Shephard Wesnitzer, Inc.

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Engineering an environment of excellence.

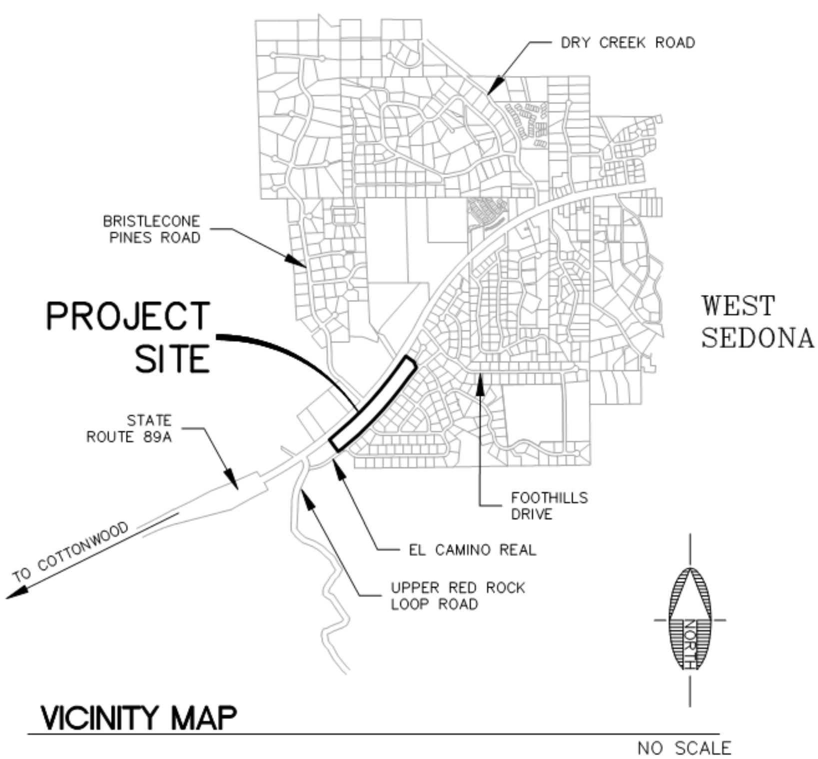
Ryan Mortillaro
Assistant Engineer (City of Sedona)
102 Roadrunner Drive
Sedona, AZ 86336

June 1, 2018
SWI # 17186

Re: Park Place Redevelopment

Dear Mr. Mortillaro:

The purpose of this letter is to present a trip generation analysis for the Park Place Redevelopment proposed at the location of the existing Park Place Private Residences in Sedona, AZ. The project site is located within Section 15 of Township 17 North, Range 5 East, Gila and Salt River Base Meridian, Yavapai County, Sedona, Arizona and consists of approximately 9.73 acres. Refer to Figure 1 – Vicinity Map below for the site location.



TRIP GENERATION

A traffic impact analysis was prepared for the original Park Place project and approved with 88 condominium units. All the recommendations of the TIA, left turn and deceleration lanes, were constructed per the plans. The proposed project consists of 12 condo units and 57 townhome units. This is a reduction of 19 units from the approved site plan for the Park Place Redevelopment. Access to the site is provided by a driveway on State Route 89A. A trip generation analysis was performed on both the originally approved 88 condo units and the proposed 12 condo units and 57 townhome units. The average daily traffic volumes, including AM and PM peak hour trips generated by both conditions have been estimated using trip rates provided by the *Institute of Transportation Engineer's (ITE) Trip Generation Manual, Ninth Edition*. For this analysis, the proposed land use for, both the originally approved plan and the proposed plan, the project site was classified as condominium/townhouse. ITE land use code 230: Residential Condominium/Townhouse was used to estimate the trips generated by the both versions of the development. Per ITE, the originally approved development with 88 dwelling units generates a total of 511 daily trips including 39 AM and 46 PM peak hour trips. Refer to Table 1 – Originally Approved Site Generated Traffic for the originally approved trip generation calculations.

Per ITE, the proposed development with 69 dwelling units will generate a total of 401 daily trips including 30 AM and 36 PM peak hour trips. This results in a decrease of 110 daily trips, including 8 AM and 10 PM peak hour trips. Refer to Table 2 – Proposed Site Generated Traffic for the trip generation calculations. No further improvements are recommended.

Please call if you have any questions or comments.

Sincerely,
Shephard – Wesnitzer, Inc.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
28658
ARTHUR H.
BECKWITH
6/5/18
Date Signed
ARIZONA, U.S.A.
Expires 3/31/2019

Arthur Beckwith, P.E.
Project Engineer

Enclosures
-Trip Generation Calculations

Park Place Redevelopment
SWI Project: # 17186
Date: 06/01/2018

TABLE 1 - ORIGINALLY APPROVED SITE GENERATED TRAFFIC

LAND USE	ITE CODE	VARIABLE	TIME PERIOD	EQUATION	% ENTERING	WEEKDAY TOTAL	AM TOTAL	AM		PM TOTAL	PM	
								in	out		in	out
Residential Condominium/Townhouse	230	88.0	*Weekday*	T=5.81(X)	50%	511						
Residential Condominium			*AM peak*	T=0.44(X)	17%		39	7	32			
Variable=Dwelling Units			*PM peak*	T=0.52(X)	67%					46	31	15
					Total Trips Generated =	**511**	**39**	**7**	**32**	**46**	**31**	**15**

Park Place Redevelopment
SWI Project: # 17186
Date: 06/01/2018

TABLE 2 - PROPOSED SITE GENERATED TRAFFIC

LAND USE	ITE CODE	VARIABLE	TIME PERIOD	EQUATION	% ENTERING	WEEKDAY TOTAL	AM TOTAL	AM		PM TOTAL	PM	
								in	out		in	out
Residential Condominium/Townhouse	230	69.0	*Weekday*	T=5.81(X)	50%	401						
Residential Condominium/Townhouse			*AM peak*	T=0.44(X)	17%		30	5	25			
Variable=Dwelling Units			*PM peak*	T=0.52(X)	67%					36	24	12
Total Trips Generated =						**401**	**30**	**5**	**25**	**36**	**24**	**12**
Total New Trips Generated* =						**-110**	**-8**	**-2**	**-7**	**-10**	**-7**	**-3**

* Total New Trips Generated = Proposed Total Trips Generated - Existing Total Trips

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PRELIMINARY Drainage Report

PARK PLACE

Sedona, Yavapai County, Arizona

Prepared for:
Miramonte Homes
4578 North First Street, Suite 160
Tucson, AZ 85781

January 2019
Job # 17186

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FIGURES

APPENDICES

INTRODUCTION

Park Place Presidio, L.L.C. is proposing the development of a 9.73-acre parcel near Foothills South, in Sedona, Arizona. The site parallels the south side of State Route 89A between Calle Del Belleza and Calle Feliz, in the west 1/2 of Section 15, T17N, R5E, G&SRB&M, Yavapai County. The purchased tax parcel number is 408-11-140Z. Single-family residential zoning surrounds the site in all directions. The site is bound by State Route 89A to the northwest and El Camino Real to the southeast.

The project consists of 60 residential condominiums clustered into 21 units, served by approximately 2300-ft of primary 20-ft wide roadway. Primary access is from State Route 89A, near the mid-point of the property. The two existing cluster units at the main entrance share common driveways from the primary roadway to underground parking structures. The remaining proposed 21 cluster units have aboveground parking garages from the primary roadway.

METHODOLOGY

Local hydrology was estimated with Haestad Method's PondPack, version 8.0, using a variation of the Rational Method. Runoff coefficients for the developed condition were selected from the Heavy Urban curve shown in Figure 2-3 of the Highway Drainage Design Manual, Hydrology. Existing condition coefficients were selected from the D-30% curve shown in Figure 2-7 of the manual. All concentration times for local hydrology were assumed to be 5-minues. Intensity-Duration-Frequency rainfall table was generated by NOAA Atlas 14, Volume 1, Version 5. Hydraulic analysis was done with StormCad (v3.0) and FlowMaster (2005), both Haestad Method products. Inlet structures and storm drains are sized to adequately convey 100-year runoff from the roadways.

EXISTING CONDITIONS

The 9.73-acre site is currently undeveloped and generally slopes towards 89A between 5% and 30%. Ground cover consists of pinon, juniper, mountain laurel, scrub oak and manzanita. The geology of the site is typical for the Sedona area, consisting of reddish dark silty loam from the Coconino and Supai Sandstone formations, hydrological soil group D.

Offsite runoff influencing the proposed development includes accumulations from the southeast, across from El Camino Real, entering the site at design points 6 and 7. At design point 6, runoff is carried beneath El Camino Real with a 28-inch by 21-inch metal arch culvert. A 24-inch by 16-inch metal arch culvert carries runoff beneath the roadway at design point 7, with only about 6-inches of headwater above the top of the pipe. Flows exceeding the headwater elevation continue northeast down the roadside ditch, along the south side of El Camino Real.

Onsite runoff concentrates at five points around the perimeter of the development, noted as design points 1 through 5. Runoff at design points 2 and 3 concentrate at the existing screen wall along 89A. Runoff passes through openings in the screen wall and enters catch basins along 89A, which have corrugated metal pipes carrying runoff beneath the highway. Runoff at design points 1 and 4 concentrate at low points on the property line near northeast and northwest corners of the property. Runoff from these areas is conveyed with open channels to catch basins along 89A outside the project area. Flow concentrations at design point 5 enter a depression on the west side of Calle Feliz at the intersection with El Camino Real. A 21-inch by 13-inch metal arch culvert conveys runoff from this depression beneath Calle Feliz. Figure 1 shows the existing condition hydrology.

PROPOSED CONDITIONS

Runoff will be conveyed from the site with three separate storm drains systems. Detention is provided as necessary at the property outfalls to keep runoff rates at or below existing levels.

Onsite runoff will be collected with catch basins and spillways then routed to the detention areas with storm drains. Roll curb will be used everywhere on the primary roadway except for the south side of the roadway at the east end. Runoff will be collected in the driveways with transverse slot drains and piped to the underground storm drains. Street and pavement calculations can be found in Appendix C.

Offsite runoff from design point 6 will be intercepted with a manhole and routed, via storm drain, to the detention area at design point 2. Off-site runoff from design point 7 will be intercepted with a manhole and routed, via storm drain, to the detention area at design point 4.

Detention is proposed at design points 1 through 4. The above ground storage reservoirs at points 1, 2 and 3 consist of new retaining walls along the property line with excavation on the property side to maximize storage volumes. The underground storage reservoir at design point 4 consists of 642-feet of 60-inch diameter corrugated metal pipe. Discharges from the detention area at design points 1 is above ground through openings in the new retaining wall. Discharges from the detention areas at points 2 and 4 are underground to existing catch basins along 89A. The existing catch basin at design point 2 will be raised to accommodate the new entry, including sidewalks and ramps. A storm drain must be constructed along 89A between the detention area at point 4 to an existing catch basins approximately 200-ft east of the project boundary.

The summary runoff table below shows existing and developed peak runoff from the site. Detention provisions will mitigate increases in peak runoff from the site resulting from increased impervious area. Detailed calculations can be found in Appendix E.

Table 4.1 – Summary Runoff and Detention Performance Table

Design Point	Drainage Area (acres)		Return Period									
			2 Year					10 Year				
	Exist	Dev	Q Exist	Q Dev	Max Vol (ac-ft)	Provided Vol (ac-ft)	Elev (ft)	Q Exist	Q Dev	Vol (ac-ft)	Provided Vol (ac-ft)	Elev (ft)
1	1.74	2.14	1.94	0.23	0.036	0.148	4483.02	3.19	0.26	0.061	0.148	4483.27
2	15.41	15.19	21.71	17.32	0.019	0.50	4485.23	35.72	28.62	0.039	0.50	4486.75
3	1.91	0.47	2.27	0.82	N/A	N/A	N/A	3.74	1.36	N/A	N/A	N/A
4	9.11	10.95	11.79	7.86	0.079	0.289	4461.41	19.4	11.40	0.147	0.289	4462.35
5	0.68	0.10	0.93	0.15	N/A	N/A	N/A	1.53	0.24	N/A	N/A	N/A

Design Point	Drainage Area (acres)		Return Period									
			25 Year					100 Year				
	Exist	Dev	Q Exist	Q Dev	Vol (ac-ft)	Provided Vol (ac-ft)	Elev (ft)	Q Exist	Q Dev	Vol (ac-ft)	Provided Vol (ac-ft)	Elev (ft)
1	1.74	2.14	4.04	0.29	0.087	0.148	4483.52	5.42	0.34	0.128	0.148	4483.98
2	15.41	15.19	45.19	33.02	0.062	0.50	4487.53	60.59	36.48	0.171	0.50	4488.26
3	1.91	0.47	4.73	1.91	N/A	N/A	N/A	6.34	2.79	N/A	N/A	N/A
4	9.11	10.95	24.55	16.14	0.192	0.289	4463.00	32.92	25.81	0.25	0.289	4463.93
5	0.68	0.10	1.93	0.34	N/A	N/A	N/A	2.59	0.50	N/A	N/A	N/A

As evidenced by the table, peak runoff rates from the site will be kept below existing levels for the 2-, 10-, 25- and 100-year recurrence intervals. Total detention provisions for the 100-year recurrence interval are 0.55 acre-feet.

CONCLUSIONS AND RECOMMENDATIONS

The design concepts in this report will ensure that the drainage integrity of the site is sustained with proper maintenance activity. Activities include frequent clearing of debris and sediment from the storm drain inlets and detention areas, disturbed slope treatment and erosion control. Frequent monitoring will ensure expedient remedies to common problems such as erosion, sedimentation, and flow obstructions.

Construction of the town homes must include positive surface runoff and adequate foundation drainage for the underground parking areas. Landscaping and final grading must ensure that positive drainage from residential structures is maintained throughout the site.

A Storm Water Pollution Prevention Plan (SWPPP) is provided to mitigate erosion and sedimentation associated with construction of the development. Permanent water quality mitigation devices may include slope treatment, rock check dams and inlet protection. Regular maintenance will consist of the removal of sediment deposits, vegetative material, or any other obstructions that may restrict flow capacity. Earthwork activities should verify compliance with Section 404 of the Clean Water Act.

References

Publications

Yavapai County Drainage Design Manual, 2015.

Arizona Department of Transportation Highway Drainage Design Manual, Hydrology, 2005

Computer Software

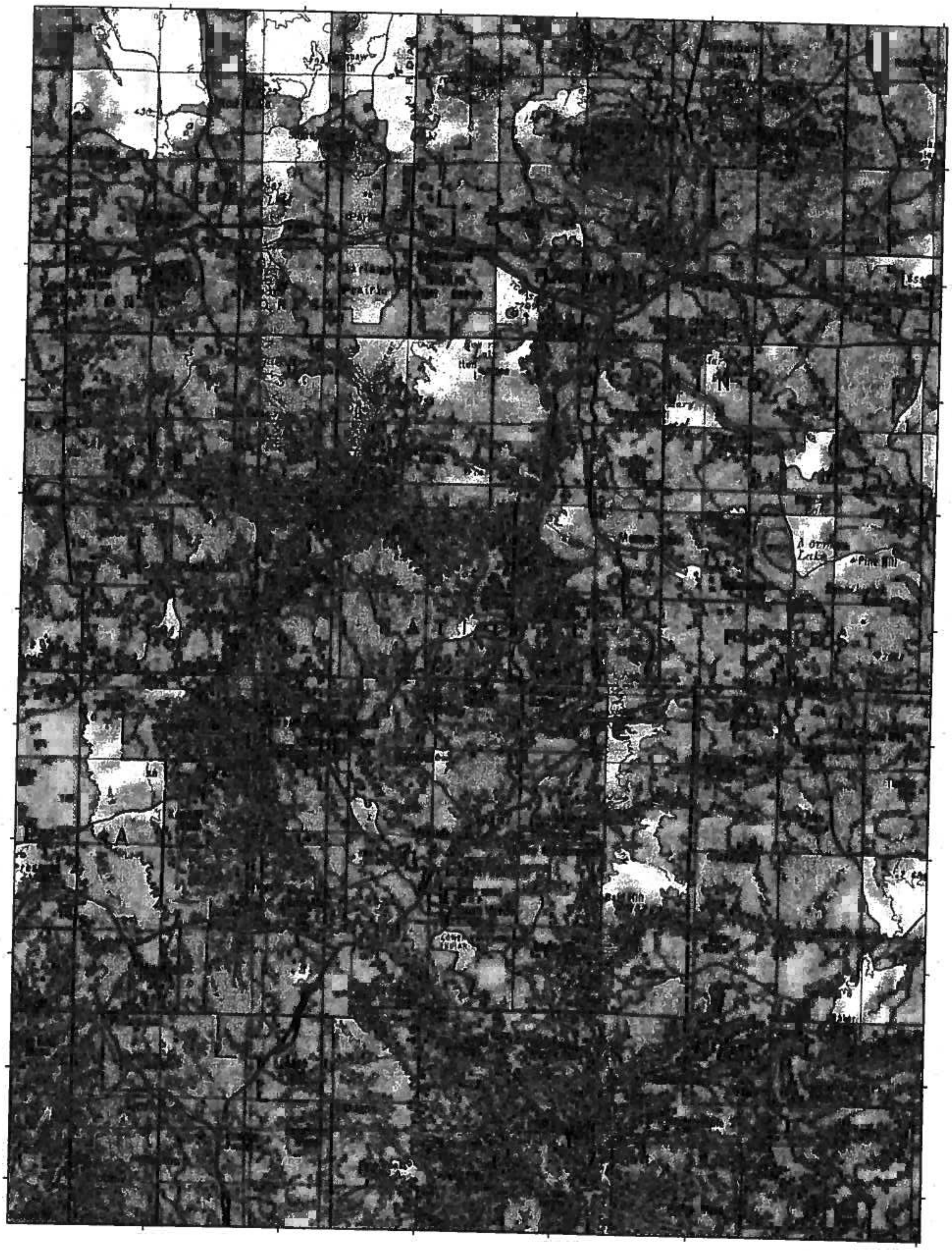
PondPack V8i, Bentley Systems, Inc.

FlowMaster, Bentley Systems, Inc.

