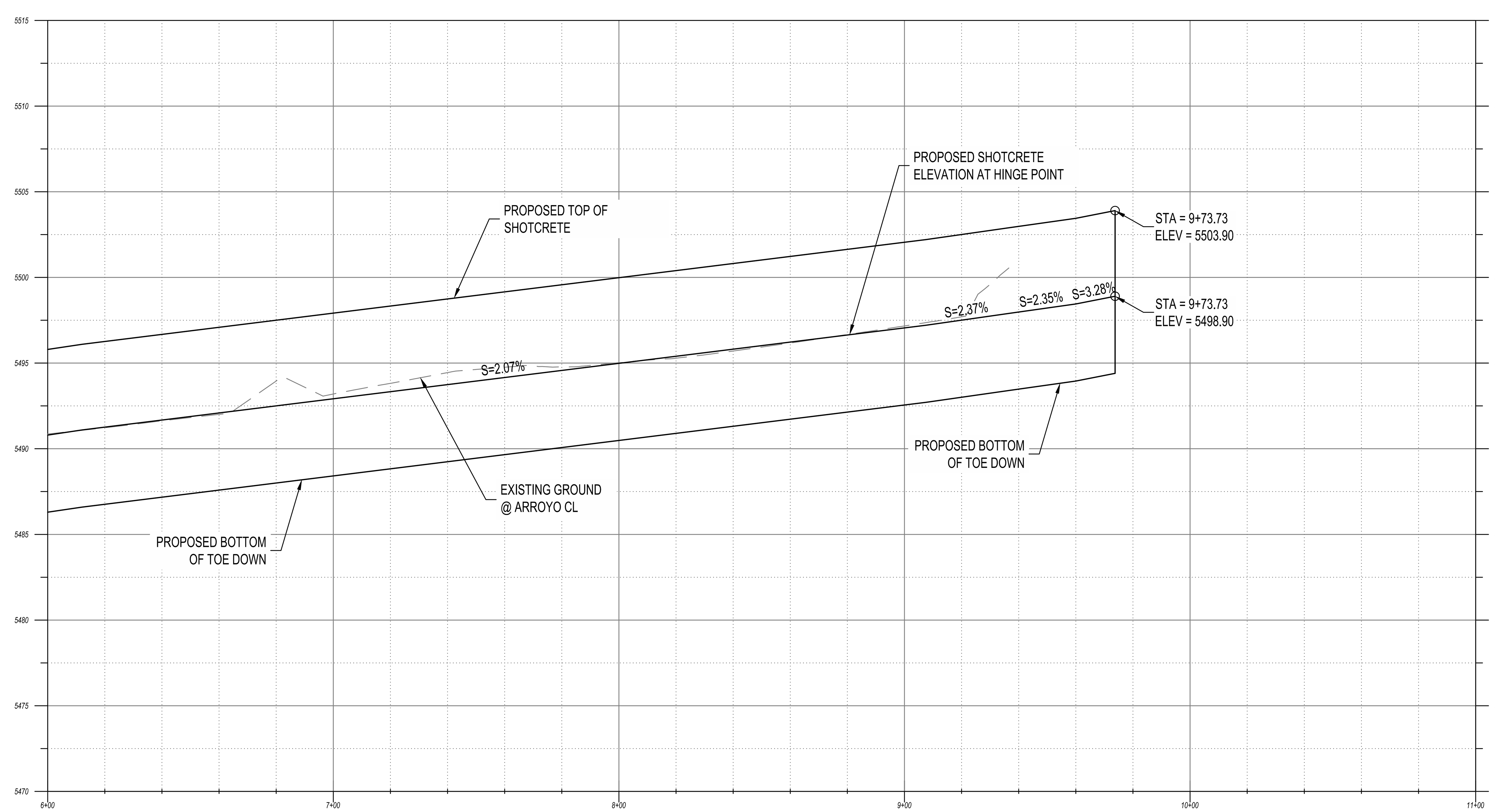
DESIGN REVIEW COMMITTEE | CITY ENGINEER APPROVAL

ZONE MAP NO.

CITY PROJECT NO.

SHEET NO. #### OF ####





GENERAL NOTES:

1. CONSTRUCTION CENTERLINE IS AT BANK PROTECTION HINGE POINT.
2. REFER TO SUBDIVISION GRADING PLAN FOR ADDITIONAL GRADING INFORMATION.
3. ORDINARY HIGH WATER MARK (OHWM) PER DELINEATION PREPARED BY MARRON & ASSOCIATES (AUGUST 2017).

LEGEND:

- DUMPED RIPRAP
- SHOTCRETE BANK PROTECTION (ABOVE GROUND)
- SHOTCRETE BANK PROTECTION (BELOW GROUND)

CONSULTANTS

Bohannan Huston
www.bhinc.com
800.877.5332

BENCH MARKS

ACS BRASS DISK STAMPED "13-E20"
GEOGRAPHIC POSITION (NAD 83)
NM STATE PLANE GRID COORDINATES (CENTRAL ZONE)
N = 1,511,612.268 (USFT), E = 1,550,598.401 (USFT)
GROUND TO GRID FACTOR = 0.999650558
DELTA ALPHA = -0°10'22.86"

SEAL

30% FOR REVIEW ONLY

October 13, 2022

NO.	DATE	DESCRIPTION	BY

AS-BUILT INFORMATION
CONTRACTOR: DATE:
WORK STAKED BY: DATE:
INSPECTOR'S ACCEPTANCE BY: DATE:
FIELD VERIFICATION BY: DATE:
DRAWINGS CORRECTED BY: DATE:

N
30 15 0 30
1"=30'

811
CALL NM ONE-CALL SYSTEM SEVEN (7) DAYS PRIOR TO ANY EXCAVATION

DESIGNED BY:	CH
DRAWN BY:	NEC
CHECKED BY:	VCS
DATE	10/13/22

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

SOUTH PINO ARROYO
BANK PROTECTION
PLAN AND PROFILE
STA. 6+00.00 TO STA. 11+00.00

DESIGN REVIEW COMMITTEE | CITY ENGINEER APPROVAL

ZONE MAP NO.

CITY PROJECT NO.

SHEET NO. #### OF ####

BHI JOB NO. 20220092

Thu, 13-Oct-2022 - 4:41 pm, Plotted by: CHOESLY
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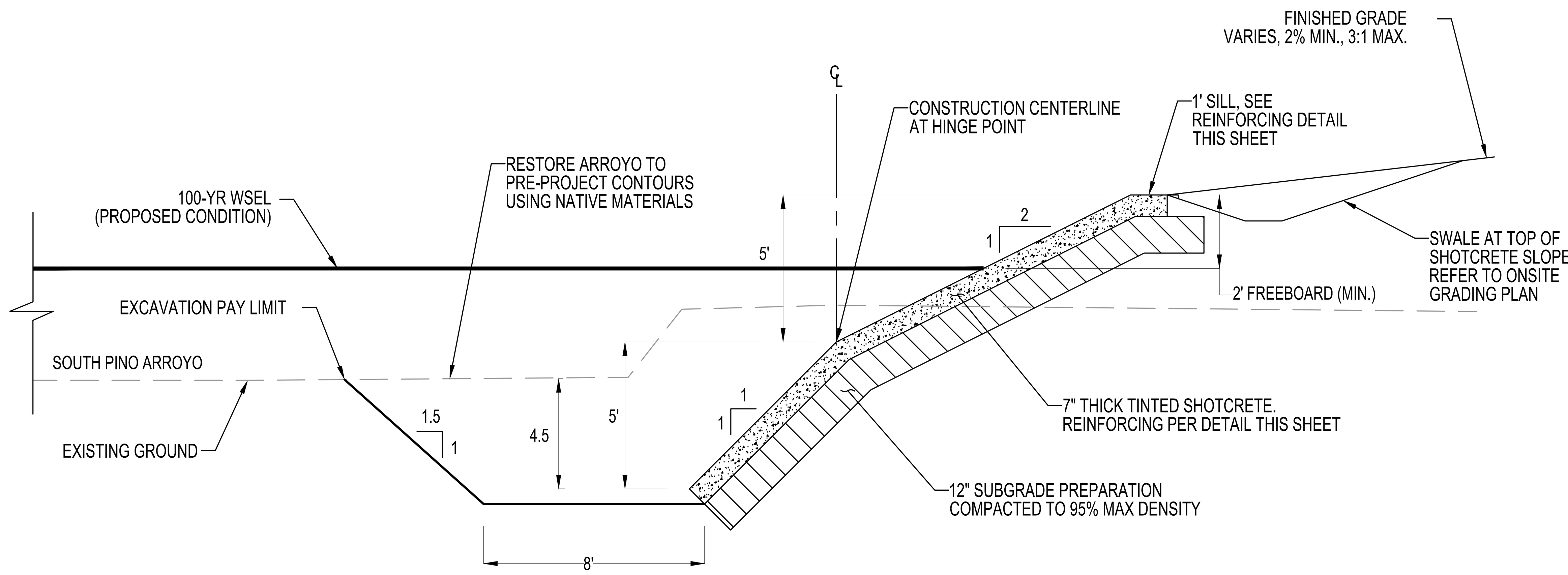
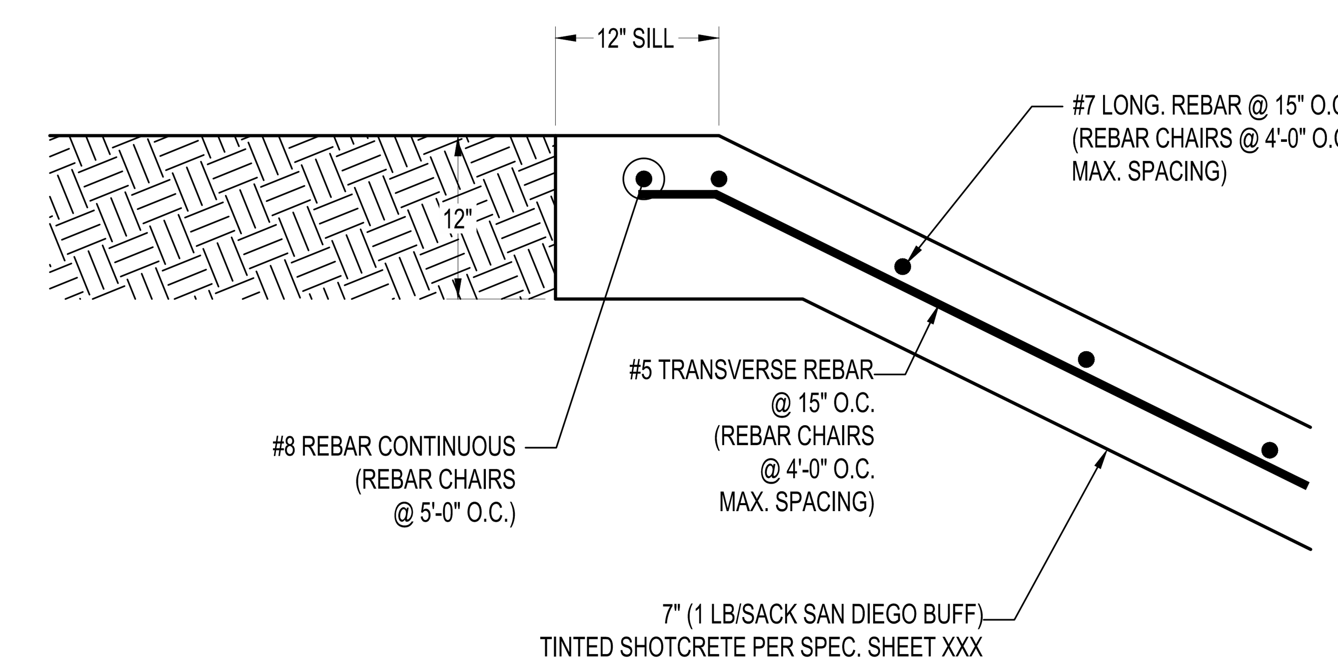


01 **TYPICAL SECTION - SHOTCRETE BANK PROTECTION**
SCALE: NOT TO SCALE



02 **SHOTCRETE REINFORCING DETAIL**
SCALE: NOT TO SCALE

CONSULTANTS

Bohannan Huston
www.bhinc.com
800.877.5332

BENCH MARKS
ACS BRASS DISK STAMPED "13-E20"
GEOGRAPHIC POSITION (NAD 83)
NM STATE PLANE GRID COORDINATES (CENTRAL ZONE)
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October 13, 2022

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AS-BUILT INFORMATION
CONTRACTOR: DATE:
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FIELD VERIFICATION BY: DATE:
DRAWINGS CORRECTED BY: DATE:

811
CALL NM ONE-CALL SYSTEM
SEVEN (7) DAYS PRIOR TO
ANY EXCAVATION

DESIGNED BY:	CH
DRAWN BY:	NEC
CHECKED BY:	VCS
DATE	10/13/22

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

SOUTH PINO ARROYO
BANK PROTECTION
SECTION AND DETAILS

DESIGN REVIEW COMMITTEE | CITY ENGINEER APPROVAL
ZONE MAP NO.
CITY PROJECT NO.
SHEET NO. #### OF ####

BHI JOB NO. 20220092

Thu, 13-Oct-2022 - 4:37 pm, Plotted by: CHOESLY
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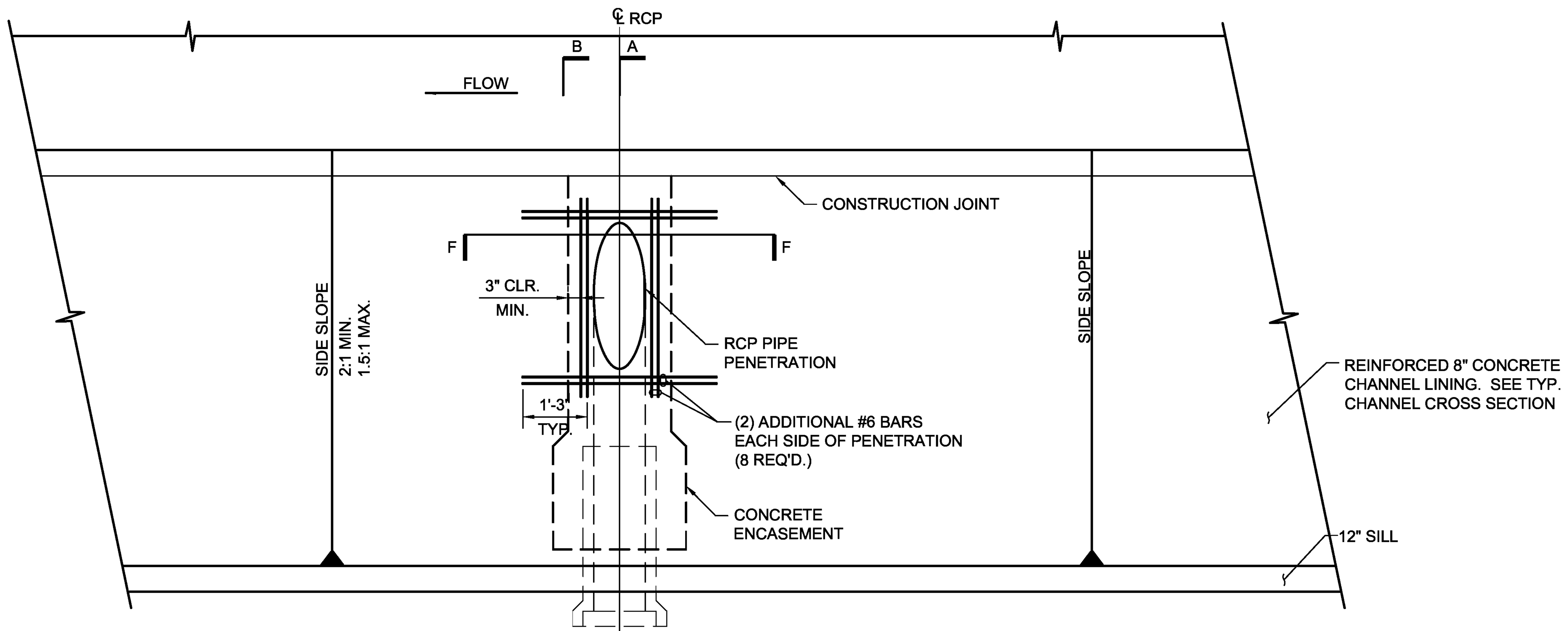
DIMENSION "A"								
SIDE SLOPE	PIPE DIAMETER (INCHES)							
	24	30	36	42	48	54	60	72
1.5:1	4'-8"	5'-5"	6'-2"	6'-11"	7'-8"	8'-5"	9'-2"	10'-8"
2:1	5'-8"	6'-8"	7'-8"	8'-8"	9'-8"	10'-8"	11'-8"	13'-8"