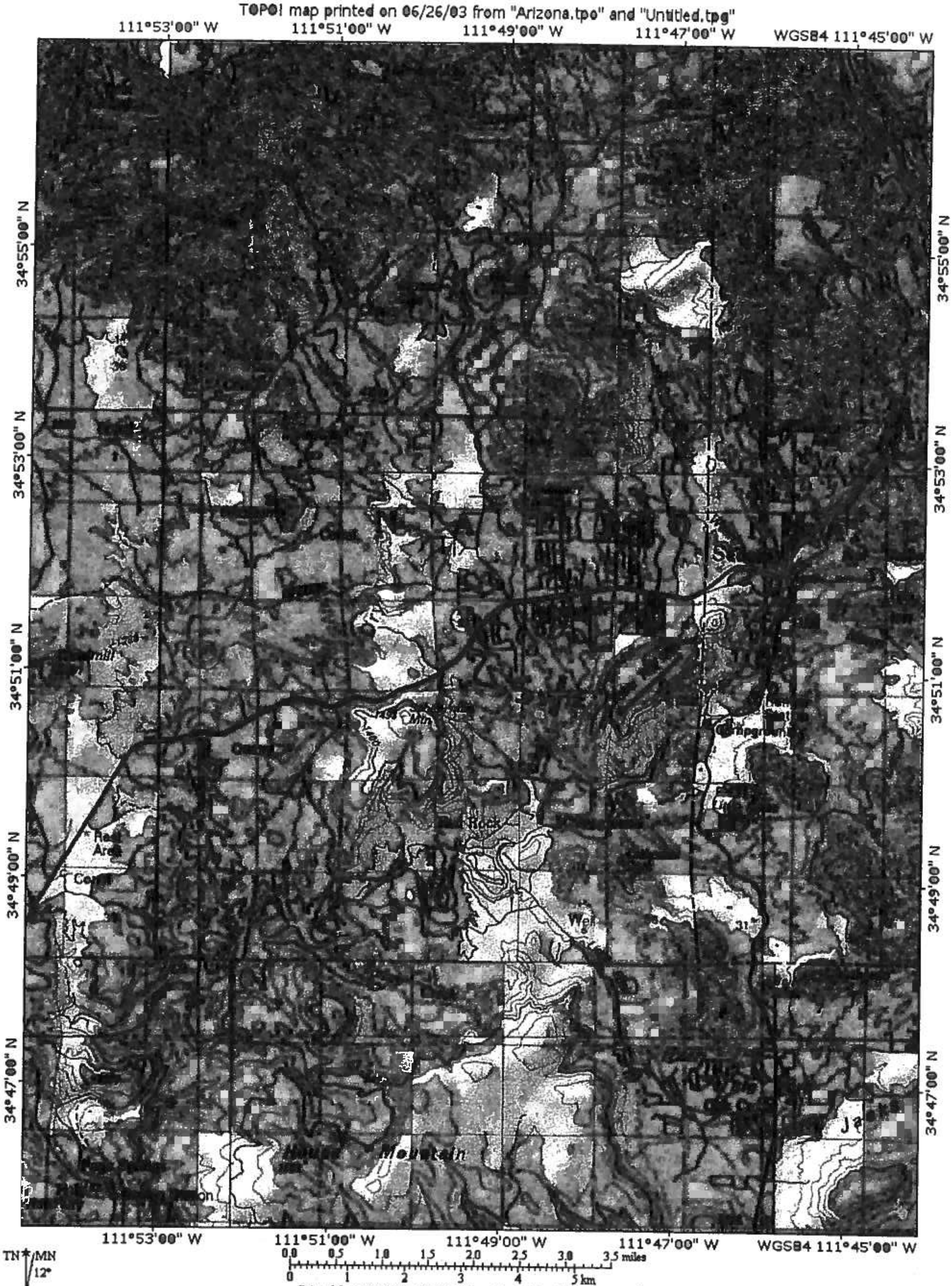
Autodesk StormCAD, 2005.

Preliminary Drainage Report
For
Park Place
SWI Project # 17186

APPENDIX A
Reference Material


Pine Hill

TOPO! map printed on 06/26/03 from "Arizona.tpo" and "Untitled.tpg"



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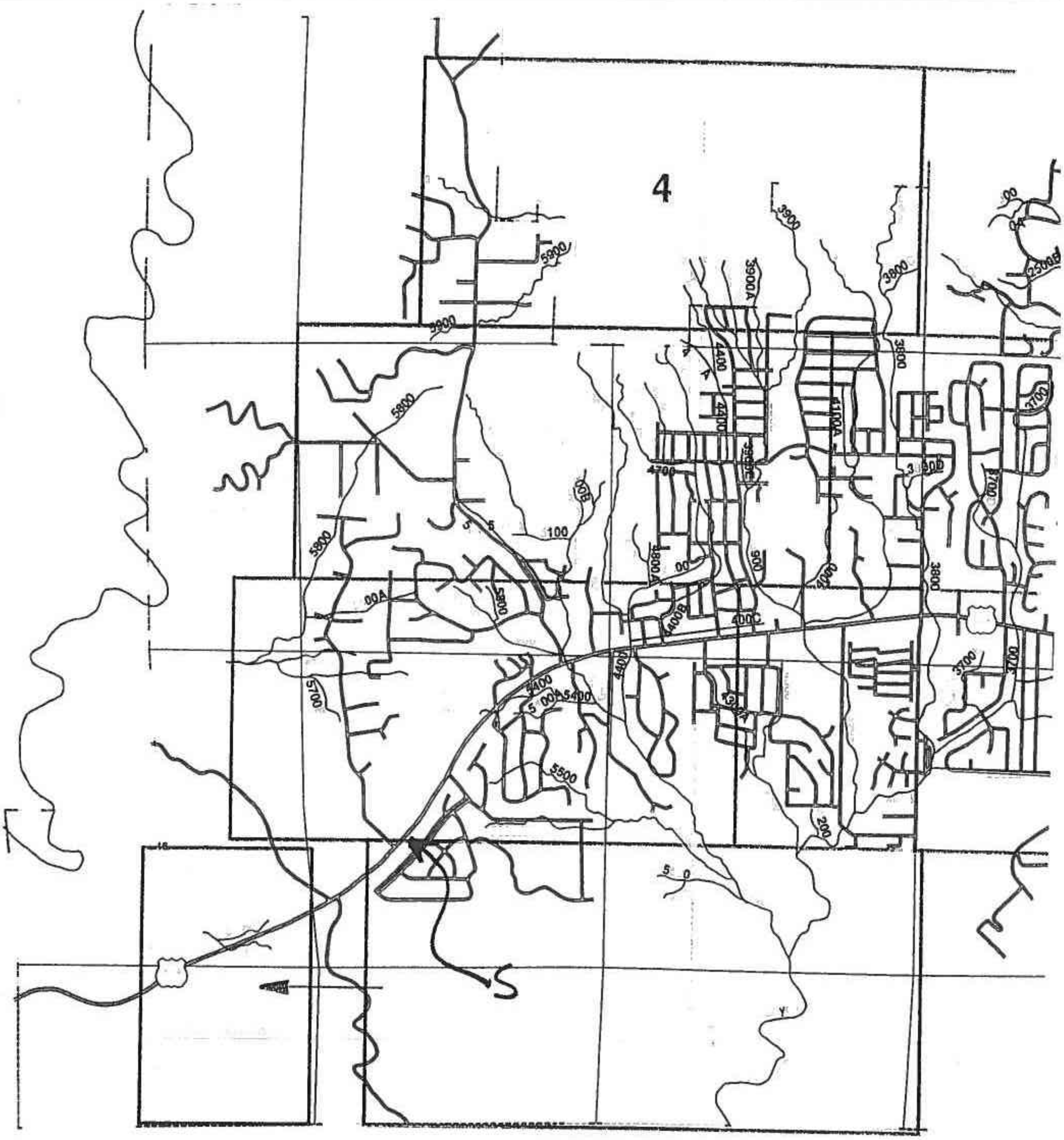

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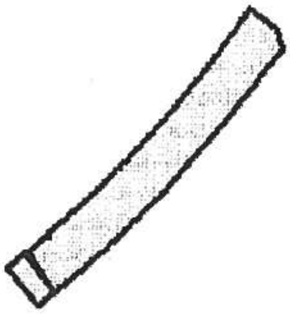

NOAA Atlas 14, Volume 1, Version 5
Location name: Sedona, Arizona, USA*
Latitude: 34.8524°, Longitude: -111.8247°
Elevation: 4518.2 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**2.53** (2.14-2.99)	**3.26** (2.75-3.85)	**4.40** (3.70-5.21)	**5.36** (4.50-6.34)	**6.73** (5.59-7.91)	**7.87** (6.49-9.25)	**9.10** (7.43-10.7)	**10.4** (8.40-12.3)	**12.4** (9.77-14.7)	**14.0** (10.9-16.7)
10-min	**1.92** (1.63-2.27)	**2.48** (2.09-2.93)	**3.35** (2.81-3.97)	**4.08** (3.43-4.82)	**5.12** (4.26-6.02)	**5.99** (4.94-7.03)	**6.92** (5.65-8.15)	**7.94** (6.39-9.35)	**9.41** (7.43-11.2)	**10.6** (8.29-12.7)
15-min	**1.59** (1.34-1.88)	**2.05** (1.72-2.43)	**2.77** (2.33-3.28)	**3.37** (2.83-3.98)	**4.23** (3.52-4.97)	**4.95** (4.08-5.81)	**5.72** (4.67-6.73)	**6.56** (5.28-7.73)	**7.78** (6.14-9.23)	**8.80** (6.85-10.5)
30-min	**1.07** (0.904-1.27)	**1.38** (1.16-1.63)	**1.86** (1.57-2.21)	**2.27** (1.91-2.68)	**2.85** (2.37-3.35)	**3.33** (2.75-3.91)	**3.85** (3.14-4.53)	**4.42** (3.56-5.20)	**5.24** (4.14-6.21)	**5.92** (4.61-7.07)
60-min	**0.663** (0.559-0.785)	**0.855** (0.719-1.01)	**1.15** (0.970-1.37)	**1.41** (1.18-1.66)	**1.76** (1.47-2.07)	**2.06** (1.70-2.42)	**2.38** (1.95-2.81)	**2.73** (2.20-3.22)	**3.24** (2.56-3.85)	**3.67** (2.85-4.37)
2-hr	**0.391** (0.340-0.452)	**0.494** (0.428-0.574)	**0.653** (0.566-0.756)	**0.788** (0.676-0.910)	**0.981** (0.837-1.13)	**1.14** (0.962-1.32)	**1.32** (1.10-1.53)	**1.51** (1.24-1.75)	**1.80** (1.45-2.09)	**2.03** (1.61-2.36)
3-hr	**0.280** (0.247-0.322)	**0.354** (0.313-0.408)	**0.455** (0.400-0.523)	**0.542** (0.475-0.621)	**0.667** (0.578-0.764)	**0.772** (0.664-0.883)	**0.889** (0.755-1.02)	**1.02** (0.851-1.17)	**1.20** (0.989-1.40)	**1.36** (1.10-1.58)
6-hr	**0.170** (0.152-0.190)	**0.211** (0.189-0.236)	**0.263** (0.234-0.294)	**0.308** (0.274-0.344)	**0.374** (0.330-0.417)	**0.426** (0.374-0.476)	**0.484** (0.420-0.542)	**0.546** (0.467-0.613)	**0.637** (0.535-0.721)	**0.711** (0.587-0.810)
12-hr	**0.108** (0.097-0.121)	**0.134** (0.120-0.149)	**0.163** (0.147-0.182)	**0.188** (0.168-0.209)	**0.222** (0.198-0.246)	**0.248** (0.220-0.275)	**0.276** (0.242-0.306)	**0.303** (0.264-0.338)	**0.343** (0.294-0.384)	**0.376** (0.319-0.423)
24-hr	**0.067** (0.061-0.074)	**0.084** (0.076-0.093)	**0.105** (0.095-0.116)	**0.121** (0.109-0.134)	**0.144** (0.130-0.159)	**0.162** (0.145-0.179)	**0.181** (0.161-0.200)	**0.200** (0.177-0.221)	**0.226** (0.198-0.251)	**0.246** (0.214-0.274)
2-day	**0.039** (0.035-0.043)	**0.048** (0.044-0.053)	**0.060** (0.055-0.067)	**0.070** (0.063-0.077)	**0.083** (0.075-0.091)	**0.094** (0.084-0.103)	**0.104** (0.093-0.115)	**0.115** (0.103-0.127)	**0.131** (0.115-0.144)	**0.142** (0.124-0.158)
3-day	**0.028** (0.025-0.031)	**0.035** (0.032-0.038)	**0.043** (0.040-0.048)	**0.050** (0.046-0.055)	**0.060** (0.054-0.066)	**0.068** (0.061-0.074)	**0.076** (0.068-0.083)	**0.084** (0.075-0.092)	**0.095** (0.084-0.105)	**0.104** (0.091-0.115)
4-day	**0.022** (0.020-0.024)	**0.028** (0.025-0.031)	**0.035** (0.032-0.038)	**0.041** (0.037-0.044)	**0.048** (0.044-0.053)	**0.055** (0.049-0.060)	**0.061** (0.055-0.067)	**0.068** (0.061-0.075)	**0.078** (0.069-0.086)	**0.085** (0.075-0.094)
7-day	**0.015** (0.014-0.016)	**0.019** (0.017-0.020)	**0.023** (0.021-0.025)	**0.027** (0.024-0.029)	**0.032** (0.029-0.035)	**0.036** (0.032-0.039)	**0.040** (0.036-0.044)	**0.044** (0.040-0.048)	**0.050** (0.044-0.055)	**0.055** (0.048-0.060)
10-day	**0.012** (0.011-0.013)	**0.015** (0.014-0.016)	**0.018** (0.017-0.020)	**0.021** (0.019-0.023)	**0.025** (0.022-0.027)	**0.027** (0.025-0.030)	**0.030** (0.027-0.033)	**0.033** (0.030-0.036)	**0.037** (0.033-0.041)	**0.040** (0.035-0.044)
20-day	**0.008** (0.007-0.008)	**0.010** (0.009-0.010)	**0.012** (0.011-0.013)	**0.013** (0.012-0.014)	**0.015** (0.014-0.016)	**0.017** (0.015-0.018)	**0.018** (0.016-0.020)	**0.019** (0.017-0.021)	**0.021** (0.019-0.023)	**0.022** (0.020-0.024)
30-day	**0.006** (0.006-0.007)	**0.008** (0.007-0.008)	**0.009** (0.008-0.010)	**0.010** (0.010-0.011)	**0.012** (0.011-0.013)	**0.013** (0.012-0.014)	**0.014** (0.013-0.016)	**0.015** (0.014-0.017)	**0.017** (0.015-0.018)	**0.017** (0.016-0.019)
45-day	**0.005** (0.004-0.005)	**0.006** (0.005-0.007)	**0.007** (0.007-0.008)	**0.008** (0.008-0.009)	**0.010** (0.009-0.011)	**0.011** (0.010-0.012)	**0.011** (0.010-0.013)	**0.012** (0.011-0.014)	**0.013** (0.012-0.015)	**0.014** (0.013-0.016)
60-day	**0.004** (0.004-0.005)	**0.005** (0.005-0.006)	**0.006** (0.006-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.009-0.011)	**0.010** (0.009-0.011)	**0.011** (0.010-0.012)	**0.012** (0.010-0.013)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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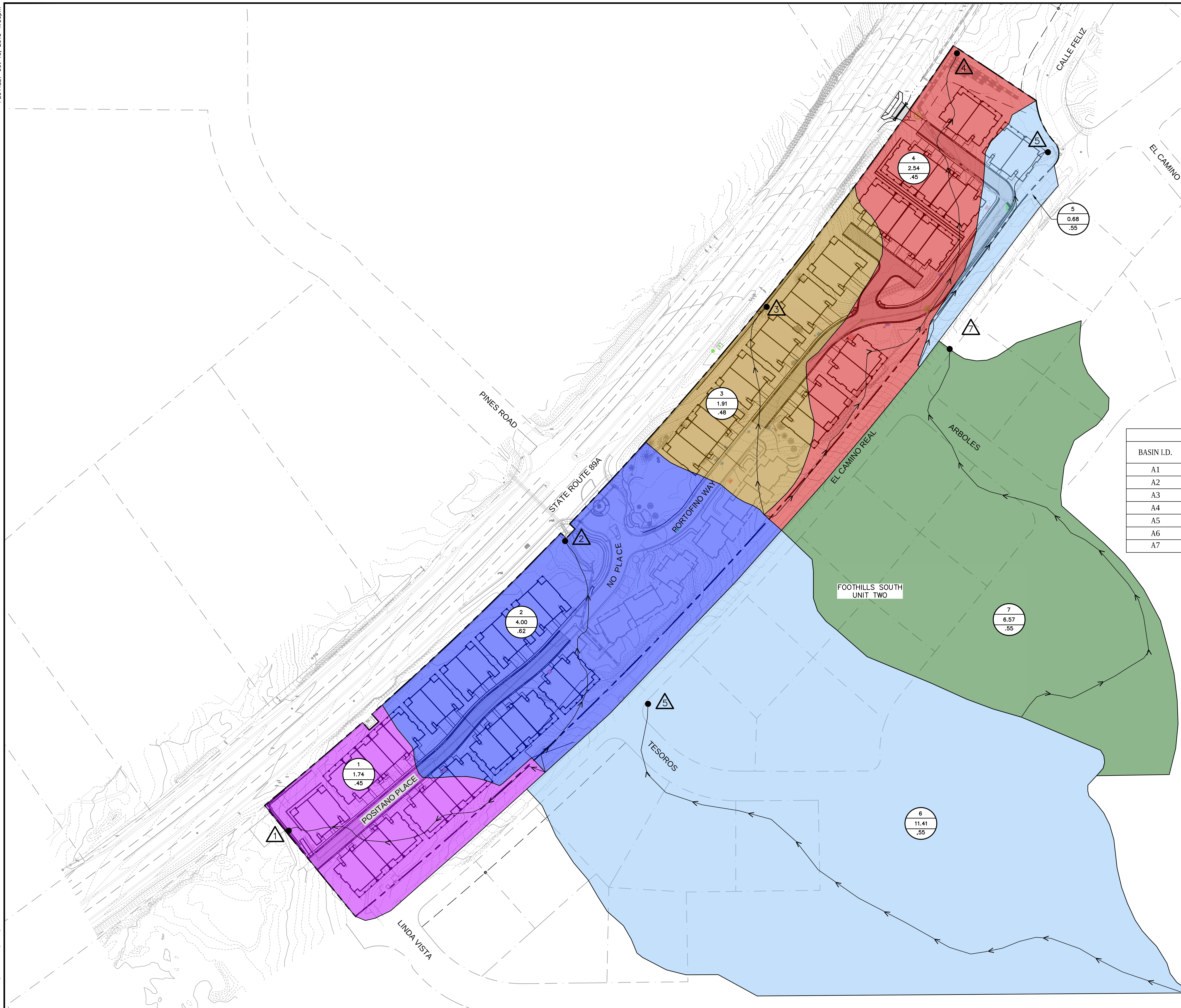
Preliminary Drainage Report
For
Park Place
SWI Project # 17186

APPENDIX B
Pre-/Post- Drainage Basin Exhibits



SCALE 1" : 80'
0 40 80

PRE PROJECT RUNOFF TABLE									
BASIN I.D.	AREA (ACRES)	Tc (MINUTES)	C2, 10	C25	C100	Q2 (CFS)	Q10 (CFS)	Q25 (CFS)	Q100 (CFS)
A1	1.740	10	0.45	0.45	0.45	1.94	3.19	4.01	5.42
A2	4.000	10	0.62	0.62	0.62	6.15	10.12	12.70	17.16
A3	1.910	10	0.48	0.48	0.48	2.27	3.74	4.69	6.34
A4	2.540	10	0.45	0.45	0.45	2.83	4.66	5.85	7.91
A5	0.680	10	0.55	0.55	0.55	0.93	1.53	1.91	2.59
A6	11.410	10	0.55	0.55	0.55	15.56	25.60	32.13	43.43
A7	6.570	10	0.55	0.55	0.55	8.96	14.74	18.50	25.01

LEGEND

- A / B / C — DRAINAGE BASIN IDENTIFIER: A = MAJOR BASIN DESIGNATION; B = APPROXIMATE BASIN AREA (ACRES); C = PRE-DEVELOPMENT 100 YEAR RUNOFF COEFFICIENT
- # — DESIGN POINT
- DRAINAGE FLOW LINE
- LOCAL WATERSHED BOUNDARY
- SUBBASIN BOUNDARY
- PROJECT BOUNDARY
- PARCELS

PLOTTED: Oct 10, 2018-1:30pm

FILE: P:\2017\17186\ENGINEERING\DRAINAGE\DWG\DRAINAGE REPORT EXHIBIT.DWG ACORDERO

Call at least two full working days before you begin excavation.
ARIZONA 811 Arizona Blue Stake, Inc.
Dial 8-1-1 or 1-800-STAKE-IT (782-5348)

REVISIONS			
NO.	DESCRIPTION	DATE	BY

Shephard Wesnitzer, Inc.
75 Kallof Place
Sedona, AZ 86336
928.282.1061
928.282.2058 fax
www.swiaz.com