DIMENSION "B"							
PIPE DIAMETER (INCHES)							
24	30	36	42	48	54	60	72
10"	11"	1'-1"	1'-2"	1'-3"	1'-4"	1'-6"	1'-8"

GENERAL NOTES:

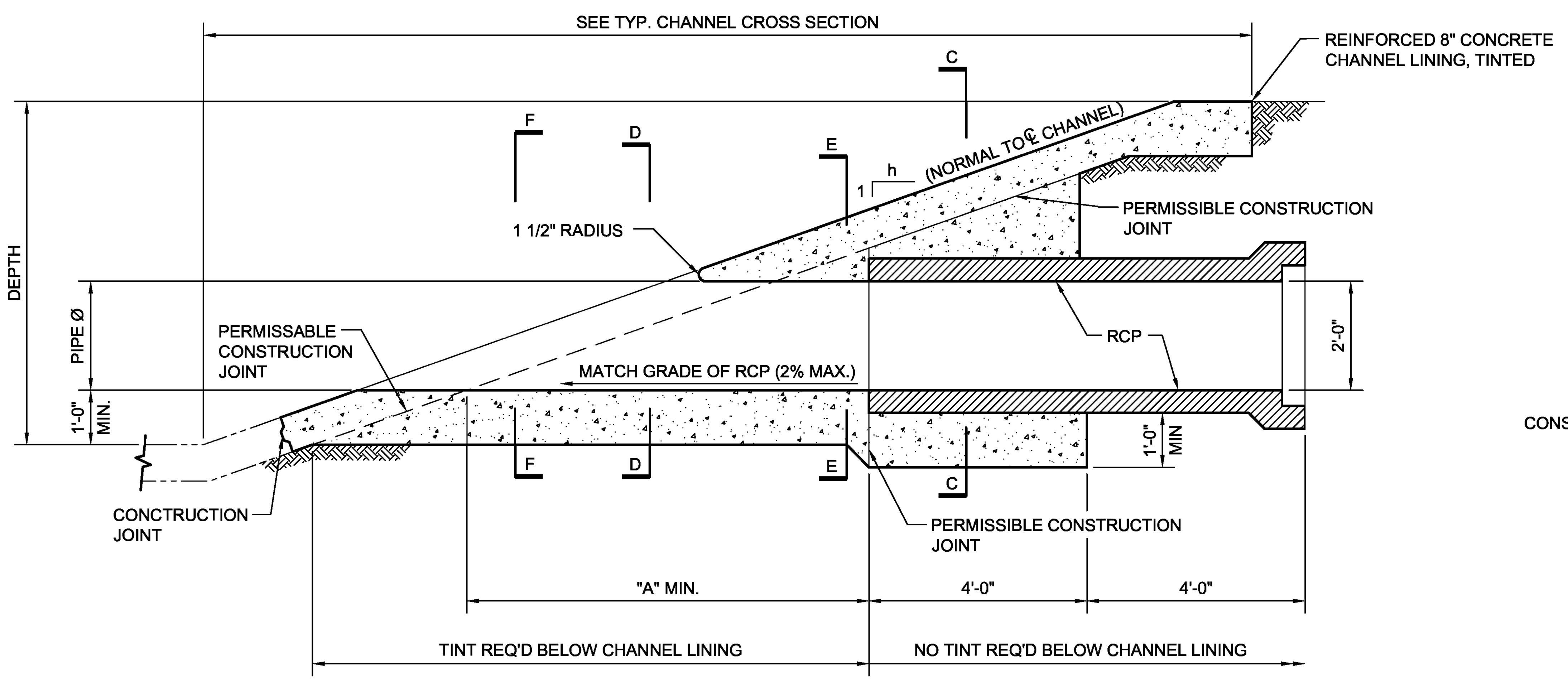
1. THE PIPE PENETRATION DETAILED HEREIN SHALL BE PAID FOR LUMP SUM AND SHALL BE COMPENSATION FOR THE PENETRATION COMPLETE AND IN PLACE. INCLUDED IN THIS WORK (BUT NOT LIMITED TO) IS GRADING, SUBGRADE PREPARATION, REINFORCED CONCRETE, CONSTRUCTION JOINTS, CONCRETE PLACEMENT AND FINISHING. NOTE THE MEASUREMENT FOR 8" CHANNEL LINING IS CONTINUOUS AND UNINTERRUPTED AT THE PENETRATION LOCATION.
2. ALL CULVERT PIPE PLACED UNDER THE CHANNEL LINING OR WITHIN AMAFCA RIGHT-OF-WAY SHALL BE RCP CLASS III MIN.
3. FOR PIPE PENETRATIONS INTO EXISTING CHANNELS, USE CHANNEL REMOVAL DETAILS FROM AMAFCA STANDARD DRAWING 102.



NOTE: CUT TYPICAL CHANNEL REINFORCING @ RCP PENETRATION. FIELD BEND CUT-BARS INTO CONCRETE ENCASEMENT 1'-3". MAINTAIN 3" CLR. (MIN.) ON ALL SIDES.

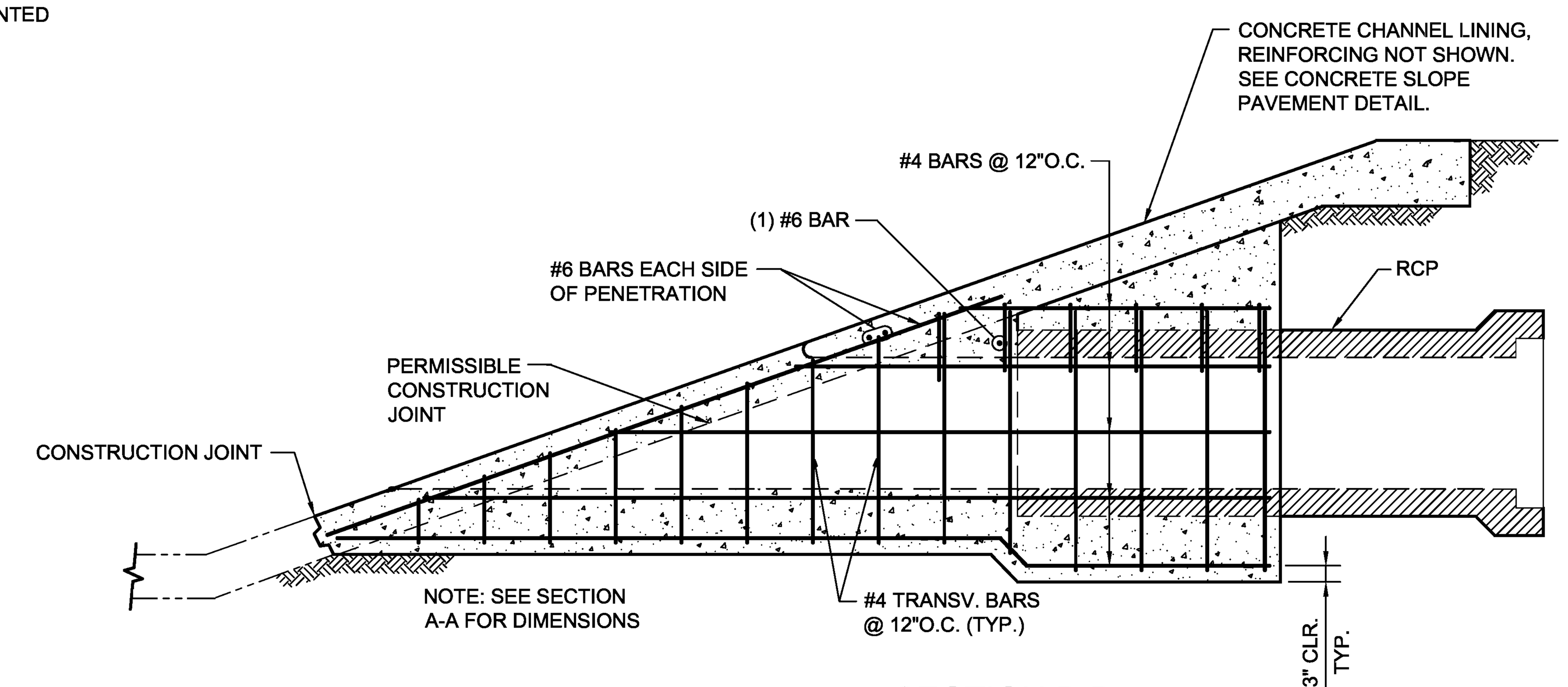
PIPE PENETRATION (PLAN VIEW)