JOB NO:	17186
DATE:	OCT 18
SCALE:	1" = 80'
DRAWN:	AKC
DESIGN:	AHB
CHECKED:	AHB

17186

CITY OF SEDONA
ARIZONA

PRE-DEVELOPMENT DRAINAGE BASINS

PRELIMINARY
NOT FOR CONSTRUCTION, BIDDING OR RECORDING

DRAWING NO. 1

SHT NO. 1 OF 2

POST PROJECT RUNOFF TABLE									
BASIN I.D.	AREA	Tc	C2, 10	C25	C100	Q2 (CFS)	Q10 (CFS)	Q25 (CFS)	Q100 (CFS)
1	0.110	5	0.80	0.89	0.95	0.29	0.47	0.66	0.95
2	0.071	5	0.68	0.76	0.81	0.16	0.26	0.36	0.53
3	0.249	5	0.58	0.64	0.69	0.47	0.77	1.08	1.57
4	0.933	5	0.72	0.80	0.86	2.20	3.62	5.04	7.29
5	0.106	5	0.44	0.50	0.54	0.15	0.25	0.36	0.52
6	11.410	10	0.55	0.55	0.55	15.56	25.60	32.13	43.43
7	6.570	10	0.55	0.55	0.55	8.96	14.74	18.50	25.01
8	0.371	5	0.53	0.60	0.65	0.65	1.06	1.50	2.19
9	0.295	5	0.56	0.62	0.67	0.54	0.88	1.24	1.81
10	0.701	5	0.71	0.79	0.84	1.62	2.67	3.72	5.38
11	0.107	5	0.57	0.63	0.68	0.20	0.32	0.45	0.66
12	0.108	5	0.56	0.63	0.68	0.20	0.33	0.46	0.67
13	0.111	5	0.56	0.62	0.67	0.20	0.33	0.47	0.68
14	0.110	5	0.56	0.62	0.67	0.20	0.33	0.46	0.68
15	0.184	5	0.56	0.63	0.67	0.33	0.55	0.77	1.13
16	0.046	5	0.80	0.89	0.95	0.12	0.20	0.27	0.40
17	0.285	5	0.45	0.50	0.55	0.41	0.68	0.97	1.42
18	0.251	5	0.38	0.44	0.48	0.31	0.52	0.74	1.09
19	0.124	5	0.80	0.89	0.95	0.32	0.53	0.74	1.07
20	1.565	5	0.75	0.83	0.89	3.81	6.27	8.72	12.62
21	0.140	5	0.57	0.64	0.69	0.26	0.43	0.60	0.88
22	0.110	5	0.56	0.62	0.67	0.20	0.33	0.46	0.68
23	0.108	5	0.56	0.63	0.68	0.20	0.33	0.46	0.67
24	0.108	5	0.56	0.63	0.68	0.20	0.33	0.46	0.67
25	0.288	5	0.54	0.60	0.65	0.50	0.83	1.17	1.70
26	0.148	5	0.58	0.64	0.69	0.28	0.46	0.64	0.93
27	3.449	5	0.62	0.69	0.74	6.97	11.46	16.04	23.33
28	0.492	5	0.45	0.51	0.55	0.72	1.19	1.69	2.48
9a	0.295	5	0.69	0.77	0.84	0.67	1.10	1.52	2.26

LEGEND

- A / B / C — DRAINAGE BASIN IDENTIFIER: A = MAJOR BASIN DESIGNATION; B = APPROXIMATE BASIN AREA (ACRES); C = PRE-DEVELOPMENT 100 YEAR RUNOFF COEFFICIENT
- # — DESIGN POINT
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PLOTTED: Oct 10, 2018-1:31pm

FILE: P:\2017\17186\ENGINEERING\DRAINAGE\DWG\DRAINAGE REPORT EXHIBIT.DWG ACORDERO

Call at least two full working days before you begin excavation.
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REVISIONS			
NO.	DESCRIPTION	DATE	BY

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JOB NO:	17186
DATE:	OCT 18
SCALE:	1" = 80'
DRAWN:	AKC
DESIGN:	AHB
CHECKED:	AHB

17186

CITY OF SEDONA
ARIZONA

Post-DEVELOPMENT DRAINAGE BASINS

PRELIMINARY
NOT FOR CONSTRUCTION, BIDDING OR RECORDING

DRAWING NO. 2

SHT NO. 2 OF 2

Preliminary Drainage Report
For
Park Place
SWI Project # 17186

APPENDIX C
Pavement Drainage/Inlet Hydraulics

Worksheet for Positano Place STA 0+20 Pond 1 Entrance - 10 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	3.62	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+37	4488.65
0+38	4488.65
0+39	4488.32
0+39	4488.33
0+50	4488.11
0+61	4487.89
0+62	4487.88
0+63	4488.21
0+63	4488.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4488.65)	(0+63, 4488.21)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.18	ft
Elevation Range	4487.88 to 4488.65 ft	
Flow Area	0.90	ft²
Wetted Perimeter	9.80	ft

Worksheet for Positano Place STA 0+20 Pond 1 Entrance - 10 Year

Results

Hydraulic Radius		0.09	ft
Top Width		9.77	ft
Normal Depth		0.18	ft
Critical Depth		0.26	ft
Critical Slope		0.00489	ft/ft
Velocity		4.02	ft/s
Velocity Head		0.25	ft
Specific Energy		0.44	ft
Froude Number		2.34	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.18	ft
Critical Depth	0.26	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.00489	ft/ft

Cross Section for Positano Place STA 0+20 Pond 1 Entrance - 10 Year

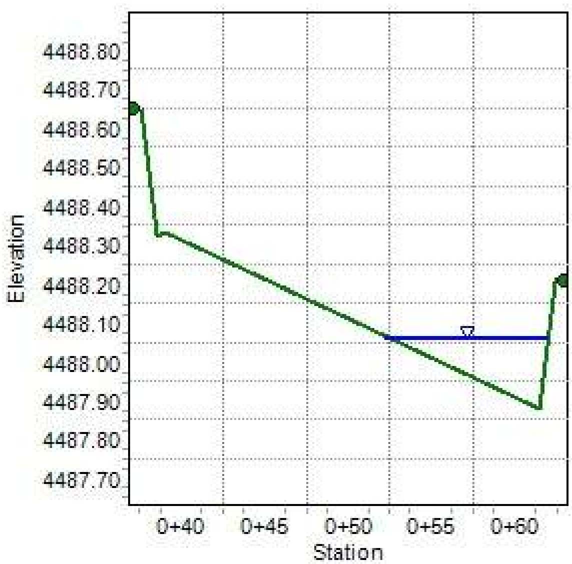
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Normal Depth	0.18	ft
Discharge	3.62	ft³/s

Cross Section Image



Worksheet for Positano Place STA 0+20 Pond 1 Entrance - 100 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	7.29	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+37	4488.65
0+38	4488.65
0+39	4488.32
0+39	4488.33
0+50	4488.11
0+61	4487.89
0+62	4487.88
0+63	4488.21
0+63	4488.21

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4488.65)	(0+63, 4488.21)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.24	ft
Elevation Range	4487.88 to 4488.65 ft	
Flow Area	1.52	ft²
Wetted Perimeter	12.73	ft

Worksheet for Positano Place STA 0+20 Pond 1 Entrance - 100 Year

Results

Hydraulic Radius		0.12	ft
Top Width		12.69	ft
Normal Depth		0.24	ft
Critical Depth		0.34	ft
Critical Slope		0.00449	ft/ft
Velocity		4.80	ft/s
Velocity Head		0.36	ft
Specific Energy		0.60	ft
Froude Number		2.45	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.24	ft
Critical Depth	0.34	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.00449	ft/ft

Cross Section for Positano Place STA 0+20 Pond 1 Entrance - 100 Year

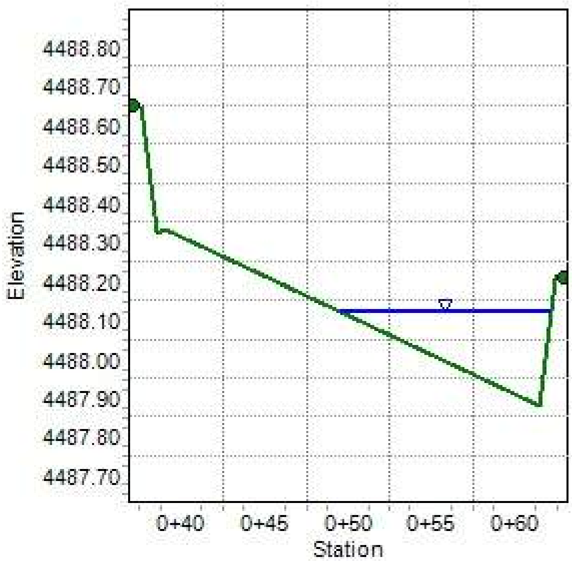
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Normal Depth	0.24	ft
Discharge	7.29	ft³/s

Cross Section Image



Worksheet for Positano Place STA 6+00 CATCH BASIN 1 - 10 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02840	ft/ft
Discharge	2.67	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+37	4492.32
0+38	4492.32
0+39	4491.99
0+39	4492.00
0+50	4492.00
0+61	4492.00
0+62	4491.99
0+63	4492.32
0+63	4492.32

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4492.32)	(0+63, 4492.32)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.06	ft
Elevation Range	4491.99 to 4492.32 ft	
Flow Area	1.08	ft²
Wetted Perimeter	23.36	ft

Worksheet for Positano Place STA 6+00 CATCH BASIN 1 - 10 Year

Results

Hydraulic Radius		0.05	ft
Top Width		23.34	ft
Normal Depth		0.06	ft
Critical Depth		0.08	ft
Critical Slope		0.00588	ft/ft
Velocity		2.47	ft/s
Velocity Head		0.09	ft
Specific Energy		0.15	ft
Froude Number		2.02	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.06	ft
Critical Depth	0.08	ft
Channel Slope	0.02840	ft/ft
Critical Slope	0.00588	ft/ft

Cross Section for Positano Place STA 6+00 CATCH BASIN 1 - 10 Year

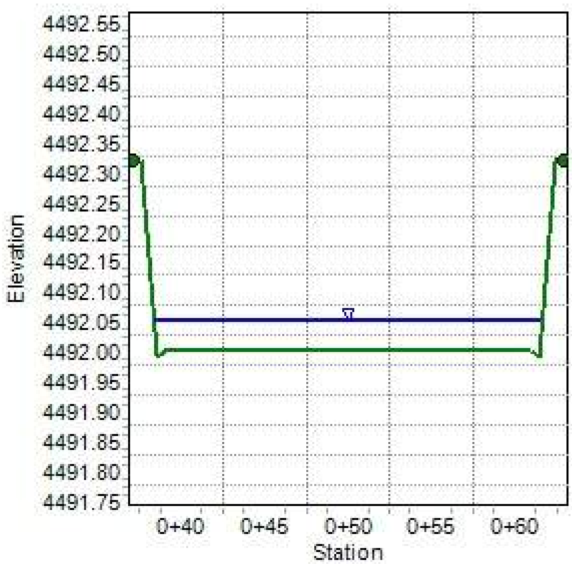
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02840	ft/ft
Normal Depth	0.06	ft
Discharge	2.67	ft³/s

Cross Section Image



Worksheet for Positano Place STA 6+00 CATCH BASIN 1 - 100 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02840	ft/ft
Discharge	5.38	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+37	4492.32
0+38	4492.32
0+39	4491.99
0+39	4492.00
0+50	4492.00
0+61	4492.00
0+62	4491.99
0+63	4492.32
0+63	4492.32

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4492.32)	(0+63, 4492.32)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.08	ft
Elevation Range	4491.99 to 4492.32 ft	
Flow Area	1.64	ft²
Wetted Perimeter	23.51	ft

Worksheet for Positano Place STA 6+00 CATCH BASIN 1 - 100 Year

Results

Hydraulic Radius		0.07	ft
Top Width		23.49	ft
Normal Depth		0.08	ft
Critical Depth		0.13	ft
Critical Slope		0.00505	ft/ft
Velocity		3.28	ft/s
Velocity Head		0.17	ft
Specific Energy		0.25	ft
Froude Number		2.18	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.08	ft
Critical Depth	0.13	ft
Channel Slope	0.02840	ft/ft
Critical Slope	0.00505	ft/ft

Cross Section for Positano Place STA 6+00 CATCH BASIN 1 - 100 Year

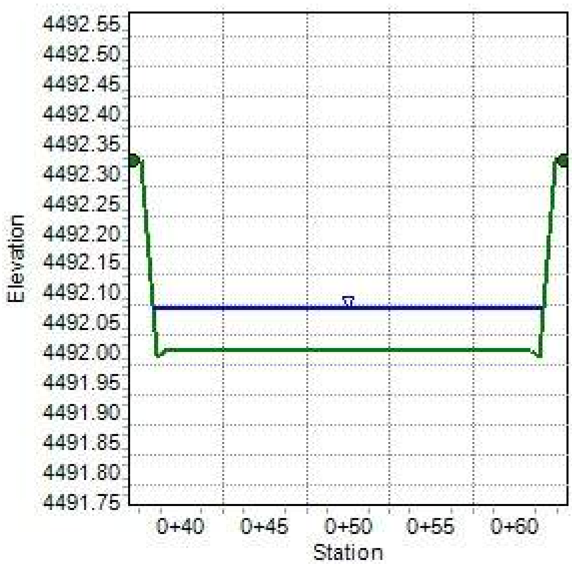
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02840	ft/ft
Normal Depth	0.08	ft
Discharge	5.38	ft³/s

Cross Section Image



Worksheet for Portofino Way STA 8+90 CATCH BASIN 5 - 10 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Discharge	4.87	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+37	4470.50
0+38	4470.50
0+39	4470.16
0+39	4470.17
0+50	4469.73
0+61	4469.51
0+63	4469.45
0+63	4469.95
0+63	4469.95

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4470.50)	(0+63, 4469.95)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.21	ft
Elevation Range	4469.45 to 4470.50 ft	
Flow Area	0.79	ft²
Wetted Perimeter	8.97	ft

Worksheet for Portofino Way STA 8+90 CATCH BASIN 5 - 10 Year

Results

Hydraulic Radius		0.09	ft
Top Width		8.76	ft
Normal Depth		0.21	ft
Critical Depth		0.32	ft
Critical Slope		0.00470	ft/ft
Velocity		6.16	ft/s
Velocity Head		0.59	ft
Specific Energy		0.80	ft
Froude Number		3.62	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.32	ft
Channel Slope	0.07410	ft/ft
Critical Slope	0.00470	ft/ft

Cross Section for Portofino Way STA 8+90 CATCH BASIN 5 - 10 Year

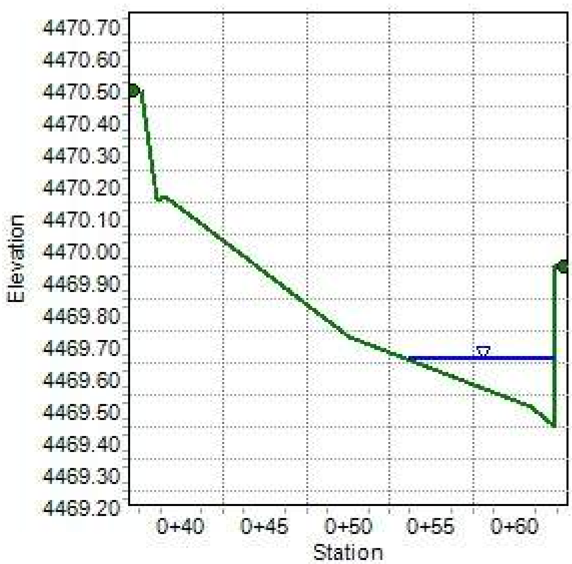
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Normal Depth	0.21	ft
Discharge	4.87	ft³/s

Cross Section Image



Worksheet for Portofino Way STA 8+90 CATCH BASIN 5 - 100 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Discharge	18.46	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+37	4470.50
0+38	4470.50
0+39	4470.16
0+39	4470.17
0+50	4469.73
0+61	4469.51
0+63	4469.45
0+63	4469.95
0+63	4469.95

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4470.50)	(0+63, 4469.95)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.32	ft
Elevation Range	4469.45 to 4470.50 ft	
Flow Area	2.09	ft²
Wetted Perimeter	13.79	ft

Worksheet for Portofino Way STA 8+90 CATCH BASIN 5 - 100 Year

Results

Hydraulic Radius		0.15	ft
Top Width		13.46	ft
Normal Depth		0.32	ft
Critical Depth		0.55	ft
Critical Slope		0.00382	ft/ft
Velocity		8.85	ft/s
Velocity Head		1.22	ft
Specific Energy		1.54	ft
Froude Number		3.97	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.55	ft
Channel Slope	0.07410	ft/ft
Critical Slope	0.00382	ft/ft

Cross Section for Portofino Way STA 8+90 CATCH BASIN 5 - 100 Year

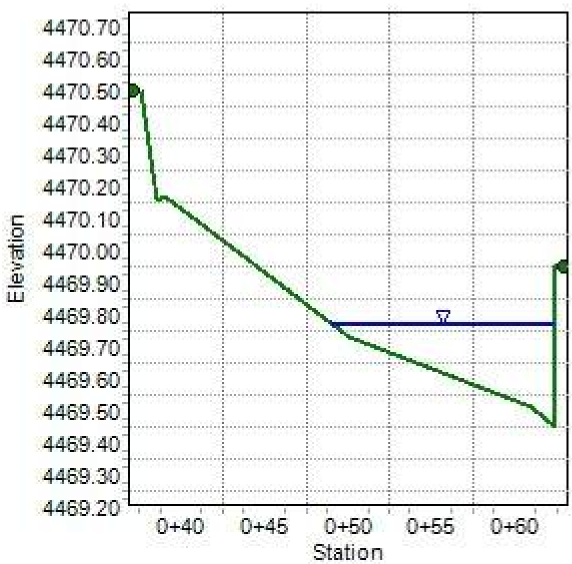
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Normal Depth	0.32	ft
Discharge	18.46	ft³/s

Cross Section Image



Worksheet for Portofino Way STA 9+05 CATCH BASIN 5 - 10 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Discharge	1.45	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+37	4469.84
0+38	4469.84
0+38	4469.34
0+39	4469.40
0+50	4469.65
0+61	4470.20
0+62	4470.19
0+63	4470.53
0+63	4470.53

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4469.84)	(0+63, 4470.53)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.14	ft
Elevation Range	4469.34 to 4470.53 ft		
Flow Area		0.31	ft²
Wetted Perimeter		5.17	ft

Worksheet for Portofino Way STA 9+05 CATCH BASIN 5 - 10 Year

Results

Hydraulic Radius	0.06	ft
Top Width	5.03	ft
Normal Depth	0.14	ft
Critical Depth	0.22	ft
Critical Slope	0.00554	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	0.49	ft
Froude Number	3.37	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.14	ft
Critical Depth	0.22	ft
Channel Slope	0.07410	ft/ft
Critical Slope	0.00554	ft/ft

Cross Section for Portofino Way STA 9+05 CATCH BASIN 5 - 10 Year

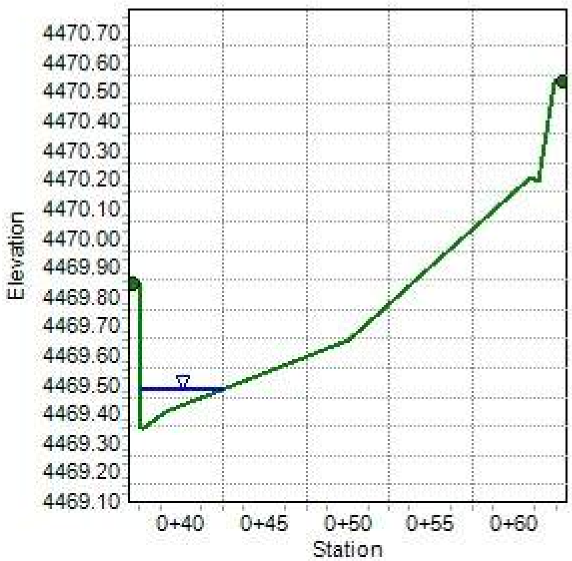
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Normal Depth	0.14	ft
Discharge	1.45	ft³/s