NO SCALE



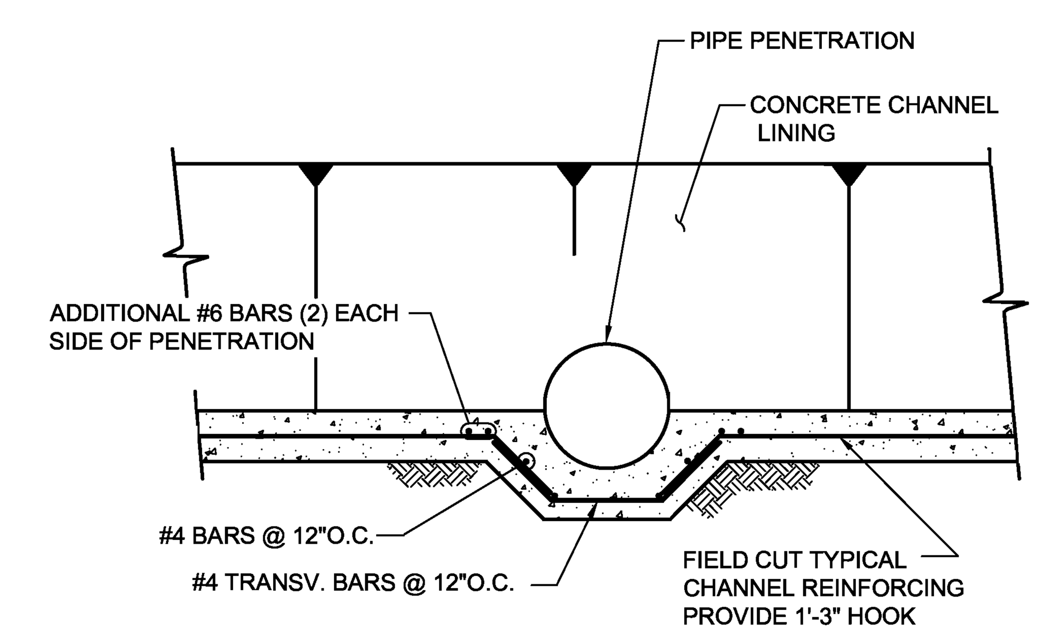
SECTION A-A

NO SCALE



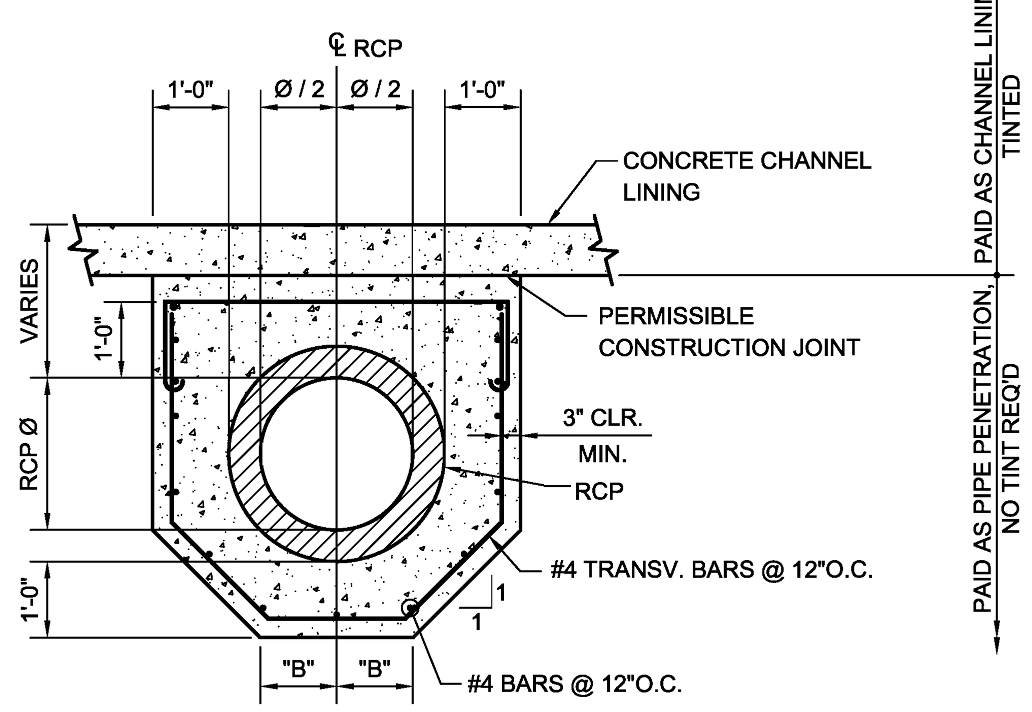
SECTION B-B

NO SCALE



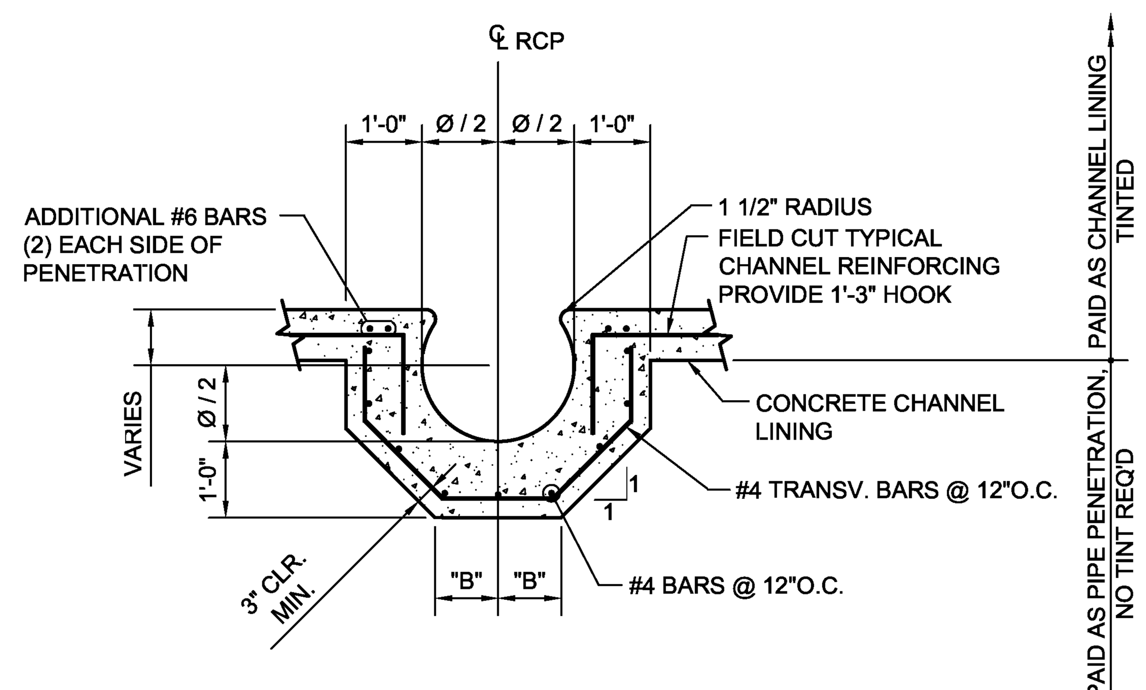
SECTION F-F

NO SCALE



SECTION C-C

NO SCALE



SECTION D-D

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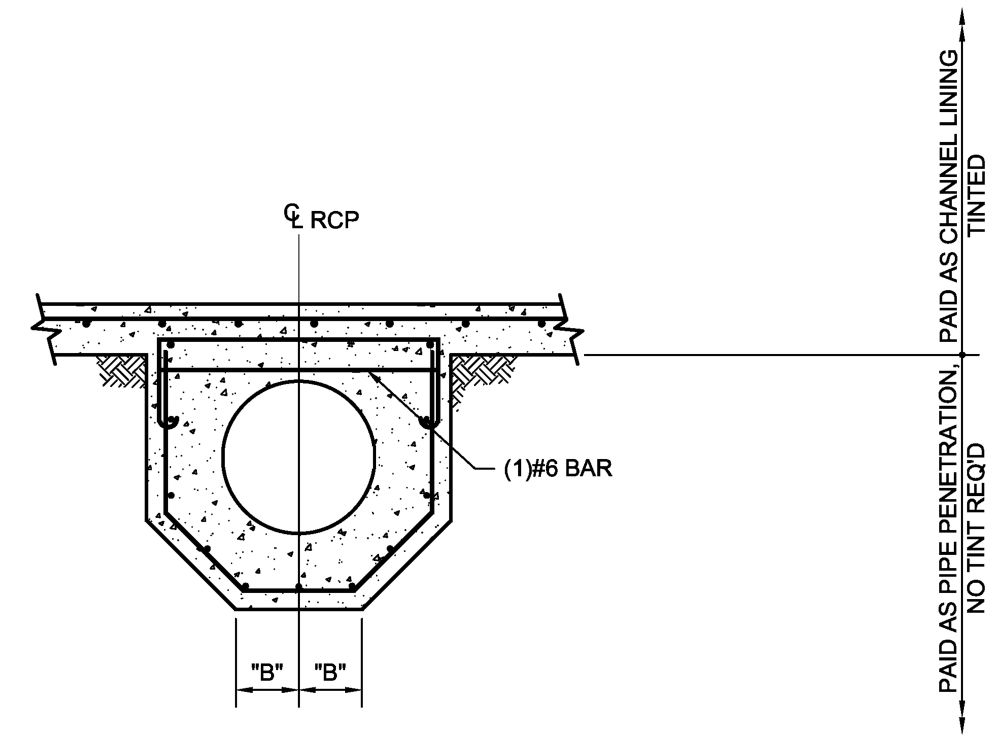


SECTION E-E

NO SCALE

P:\080313\Struct\ACAD\Submittals\100% Final\8-12-08\Acad dwg\AMAFCA-103.dwg
August 12, 2008 - 9:23am

ISSUE DATE: 8-12-2008

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

AMAFCA
STANDARD DETAILS

RCP CHANNEL PENETRATION
PIPE DIAMETER > 12", 0° SKEW

REV	DATE	DESCRIPTION	CHKD

DRAWING NO.	MAP NO.	SHEET	OF
103			

EXHIBITS

EXHIBIT A:	**SUBDIVISION LOCATION MAP AND PRELIMINARY PLAT**
EXHIBIT B:	**EXISTING CONDITIONS BASIN MAP**
EXHIBIT C:	**PROPOSED CONDITIONS BASIN MAP**
EXHIBIT D:	**INLET AND STORM DRAIN NETWORK**
EXHIBIT E:	**GRADING PLAN**

EXHIBIT A

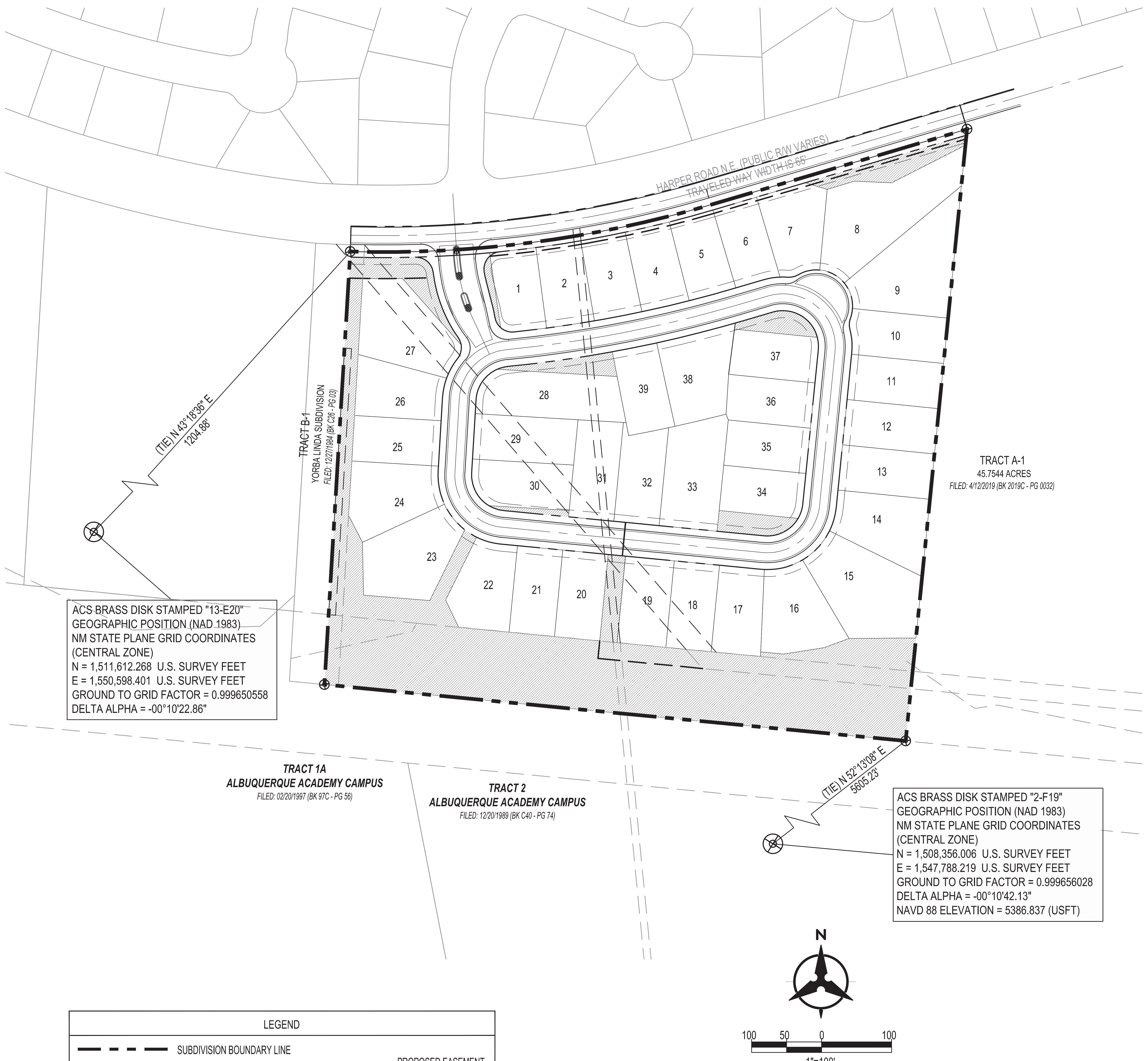
SUBDIVISION LOCATION MAP AND PRELIMINARY PLAT

PRELIMINARY PLAT
THE ESTATES AT ACADEMY

(REPLAT OF TRACT A-1 AND TRACT A-2 HOFFMANTOWN BAPTIST CHURCH SITE)

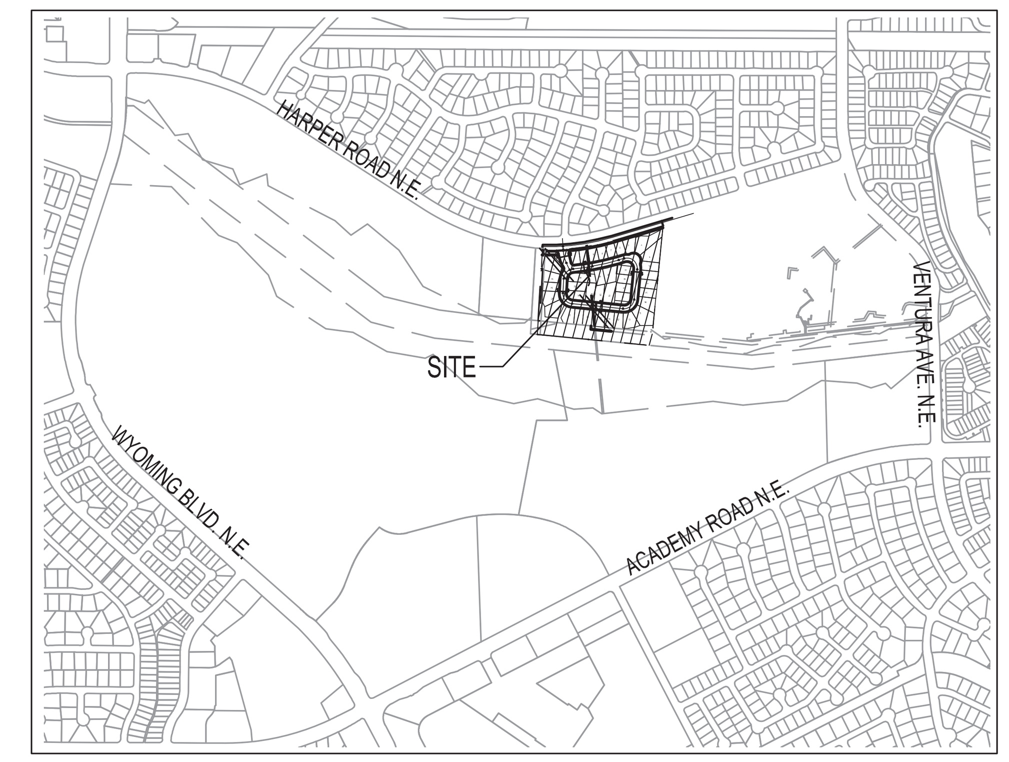
CITY OF ALBUQUERQUE
BERNALILLO COUNTY, NEW MEXICO

SEPTEMBER, 2022



LEGEND

SUBDIVISION BOUNDARY LINE	PROPOSED EASEMENT
TRACT LINE	PERIMETER FENCE
ADJOINING PROPERTY LINE	PROPOSED HOA TRACT
EXISTING EASEMENT	



LOCATION MAP (ZONE ATLAS E-20-Z)
NOT TO SCALE

SURVEY NOTES:

1. UNLESS OTHERWISE NOTED, ALL BOUNDARY CORNERS SHOWN THUS (⊕) SHALL BE MARKED BY A #5 REBAR STAMPED "PLOTNER, PS 14271".
2. ALL STREET CENTERLINE MONUMENTATION SHALL BE INSTALLED AT ALL CENTERLINE PC'S, PT'S, ANGLE POINTS AND STREET INTERSECTIONS AND SHOWN THUS (▲) WILL BE MARKED BY A FOUR (4") ALUMINUM CAP STAMPED "CITY OF ALBUQUERQUE CENTERLINE MONUMENTATION MARKED. DO NOT DISTURB, P.L.S. 14271".
3. THE SUBDIVISION BOUNDARY WILL BE TIED TO THE NEW MEXICO STATE PLANE COORDINATE SYSTEM AS SHOWN.
4. BASIS OF BEARINGS WILL BE NEW MEXICO STATE PLANE GRID BEARINGS.
5. DISTANCES SHALL BE GROUND DISTANCES.
6. MANHOLES WILL BE OFFSET AT ALL POINTS OF CURVATURE POINTS OF TANGENCY, STREET INTERSECTIONS AND ALL OTHER ANGLE POINTS TO ALLOW THE USE OF CENTERLINE MONUMENTATION.

APPROVED FOR MONUMENTATION AND STREET NAMES

____
CITY SURVEYOR DATE

OWNER:

BY: _________________________

NAME: _________________________

TITLE: _________________________

DATE: _________________________

Solar Collection Note

NO PROPERTY WITHIN THE AREA OF REQUESTED FINAL ACTION SHALL AT ANY TIME BE SUBJECT TO A DEED RESTRICTION, COVENANT, OR BUILDING AGREEMENT PROHIBITING SOLAR COLLECTORS FROM BEING INSTALLED ON BUILDINGS OR ERECTED ON THE LOTS OR PARCELS WITHIN THE AREA OF PROPOSED PLAT, THE FOREGOING REQUIREMENT SHALL BE A CONDITION TO APPROVAL OF THIS PLAT.

Purpose of Plat

1. SUBDIVIDE AS SHOWN HEREON.
2. GRANT EASEMENTS AS SHOWN HEREON.
3. DEDICATE ADDITIONAL RIGHT-OF-WAY AS SHOWN HEREON.

PLAT IS LOCATED WITHIN PROJECTED SECTIONS 29, TOWNSHIP 11 NORTH, RANGE 4 EAST, NEW MEXICO PRINCIPAL MERIDIAN, CITY OF ALBUQUERQUE, BERNALILLO COUNTY, NEW MEXICO.