Cross Section Image



Worksheet for Portofino Way STA 9+05 CATCH BASIN 5 - 100 Year

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Discharge	5.51	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+37	4469.84
0+38	4469.84
0+38	4469.34
0+39	4469.40
0+50	4469.65
0+61	4470.20
0+62	4470.19
0+63	4470.53
0+63	4470.53

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+37, 4469.84)	(0+63, 4470.53)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.22	ft
Elevation Range	4469.34 to 4470.53 ft	
Flow Area	0.84	ft²
Wetted Perimeter	8.73	ft

Worksheet for Portofino Way STA 9+05 CATCH BASIN 5 - 100 Year

Results

Hydraulic Radius	0.10	ft
Top Width	8.51	ft
Normal Depth	0.22	ft
Critical Depth	0.35	ft
Critical Slope	0.00456	ft/ft
Velocity	6.55	ft/s
Velocity Head	0.67	ft
Specific Energy	0.89	ft
Froude Number	3.67	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.22	ft
Critical Depth	0.35	ft
Channel Slope	0.07410	ft/ft
Critical Slope	0.00456	ft/ft

Cross Section for Portofino Way STA 9+05 CATCH BASIN 5 - 100 Year

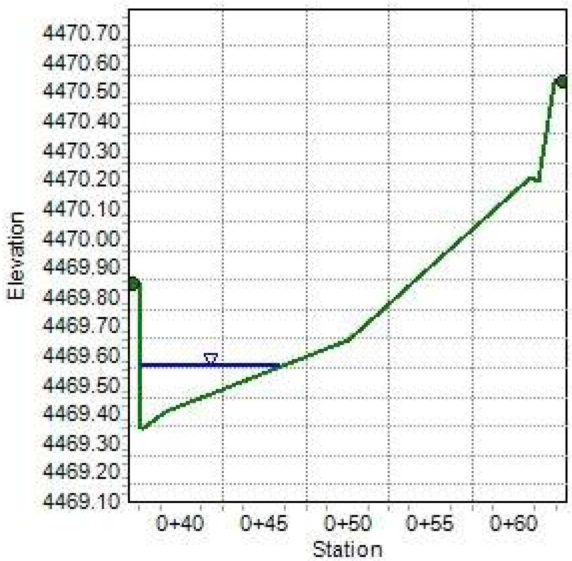
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.07410	ft/ft
Normal Depth	0.22	ft
Discharge	5.51	ft³/s

Cross Section Image



Worksheet for STA 6+00 Curb Inlet

Project Description

Solve For	Spread

Input Data

Discharge		2.67	ft³/s
Gutter Width		1.50	ft
Gutter Cross Slope		0.02	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		9.00	ft
Opening Height		0.42	ft
Curb Throat Type	Horizontal		
Local Depression		2.00	in
Local Depression Width		9.00	ft
Throat Incline Angle		90.00	degrees

Results

Spread	7.66	ft
Depth	0.13	ft
Gutter Depression	0.00	ft
Total Depression	0.17	ft

Worksheet for STA 9+00 Inlet On Grade

Project Description

Solve For	Efficiency

Input Data

Discharge	11.46	ft³/s
Slope	0.07410	ft/ft
Gutter Width	2.00	ft
Gutter Cross Slope	0.03	ft/ft
Road Cross Slope	0.03	ft/ft
Roughness Coefficient	0.013	
Local Depression	2.00	in
Local Depression Width	3.00	ft
Grate Width	2.00	ft
Grate Length	3.00	ft
Grate Type	P-50 mm (P-1-7/8")	
Clogging	50.00	%
Curb Opening Length	20.00	ft

Options

Calculation Option	Use Both
Grate Flow Option	Exclude None

Results

Efficiency	76.50	%
Intercepted Flow	8.77	ft³/s
Bypass Flow	2.69	ft³/s
Spread	9.25	ft
Depth	0.26	ft
Flow Area	1.20	ft²
Gutter Depression	0.00	ft
Total Depression	0.17	ft
Velocity	9.53	ft/s
Splash Over Velocity	6.99	ft/s
Frontal Flow Factor	0.77	
Side Flow Factor	0.01	
Grate Flow Ratio	0.48	
Equivalent Cross Slope	0.05538	ft/ft
Active Grate Length	1.50	ft
Length Factor	0.31	
Total Interception Length	58.83	ft

Preliminary Drainage Report
For
Park Place
SWI Project # 17186

APPENDIX D
Storm Drain Hydraulics

```
==================================================================
Scenario: Base

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

>>>> Info: Subsurface Network Rooted by: O-3
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

>>>> Info: Subsurface Network Rooted by: O-2
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.
```

CALCULATION SUMMARY FOR SURFACE NETWORKS

Label	Inlet Type	Inlet	Total Intercepted Flow (cfs)	Total Bypassed Flow (cfs)	Capture Efficiency (%)	Gutter Spread (ft)	Gutter Depth (ft)
I-3	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-2	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-4	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-16	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-1	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-8	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-6	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-5	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-7	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-9	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-10	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-17	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-15	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-11	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-12	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-13	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00
I-14	Generic Inlet	Generic Default 100%	0.00	0.00	100.0	0.00	0.00

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-3

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-6	1	24 inch	Circular	23.83	6.52	2.08	4,489.42	4,489.35
P-4	1	36 inch	Circular	89.50	44.49	6.29	4,489.64	4,489.35
P-5	1	24 inch	Circular	81.62	6.14	1.95	4,489.66	4,489.45
P-3	1	36 inch	Circular	72.46	44.49	6.29	4,490.24	4,490.00
P-7	1	24 inch	Circular	17.55	4.81	1.53	4,490.26	4,490.24
P-2	1	36 inch	Circular	12.53	39.68	5.61	4,490.27	4,490.24
P-32	1	36 inch	Circular	65.49	39.68	5.61	4,490.73	4,490.56
P-31	1	24 inch	Circular	26.62	36.45	11.60	4,490.49	4,490.00

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
O-3	51.01	4,487.00	4,489.35	4,489.35
I-3	6.52	4,489.50	4,489.45	4,489.42
J-2	44.49	4,490.50	4,490.00	4,489.64
I-2	6.14	4,489.50	4,489.50	4,489.50
J-4	44.49	4,491.50	4,490.24	4,490.24
I-4	4.81	4,491.50	4,490.26	4,490.26
J-1	39.68	4,491.40	4,490.56	4,490.27
I-16	39.68	4,490.00	4,490.00	4,490.00

I-1	36.45	4,501.00	4,490.49	4,490.49

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-16	1	18 inch	Circular	42.72	1.24	0.70	4,484.68	4,484.66
P-15	1	18 inch	Circular	22.20	1.24	0.70	4,484.70	4,484.69
P-18	1	12 inch	Circular	48.53	0.22	1.98	4,484.70	4,484.70
P-14	1	18 inch	Circular	155.15	1.02	1.64	4,484.74	4,484.70
P-13	1	18 inch	Circular	83.05	0.64	1.45	4,484.75	4,484.74
P-17	1	12 inch	Circular	32.12	0.38	1.30	4,484.76	4,484.74
P-12	1	18 inch	Circular	55.22	0.64	1.43	4,484.77	4,484.75
P-11	1	18 inch	Circular	73.01	0.43	1.13	4,484.78	4,484.77
P-19	1	12 inch	Circular	30.10	0.21	0.27	4,484.77	4,484.77
P-10	1	18 inch	Circular	67.24	0.25	1.22	4,484.79	4,484.78
P-33	1	12 inch	Circular	29.14	0.18	3.55	4,487.67	4,484.78
P-20	1	12 inch	Circular	69.17	0.00	0.00	4,484.84	4,484.79
P-9	1	18 inch	Circular	128.80	0.25	1.11	4,485.08	4,484.79
P-8	1	12 inch	Circular	59.25	0.25	1.15	4,485.32	4,485.08

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
O-1	1.24	4,487.00	4,484.66	4,484.66
J-5	1.24	4,487.60	4,484.69	4,484.68
J-6	1.24	4,488.40	4,484.70	4,484.70
I-5	0.22	4,486.70	4,484.70	4,484.70
J-7	1.02	4,493.00	4,484.74	4,484.74
J-8	0.64	4,496.00	4,484.75	4,484.75
I-6	0.38	4,486.17	4,484.76	4,484.76
J-9	0.64	4,498.20	4,484.77	4,484.77
J-10	0.43	4,497.60	4,484.78	4,484.78
I-7	0.21	4,496.20	4,484.77	4,484.77
J-11	0.25	4,494.50	4,484.79	4,484.79
I-10	0.18	4,490.20	4,487.67	4,487.67
I-9	0.00	4,486.20	4,484.84	4,484.84
J-12	0.25	4,491.40	4,485.08	4,485.08
I-8	0.25	4,487.60	4,485.32	4,485.32

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-2

Label	Number of Sections	Section Size	Section Shape	Length (ft)	Total System Flow (cfs)	Average Velocity (ft/s)	Hydraulic Grade Upstream (ft)	Hydraulic Grade Downstream (ft)
P-27	1	48 inch	Circular	112.57	32.96	2.62	4,464.13	4,463.93
P-26	1	48 inch	Circular	181.79	32.96	2.62	4,464.46	4,464.13
P-30	1	12 inch	Circular	56.03	0.00	0.00	4,464.54	4,464.54
P-25	1	36 inch	Circular	36.65	32.26	4.56	4,464.84	4,464.54
P-29	1	24 inch	Circular	12.15	11.10	16.41	4,465.48	4,464.84
P-24	1	24 inch	Circular	225.48	21.16	9.68	4,476.82	4,465.06
P-23	1	18 inch	Circular	112.85	0.16	0.96	4,476.82	4,476.82
P-34	1	12 inch	Circular	32.85	21.00	26.74	4,483.57	4,476.82
P-22	1	18 inch	Circular	110.15	0.16	1.56	4,477.66	4,476.82
P-28	1	12 inch	Circular	61.15	0.00	0.00	4,476.82	4,476.82
P-21	1	12 inch	Circular	41.48	0.16	1.59	4,478.19	4,477.69

Label	Total System Flow (cfs)	Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)

O-2	32.96	4,468.00	4,463.93	4,463.93
J-17	32.96	4,475.00	4,464.13	4,464.13
I-15	32.96	4,467.70	4,464.54	4,464.46
I-14	0.00	4,464.70	4,464.54	4,464.54
J-16	32.26	4,468.20	4,464.84	4,464.84
I-13	11.10	4,468.40	4,465.48	4,465.48
J-15	21.16	4,480.40	4,476.82	4,476.82
J-14	0.16	4,484.20	4,476.82	4,476.82
I-17	21.00	4,485.00	4,483.57	4,483.57
J-13	0.16	4,488.00	4,477.69	4,477.66
I-12	0.00	4,479.20	4,476.82	4,476.82
I-11	0.16	4,480.70	4,478.19	4,478.19

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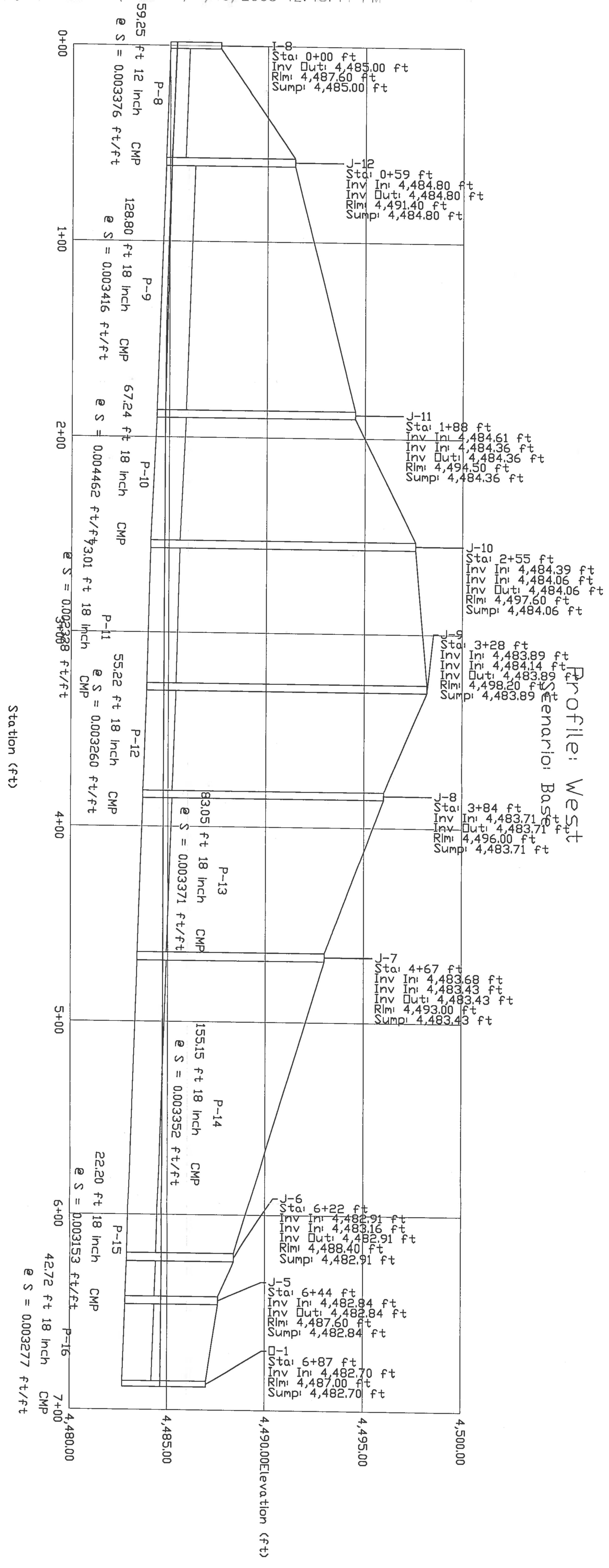
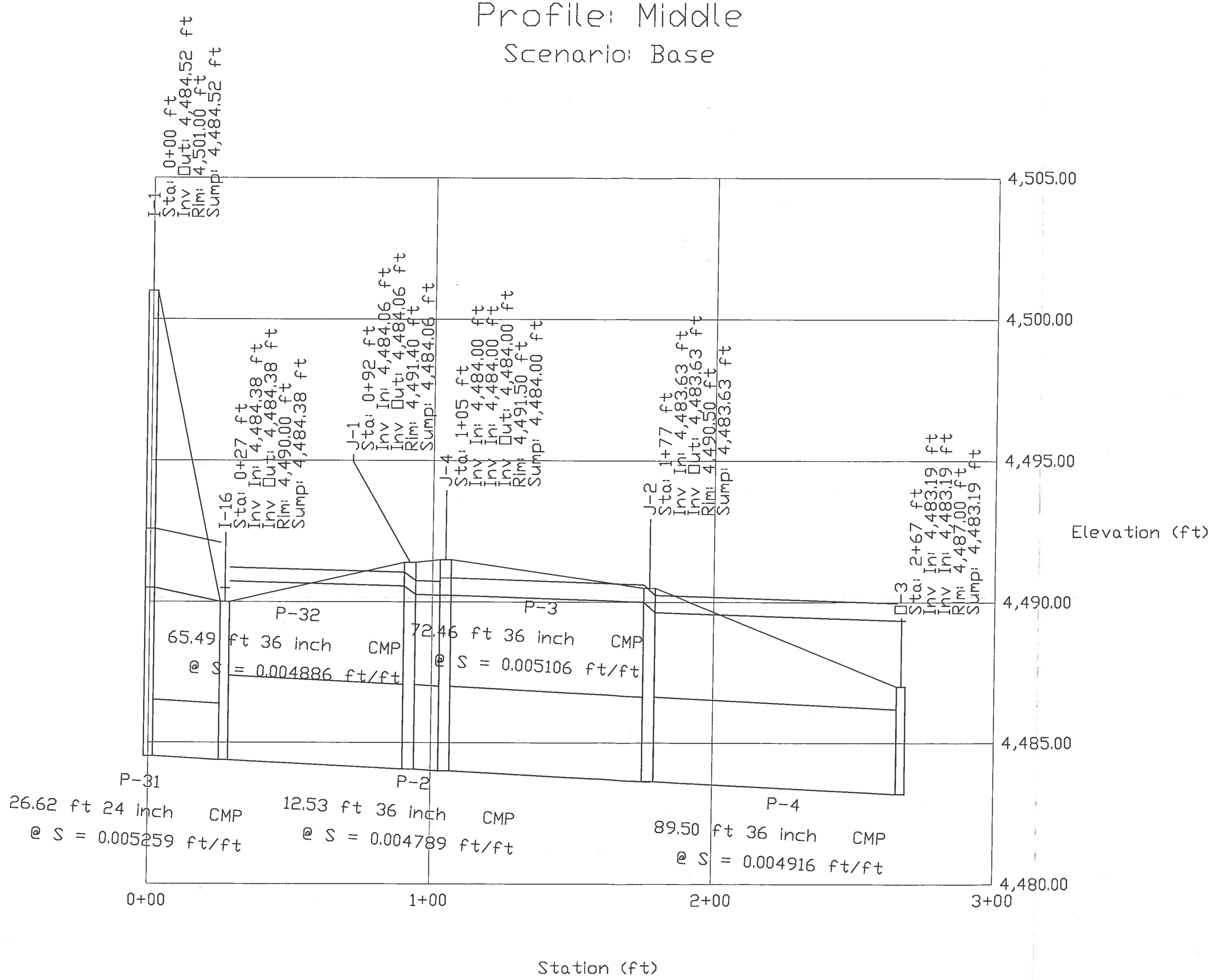


Profile: Middle

Scenario: Base



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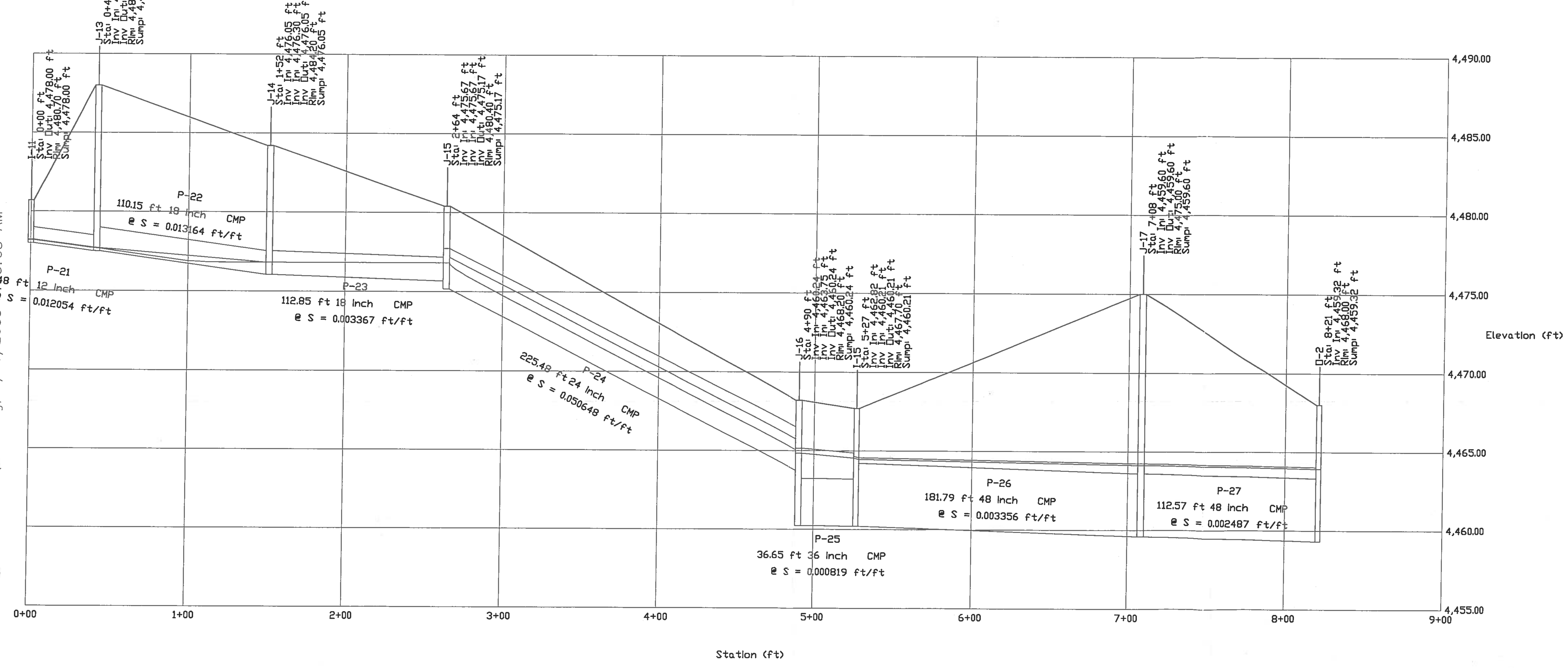
Scenario: Base



Preliminary Drainage Report
For
Park Place
SWI Project # 17186

APPENDIX E
Detention Hydrology/Hydraulics

Park Place

Project Summary	
Title	Park Place
Engineer	Adam Cordero
Company	Shephard-Wesnitzer, Inc.
Date	10/8/2018

Notes	Original storm drain impervious areas have been updated to reflect the new Park Place buildings.