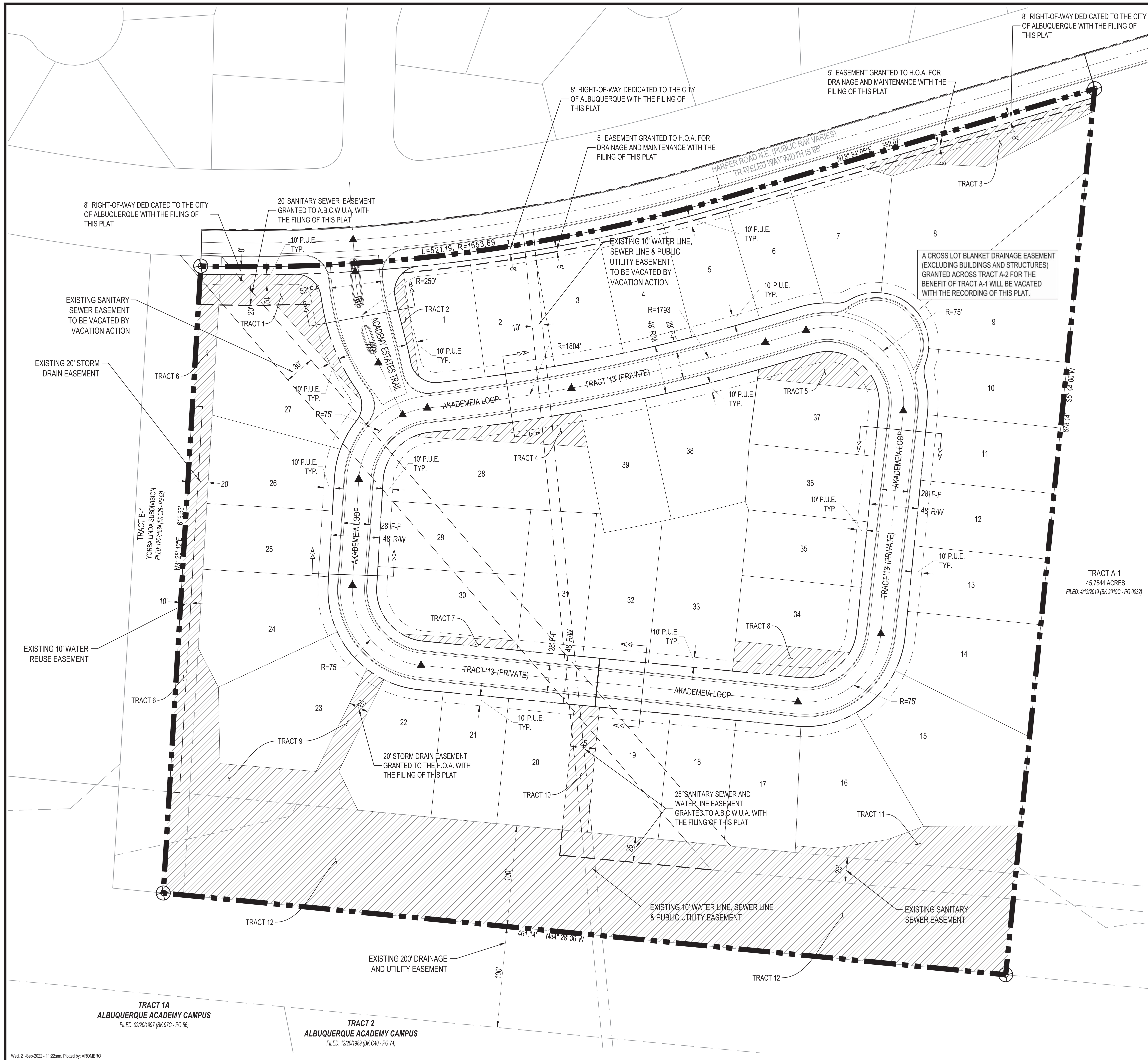
Wed, 21-Sep-2022 - 11:22:am, Plotted by: AROMERO
P:\20220092\CDP\Plans\General\20220092_PreliminaryPlat.dwg

PRELIMINARY PLAT
THE ESTATES AT ACADEMY

(REPLAT OF TRACT A-1 AND TRACT A-2 HOFFMANTOWN BAPTIST CHURCH SITE)

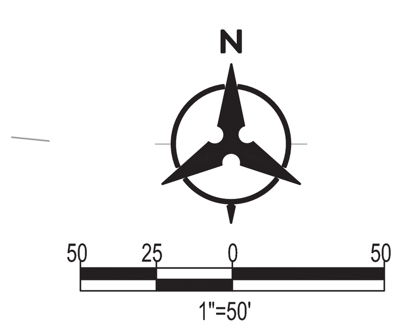
CITY OF ALBUQUERQUE
BERNALILLO COUNTY, NEW MEXICO

SEPTEMBER, 2022



LEGEND

- SUBDIVISION BOUNDARY LINE
- TRACT LINE
- ADJOINING PROPERTY LINE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- PERIMETER FENCE
- PROPOSED HOA TRACT



Wed, 21-Sep-2022 - 11:22am, Plotted by: AROMERO
P:\20220092\CDP\Plans\General\20220092_PreliminaryPlat.dwg

LEGAL DESCRIPTION:

TRACT 'A-2', OF THE PLAT OF TRACTS A-1 AND A-2 HOFFMANTOWN BAPTIST CHURCH SITE WITHIN THE ELENA GALLEGOS GRANT WITHIN PROJECTED SECTION 29, TOWNSHIP 11 NORTH, RANGE 4 EAST OF THE NEW MEXICO PRINCIPAL MERIDIAN, BERNALILLO COUNTY, ALBUQUERQUE, NEW MEXICO AS THE SAME IS SHOWN AND DESIGNATED ON SAID PLAT FILED FOR RECORD IN THE OFFICE OF THE COUNTY CLERK OF BERNALILLO COUNTY, NEW MEXICO

1. EXISTING ZONING: RC-1
   PROPOSED ZONING: RC-1

   PROPOSED RESIDENTIAL DEVELOPMENT:
   SINGLE FAMILY DETACHED RESIDENTIAL

2. TOTAL ACREAGE:
   EXISTING TRACT 'A-2' = 14.0710 ACRES

ACREAGE:

	ENCUMBERED BY EASEMENT
TRACT '1' = 0.1087 Acres	B
TRACT '2' = 0.0189 Acres	B
TRACT '3' = 0.1182 Acres	B
TRACT '4' = 0.0723 Acres	B
TRACT '5' = 0.0652 Acres	B
TRACT '6' = 0.2352 Acres	B
TRACT '7' = 0.0178 Acres	B
TRACT '8' = 0.0681 Acres	B
TRACT '9' = 0.2218 Acres	B
TRACT '10' = 0.0712 Acres	B
TRACT '11' = 0.1297 Acres	B
TRACT '12' = 1.920 Acres	B
TRACT '13' = 1.997 Acres	A, C, D

EASEMENT LEGEND

A PRIVATE DRAINAGE EASEMENT SEE NOTE 4

B PRIVATE DRAINAGE EASEMENT SEE NOTE 10

C PUBLIC SUBSURFACE SANITARY AND WATERLINE EASEMENT SEE NOTE 4

D PRIVATE PEDESTRIAN AND VEHICULAR ACCESS EASEMENT SEE NOTE 4

NUMBER OF LOTS:
HOFFMANTOWN SUBDIVISION = 39

PROPOSED DENSITY: 2.77 D.U./ACRE

3. MINIMUM LOT DIMENSIONS: 50'x120'
   MINIMUM LOT AREA: 6,100 SF

4. TRACT 13 TO BE OWNED BY THE H.O.A. AND CONTAINS THE FOLLOWING BLANKET EASEMENTS:

   - PUBLIC SUBSURFACE SANITARY SEWER, PUBLIC SUBSURFACE WATERLINE EASEMENT TO BE GRANTED TO ABCWUA FOR OWNERSHIP, OPERATIONS AND MAINTENANCE OF THE PUBLIC WATER AND SANITARY SEWER INFRASTRUCTURE.
   - A PRIVATE SURFACE AND SUBSURFACE DRAINAGE EASEMENT TO BE GRANTED TO THE CITY OF ALBUQUERQUE. SEE SHEET 3 OF 3 FOR 'DRAINAGE FACILITIES MAINTENANCE NOTE' FOR OWNERSHIP AND MAINTENANCE RESPONSIBILITY.
   - A PRIVATE PEDESTRIAN AND VEHICULAR ACCESS EASEMENT TO BE GRANTED TO THE H.O.A. FOR THE OWNERSHIP, OPERATIONS AND MAINTENANCE OF THE SIDEWALK AND ROADWAY INFRASTRUCTURE TO SERVE THE RESIDENCE IN 'HOFFMANTOWN SUBDIVISION'.

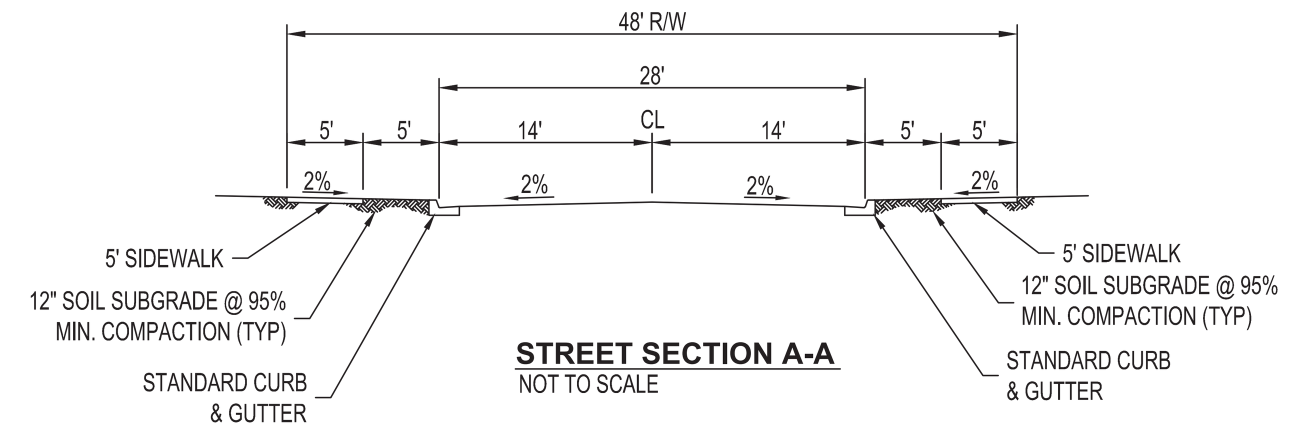
5. LOT SETBACKS:
   FRONT: 15'
   SIDE : 5'
   REAR: 15'

6. PROPOSED SOLAR ACCESS PROVISIONS, SHALL BE IN ACCORDANCE WITH INTEGRATED DEVELOPMENT ORDINANCE 14-16-5-10.

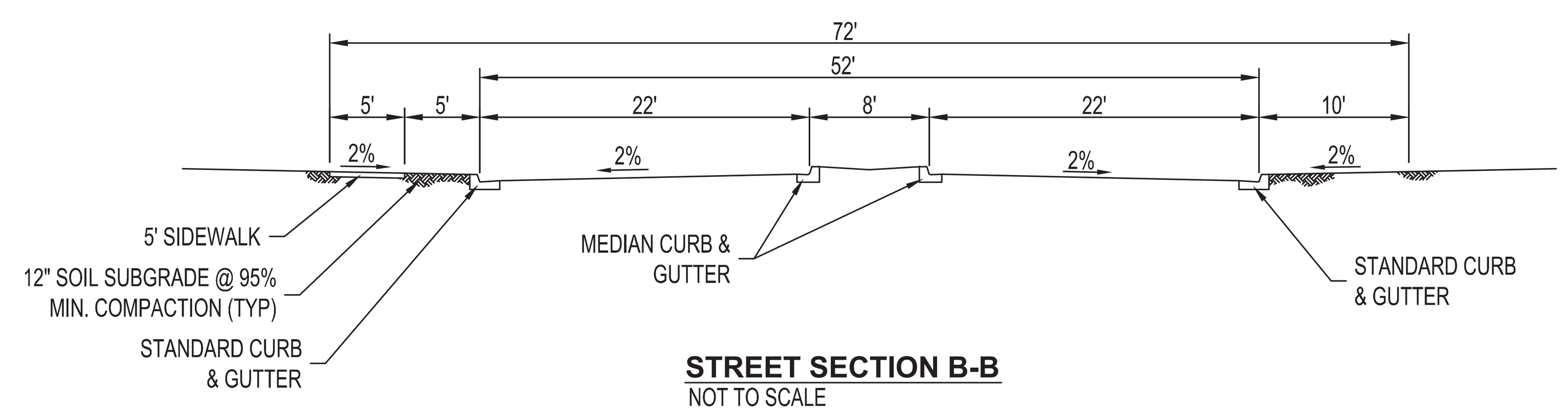
7. THE H.O.A. SHALL MAINTAIN ALL TRAILS LOCATED WITHIN H.O.A. TRACTS AND ITS CONNECTIONS TO ANY PUBLIC OWNED AND MAINTAINED SIDEWALK / TRAIL.