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Park Place

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)
1PI	IDF Storms - I-D-F Table, 2 yrs	2	1,537.000	0.167	1.96
1PI	IDF Storms - I-D-F Table, 10 yrs	10	2,529.000	0.167	3.22
1PI	IDF Storms - I-D-F Table, 25 yrs	25	3,174.000	0.167	4.04
1PI	IDF Storms - I-D-F Table, 100 yrs	100	4,290.000	0.167	5.46
2PI	IDF Storms - I-D-F Table, 2 yrs	2	4,869.000	0.167	6.20
2PI	IDF Storms - I-D-F Table, 10 yrs	10	8,011.000	0.167	10.20
2PI	IDF Storms - I-D-F Table, 25 yrs	25	10,053.000	0.167	12.80
2PI	IDF Storms - I-D-F Table, 100 yrs	100	13,587.000	0.167	17.30
6PI	IDF Storms - I-D-F Table, 2 yrs	2	12,322.000	0.167	15.69
6PI	IDF Storms - I-D-F Table, 10 yrs	10	20,271.000	0.167	25.81
6PI	IDF Storms - I-D-F Table, 25 yrs	25	25,439.000	0.167	32.39
6PI	IDF Storms - I-D-F Table, 100 yrs	100	34,382.000	0.167	43.78
3PI	IDF Storms - I-D-F Table, 2 yrs	2	1,800.000	0.167	2.29
3PI	IDF Storms - I-D-F Table, 10 yrs	10	2,961.000	0.167	3.77
3PI	IDF Storms - I-D-F Table, 25 yrs	25	3,716.000	0.167	4.73
3PI	IDF Storms - I-D-F Table, 100 yrs	100	5,023.000	0.167	6.40
4PI	IDF Storms - I-D-F Table, 2 yrs	2	2,244.000	0.167	2.86
4PI	IDF Storms - I-D-F Table, 10 yrs	10	3,692.000	0.167	4.70
4PI	IDF Storms - I-D-F Table, 25 yrs	25	4,633.000	0.167	5.90
4PI	IDF Storms - I-D-F Table, 100 yrs	100	6,262.000	0.167	7.97
7PI	IDF Storms - I-D-F Table, 2 yrs	2	7,095.000	0.167	9.03
7PI	IDF Storms - I-D-F Table, 10 yrs	10	11,672.000	0.167	14.86
7PI	IDF Storms - I-D-F Table, 25 yrs	25	14,648.000	0.167	18.65

Park Place

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (hours)	Peak Flow (ft^3/s)
7PI	IDF Storms - I-D-F Table, 100 yrs	100	19,797.000	0.167	25.21
5PI	IDF Storms - I-D-F Table, 2 yrs	2	734.000	0.167	0.94
5PI	IDF Storms - I-D-F Table, 10 yrs	10	1,208.000	0.167	1.54
5PI	IDF Storms - I-D-F Table, 25 yrs	25	1,516.000	0.167	1.93
5PI	IDF Storms - I-D-F Table, 100 yrs	100	2,049.000	0.167	2.61
1DI	IDF Storms - I-D-F Table, 2 yrs	2	1,798.000	0.083	4.57
1DI	IDF Storms - I-D-F Table, 10 yrs	10	2,956.000	0.083	7.52
1DI	IDF Storms - I-D-F Table, 25 yrs	25	4,111.000	0.083	10.46
1DI	IDF Storms - I-D-F Table, 100 yrs	100	5,944.000	0.083	15.12
2DI	IDF Storms - I-D-F Table, 2 yrs	2	3,273.000	0.083	8.33
2DI	IDF Storms - I-D-F Table, 10 yrs	10	5,381.000	0.083	13.69
2DI	IDF Storms - I-D-F Table, 25 yrs	25	7,463.000	0.083	18.98
2DI	IDF Storms - I-D-F Table, 100 yrs	100	10,909.000	0.083	27.75
6DI	IDF Storms - I-D-F Table, 2 yrs	2	12,337.000	0.167	15.68
6DI	IDF Storms - I-D-F Table, 10 yrs	10	20,297.000	0.167	25.80
6DI	IDF Storms - I-D-F Table, 25 yrs	25	25,471.000	0.167	32.38
6DI	IDF Storms - I-D-F Table, 100 yrs	100	34,425.000	0.167	43.76
5DI	IDF Storms - I-D-F Table, 2 yrs	2	60.000	0.083	0.15
5DI	IDF Storms - I-D-F Table, 10 yrs	10	99.000	0.083	0.25
5DI	IDF Storms - I-D-F Table, 25 yrs	25	141.000	0.083	0.36
5DI	IDF Storms - I-D-F Table, 100 yrs	100	206.000	0.083	0.53
4DI	IDF Storms - I-D-F Table, 2 yrs	2	3,340.000	0.083	8.49
4DI	IDF Storms - I-D-F Table, 10 yrs	10	5,491.000	0.083	13.97

Park Place

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)
4DI	IDF Storms - I-D-F Table, 25 yrs	25	7,712.000	0.083	19.62
4DI	IDF Storms - I-D-F Table, 100 yrs	100	11,218.000	0.083	28.54
7DI	IDF Storms - I-D-F Table, 2 yrs	2	7,095.000	0.167	9.03
7DI	IDF Storms - I-D-F Table, 10 yrs	10	11,672.000	0.167	14.86
7DI	IDF Storms - I-D-F Table, 25 yrs	25	14,648.000	0.167	18.65
7DI	IDF Storms - I-D-F Table, 100 yrs	100	19,797.000	0.167	25.21
3DI	IDF Storms - I-D-F Table, 2 yrs	2	340.000	0.083	0.87
3DI	IDF Storms - I-D-F Table, 10 yrs	10	559.000	0.083	1.42
3DI	IDF Storms - I-D-F Table, 25 yrs	25	790.000	0.083	2.01
3DI	IDF Storms - I-D-F Table, 100 yrs	100	1,153.000	0.083	2.93

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)
1PO	IDF Storms - I-D-F Table, 2 yrs	2	1,538.000	0.170	1.93
1PO	IDF Storms - I-D-F Table, 10 yrs	10	2,530.000	0.170	3.17
1PO	IDF Storms - I-D-F Table, 25 yrs	25	3,175.000	0.170	3.98
1PO	IDF Storms - I-D-F Table, 100 yrs	100	4,292.000	0.170	5.38
2PO	IDF Storms - I-D-F Table, 2 yrs	2	17,198.000	0.170	21.56
2PO	IDF Storms - I-D-F Table, 10 yrs	10	28,293.000	0.170	35.47
2PO	IDF Storms - I-D-F Table, 25 yrs	25	35,505.000	0.170	44.51
2PO	IDF Storms - I-D-F Table, 100 yrs	100	47,988.000	0.170	60.16
3PO	IDF Storms - I-D-F Table, 2 yrs	2	1,801.000	0.170	2.26
3PO	IDF Storms - I-D-F Table, 10 yrs	10	2,963.000	0.170	3.71

Park Place

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)
3PO	IDF Storms - I-D-F Table, 25 yrs	25	3,718.000	0.170	4.66
3PO	IDF Storms - I-D-F Table, 100 yrs	100	5,025.000	0.170	6.30
4PO	IDF Storms - I-D-F Table, 2 yrs	2	9,343.000	0.170	11.71
4PO	IDF Storms - I-D-F Table, 10 yrs	10	15,371.000	0.170	19.27
4PO	IDF Storms - I-D-F Table, 25 yrs	25	19,289.000	0.170	24.18
4PO	IDF Storms - I-D-F Table, 100 yrs	100	26,070.000	0.170	32.68
5PO	IDF Storms - I-D-F Table, 2 yrs	2	735.000	0.170	0.92
5PO	IDF Storms - I-D-F Table, 10 yrs	10	1,209.000	0.170	1.52
5PO	IDF Storms - I-D-F Table, 25 yrs	25	1,517.000	0.170	1.90
5PO	IDF Storms - I-D-F Table, 100 yrs	100	2,050.000	0.170	2.57
1DO	IDF Storms - I-D-F Table, 2 yrs	2	1,852.000	0.280	0.23
1DO	IDF Storms - I-D-F Table, 10 yrs	10	3,046.000	0.310	0.26
1DO	IDF Storms - I-D-F Table, 25 yrs	25	4,236.000	0.320	0.29
1DO	IDF Storms - I-D-F Table, 100 yrs	100	6,126.000	0.340	0.34
2DO	IDF Storms - I-D-F Table, 2 yrs	2	15,614.000	0.180	17.32
2DO	IDF Storms - I-D-F Table, 10 yrs	10	25,684.000	0.180	28.62
2DO	IDF Storms - I-D-F Table, 25 yrs	25	32,940.000	0.190	33.02
2DO	IDF Storms - I-D-F Table, 100 yrs	100	45,342.000	0.220	36.48
4DO	IDF Storms - I-D-F Table, 2 yrs	2	10,435.000	0.220	7.86
4DO	IDF Storms - I-D-F Table, 10 yrs	10	17,164.000	0.230	11.40
4DO	IDF Storms - I-D-F Table, 25 yrs	25	22,360.000	0.220	16.14
4DO	IDF Storms - I-D-F Table, 100 yrs	100	31,015.000	0.200	25.81
5DO	IDF Storms - I-D-F Table, 2 yrs	2	62.000	0.080	0.15

Park Place

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)
5DO	IDF Storms - I-D-F Table, 10 yrs	10	102.000	0.080	0.24
5DO	IDF Storms - I-D-F Table, 25 yrs	25	146.000	0.080	0.34
5DO	IDF Storms - I-D-F Table, 100 yrs	100	213.000	0.080	0.50
3DO	IDF Storms - I-D-F Table, 2 yrs	2	351.000	0.080	0.82
3DO	IDF Storms - I-D-F Table, 10 yrs	10	577.000	0.080	1.36
3DO	IDF Storms - I-D-F Table, 25 yrs	25	816.000	0.080	1.91
3DO	IDF Storms - I-D-F Table, 100 yrs	100	1,190.000	0.080	2.79

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
P1 (IN)	IDF Storms - I-D-F Table, 2 yrs	2	1,856.000	0.080	4.36	(N/A)	(N/A)
P1 (OUT)	IDF Storms - I-D-F Table, 2 yrs	2	1,852.000	0.280	0.23	4,483.02	1,574.000
P1 (IN)	IDF Storms - I-D-F Table, 10 yrs	10	3,052.000	0.080	7.16	(N/A)	(N/A)
P1 (OUT)	IDF Storms - I-D-F Table, 10 yrs	10	3,046.000	0.310	0.26	4,483.27	2,662.000
P1 (IN)	IDF Storms - I-D-F Table, 25 yrs	25	4,244.000	0.080	9.96	(N/A)	(N/A)
P1 (OUT)	IDF Storms - I-D-F Table, 25 yrs	25	4,236.000	0.320	0.29	4,483.52	3,774.000
P1 (IN)	IDF Storms - I-D-F Table, 100 yrs	100	6,138.000	0.080	14.41	(N/A)	(N/A)
P1 (OUT)	IDF Storms - I-D-F Table, 100 yrs	100	6,126.000	0.340	0.34	4,483.98	5,561.000

Park Place

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
P2 (IN)	IDF Storms - I -D-F Table, 2 yrs	2	15,614.000	0.170	18.03	(N/A)	(N/A)
P2 (OUT)	IDF Storms - I -D-F Table, 2 yrs	2	15,614.000	0.180	17.32	4,485.23	822.000
P2 (IN)	IDF Storms - I -D-F Table, 10 yrs	10	25,684.000	0.170	29.65	(N/A)	(N/A)
P2 (OUT)	IDF Storms - I -D-F Table, 10 yrs	10	25,684.000	0.180	28.62	4,486.75	1,687.000
P2 (IN)	IDF Storms - I -D-F Table, 25 yrs	25	32,940.000	0.170	37.77	(N/A)	(N/A)
P2 (OUT)	IDF Storms - I -D-F Table, 25 yrs	25	32,940.000	0.190	33.02	4,487.53	2,689.000
P2 (IN)	IDF Storms - I -D-F Table, 100 yrs	100	45,342.000	0.160	51.74	(N/A)	(N/A)
P2 (OUT)	IDF Storms - I -D-F Table, 100 yrs	100	45,342.000	0.220	36.48	4,488.26	7,434.000
P4 (IN)	IDF Storms - I -D-F Table, 2 yrs	2	10,435.000	0.090	11.76	(N/A)	(N/A)
P4 (OUT)	IDF Storms - I -D-F Table, 2 yrs	2	10,435.000	0.220	7.86	4,461.41	3,455.000
P4 (IN)	IDF Storms - I -D-F Table, 10 yrs	10	17,164.000	0.090	19.33	(N/A)	(N/A)
P4 (OUT)	IDF Storms - I -D-F Table, 10 yrs	10	17,164.000	0.230	11.40	4,462.35	6,383.000
P4 (IN)	IDF Storms - I -D-F Table, 25 yrs	25	22,360.000	0.090	26.22	(N/A)	(N/A)
P4 (OUT)	IDF Storms - I -D-F Table, 25 yrs	25	22,360.000	0.220	16.14	4,463.00	8,374.000
P4 (IN)	IDF Storms - I -D-F Table, 100 yrs	100	31,015.000	0.090	37.33	(N/A)	(N/A)

Park Place

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft^3)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft^3)
P4 (OUT)	IDF Storms - I -D-F Table, 100 yrs	100	31,015.000	0.200	25.81	4,463.93	10,879.000

I-D-F Curve

Time (hours)	Intensity (in/h)
0.083	5.360
0.167	4.080
0.250	3.370
0.500	2.270
1.000	1.410
2.000	0.788
3.000	0.542
6.000	0.308
12.000	0.188
24.000	0.121

Park Place

Subsection: I-D-F Table — Return Event: 100 years
Label: IDF Storms — Storm Event: IDF Storms - 100 Year

I-D-F Curve

Time (hours)	Intensity (in/h)
0.083	9.100
0.167	6.920
0.250	5.720
0.500	3.850
1.000	2.380
2.000	1.320
3.000	0.889
6.000	0.484
12.000	0.276
24.000	0.181

Park Place

Subsection: I-D-F Table — Return Event: 2 years
Label: IDF Storms — Storm Event: IDF Storms - 2 Year

I-D-F Curve

Time (hours)	Intensity (in/h)
0.083	3.260
0.167	2.480
0.250	2.050
0.500	1.380
1.000	0.855
2.000	0.494
3.000	0.354
6.000	0.211
12.000	0.134
24.000	0.084

Park Place

Subsection: I-D-F Table | Return Event: 25 years

Label: IDF Storms | Storm Event: IDF Storms - 25 Year

I-D-F Curve

Time (hours)	Intensity (in/h)
0.083	6.730
0.167	5.120
0.250	4.230
0.500	2.850
1.000	1.760
2.000	0.981
3.000	0.667
6.000	0.374
12.000	0.222
24.000	0.144

Park Place

Subsection: Elevation vs. Volume Curve | Return Event: 2 years
Label: P1 | Storm Event: IDF Storms - 2 Year

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft^3)
4,482.00	0.000
4,483.00	1,492.250
4,483.90	5,424.310
4,484.50	6,444.000

Park Place

Subsection: Elevation vs. Volume Curve — Return Event: 2 years
Label: P2 — Storm Event: IDF Storms - 2 Year

Elevation-Volume

Pond Elevation (ft)	Pond Volume (ft³)
4,483.19	0.000
4,484.00	87.120
4,485.00	653.400
4,486.00	1,393.920
4,487.00	1,785.960
4,487.50	2,526.480
4,488.00	5,401.440
4,489.00	13,285.800
4,490.00	21,780.000

Park Place

Subsection: Pipe Volume
Label: P4

Return Event: 2 years
Storm Event: IDF Storms - 2 Year

Volume Results (Pipe)	
Pipe Storage Upstream Invert	4,460.21 ft
Pipe Storage Downstream Invert	4,459.45 ft
Pipe Storage Length	642.00 ft
Pipe Storage Diameter	60.0 in
Pipe Storage Number of Barrels	1
Pipe Storage Slice Width	0.10 ft
Pipe Storage Vertical Increment	1.00 ft

Elevation (ft)	Perpendicular Downstream Depth (ft)	Perpendicular Downstream Area (ft²)	Wetted Length (ft)	Filled Length (ft)	Perpendicular Upstream Depth (ft)	Perpendicular Upstream Area (ft²)	Total Volume (ft³)
4,459.45	0.00	0.0	0.00	0.00	0.00	0.0	0.000
4,460.45	1.00	2.8	642.00	0.00	0.24	0.3	935.000
4,461.45	2.00	7.3	642.00	0.00	1.24	3.8	3,549.000
4,462.45	3.00	12.3	642.00	0.00	2.24	8.5	6,686.000
4,463.45	4.00	16.8	642.00	0.00	3.24	13.5	9,758.000
4,464.45	5.00	19.6	642.00	0.00	4.24	17.8	12,115.000
4,465.21	5.00	19.6	642.00	642.00	5.00	19.6	12,606.000

Park Place

Subsection: Outlet Input Data | Return Event: 2 years
Label: R1 | Storm Event: IDF Storms - 2 Year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	4,482.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	4,484.50 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Culvert-Circular	O1	Forward	TW	4,482.00	4,484.50
Rectangular Weir	O0	Forward	TW	4,484.00	4,484.50
Tailwater Settings	Tailwater			(N/A)	(N/A)

Park Place

Subsection: Outlet Input Data — Return Event: 2 years
Label: R1 — Storm Event: IDF Storms - 2 Year

Structure ID: O0 Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	4,484.00 ft
Weir Length	1.33 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: O1 Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	3.0 in
Length	0.67 ft
Length (Computed Barrel)	0.67 ft
Slope (Computed)	0.000 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.500
Kb	0.199
Kr	0.500
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0078
M	2.0000
C	0.0379
Y	0.6900
T1 ratio (HW/D)	1.135
T2 ratio (HW/D)	1.296
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	4,482.28 ft	T1 Flow	0.09 ft³/s
T2 Elevation	4,482.32 ft	T2 Flow	0.10 ft³/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	40
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft^3/s
Flow Tolerance (Maximum)	10.000 ft^3/s