8. TRACT '1' THROUGH TRACT '13' TO BE OWNED AND MAINTAINED BY THE HOME OWNERS ASSOCIATION.

10. TRACTS '1' - '12' CONTAIN A PRIVATE DRAINAGE EASEMENT GRANTED TO THE H.O.A. SEE THIS SHEET FOR 'DRAINAGE FACILITIES MAINTENANCE NOTE' FOR OWNERSHIP AND MAINTENANCE RESPONSIBILITY



STREET SECTION A-A
NOT TO SCALE



STREET SECTION B-B
NOT TO SCALE

DRAINAGE FACILITIES MAINTENANCE NOTES:

AREAS DESIGNATED ON THE ACCOMPANYING PLAT AS "DRAINAGE EASEMENTS" ["DETENTION AREAS"] ARE HEREBY DEDICATED BY THE OWNER AS A PERPETUAL EASEMENT FOR THE COMMON USE AND BENEFIT OF THE VARIOUS LOTS WITHIN THE SUBDIVISIONS FOR THE PURPOSE OF PERMITTING THE CONVEYANCE OF STORM WATER RUNOFF AND THE CONSTRUCTING AND MAINTAINING OF DRAINAGE FACILITIES [STORM WATER DETENTION FACILITIES] IN ACCORDANCE WITH STANDARDS PRESCRIBED BY THE CITY OF ALBUQUERQUE. NO FENCE, WALL, BUILDING OR OTHER OBSTRUCTION (UNLESS SHOWN ON THE APPROVED GRADING PLAN) MAY BE PLACED OR MAINTAINED IN THE EASEMENT AREA WITHOUT APPROVAL OF THE CITY ENGINEER OF THE CITY OF ALBUQUERQUE. THERE ALSO SHALL BE NO ALTERATION OF THE GRADES OR CONTOURS IN SAID EASEMENT AREA WITHOUT THE APPROVAL OF THE CITY ENGINEER. IT SHALL BE THE DUTY OF THE LOT OWNERS OF THIS SUBDIVISION TO MAINTAIN SAID DRAINAGE EASEMENT [DETENTION AREA] AND FACILITIES AT THEIR COST IN ACCORDANCE WITH STANDARDS PRESCRIBED BY THE CITY OF ALBUQUERQUE. THE CITY SHALL HAVE THE RIGHT TO ENTER PERIODICALLY TO INSPECT THE FACILITIES. IN THE EVENT SAID LOT OWNERS FAIL TO ADEQUATELY AND PROPERLY MAINTAIN DRAINAGE EASEMENT [DETENTION AREA] AND FACILITIES, AT ANY TIME FOLLOWING FIFTEEN (15) DAYS WRITTEN NOTICE TO SAID LOT OWNERS, THE CITY MAY ENTER UPON SAID AREA, PERFORM SAID MAINTENANCE, AND THE COST OF PERFORMING SAID MAINTENANCE SHALL BE PAID BY APPLICABLE LOT OWNERS PROPORTIONATELY ON THE BASIS OF LOT OWNERSHIP. IN THE EVENT LOT OWNERS FAIL TO PAY THE COST OF MAINTENANCE WITHIN THIRTY (30) DAYS AFTER DEMAND FOR PAYMENT MADE BY THE CITY, THE CITY MAY FILE A LIEN AGAINST ALL LOTS IN THE SUBDIVISION FOR WHICH PROPORTIONATE PAYMENT HAS NOT BEEN MADE. THE OBLIGATIONS IMPOSED HEREIN SHALL BE BINDING UPON THE OWNER, HIS HEIRS, AND ASSIGNS AND SHALL RUN WITH ALL LOTS WITHIN THIS SUBDIVISION.

THE GRANTOR AGREES TO DEFEND, INDEMNIFY, AND HOLD HARMLESS, THE CITY, ITS OFFICIALS, AGENTS AND EMPLOYEES FROM AND AGAINST ANY AND ALL CLAIMS, ACTIONS, SUITS, OR PROCEEDINGS OF ANY KIND BROUGHT AGAINST SAID PARTIES FOR OR ON ACCOUNT OF ANY MATTER ARISING FROM THE DRAINAGE FACILITY PROVIDED FOR HEREIN OR THE GRANTOR'S FAILURE TO CONSTRUCT, MAINTAIN, OR MODIFY SAID DRAINAGE FACILITY.

Free Consent & Dedication

THE SUBDIVISION SHOWN AND DESCRIBED HEREON IS WITH THE FREE CONSENT AND IN ACCORDANCE WITH THE DESIRES OF THE UNDERSIGNED OWNER(S) THEREOF AND GRANT ALL EASEMENTS AS SHOWN HEREON. EXISTING AND/OR GRANTED PUBLIC UTILITY EASEMENTS (P.U.E) AS SHOWN HEREON, UNLESS NOTED OTHERWISE, ARE FOR THE COMMON AND JOINT USE OF GAS, ELECTRICAL POWER AND COMMUNICATION SERVICES FOR BURIED AND/OR OVERHEAD DISTRIBUTION LINES, CONDUIT AND PIPES FOR UNDERGROUND UTILITIES. SAID UTILITY COMPANIES HAVE THE RIGHT OF INGRESS/EGRESS FOR CONSTRUCTION OF, MAINTENANCE OF AND REPLACEMENT OF SAID UTILITIES INCLUDING THE RIGHT TO TRIM INTERFERING TREES AND SHRUBS WITHIN SAID P.U.E.. SAID OWNERS CERTIFY THAT THIS SUBDIVISION IS THEIR FREE ACT AND DEED.

____

MANAGING MEMBER

STATE OF NEW MEXICO }
COUNTY OF BERNALILLO } SS

THIS INSTRUMENT WAS ACKNOWLEDGED BEFORE ME ON ______________, 20___
BY: STAN DIAMOND, MANAGING MEMBER, ELK HAVEN, LLC

By: ______________________________
NOTARY PUBLIC

MY COMMISSION EXPIRES ______________

PRELIMINARY PLAT
THE ESTATES AT ACADEMY

(REPLAT OF TRACT A-1 AND TRACT A-2 HOFFMANTOWN BAPTIST CHURCH SITE)

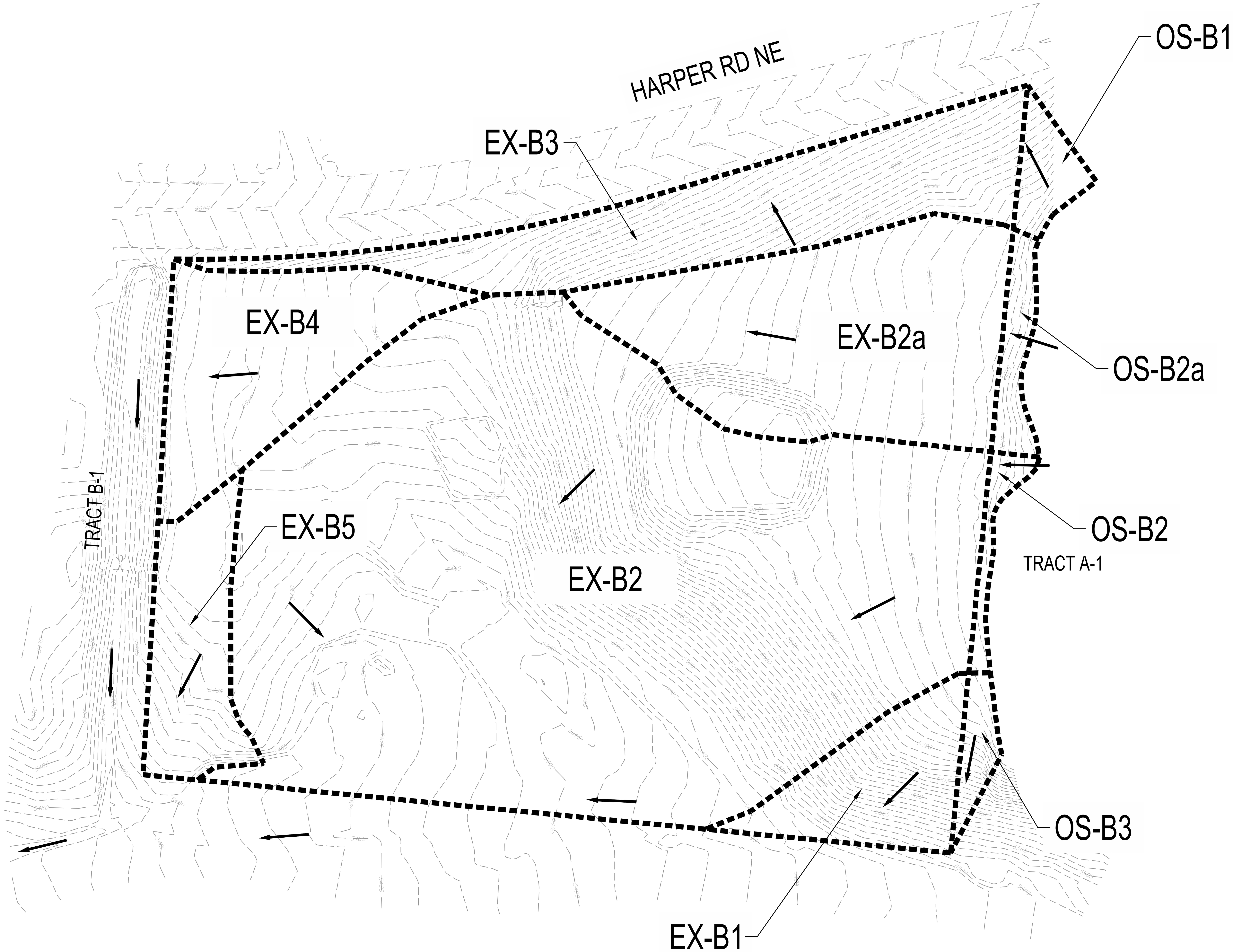
CITY OF ALBUQUERQUE
BERNALILLO COUNTY, NEW MEXICO

SEPTEMBER, 2022

Wed, 21-Sep-2022 - 11:22:am, Plotted by: AROMERO
P:\20220092\CDP\Plans\General\20220092_PreliminaryPlat.dwg

EXHIBIT B:

EXISTING CONDITIONS BASIN MAP



LEGEND

EXISTING BASIN BOUNDARY

FLOW ARROW

EXISTING CONDITIONS

BASIN I.D.	AREA (AC)	% LAND TREATMENT A	B	C	D	DISCHARGE (CFS) 10 YR	100YR
EX-B1	0.5	10.0%	90.0%	0.0%	0.0%	0.5	1.3
EX-B2	6.9	80.0%	20.0%	0.0%	0.0%	4.2	13.6
EX-B2a	1.6	80.0%	20.0%	0.0%	0.0%	1.0	3.2
EX-B3	1.3	10.0%	90.0%	0.0%	0.0%	1.3	3.1
EX-B4	1.0	90.0%	10.0%	0.0%	0.0%	0.5	1.8
EX-B5	0.5	90.0%	10.0%	0.0%	0.0%	0.3	1.0
OS-B1	0.1	10.0%	90.0%	0.0%	0.0%	0.1	0.4
OS-B2	0.1	90.0%	10.0%	0.0%	0.0%	0.1	0.2
OS-B2a	0.2	90.0%	10.0%	0.0%	0.0%	0.1	0.3
OS-B3	0.1	10.0%	90.0%	0.0%	0.0%	0.1	0.3
TOTAL	12.4					8.3	25.2

N

60 30 0 60

1" = 60'

EXISTING DRAINAGE PLAN

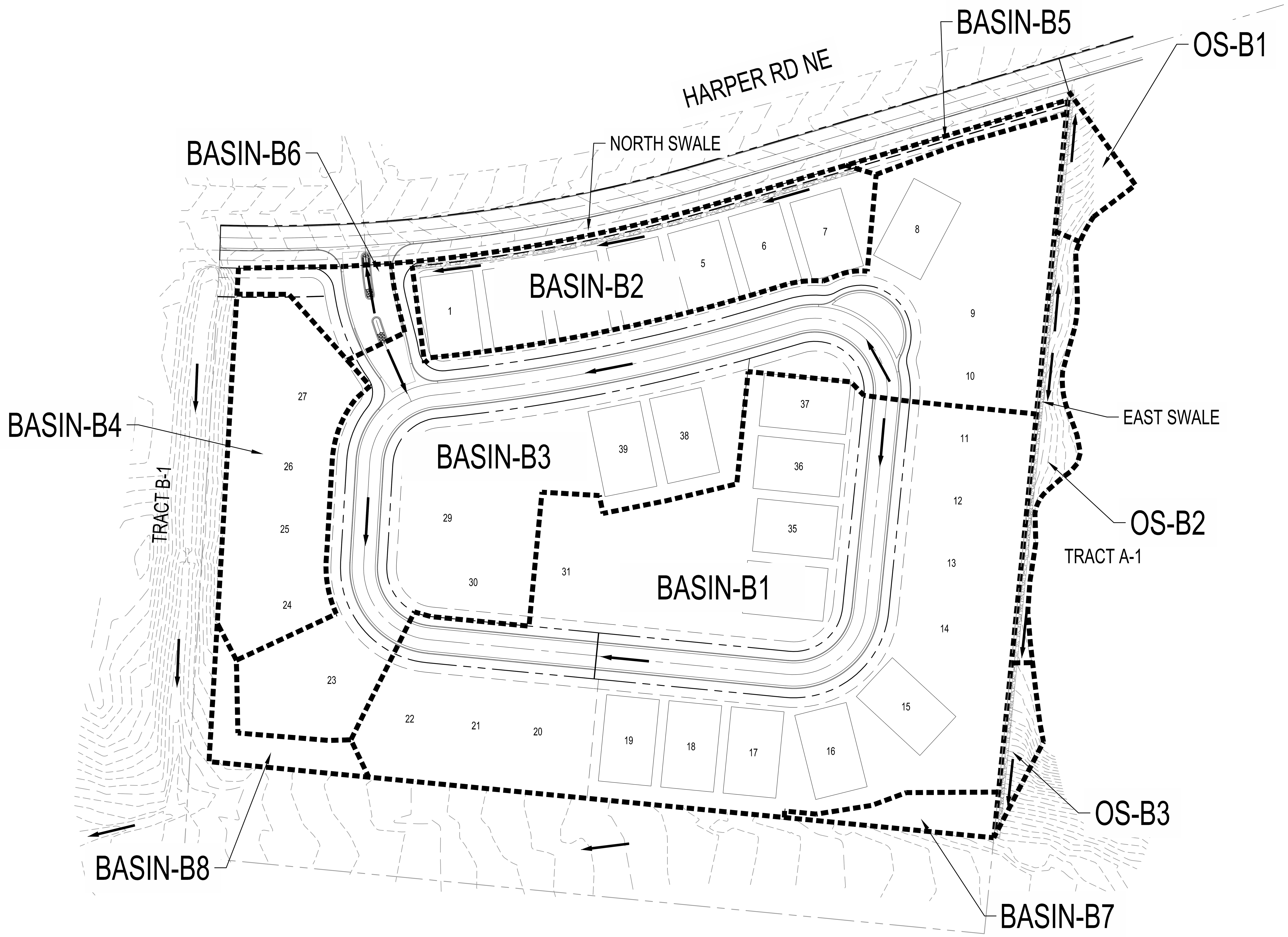
HOFFMANTOWN

DRAWN BY: SS	DATE: 10/12/2022	
CHECKED BY: YPM	BHI PROJECT NO. 20220092	SHEET NO. 1

Bohannan Huston
www.bhinc.com 800.877.5332

EXHIBIT C:

PROPOSED CONDITIONS BASIN MAP



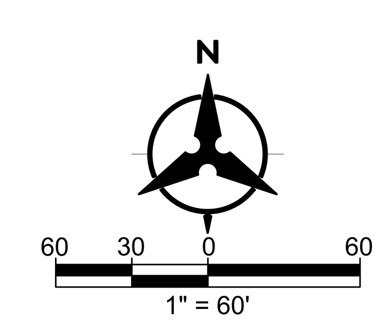
LEGEND

PROPOSED BASIN BOUNDARY

FLOW ARROW

PROPOSED CONDITIONS								
BASIN I.D.	AREA (AC)	UNITS #	% LAND TREATMENT				DISCHARGE (CFS)	
			A	B	C	D	10 YR	100YR
Basin B1	5.0	19	0.0%	31.0%	31.0%	38.0%	**9.6**	**17.3**
Basin B2	1.1	7	0.0%	31.0%	31.0%	38.0%	**2.2**	**3.9**
Basin B3	4.1	9	0.0%	31.0%	31.0%	38.0%	**7.9**	**14.2**
Basin B4	0.9	4	0.0%	31.0%	31.0%	38.0%	**1.7**	**3.1**
Basin B5	0.1	0	0.0%	50.0%	50.0%	0.0%	**0.1**	**0.2**
Basin B6	0.2	0	0.0%	25.0%	25.0%	50.0%	**0.5**	**0.8**
Basin B7	0.1	0	0.0%	50.0%	50.0%	0.0%	**0.2**	**0.4**
Basin B8	0.2	0	0.0%	50.0%	50.0%	0.0%	**0.2**	**0.5**
OS-B1	0.1	0	10.0%	90.0%	0.0%	0.0%	**0.1**	**0.4**
OS-B2	0.2	0	90.0%	10.0%	0.0%	0.0%	**0.1**	**0.5**
OS-B3	0.1	0	10.0%	90.0%	0.0%	0.0%	**0.1**	**0.3**
TOTAL	**12.2**	**39**					**22.7**	**41.6**