Requested Pond Water Surface Elevations	
Minimum (Headwater)	4,483.19 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	4,490.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Culvert-Circular	C0	Forward	TW	4,483.19	4,490.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: C0 Structure Type: Culvert-Circular	
Number of Barrels	2
Diameter	18.0 in
Length	10.00 ft
Length (Computed Barrel)	10.00 ft
Slope (Computed)	0.006 ft/ft

Outlet Control Data	
Manning's n	0.024
Ke	0.500
Kb	0.062
Kr	0.500
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0078
M	2.0000
C	0.0379
Y	0.6900
T1 ratio (HW/D)	1.133
T2 ratio (HW/D)	1.293
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	4,484.89 ft	T1 Flow	7.58 ft³/s
T2 Elevation	4,485.13 ft	T2 Flow	8.66 ft³/s

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	40
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Requested Pond Water Surface Elevations	
Minimum (Headwater)	4,459.45 ft
Increment (Headwater)	0.10 ft
Maximum (Headwater)	4,465.21 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Culvert-Circular	C0	Forward	TW	4,459.45	4,465.21
Culvert-Circular	C1	Forward	TW	4,462.00	4,465.21
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: C0 Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	18.0 in
Length	20.80 ft
Length (Computed Barrel)	20.80 ft
Slope (Computed)	0.008 ft/ft

Outlet Control Data	
Manning's n	0.024
Ke	0.500
Kb	0.062
Kr	0.500
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0078
M	2.0000
C	0.0379
Y	0.6900
T1 ratio (HW/D)	1.132
T2 ratio (HW/D)	1.293
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	4,461.15 ft	T1 Flow	7.58 ft³/s
T2 Elevation	4,461.39 ft	T2 Flow	8.66 ft³/s

Structure ID: C1 Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	24.0 in
Length	20.80 ft
Length (Computed Barrel)	20.80 ft
Slope (Computed)	0.005 ft/ft

Outlet Control Data	
Manning's n	0.024
Ke	0.500
Kb	0.042
Kr	0.500
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0078
M	2.0000
C	0.0379
Y	0.6900
T1 ratio (HW/D)	1.133
T2 ratio (HW/D)	1.294
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	4,464.27 ft	T1 Flow	15.55 ft³/s
T2 Elevation	4,464.59 ft	T2 Flow	17.77 ft³/s

Park Place

Subsection: Outlet Input Data | Return Event: 2 years
Label: R4 | Storm Event: IDF Storms - 2 Year

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall

Convergence Tolerances

Maximum Iterations	40
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 1DI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Proposed	0.650	2.140	(N/A)
Weighted C & Total Area --->	0.650	2.140	1.391

Park Place

Subsection: C and Area
Label: 1PI

Return Event: 2 years
Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.450	1.740	(N/A)
Weighted C & Total Area --->	0.450	1.740	0.783

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 2DI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Proposed	0.670	3.780	(N/A)
Weighted C & Total Area --->	0.670	3.780	2.533

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 2PI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.620	4.000	(N/A)
Weighted C & Total Area --->	0.620	4.000	2.480

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 3DI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
	0.560	0.470	(N/A)
Weighted C & Total Area --->	0.560	0.470	0.263

Park Place

Subsection: C and Area
Label: 3PI

Return Event: 2 years
Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existnig	0.480	1.910	(N/A)
Weighted C & Total Area --->	0.480	1.910	0.917

Park Place

Subsection: C and Area
Label: 4DI

Return Event: 2 years
Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Proposed	0.590	4.380	(N/A)
Weighted C & Total Area --->	0.590	4.380	2.584

Park Place

Subsection: C and Area
Label: 4PI

Return Event: 2 years
Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.450	2.540	(N/A)
Weighted C & Total Area --->	0.450	2.540	1.143

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 5DI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Proposed	0.440	0.106	(N/A)
Weighted C & Total Area --->	0.440	0.106	0.047

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 5PI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.550	0.680	(N/A)
Weighted C & Total Area --->	0.550	0.680	0.374

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 6DI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.550	11.410	(N/A)
Weighted C & Total Area --->	0.550	11.410	6.276

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 6PI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.550	11.410	(N/A)
Weighted C & Total Area --->	0.550	11.410	6.276

Park Place

Subsection: C and Area | Return Event: 2 years
Label: 7DI | Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.550	6.570	(N/A)
Weighted C & Total Area --->	0.550	6.570	3.614

Park Place

Subsection: C and Area
Label: 7PI

Return Event: 2 years
Storm Event: IDF Storms - 2 Year

C and Area Results

Soil/Surface Description	C Coefficient	Area (acres)	Area (Adjusted) (acres)
Existing	0.550	6.570	(N/A)
Weighted C & Total Area --->	0.550	6.570	3.614

GEOTECHNICAL ENGINEERING EVALUATION

Park Place Sedona

Southeast of Bristlecone Pines Road
and State Highway 89
Sedona, Arizona

PATTISON ENGINEERING, LLC
Project Number 17-101

PATTISON
ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

PATTISON ENGINEERING, LLC
Geotechnical Engineering · Construction Inspection · Materials Testing

August 28, 2017
Project Number 17-101

Jack Kemmerly
Miramonte Homes
4578 N. 1st Avenue, Suite 160
Tucson, AZ 85718

GEOTECHNICAL ENGINEERING EVALUATION
Park Place Sedona
Southeast of Bristlecone Pines Road and State Highway 89
Sedona, Arizona

We have completed the geotechnical evaluation for the proposed development in accordance with our Proposal Number 17-P206, dated July 31, 2017. Our project study results are attached.

In our opinion, the site's subsurface soil and other conditions are suitable for support of the proposed development provided the designers, contractors, and owners follow the report recommendations. The soils we encountered are generally silty sand with gravel and clayey sands with gravel, underlain by bedrock. We expect the subsurface and underlying soils to provide suitable support for structures provided that these soils do not experience dramatic moisture increases. The general soil conditions and specific recommendations are presented in the report.

We are available for consultation during the various design stages. To provide continuity of geotechnical services, we should perform construction observation and testing.

We thank you for selecting PATTISON ENGINEERING, L.L.C. and look forward to being a member of your team on the remainder of this project. If you have any questions about this report, or require additional consultation, please call us.

Sincerely,
PATTISON ENGINEERING, L.L.C.
Geotechnical, Construction Inspection, and Materials Testing Services

Oleg B. Lysyj, P.E.
Principal

Francisco J. Jacinto, P.E.
Managing Principal

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TABLE OF CONTENTS

INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed Park Place Sedona residential development to be located at the southeast corner of Bristlecone Pines Road and State Highway 89 in Sedona, Arizona. The Site Plan in the Appendix shows the location of the site.

We obtained information on site soil conditions, performed field and laboratory testing, and geotechnical engineering analyses. This report presents our conclusions and recommendations regarding the engineering properties of the soils encountered and their relationship to the proposed development. Specifically, the report addresses the following information:

- General site and subsurface conditions encountered during our evaluation.
- Recommendations and design criteria for foundation systems, including allowable bearing capacity, lateral earth pressures and estimated settlements.
- Recommendations for support of interior concrete slabs-on-grade.
- Recommendations for grading requirements, including site and building area preparation, fill placement, and suitability of existing soils for fill.

The Appendix contains the results of the field explorations and tests and provides a site plan showing the exploration locations.

Project Information

We understand that you plan to construct 52 new townhome units within this partially developed residential project. We further understand that the structures will be one- or two-story wood-frame structures with slab-on-grade floors. We expect foundations will be either conventional spread footings and independent floor slabs, or post-tensioned slab/foundation systems. We are also assuming that the structural loads for continuous wall footings and column footings will be about 2 kips per linear foot and 20 kips, respectively.

Evaluation and Testing

To obtain information on the conditions at this site and to determine applicable soil properties, we completed an on-site evaluation. The extent of our evaluation and testing programs is described in the following section.

Field Evaluation

Eduardo Garcia, a Field Geologist with our firm, reviewed the site to obtain information on the general surface conditions. On August 9 and 10, 2017, he also observed the drilling of 21 soil borings to depths ranging in depths between approximately 1 and 11 feet below the existing site grade.

The site plan shows the approximate exploration locations. The Appendix contains logs of the subsurface conditions encountered at the explorations.

During the field exploration, the subsurface conditions were described and the encountered soils were samples visually classify and logged. We used the Unified Soil Classification System to classify soils. The soil classification symbols appear on the exploration logs and are briefly described in the Appendix.

Laboratory Evaluation

We performed laboratory analyses on soil samples to aid in material classification and estimate pertinent engineering properties of the on-site soils. We performed the tests in general accordance with applicable ASTM standards. The Appendix contains our laboratory test results.

FINDINGS

Site Conditions

The site is located to the southeast of the intersection of Bristlecone Pines Road and State Highway 89 in Sedona, Arizona. The proposed townhome subdivision is on a partially developed parcel with some of the interior roadways and subsurface utilities in-place. Existing residential structures are near the development entrance across from Bristlecone Pines Road. Other areas of the site have had clearing and grading. Some areas support a moderate growth of juniper and manzanita bush. The site is hilly with good drainage generally to the north. There is about 40 feet of elevation difference across the property.

Subsurface Conditions

The soils encountered in our explorations were silty sand with gravel and clayey sands with gravel, underlain by sandstone bedrock. Many of our borings terminated in refusal on the bedrock surface at depths between 1 and 10 feet below the ground surface.

Soil moisture contents were relatively low at the time of our field evaluation and no free groundwater was encountered in any of the explorations. The logs in the Appendix show details of the subsurface conditions encountered during the field evaluation.

Conclusions

In our opinion, the site's natural subsurface soil conditions are suitable for support of the proposed development provided the designers, contractors, and owners follow the report recommendations. Our conclusions regarding the soils and planned development are given in the following discussion.

Compressive Properties

At their existing and increased moisture contents, the natural soils are expected to have low to moderate compressive potentials under the loads expected for the construction. At increased moisture contents, the soils also have low to moderate compressive potentials. We expect that total settlement of the proposed structures, supported as recommended, will be less than 1 inch. Differential settlement should be approximately half of the total settlement provided there is positive drainage and typical local climatic conditions prevail.

Most settlement is expected to occur soon after construction, although additional foundation movements could occur if water from any source infiltrates the underlying soils. Severe overwatering, ponding water, and significant or prolonged leaks that wet soils below the structure can result in adverse differential settlement.

The potential differential movement is a function of the depth and lateral extent of wetting of the supporting soils. It is extremely important, therefore, that precautions be taken in design, construction preparations, and maintenance to minimize the potential for moisture increases (from any source) beneath the structures. We suggest that all underground piping within or near the structures be designed with flexible couplings so minor deviations in alignment do not cause damage. Any utility knockouts should be oversized to accommodate differential movements.

8***Expansive Properties***

Expansive Properties

The existing clayey soils have a low remolded expansive potential. Special preparations or construction details related to swelling pressure or heave are currently considered unnecessary. The earthwork must be carefully monitored by experienced personnel supervised by a Geotechnical Engineer. The contractor should notify the Geotechnical Engineer if the soil conditions vary significantly from those shown in this report or if there are any questions regarding the type of soil or its condition.

RECOMMENDATIONS

General

All structural elements will experience at least some differential movement and the various components must accommodate this potential. We recommend that you have the Architect, the Structural Engineer, Civil Engineer, Landscape Architect, and all other design team members and contractors read this report and consider our comments. The basis for our comments on foundation and slab design details is primarily our experiences with recurring problems associated with many of these items.

In the following section, we provide recommendations for the supporting systems that we believe are appropriate for the construction conditions. We do not intend to provide recommendations that prevent all undesirable effects resulting from structural movements. We intend to provide reasonable solutions to help control effects the soil may have on the structures.

Shallow Conventional Foundations

The proposed structures can be supported by conventional shallow, spread foundations bearing on properly constructed subbase fill, natural soils, or both provided the recommendations presented in our report are followed. Subbase fill should be constructed according to the recommendations given in the Earthwork section of this report. The supporting system may consist of continuous wall footings and independent spread footings and slabs-on-grade. Monolithic foundations and slabs could be used provided they are properly designed and constructed.

Thin masonry screen walls, although lightly loaded, are often minimally reinforced or sometimes unreinforced. Such walls are rather intolerant of differential movement and may distort or crack should the supporting soils increase in moisture. If such risk is undesirable, these walls should also be supported by engineered fill, especially if they occur in the path of surface drainage. If you decide to not provide engineered fill for screen walls, their support could be improved by such measures as: compacting the foundation excavation bottoms to at least 8 inches, deepening the foundations, designing the foundations for half the allowable bearing values presented, additional reinforcing, providing frequent joints, or carefully controlling drainage. Where foundations for such walls will bear at depths greater than about 2 feet below existing grade or on prepared fills greater than about 2 feet, suitable support is expected.

The following table presents alternative foundation depths and allowable bearing pressures:

Footing Depth Below Finished Grade, ft.[1]	Allowable Bearing Pressure, psf[2]
1.5	2500
2.0	3000

1 Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

2 Allowable bearing pressures depend on compliance with the Earthwork recommendations of this report.

Recommended minimum widths of column, wood-frame and masonry wall footings are 24, 12, and 16 inches, respectively. Governing building codes may require greater widths. A one-third increase in the bearing pressures is allowable for transient wind or seismic loads. The bearing values given are net bearing values so the weight of the concrete in the footings may be ignored.

All footings, stemwalls, and masonry walls should be reinforced to reduce the effects of potential differential movements. Reinforcement should be consistent with structural requirements to minimize the possibility of longitudinal cracking along the wall. We suggest continuous reinforcement through these areas because we frequently see cracks in the slab portions of monolithic construction parallel to the thickened edges. This cracking occurs because of differential movement between the slab and thickened edge and insufficient reinforcing to resist the shear and flexural stresses. In our opinion, such differential movement should be expected because of the different loading conditions and potential variations in soil properties.

The Geotechnical Engineer or his representative must observe the site preparations and foundation excavations. The purpose of this review would be to determine if the soils and conditions are similar to those expected for support of the footings. Any soft, loose or unacceptable soils should be properly compacted and may require additional undercutting.

Post-Tensioned Foundations

Post-tensioned or reinforced-mat foundation-and-slab system amy be used for support of the planned structures. In our opinion, these systems are preferential for use at this site. The floor areas of these systems should, however, be supported by at least 4 inches of base course. These structural systems must be designed by a Structural Engineer, who should specify the concrete strength, concrete strength required for post tensioning, required thickness of elements, post-tensioning force, and expected post tensioning cable elongation; we are providing the following parameters needed for the commonly used design methods, especially the Post-Tensioning Institute's methodology (PTI).

Although we do not expect the site soils to be expansive, they also are not expected to deform as a "compressible" soil as defined in the PTI methodology. The PTI method is based and developed primarily to provide support for expansive conditions and thus generally deforms the system in a concave or convex shape caused by the soils either shrinking along the edges (PTI center lift nomençlature) or heaving along the edges (PTI edge lift nomenclature). We expect, however, that the site soils can have potential differential settlement that result in similar slab deformations, albeit from a reversal of vertical movement. That is, the center lift condition is more likely to occur as a result of the edges dropping because of potential perimeter wetting, which we believe is more likely than the center dropping. Therefore, we recommend that the design be developed for the edge-moisture variation associated movements shown below.

- Allowable Bearing Capacity: 1000 psf at grade, provided the supporting soils are protected from possible erosion and compacted as recommended, and perimeters are embedded to at least minimum code frost depths
  2500 psf at a depth of 1.5 foot below lowest adjacent grade
  3000 psf at a depth of 2.0 feet below lowest adjacent grade

- Modulus of Subgrade Reaction: 250 pci

- Coefficient of Friction: 1.0 (Coefficient of 0.75 may be used with vapor retarder)

- Edge Moisture Variation Distance, e_m
  Center Lift Condition 9.0 feet
  Edge Lift Condition 5.2 feet

- Differential Soil Movement, y_m
  - Center Lift Condition 0.20 inches
  - Edge Lift Condition 0.60 inches

As previously stated, the potential differential movement is a function of the depth and lateral extent of wetting of the supporting soils. It is extremely important, therefore, that precautions be taken in design, construction preparations, and maintenance to minimize the potential for moisture increases (from any source) beneath the structures. The above estimates reflect the conditions reasonably expected based on positive drainage and typical local climatic conditions. Significant wetting of the soils below the supporting soil and beyond the above edge moisture distances could result in additional differential vertical movements and superstructure distortions.

Certain designs sometimes incorporate isolated spread foundations. The bearing capacities presented above, for the indicated depths of embedment, may be used for design. A one-third increase in the bearing pressure is allowable for transient wind or seismic loads. The bearing values given are net bearing values so the weight of the concrete in the footings may be ignored. The Structural Engineer should specify the concrete strength, concrete strength required for post-tensioning, required thickness of elements, post-tensioning force, and expected post-tensioning cable elongation.

Furthermore, the subsoil moisture conditions can vary over time, even before actual construction at a particular lot. Changes in the pre-slab-construction moisture content can effectively alter the appropriate differential soil movement used in the design. Some moisture variations will undoubtedly occur because of differing amounts of subbase fill, extent of cuts, material changes, and the time elapsed between grading and construction.

A one-third increase in the bearing pressure is allowable for transient wind or seismic loads. The bearing values given are net bearing values so the weight of the concrete in the footings may be ignored. The Structural Engineer should specify the concrete strength, concrete strength required for post-tensioning, required thicknesses of elements, post-tensioning force, and expected post-tensioning cable elongation.

Although post-tensioning the foundation and slabs will help close minor cracks that form during hydration, it is still beneficial to properly cure the concrete. The proper curing of concrete, especially for flatwork (slabs), is extremely important in minimizing plastic shrinkage cracks and slab curling. We believe that many slab cracking problems can be mitigated or possibly eliminated by proper curing. We strongly suggest moist-curing slabs for 3 to 7 days after placement. Curing promotes more complete hydration of the cement and reduces plastic drying shrinkage, especially near the exposed upper portion of the slab. Alternatively, moist-curing for several days and then applying a liquid membrane curing compound would also be beneficial. Also important are the mix design and quality control during construction.

All concrete placement and curing operations should follow recommendations of the American Concrete Institute manual. Improper curing and excessive slump (water-cement ratio) could cause excessive shrinkage, cracking, or curling of the concrete. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture-sensitive floor covering.

Important Comments Regarding Post-Tensioned Systems

On the basis of our experience, it appears that many people have a misunderstanding of the performance of post-tensioned systems and the need for ground preparations. The use of a post-tensioned supporting system does not preclude the need for appropriate ground preparation. If soils capable of volume change underlie any shallow system, there is still the possibility of differential slab/foundation movement and damage. A post-tensioned system can merely lessen the effects of differential movement, especially to the superstructure that it supports. It does this primarily by redistributing stresses because of its higher internal strength (as compared to a conventional unreinforced slab and separate foundations). One cannot expect to design a single, specific post-tensioned system for any soil and loading situation and have it perform adequately under all conditions. The design should be specific to the site soils and structural loading and good construction practices should be followed.

The need for appropriate soil preparation is not diminished by using a post-tensioned system. In fact, prior to actually tensioning the cables, the system is an unreinforced monolithic slab/foundation, deriving all of its support directly from the soil during its critical hydration period. Subgrade preparation, subbase fill construction, base course provisions and compaction, and utility backfill compaction are all important aspects of the construction and should be done in accordance with the geotechnical report and plans.

It is also important to avoid overstressing the planned post-tensioned system (by stacking supplies or by premature construction of the superstructure) prior to gaining appropriate concrete strength and stressing the cables. These service-load-induced stresses can also adversely affect the performance of the system.

To help determine suitable phasing and types of construction activities, we should meet together with you, the structural engineer, and the appropriate subcontractors. Our intention is to help you secure a product that performs as expected.

Floor Slabs

Floor slabs may be supported on properly prepared subgrade or properly placed and compacted fill. The contractor should prepare the slab subgrade, subbase fill, and base course as outlined in the Earthwork section of this report. For lightly loaded slabs, a minimum 4-inch layer of base course should be provided beneath all slabs to provide more uniform support and help prevent capillary rise and a damp slab. We have sometimes seen upward vapor transmission through floor slabs that has caused distortion of vinyl tiling and various other moisture-related annoyances. Most of these problems appear to us to be more common when the underlying soils are clayey or there are subbase fills of several feet or more. You may want to consider providing a vapor retarder beneath slabs to help reduce the transmission potential.

The slab thickness, concrete strength, and reinforcing should be designed by a Structural Engineer. We recommend that slabs supporting typical light loads be at least 4 inches thick. We believe using reinforcing steel in slabs is beneficial for minimizing cracks and strengthening the cross-section in the event tensile or flexural stresses develop. If a nonreinforced slab is chosen, we still suggest using steel reinforcing at least in interior or re-entrant corners.

Reinforcing should be placed diagonally across the interior projection of corners. Reinforcement should be positioned as near the mid-height of the slab as possible while maintaining codes. Slabs should be jointed around columns and along footing supported walls so the slab and footings are able to settle independently. If steel reinforcing is not used, we recommend using a fibermesh additive to the concrete to aid in controlling cracks from drying shrinkage and thermal changes.

To provide stress relief and help eliminate random cracking, we suggest providing control joints at spacings less than 12 feet. Wider joint spacings are possible depending on the slab thickness, absence or presence of reinforcing, concrete mix design, and the curing environment. The joint locations should be determined by the Structural Engineer. Joint locations should be developed considering such items as shrinkage potential, slab thickness, curing, fixed element restrictions, slab penetrations, type of floor covering, and specialized equipment placement.

The proper curing of concrete, especially for flatwork (slabs), is extremely important in minimizing plastic shrinkage cracks and slab curling. We believe that many slab cracking problems can be mitigated or even eliminated by proper curing. We strongly suggest moist-curing slabs for at least three days after placement and preferably a week, unless moisture-sensitive coverings are planned. Curing promotes more complete hydration of the cement and reduces plastic drying shrinkage, especially near the exposed upper portion of the slab. Alternatively, applying a liquid membrane curing compound could also be beneficial, but the type of floor covering and manufacturer specifications should be considered because the compound could adversely affect their warranties. For vinyl or wood flooring, it is generally preferable to cure concrete with water-proof paper or plastic sheets for 3 to 7 days because these methods do not add moisture. Also important are the mix design and quality control during construction.

All concrete placement and curing operations should follow recommendations of the American Concrete Institute manual. Improper curing and excessive slump (water-cement ratio) could cause excessive shrinkage, cracking, or curling of the concrete. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture-sensitive floor covering. To prevent incomplete bonding, distortion, and water vapor entrapment, flooring should not be placed until the moisture content of the slab is at or below the manufacturer's requirements. We can provide third-party relative humidity (RH) probe testing during construction if desired. This method is generally regarded as a more optimal way of testing for water vapor transmission because it measures emissions within the slab and not just the surface.

Lateral Earth Pressures

For cantilevered or restrained (at-rest case) walls above any free water surface with level backfill and no surcharge loads, the recommended equivalent fluid pressures and coefficients of base friction are presented in the following table.

EARTH PRESSURE STATE		EQUIVALENT FLUID PRESSURE, psf/ft
Active		
	Undisturbed Native Soil	38
	Granular Backfill	30
Passive		
	Undisturbed Native Soil	300
	Granular Backfill	450
At-rest (restrained)		
	Undisturbed Native Soil	60
	Granular Backfill	50
Coefficient of Base Friction = 0.45*		

* For short retaining walls with minimal cover on the outside face, the coefficient of base friction should be reduced to 0.35 when used in conjunction with passive pressure.

We do not expect submerged soil conditions; the lateral earth pressures shown therefore do not include this condition. We should be consulted for additional recommendations if submerged conditions are to be included in the design. Any surcharge from adjacent loading will also increase the lateral pressure and must be added to the above earth pressures.

The contractor should use granular, relatively free-draining soil for retaining wall backfill to reduce the potential for hydrostatic pressure buildup. Retaining walls should be designed with a backdrain that either drains to lower ground or to a sump with a float-activated pump. The level of this drain should be lower than the lowest retained earth behind the wall; the perforations in the drain pipe should be at least 8 inches lower than the top of any interior slabs in front of the wall.

Moderate to high plasticity clay soils should not be used as backfill against retaining structures. Properly place and compact all backfill as recommended in this report. Cobbles, if present, should be removed from the soils placed adjacent to walls so high-intensity point loads do not occur. Avoid nesting of larger particles because voids could form and cause subsidence of the backfill.

Waterproof the exterior face of below-grade walls that are exposed to interior spaces to retard moisture penetration. It is important that all backfill be properly placed and compacted.

Mechanically compact all backfill in layers. Water settling or flooding is not acceptable. Care should be taken to avoid damaging the walls when placing the backfill. Backfill should be inspected and tested during placement and compaction, especially if there will be overlying elements supported by the backfill such as foundations, stairs, walls, and planters.

Seismicity

For structural designs based upon the International Building Code 2012, the soil site class is C. S_S, the spectral response acceleration at short period is 0.380. S_1, the spectral response acceleration at 1-second period is 0.093. Site coefficients Fa and Fv in accordance with tables 1613.3.3 (1) and 1613.3.3 (2) are 1.20 and 1.69, respectively.

Exterior Features

Exterior slabs-on-grade, exterior architectural features, and utilities may experience some movement due to the volume change of the underlying soils. The potential for movement and resulting distress could be reduced by the following measures:

- Minimizing moisture increases in the soil
- Moisture-density control during placement of soil
- Use of designs which allow vertical movement between the exterior features and adjoining structural elements
- Placement of effective control joints on relatively close centers
- Allowance for vertical movements in utility connections

Temporary Construction Excavations

Temporary unsurcharged construction excavations should be sloped or shored. Slopes should not be steeper than 1 to 1 (horizontal to vertical) in the natural soil. Slopes may need to be flattened depending on conditions exposed during construction. If there is not enough space for sloped excavations, shoring should be used.

Various shoring systems are possible; their selection and design, however, is beyond the scope of our current evaluation. The design of a retaining system is dependent on the construction method, the sequence of operations, and adjacent construction. The contractor's and designer's responsibilities for design and construction should be clearly defined. Exposed slopes should be kept moist (but not saturated) during construction. Traffic and surcharge loads should be at least 10 feet from the top of the excavation. All excavations should be completed in accordance with the most recent OSHA requirements.

Slopes and Soil Erodibility

To provide slope stability against mass failure, we recommend that cut and fill slopes less than 7 feet in height have maximum gradients of 1 to 1 (horizontal to vertical). Fill embankments must be properly compacted and, when occurring on natural slopes with inclinations equal to or greater than 5 to 1, constructed on reasonably level cut benches. We recommend that fill slopes be compacted and then cut back or shaped so that proper compaction is obtained. It may not be necessary to overbuild and cut back slopes if the contractor demonstrates that the techniques used result in a properly compacted and prepared slope face. These allowable slope gradients assume proper protection against erosion.

We did not perform a formal study of existing erosional conditions across the entire site. However, erosional features such as slope retreat, rilling, gullying, and sloughing were observed throughout various areas on the site. These features are generally concentrated near naturally occurring drainage channels, especially those traversing more steeply sloping terrain where erosive velocities are more prominent. The deeper natural dense, gravelly sands should be moderately resistant to erosion.

Exposed slopes should be covered as quickly as possible with vegetative or other ground covers such as mulch, jute netting, crushed rock, or rip-rap to avoid unnecessary soil losses. Slopes should be scraped or raked across the slopes (perpendicular to flow), unless they are trackwalked, to aid in providing greater infiltration rates of surface water. If the slopes are shaped by trackwalking, with tracked vehicles, they should be worked up and down as the tread imprints will create grooves parallel to the slope which will aid infiltration rates and trap seeds.

During construction, graded, unprotected areas should retain as much natural vegetation as possible. Vegetation along the perimeters of graded areas should be left intact to control erosion and serve as a sediment trap. Exposed soil areas should be sprinkled with water during construction to reduce transportation of soil by wind. If rains are anticipated during construction, flows over the disturbed areas can be minimized by diverting upslope surface water through use of berms or ditches. Outfall areas associated with detention areas, diversion features, or collection facilities should be provided with energy dissipators such as riprap aprons to reduce surface water velocity.

The following table shows the recommended slope protection for various slope gradients with vertical slope heights of less than 7 feet.

Slope Gradient (horizontal to vertical)	Slope Protection
3:1 or flatter	Revegetate with native species or provide other ground covers such as netting or crushed rock
steeper than 3:1 to 2:1	Rip-rap with filter cloth or cover with mulch, jute, or excelsior netting and then revegetate with native species or provide other ground covers
steeper than 2:1 to 1:1	Grouted or wire-tied rip-rap, asphalt emulsion, or concrete revetments
steeper than 1:1	Stability analysis or retaining wall designed by a structural engineer

Often, unprotected cut and fill slopes are desired for portions of the project. Given the same slope gradients and slope lengths, unprotected slopes can result in about 10 times more soil loss than protected slopes However, slope gradients and slope lengths are the most critical aspects controlling soil loss since they directly influence the velocity of runoff. If unprotected slopes are used, we suggest they be 5 to 1 (horizontal to vertical) or flatter and at least protected from concentrated upslope drainage. Continuous slope lengths should also be kept relatively short, preferably less than 15 feet. Slope lengths can be reduced by providing frequent intercepting benches or terraces. Areas beneath unprotected slopes may require sediment retention structures to trap eroded soil before it is deposited on undesirable areas. Unprotected slopes should eventually become vegetated and an erosion pavement, resulting from the erosion process, is likely to form across the surface.

Erosional activity, if allowed to form and propagate, will increase soil loss and could cause loss of support to structures, streets and other facilities. Periodic maintenance and prompt repair of erosional features is important to prevent unnecessary soil losses. The effectiveness of erosion control measures should be evaluated subsequent to heavy or prolonged rains. We also recommend an erosional maintenance program be established and implemented.

Surface Drainage

A major cause of soil-related damage to structures in this region is moisture increases in the supporting soil. It is therefore extremely important to provide positive drainage away from the structures, both during construction and throughout their lives. Infiltration of water into utility or foundation excavations must be prevented.

Waterlines and sewerlines should be carefully tested and inspected for leaks prior to backfilling. Planters and other surface features that could retain water in areas adjacent to the structures or pavement should be eliminated or constructed so that accumulated water is discharged onto a positive gradient at least 5 feet from the structures. Roof rainwater, water from cooling unit condensation, and water heater drains should also be discharged onto a positive gradient at least 5 feet from the structures. Trees should not be planted closer to structures than their expected canopy radius at maturity.

In areas where sidewalks or paving do not immediately adjoin the structures, protective slopes should be provided with an outfall of at least 3 percent for at least 5 feet from perimeter walls. Backfill against footings, exterior stemwalls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of moisture infiltration.

We are aware of many pavement settlement problems within developments. These settlements appear to mostly have been related to inadequate utility backfill compaction, both in primary trenches and subsequent connection service trenches and the introduction of water. Oftentimes, dry utility trenches are located along roadways and outside of curb lines (hence not protected by pavement) where surface and irrigation water can infiltrate. Furthermore, house connection services from the utilities are often loosely backfilled and frequently occur within drainage swales, conditions that increase the potential for water to infiltrate beneath the pavement and curbs. Inadequately compacted trenches, or even trenches backfilled with soils more permeable than the adjacent soils, can act as conduits for moisture migration. It is very important, therefore, to provide adequate testing and monitoring of all backfill. If possible, it is preferable to locate connection services beyond drainage swales.

Some drainage facilities, such as rock-lined drainage swales, often degrade over time and become inefficient or ineffective. Additionally, they are often just dumped into place and not shaped so as to properly receive and channelize water. We highly recommend that such porous swales not be constructed within 10 feet of the structures unless they have significant positive gradients and are constructed to efficiently receive and direct water. A more effective and desirable method would be to conduct water through closed conduits directly to a properly prepared discharge area. The owners should be made aware that extensive water infiltrating the supporting soils beneath the structures could cause differential movements of the supporting system and thus the framing.

Underground Utility Systems

All underground piping within or near the structures should be designed with flexible couplings so minor deviations in alignment do not cause damage. Any utility knockouts should be oversized to accommodate differential movements. All trench backfill throughout the development should be well-compacted to help avoid serving as a subsurface conduit beneath structures.

Construction Review

The Geotechnical Engineer or his representative must observe the site preparations and foundation bearing conditions. The purpose of this review would be to determine if the soils and conditions are similar to those expected for support of the footings. Subgrade preparation and engineered fill construction supporting structural elements is considered Special Inspection and must be completed under the continuous supervision of the Geotechnical Engineer. Any soft, loose or unacceptable soils should be properly compacted and may require supplemental recommendations.

We recommend surveying the finished floor elevation of all slabs-on-grade and maintaining this record. In the event of future movement, this information could be extremely helpful in assessing the conditions and providing remedial measures.

EARTHWORK

General

The Geotechnical Engineer or his representative must observe the site preparations and foundation bearing conditions. The purpose of this review would be to determine if the soils and conditions are similar to those expected for support of the footings. Subgrade preparation and engineered fill construction supporting structural elements is considered Special Inspection and must be completed under the continuous supervision of the Geotechnical Engineer. Any soft, loose or unacceptable soils should be properly compacted and may require supplemental recommendations.

We recommend surveying the finished floor elevation of all slabs-on-grade as soon as possible at the time of completion and maintaining this record. In the event of future movement, this information could be extremely helpful in assessing the conditions and providing remedial measures.

Site Clearing

Strip and remove any debris, vegetation, loose or wet soil and other deleterious materials from the building areas and at least 5 feet beyond. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

In areas that will receive fill, slopes steeper than 5 to 1 (horizontal to vertical) should be benched to reduce potential slippage between slopes and fills. Benches should be reasonably level and wide enough to allow appropriate use of compaction and earth-moving equipment on a level plane.

Excavation

Shallow excavations in the near-surface soils we encountered during our evaluation should be possible with conventional equipment. The bedrock encountered at depths of 1 to 10 feet below the ground surface may require heavy ripping equipment or jack-hammering to facilitate breakup and removal. The speed and ease of excavating will depend on the type of grading equipment, the skill of the operators and the structure of the deposit. If more information regarding excavation is desired, we suggest a study using equipment similar to that expected for the actual construction. The information contained in this report is intended for design and preliminary estimating purposes. Contractors reviewing the report must draw their own conclusions regarding the types of equipment and methods required to complete the construction.

Foundation Preparation

We expect that specialized treatment of the existing undisturbed soils will be unnecessary in most areas. All disturbed or loose soil must be removed from foundation excavations and the excavations should be reviewed by the Geotechnical Engineer or his representative prior to placing reinforcing steel and concrete to determine if the soils and conditions are as expected.

The contractor should construct all subbase fill in a manner resulting in *uniform* water contents and densities after compaction. All subgrade and subbase fill should be constructed according to the report requirements. The contractor should notify the Geotechnical Engineer if the conditions vary significantly from those shown in this report or if there are any questions regarding the type of soil or its condition.

Floor Slab Preparation (Including Post-Tension)

The contractor should scarify and recompact the exposed subgrade soil to a depth of at least 12 inches. This includes areas to be filled and exposed cut-to-grade areas. The overall site preparation should satisfy this provided the grades aren't subsequently changed. The contractor should notify the Geotechnical Engineer if the soil conditions vary significantly from those shown in this report or if there are any questions regarding the type of soil or its condition.

The contractor should prepare the subgrade and construct any subbase fill in a manner resulting in *uniform* water contents and densities after compaction. Place and compact at least four inches of base course beneath interior slabs to provide more uniform support and help prevent a damp slab.

Vapor Retarder Considerations

If moisture-sensitive floor coverings are used, an impermeable vapor retarder should be considered beneath the floor sections. If used, the vapor retarder should be at least 11-mil polyethylene and placed beneath the underside of the slab as recommended by ACI. Because this positioning doesn't allow water from placed concrete to bleed from the bottom, we suggest using a low water-cement ratio, appropriate jointing, and good curing techniques to help avoid slab curling issues. Slab curling is a common occurrence in our area because of the often dry, hot, and windy conditions. These conditions, especially if bottom drainage can't occur, create differential drying from the top and thus the upper part of the slab concrete shrinks at a faster rate.

Utility Trench Backfill

Utility trenches within and beyond the building pad should be made as narrow as possible to reduce the potential for settlement of overlying slabs and other structures. The practice of digging wide trenches for the convenience of plumbers and electricians should be avoided, unless such trenches are carefully backfilled in lifts compacted to 95 percent of Standard Proctor Maximum Dry Density according to ASTM D-698.

Materials

Imported soils and existing granular soils with low expansive potentials and all particles passing the 6-inch sieve may be used as fill material for the following areas:

- Foundation areas
- Interior slab areas
- Backfill

Imported soils should conform to the following requirements:

IMPORT SOIL PROPERTIES	
SIEVE SIZE	**PERCENT PASSING, by dry weight**
6"	**100**
No. 4	**50-100**
No. 200	**40 max.**
Maximum Expansive Potential = 1.5%*	
Maximum Soluble Sulfates = 0.10%	

* Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about three percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

Aggregate base course below concrete floor slabs should conform to the following requirements:

AGGREGATE BASE COURSE	
SIEVE SIZE	**PERCENT PASSING, by dry weight**
1"	**100**
3/4"	**90 to 100**
1/4"	**45 to 75**
No. 200	**0 to 10**
Plasticity Index = 5 max.	

Placement and Compaction

The contractor should place and compact fill in horizontal lifts, 8 to 10 inches in loose thickness, using equipment and procedures that will produce the recommended moisture contents and densities throughout the lift. When lighter hand-held compaction equipment is used, the loose lift thickness should be 4 to 6 inches.

Materials should be compacted to the following standards. Depending on the actual soils and compaction equipment, compaction moisture contents may need to be changed to avoid or limit soil yielding or pumping.

Imported soils (if required to raise grades) and on-site soils with low expansion potential should be compacted within a water content range of 3 percent below to 3 percent above optimum.

Soil Type and Area		Minimum Percent Compaction, ASTM D-698
On-site subgrade soils, on-site soils as subbase fill, and imported soils*		
	Below foundations	**95**
	Below slabs-on-grade	**95**
Base Course below slabs		**95**
Nonstructural backfill, ***not providing lateral or vertical support of structural elements***		**90**

* Fill 5 feet or more below finished grade should be compacted to at least 100 percent of ASTM D-698.

CLOSURE

Additional Services

Field observation and testing during construction, and reviewing the plans and specifications are integral factors in developing and implementing our conclusions and recommendations. Our involvement during construction is important to observe compliance with the design concepts, specifications, or recommendations, and to allow efficient design changes if the subsurface conditions differ from those anticipated. PATTISON ENGINEERING, L.L.C. offers these services and is the most qualified to determine consistency of field conditions with the data used in our analyses. It is the client's responsibility to make this report available, in its entirety, to all design team members, contractors, and owners.

Limitations

The services we performed for this project include professional opinions and judgments based on the data collected. We performed our professional services using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in southern Arizona. We do not intend to provide recommendations that prevent all undesirable effects resulting from structural movements. We intend to provide reasonable solutions to help control effects the soil may have on the structures. We make no other warranty, expressed or implied.