Only Basin-B1, Basin-B2, Basin-B3 and Basin-B4 is considered in calculating %D



PROPOSED DRAINAGE PLAN

HOFFMANTOWN

DRAWN BY: SS	DATE: 08/31/2022	
CHECKED BY: YPM	BHI PROJECT NO. 20220092	SHEET NO. 1

Bohannan Huston
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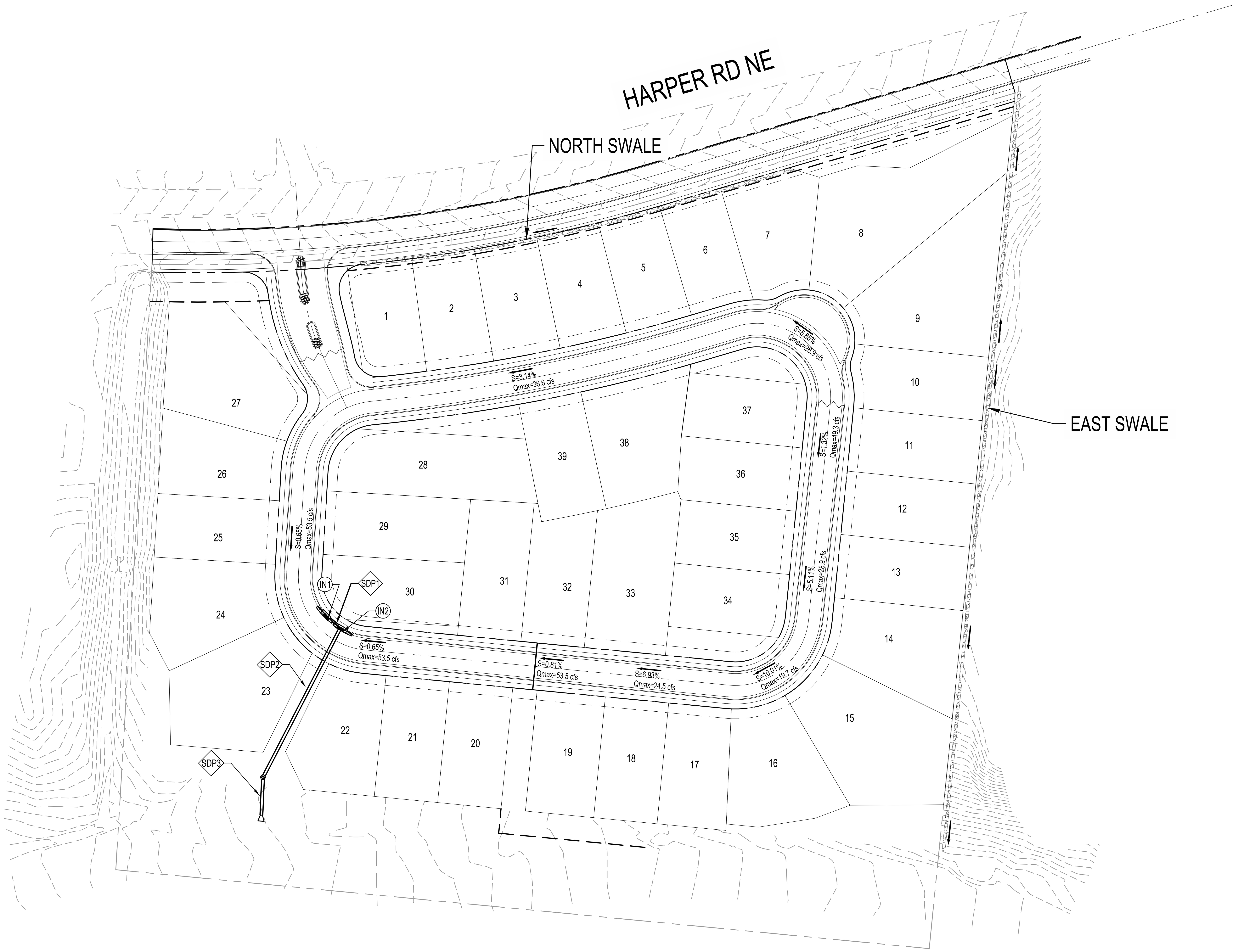
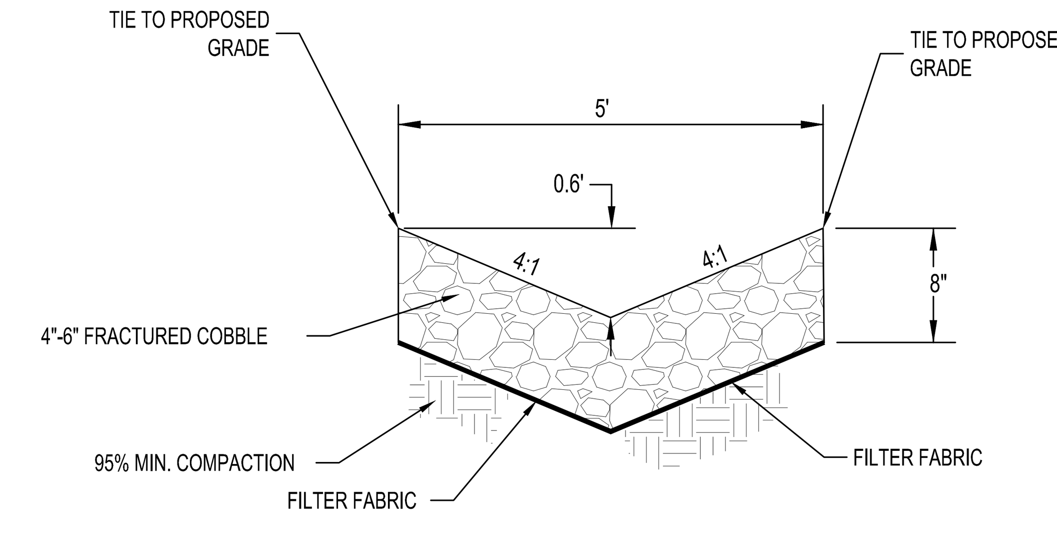
Thu, 1-Sep-2022 - 2:12:pm, Plotted by: SSUSMITA
P:\20220092\CDP\Plans\General\20220092_ProposedDrainage.dwg

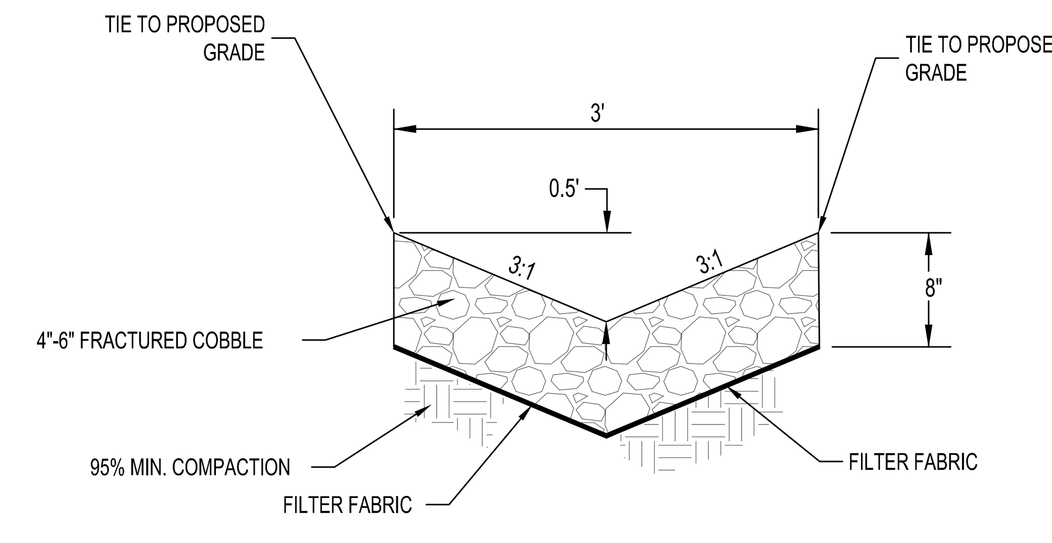
EXHIBIT D:

INLET AND STORM DRAIN NETWORK





NORTH COBBLE SWALE
NOT TO SCALE



EAST COBBLE SWALE
NOT TO SCALE

LEGEND

- PROPOSED BASIN BOUNDARY
- FLOW ARROW
- PROPOSED STORM DRAIN
- PROPOSED STORM DRAIN MANHOLE
- PROPOSED STORM DRAIN INLET
- WATER BLOCK / HIGH POINT
- S=X% Qmax=X cfs — STREET SLOPE Q(MAX)=MAX FLOW CAPACITY BY STREET SECTION WITH THAT SLOPE

INLET TABLE

Inlet #	UPSTREAM FLOW (cfs)	Inlet Type	FLOW CAPTURED (cfs)	BYPASS FLOW (cfs)
IN1	17.7	1DBL TYPE A SUMP	17.7	0.0
IN2	17.7	1DBL TYPE A SUMP	17.7	0.0

STORM DRAIN PIPE TABLE

PIPE #	Size in.	Slope	Capacity1 cfs	ACTUAL FLOW cfs
ONSITE				
SDP1	24	0.70%	18.9	17.7
SDP2	30	1.20%	44.9	35.5
SDP3	30	1.20%	44.9	35.5

1- Capacity Based on Manning's Eq w/ n=0.013

N

60 30 0 60
1" = 60'

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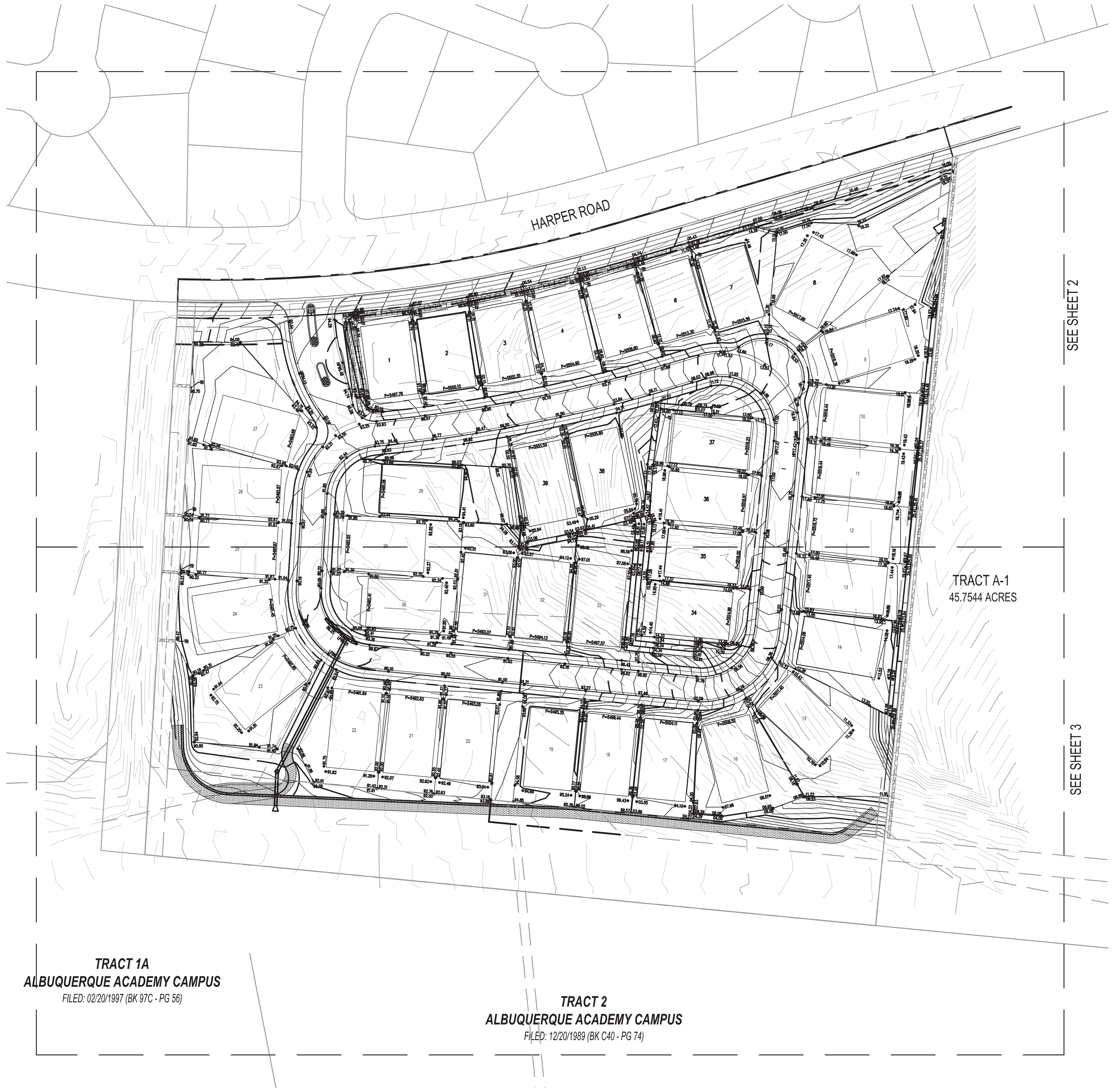
STORMDRAIN EXHIBIT

HOFFMANTOWN

DRAWN BY: SS	DATE: 08/10/2022	
CHECKED BY: YPM	BHI PROJECT NO. 20220092	SHEET NO. 1

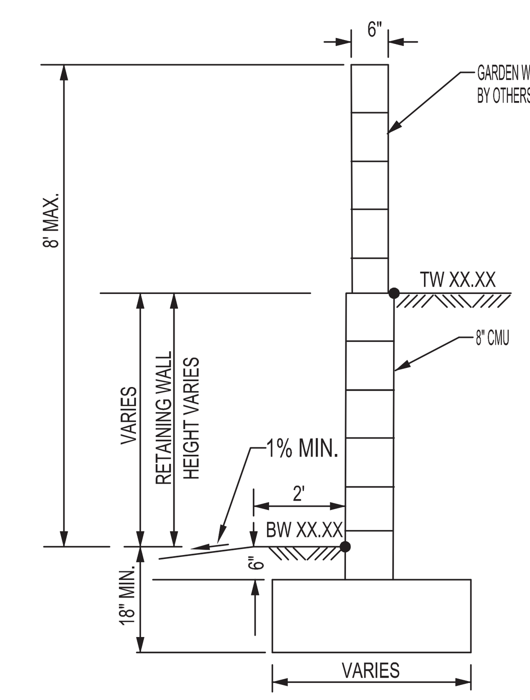
EXHIBIT E:

GRADING PLAN



LEGEND

- PROPOSED SPOT ELEVATION — • 5235.25
- EXISTING SPOT ELEVATION — EX 5235.25
- PROPOSED CONTOUR — 5025
- EXISTING STORM DRAIN LINE
- PROPOSED STORM DRAIN INLET
- PROPOSED STORM DRAIN LINE
- PROPOSED STORM DRAIN MANHOLE
- PROPOSED WATER BLOCK
- PERIMETER WALL
- RETAINING WALL
- GARDEN WALL
- PAD — 10 P=5300.00
- TURNED BLOCK — TB
- STREET SLOPE — XX
- DIRECTION OF FLOW



TW=FINISHED GRADE ELEVATION AT TOP OF RETAINING WALL
BW=FINISHED GRADE ELEVATION AT BOTTOM OF RETAINING WALL

TYPICAL RETAINING WALL NOMENCLATURE
NOT TO SCALE

(RETAINING HEIGHT IS TAKEN TO BE DIFFERENCE IN FINISHED GRADES ON LEFT AND RIGHT SIDE OF WALL.)

HEIGHT IS IN ACCORDANCE WITH CITY COMPREHENSIVE ZONING CODE, SECTION 14-16-3-19, GENERAL HEIGHT AND DESIGN REGULATIONS FOR WALLS, FENCES, AND RETAINING WALLS.

GENERAL NOTES

1. ALL WORK DETAILED ON THESE PLANS AND PERFORMED UNDER THIS CONTRACT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS AND THE PROJECT GEOTECHNICAL REPORT. WHERE APPLICABLE, CITY OF ABUQUERQUE PUBLIC WORKS STANDARDS SHALL APPLY.

2. THE CONTRACTOR SHALL ABIDE BY ALL LOCAL, STATE, AND FEDERAL LAWS, RULES AND REGULATIONS WHICH APPLY TO THE CONSTRUCTION OF THESE IMPROVEMENTS, INCLUDING EPA REQUIREMENTS WITH RESPECT TO STORM WATER DISCHARGE.

3. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL FIELD VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL POTENTIAL OBSTRUCTIONS INCLUDING ALL UNDERGROUND UTILITIES. SHOULD A CONFLICT EXIST, THE CONTRACTOR SHALL NOTIFY THE CONSTRUCTION OBSERVER OR ENGINEER SO THAT THE CONFLICT CAN BE RESOLVED WITH A MINIMUM AMOUNT OF DELAY.

4. TWO (2) WORKING DAYS PRIOR TO ANY EXCAVATION, THE CONTRACTOR SHALL CONTACT LINE LOCATING SERVICE FOR LOCATION OF EXISTING UTILITIES.

5. ALL ELECTRICAL, TELEPHONE, CABLE TV, GAS AND OTHER UTILITY LINES, CABLES, AND APPURTENANCES ENCOUNTERED DURING CONSTRUCTION THAT REQUIRE RELOCATION, SHALL BE COORDINATED WITH THAT UTILITY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATION OF ALL NECESSARY UTILITY ADJUSTMENTS. NO ADDITIONAL COMPENSATION WILL BE ALLOWED FOR DELAYS OR INCONVENIENCES CAUSED BY UTILITY COMPANY WORK CREWS. THE CONTRACTOR MAY BE REQUIRED TO RESCHEDULE HIS ACTIVITIES TO ALLOW UTILITY CREWS TO PERFORM THEIR REQUIRED WORK.

6. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ALL EXISTING UTILITY LINES WITHIN THE CONSTRUCTION AREA. ANY DAMAGE TO EXISTING FACILITIES CAUSED BY CONSTRUCTION ACTIVITY SHALL BE REPAIRED OR REPLACED AT THE CONTRACTOR'S EXPENSE AND APPROVED BY THE CONSTRUCTION OBSERVER.

7. CONSTRUCTION ACTIVITY SHALL BE LIMITED TO THE PROPERTY AND/OR PROJECT LIMITS. ANY DAMAGE TO ADJACENT PROPERTIES RESULTING FROM THE CONSTRUCTION PROCESS SHALL BE REPAIRED OR REPLACED AT THE CONTRACTOR'S EXPENSE.

8. OVERNIGHT PARKING OF CONSTRUCTION EQUIPMENT SHALL NOT OBSTRUCT DRIVEWAYS OR DESIGNATED TRAFFIC LANES. THE CONTRACTOR SHALL NOT STORE ANY EQUIPMENT OR MATERIAL WITHIN THE PUBLIC RIGHT-OF-WAY.

9. THE CONTRACTOR SHALL OBTAIN ALL THE NECESSARY PERMITS FOR THE PROJECT PRIOR TO COMMENCING CONSTRUCTION (I.E., BARRICADING, TOPSOIL DISTURBANCE, EXCAVATION PERMITS, EPA STORM WATER PERMITS, ETC.).

10. ALL PROPERTY CORNERS DESTROYED DURING CONSTRUCTION SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE. ALL PROPERTY CORNERS MUST BE RESET BY A REGISTERED LAND SURVEYOR.

11. THE CONTRACTOR SHALL PREPARE A CONSTRUCTION TRAFFIC CONTROL AND SIGNING PLAN AND OBTAIN APPROVAL OF SUCH PLAN FROM THE CITY OF ALBUQUERQUE, TRAFFIC ENGINEERING DEPARTMENT, PRIOR TO BEGINNING ANY CONSTRUCTION WORK ON OR ADJACENT TO EXISTING STREETS.

12. ALL BARRICADES AND CONSTRUCTION SIGNING SHALL CONFORM TO APPLICABLE SECTIONS OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD), US DEPARTMENT OF TRANSPORTATION, LATEST EDITION.

13. THE CONTRACTOR SHALL MAINTAIN ALL CONSTRUCTION BARRICADES AND SIGNING AT ALL TIMES. THE CONTRACTOR SHALL VERIFY THE PROPER LOCATION OF ALL BARRICADING AT THE END AND BEGINNING OF EACH DAY.

14. THE CONTRACTOR SHALL TAKE ALL STEPS NECESSARY TO CONFORM WITH EPA REQUIREMENTS, INCLUDING COMPLIANCE WITH NPDES REQUIREMENTS.

GRADING NOTES

1. EXCEPT AS PROVIDED HERIN, GRADING SHALL BE PERFORMED AT THE ELEVATIONS AND IN ACCORDANCE WITH THE DETAILS SHOWN ON THIS PLAN.

2. CONTRACTOR SHALL OBTAIN AND ABIDE BY A TOPSOIL DISTURBANCE PERMIT FROM THE CITY OF ALBUQUERQUE ENVIRONMENTAL HEALTH DIVISION, PRIOR TO CONSTRUCTION. THE COST FOR REQUIRED CONSTRUCTION DUST AND EROSION CONTROL MEASURES SHALL BE INCIDENTAL TO THE PROJECT COST. THE CONTRACTOR SHALL CONFORM TO ALL CITY, COUNTY, STATE, AND FEDERAL DUST CONTROL MEASURES AND REQUIREMENTS AND WILL BE RESPONSIBLE FOR PREPARING AND OBTAINING ALL NECESSARY APPLICATIONS AND APPROVALS.

3. ALL WORK RELATIVE TO FOUNDATION CONSTRUCTION, SITE PREPARATION, AND PAVEMENT INSTALLATION, AS SHOWN ON THIS PLAN, SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE SOILS REPORT. ALL OTHER WORK, UNLESS OTHERWISE STATED OR PROVIDED FOR HEREON, SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS (FIRST PRIORITY), AND/OR THE CITY OF ALBUQUERQUE (COA) STANDARD SPECIFICATIONS FOR PUBLIC WORKS (SECOND PRIORITY)

4. TWO WORKING DAYS PRIOR TO EXCAVATION, CONTRACTOR MUST CONTACT LINE LOCATING SERVICE FOR LOCATION OF EXISTING UTILITIES.

5. PRIOR TO GRADING, ALL VEGETATION DEBRIS, AND NEAR SURFACE ORGANICALLY CONTAMINATED SOIL SHALL BE STRIPPED FROM ALL AREAS TO BE GRADED. VEGETATION AND DEBRIS SHALL BE DISPOSED OF OFF-SITE OR STOCK-PILED FOR USE IN PLANTERS AND NON-STRUCTURAL FILLS.

6. EARTH SLOPES SHALL NOT EXCEED 4 HORIZONTAL TO 1 VERTICAL UNLESS SHOWN OTHERWISE.

7. IT IS THE INTENT OF THESE PLANS THAT THIS CONTRACTOR SHALL NOT PERFORM ANY WORK OUTSIDE OF THE PROPERTY BOUNDARIES EXCEPT AS REQUIRED BY THIS PLAN.

8. THE CONTRACTOR IS TO ENSURE THAT NO SOIL ERODES FROM THE SITE ONTO ADJACENT PROPERTY OR PUBLIC RIGHT-OF-WAY. THIS SHOULD BE ACHIEVED BY CONSTRUCTING TEMPORARY BERMS AT THE PROPERTY LINES WETTING THE SOIL TO PROTECT IT FROM WIND EROSION.

9. A DISPOSAL SITE FOR ALL EXCESS EXCAVATION AND UNSUITABLE MATERIAL SHALL BE OBTAINED BY THE CONTRACTOR IN COMPLIANCE WITH APPLICABLE ENVIRONMENTAL REGULATIONS AND APPROVED BY THE OBSERVER. ALL COSTS INCURRED IN OBTAINING A DISPOSAL SITE AND HAUL THERETO SHALL BE CONSIDERED INCIDENTAL TO THE PROJECT, AND NO SEPARATE MEASUREMENT OR PAYMENT SHALL BE MADE.

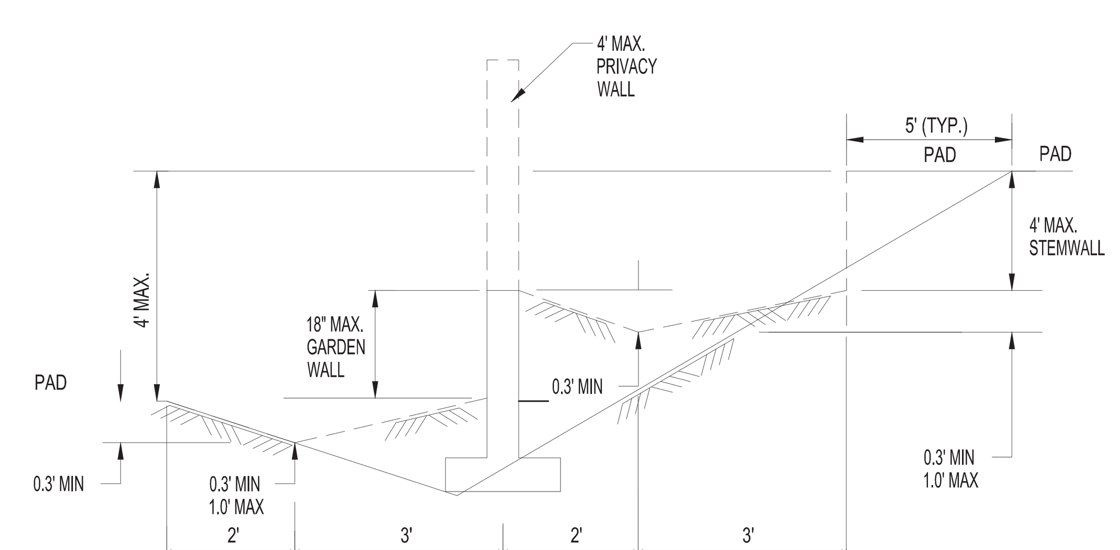
10. PAVING AND ROADWAY GRADES SHALL BE +/- 0.1' FROM PLAN ELEVATIONS. PAD ELEVATION SHALL BE +/- 0.05' FROM BUILDING PLAN ELEVATIONS.

11. ALL SPOT ELEVATIONS ARE TO FLOWLINE UNLESS OTHERWISE NOTED. VALLEY GUTTER ELEVATIONS ARE SHOWN AT FLOWLINE ELEVATION.

12. GRADING SHALL BE IN ACCORDANCE WITH THE GEOTECHNICAL REPORT.

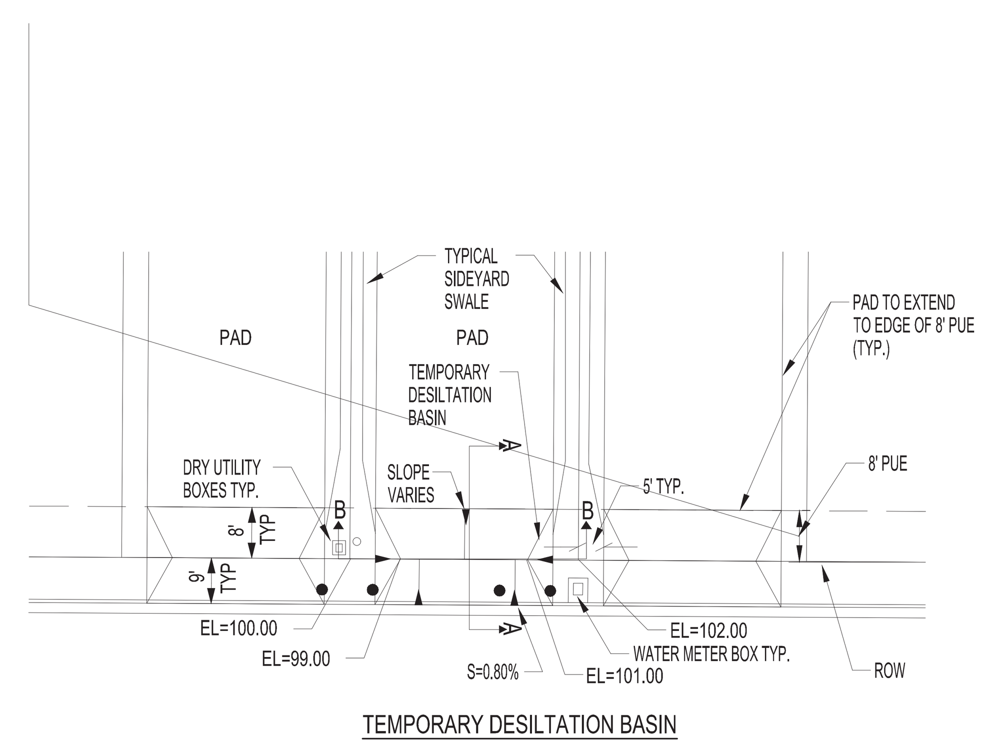
811

CALL NM ONE-CALL SYSTEM SEVEN (7) DAYS PRIOR TO ANY EXCAVATION



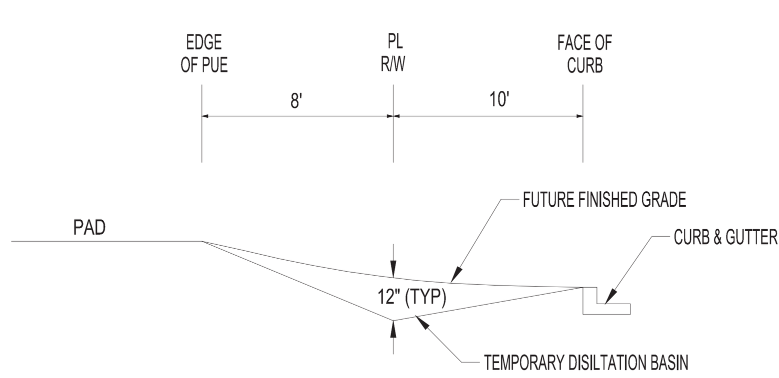
TYPICAL SIDE LOT LINE SECTION
NOT TO SCALE

NOTE: DASHED LINES IN TYP. SIDE LOT LINE SECTIONS REPRESENT THE FINAL CONDITION AFTER THE GARDEN, STEM, AND PRIVACY WALLS HAVE BEEN CONSTRUCTED. THE INTERIM CONDITION, WHICH IS TO BE CONSTRUCTED BY THE GRADING CONTRACTOR AND CERTIFIED BY THE ENGINEER, IS REPRESENTED BY THE SOLID LINES. RETAINING WALLS WILL BE CONSTRUCTED PRIOR TO GRADING CERTIFICATION.

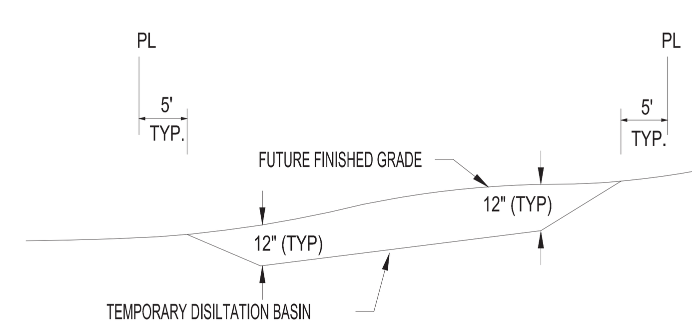


TEMPORARY DESILTATION BASIN
NOT TO SCALE

** BOTTOM OF BASIN IS 1' BELOW PROPERTY LINE ELEVATION SEE GRADING PLANS FOR EXACT ELEVATIONS



TEMPORARY DESILTATION SECTION A-A
NOT TO SCALE



TEMPORARY DESILTATION SECTION B-B
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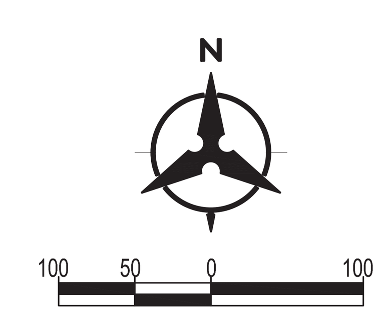

BHI JOB NO. 20220092

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CONSULTANTS

BENCH MARKS

ACS BRASS DISK STAMPED "13-E20"
GEOGRAPHIC POSITION (NAD 83)
NM STATE PLANE GRID COORDINATES (CENTRAL ZONE)
N = 1,511,612.268 (USFT), E = 1,550,598.401 (USFT)
GROUND TO GRID FACTOR = 0.999650558
DELTA ALPHA = -0°10'22.86"

SEAL

YOLANDA PADILLA MOYER
NEW MEXICO
16035
10-14-2022
LICENSED PROFESSIONAL ENGINEER

NO.	DATE	DESCRIPTION	BY
AS-BUILT INFORMATION		CONTRACTOR:	
WORK STAKED BY:		DATE:	
INSPECTOR'S ACCEPTANCE BY:		DATE:	
FIELD VERIFICATION BY:		DATE:	
DRAWINGS CORRECTED BY:		DATE:	

DESIGNED BY: YPM
DRAWN BY: AR
CHECKED BY: YPM
DATE 6/28/2022

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

HOFFMANTOWN ESTATES
OVERALL GRADING PLAN

DESIGN REVIEW COMMITTEE	CITY ENGINEER APPROVAL	ZONE MAP NO.
		CITY PROJECT NO.
		SHEET NO. 1 OF 3

Thu, 13-Oct-2022 - 1:20:pm, Plotted by: AROMERO
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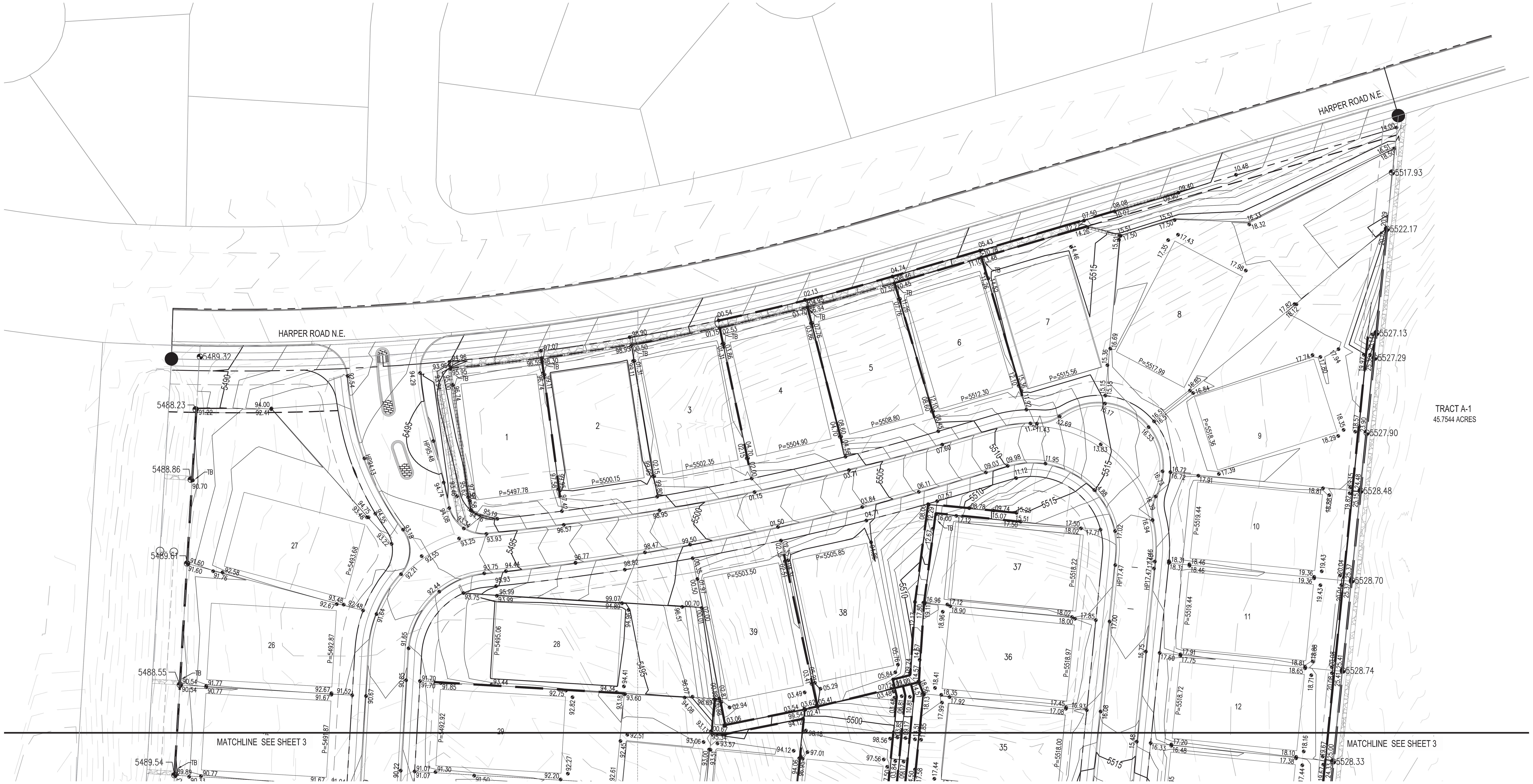

LEGEND

- PROPOSED SPOT ELEVATION — 5235.25
- EXISTING SPOT ELEVATION — EX 5235.25
- PROPOSED CONTOUR — 5025
- EXISTING STORM DRAIN LINE
- PROPOSED STORM DRAIN INLET
- PROPOSED STORM DRAIN LINE
- PROPOSED STORM DRAIN MANHOLE
- PROPOSED WATER BLOCK
- PERIMETER WALL
- RETAINING WALL
- GARDEN WALL
- PAD — 10 P=5300.00
- TURNED BLOCK — TB
- STREET SLOPE — XX
- DIRECTION OF FLOW

N

40 20 0 40
1"=40'

811

CALL NM ONE-CALL SYSTEM
SEVEN (7) DAYS PRIOR TO
ANY EXCAVATION

CONSULTANTS

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BENCH MARKS

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SEAL

NO.	DATE	DESCRIPTION	BY

AS-BUILT INFORMATION
CONTRACTOR:
WORK STAKED BY: DATE:
INSPECTOR'S ACCEPTANCE BY: DATE:
FIELD VERIFICATION BY: DATE:
DRAWINGS CORRECTED BY: DATE:

DESIGNED BY: YPM
DRAWN BY: AR
CHECKED BY: YPM
DATE 6/28/2022

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

HOFFMANTOWN ESTATES
OVERALL GRADING PLAN

DESIGN REVIEW COMMITTEE	CITY ENGINEER APPROVAL

ZONE MAP NO.
CITY PROJECT NO.
SHEET NO. 2 OF 3

BHI JOB NO. 20220092

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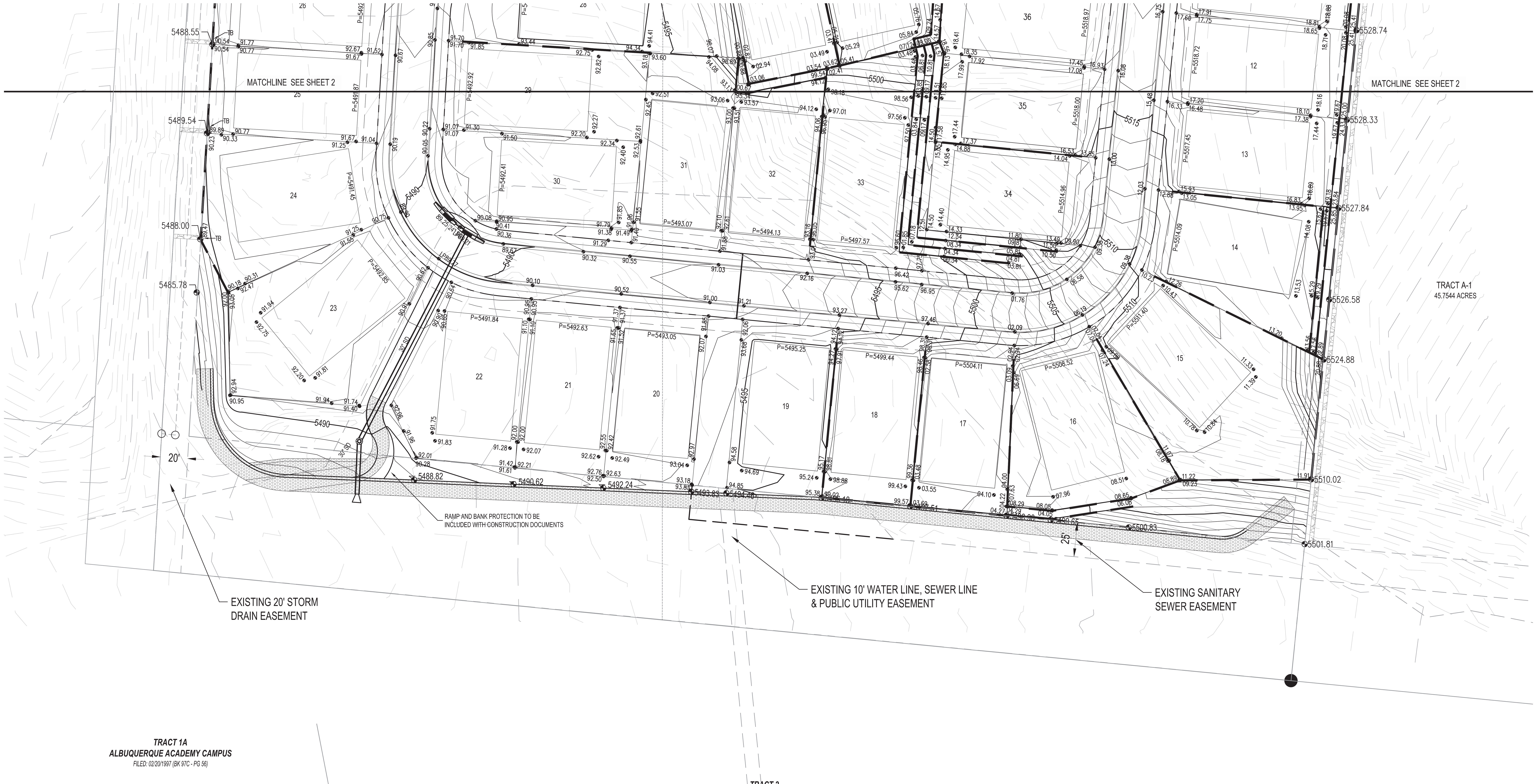

LEGEND

PROPOSED SPOT ELEVATION	• 5235.25
EXISTING SPOT ELEVATION	• EX 5235.25
PROPOSED CONTOUR	5025
EXISTING STORM DRAIN LINE	
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PROPOSED STORM DRAIN MANHOLE	
PROPOSED WATER BLOCK	
PERIMETER WALL	
RETAINING WALL	
GARDEN WALL	
PAD	10 P=5300.00
TURNED BLOCK	TB
STREET SLOPE	XX
DIRECTION OF FLOW	

N

40 20 0 40

1"=40'

CALL NM ONE-CALL SYSTEM SEVEN (7) DAYS PRIOR TO ANY EXCAVATION

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NO.	DATE	DESCRIPTION	BY

AS-BUILT INFORMATION
CONTRACTOR: DATE:
WORK STAKED BY: DATE:
INSPECTOR'S ACCEPTANCE BY: DATE:
FIELD VERIFICATION BY: DATE:
DRAWINGS CORRECTED BY: DATE:

DESIGNED BY: YPM
DRAWN BY: AR
CHECKED BY: YPM
DATE 6/28/2022

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

HOFFMANTOWN ESTATES
OVERALL GRADING PLAN

DESIGN REVIEW COMMITTEE | CITY ENGINEER APPROVAL

ZONE MAP NO.

CITY PROJECT NO.

SHEET NO. 3 OF 3

BHI JOB NO. 20220092

Thu, 13-Oct-2022 - 1:21 pm, Plotted by: AROMERO
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