We prepared the report as an aid for the design of the project. This report is not a bidding document and any contractors reviewing it must draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

Our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or air, on or below or around, this site. All conditions documented or observed are strictly for the information of our client. If environmental information is required, we recommend that an environmental assessment be completed which addresses these concerns.

We based our recommendations on the assumption the soil and groundwater conditions across the site are similar to those encountered at the exploration locations. The extent and nature of subsurface soil and groundwater variations may not be evident until construction. If conditions encountered during construction appear to differ from those described in this report, we should be consulted to assess the impact and provide supplemental recommendations. Our evaluation and report does not include the effects, if any, of underlying geologic hazards or regional groundwater withdrawal and we express no opinion regarding their effects on surface movement.

APPENDIX

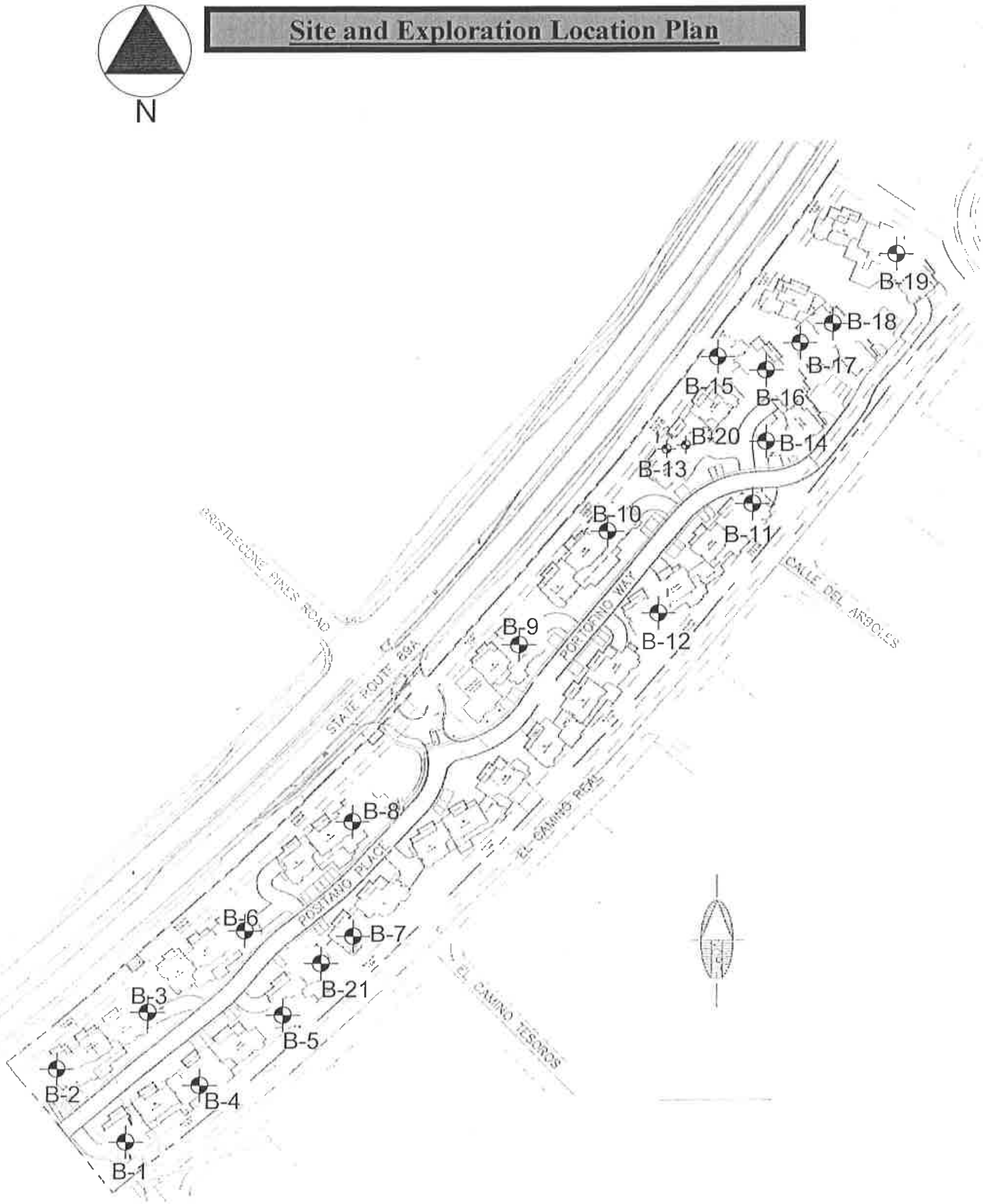
Geotechnical Engineering

Construction Inspection

Materials Testing

PATTISON ENGINEERING, LLC

Site and Exploration Location Plan



BORING LOCATION

Method of Soil Classification

Major Divisions	Subdivisions	USCS Symbol		Typical Names
Coarse-grained soils (More than 50% retained on No. 200 sieve)	Gravels (More than 50% of coarse fraction retained on No. 4 sieve)	GW	Less than 5% fines*	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Less than 5% fines*	Poorly graded gravels or gravelly sands, little or no fines
		GM	More than 12% fines*	Silty gravels, gravel-sand-silt mixtures
		GC	More than 12% fines*	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes No. 4 sieve)	SW	Less than 5% fines*	Well-graded sands or gravelly sands, little or no fines
		SP	Less than 5% fines*	Poorly graded sands or gravelly sands, little or no fines
		SM	More than 12% fines*	Silty sands, sand-silt mixtures
		SC	More than 12% fines*	Clayey sands, sand-clay mixtures
Fine-grained soils (50% or more passes the No. 200 sieve)	Silts and Clays (Liquid limit less than 50)	ML	Inorganic soil	Inorganic silts, rock flour, silts of low plasticity
		CL	Inorganic soil	Inorganic clays of low plasticity, gravelly clays, sandy clays, etc.
		OL	Organic soil	Organic silts and organic clays of low plasticity
	Silts and Clays (Liquid limit 50 or more)	MH	Inorganic soil	Inorganic silts, micaceous silts, silts of high plasticity
		CH	Inorganic soil	Inorganic highly plastic clays, fat clays, silty clays, etc.
		OH	Organic soil	Organic silts and organic clays of high plasticity
Peat	Highly Organic	PT		Peat and other highly organic soils

- *Fines* are those soil particles that pass the No. 200 sieve. For gravels and sands with between 5 and 12% fines, use of dual symbols is required (i.e., GW-GM, GW-GC, GP-GM, or GP-GC).

CLASSIFICATION	U.S. Standard Sieve Size
BOULDERS	Above 12"
COBBLES	12" to 3"
GRAVEL	3" to No. 4
Coarse	3" to 3/4"
Fine	3/4" to No. 4
SAND	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 -- No. 200
SILT & CLAY	Below No. 200

Coarse Grained Scale
(50% retained on #200 sieve)

ADJECTIVE	%
trace	0-10
some	10-20
with	20-30
"-y" or "-ey"	30-50

P = poorly graded
W = well graded

P.I.	ADJECTIVE
< 1	non-plastic
1-10	low plasticity
11-25	medium plasticity
> 25	high plasticity

Boring Log Notes

The number shown in **Boring No.** refers to the approximate location of the same number shown on the **Site Plan** as positioned in the field by pacing from property lines and/or existing features.

The number shown in **Blows/6"** refers to the number of blows of a 140-pound weight dropped 30 inches, required to advance the sampler. **H** in **Sample Type** is a hand sample from the auger cuttings. **RS** in **Sample Type** is a 2.42-inch-inside-diameter ring sampler. Refusal to penetration for the ring sampler is considered more than 50 blows per foot. **SS** in **Sample Type** is a 2.0-inch-outside-diameter split-spoon sampler. This sampler is used to perform the Standard Penetration Test (SPT) ASTM D1586. Refusal to penetration is considered to be one of the following items: 1. A total of 50 blows has been applied during any one of the three 6-inch increments; 2. A total of 100 blows has been applied; 3. There is no observed advance of the sampler during application of 10 successive blows of the hammer.

USCS Code refers to the soil type as defined by the **Unified Soil Classification System.** The soils were visually classified in the field and, where appropriate, classifications were modified by visual examination of samples in the laboratory and by appropriate test.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans or as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) shown. Variations in subsurface conditions and soil characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

In general, terms and symbols on the boring logs conform with **"Standard Definitions of Terms and Symbols Relating to Soil and Rock Mechanics"** (ASTM D653).

Laboratory Test Results

BORING NO.	DEPTH (FT)	PLASTICITY		% PASSING #200 SIEVE	SOIL CLASS	IN-SITU DRY DENSITY (PCF)	IN-SITU MOISTURE CONTENT (%)
		LL	PI				
B-1	0-1.5	25	3	42.2	SM		
B-5	0-1.5	22	3	38.1	SM		
B-6	0-1.5	22	2	36.4	SM		
B-7	0-1.5	23	6	36.9	SC-SM		
B-9	0-1.5	25	8	55.7	CL		
B-12	0-1.5	23	6	31.3	SC-SM		
B-13	0-1.5	22	3	48.9	SM		
B-19	0-1.5	22	4	52.9	CL-ML		
B-7	2-3				SC-SM	132	3.7
B-8	2-3				SC-SM	96	3.9
B-9	2-3				CL	127	6.8
B-10	2-3				SC-SM	139	3.9
B-11	2-3				SC-SM	124	6.0
B-19	2-3				CL-ML	134	2.9

COMPRESSION TESTING						
BORING NO.	DEPTH (FT)	IN-SITU DRY DENSITY (PCF)	IN-SITU MOISTURE CONTENT (%)	SURCHARGE (KSF)	TOTAL COMPRESSION (%)	
					UNSATURATED	SATURATED
B-8	2-3	96	3.9	1.5	0.9	11.6
B-10	2-3	139	3.9	1.5	0.5	2.8

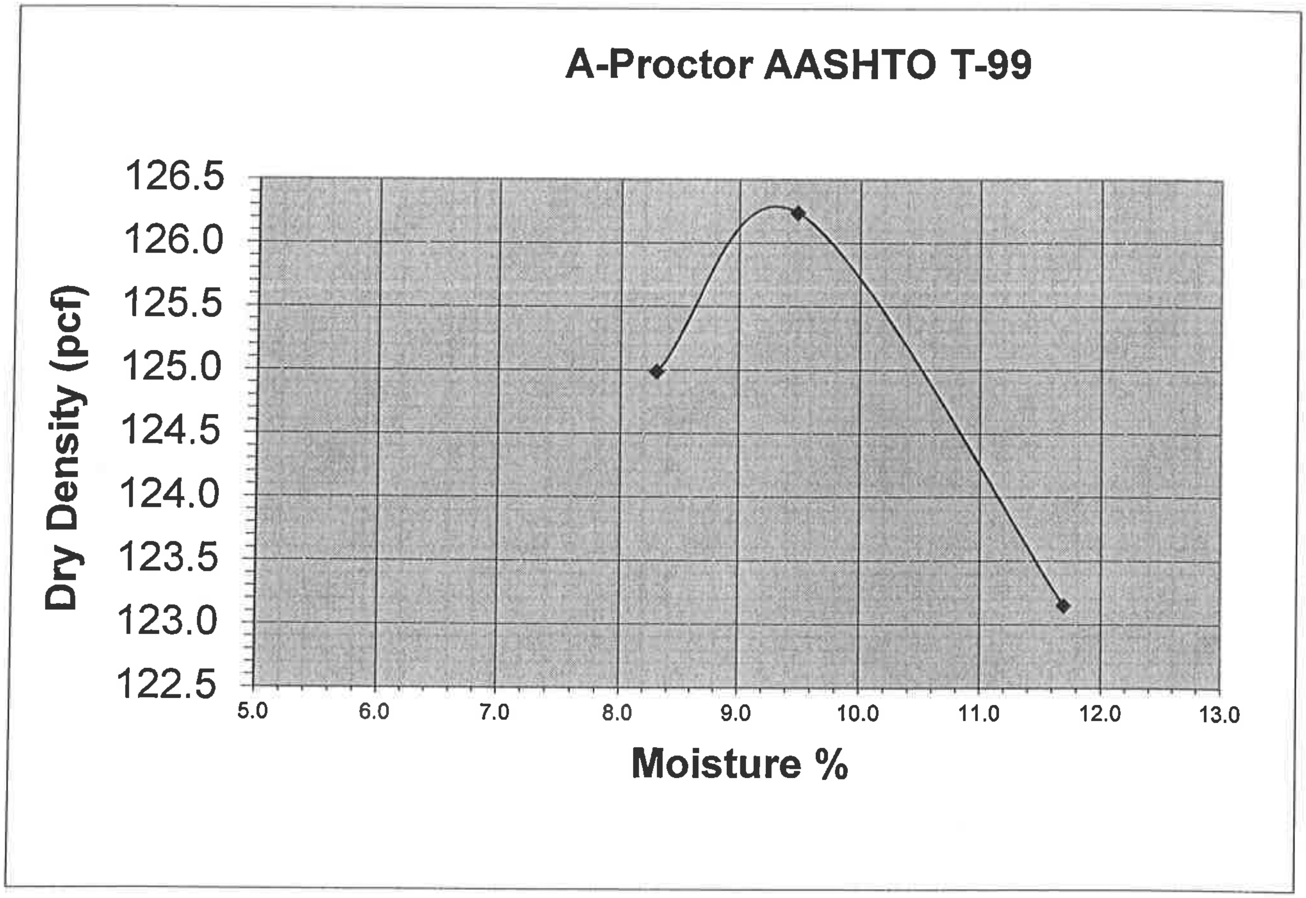
EXPANSION TESTING						
BORING NO.	DEPTH (FT)	SOIL CLASS	COMPACTED DRY DENSITY (PCF)	MOISTURE CONTENT (%)	SURCHARGE (KSF)	EXPANSION (%)
B-9	0-1.5	CL	120.0	6.3	0.1	1.2

Notes: Percent expansion measured on a soil sample compacted to approximately 95% of the ASTM D698 at about 3% below optimum moisture content. The sample was confined under a 100-psf surcharge and saturated.

Proctor Test Results

A-Method Proctor Calcs

	1	2	3
wt soil+ mold (gm)	6291	6334	6324
wt mold (gm)	4244	4244	4244
wt soil (gm)	2047	2090	2080
wet soil	223.0	250.5	230.2
dry soil	205.9	228.8	206.1
% H2O	8.3	9.5	11.7
wet density (pcf)	135.4	138.2	137.6
dry density (pcf)	125.0	126.2	123.2



Sample I.D.	B9, 0-1.5'
Job	17-101

Max. Dry Density, pcf	126.3
Opt. % Moisture	9.3

Boring Logs

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-1
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: **SEE SITE PLAN**

Elevation: Datum:
Logged By: Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND, with gravel, red, slightly damp, low plasticity		
				1		AUGER REFUSAL AT 1 FEET *No Free Water Encountered*		
				2				
				3				
				4				
				5				
				6				
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				
				23				
				24				
				25				
				26				
				27				
				28				
				29				
				30				

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC	*Geotechnical Engineering* *Construction Inspection* *Materials Testing*	BORING NUMBER **B-2** SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0	SC-SM	SILTY, CLAYEY SAND, with gravel, dark red, slightly damp, low plasticity, very dense		
RS	50/5	12/12		2				
SS	50/0	0/0		5		AUGER REFUSAL AT 4.5 FEET *No Free Water Encountered*		

Depth scale: 0–30 feet

Sample Type Key:	Drilling Equipment:
SS = Split Spoon RS = Ring Sample H = Hand Sample	CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-3
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: **SEE SITE PLAN**

Elevation: Datum:
Logged By: Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0		Bedrock at surface, 3" of soil		
				1		AUGER REFUSAL AT 0.2 FEET *No Free Water Encountered*		
				2				
				3				
				4				
				5				
				6				
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				
				23				
				24				
				25				
				26				
				27				
				28				
				29				
				30				

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-4
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0–1	SM	SILTY SAND, trace gravel, red, slightly damp, low plasticity		
				1		AUGER REFUSAL AT 1 FEET *No Free Water Encountered*		

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-5
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND, with gravel, dark red, slightly damp, low plasticity		
				1		AUGER REFUSAL AT 1 FEET *No Free Water Encountered*		
				2				
				3				
				4				
				5				
				6				
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				
				23				
				24				
				25				
				26				
				27				
				28				
				29				
				30				

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-6
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: | Datum:
Logged By: | Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND, with gravel, red, slightly damp, low plasticity, very dense		
RS	38 50/2	8/8		2				
SS	50/0	0/0		4		AUGER REFUSAL AT 4 FEET *No Free Water Encountered*		

Depth scale: 0–30 feet

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-7
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: **SEE SITE PLAN**

Elevation: Datum:
Logged By: Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0–1	SC-SM	SILTY, CLAYEY SAND, trace gravel, red, slightly damp, low plasticity, medium dense		
RS	21 32	12/12		2–3		Less gravel	132	3.7
				4				
SS	4 50/3	9/9		5–6		Moist, very dense		
				6–30		AUGER REFUSAL AT 6 FEET *No Free Water Encountered*		

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-8
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SC-SM	Possible fill: SILTY, CLAYEY SAND, trace gravel, red, slightly damp, low-medium plasticity, loose		
				1				
RS	9 7	12/12		2			96	3.9
				3				
				4				
SS	50/5	5/5		5		Native: Damp, very dense		
				6				
				7				
				8				
SS	50/0	0/0		9		AUGER REFUSAL AT 9 FEET *No Free Water Encountered* Auger refusal on bedrock		
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				
				23				
				24				
				25				
				26				
				27				
				28				
				29				
				30				

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-9
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: | Datum:
Logged By: | Date: 8/9/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0–1	CL	Possible fill: SANDY LEAN CLAY, trace gravel, red, slightly damp, low-medium plasticity, medium dense-dense		
RS	21 48	12/12		2–3			127	6.8
SS	50/5	5/5		5		Native: very dense		
				6		AUGER REFUSAL AT 6 FEET *No Free Water Encountered*		

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER **B-10** SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0	SC-SM	CLAYEY SAND, trace gravel, dark red, slightly damp, low plasticity, medium dense		
RS	13 25	12/12		2			139	3.9
SS	4 6 9	18/18		5				
SS	50/5	5/5		10	CL-ML	SILTY LEAN CLAY, dark red, slightly damp, low plasticity, very dense		

AUGER REFUSAL AT 10.5 FEET
No Free Water Encountered

Depth scale (feet): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC	*Geotechnical Engineering* *Construction Inspection* *Materials Testing*	BORING NUMBER **B-11** SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0–1	SC-SM	SILTY CLAYEY SAND, trace gravel, dark red, slightly damp, low plasticity, weak cementation, med. dense		
RS	15 40	12/12		2			124	6.0
RS	50/5	5/0		5		Very dense		
SS	50/3	3/3		10	CL	LEAN CLAY, dark red, slightly damp, medium plasticity, very hard		
						AUGER REFUSAL AT 10.3 FEET *No Free Water Encountered*		

Depth scale: 0–30 feet.

Sample Type Key:	Drilling Equipment:
SS = Split Spoon RS = Ring Sample H = Hand Sample	CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-12
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SC-SM	SILTY, CLAYEY SAND, with gravel, dark red, slightly damp, low plasticity, medium dense		
RS	29 35	12/0		2				
SS	50/5	5/5		5	CL-ML	SILTY LEAN CLAY, red, slightly damp, low plasticity, very hard		
SS	47 50/4	10/10		10		Low-medium plasticity		
				10.8		AUGER REFUSAL AT 10.8 FEET *No Free Water Encountered*		

Depth scale: 0 – 30 feet

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-13
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SM	SILTY SAND, with gravel, dark red, slightly damp, low plasticity, very dense		
				1				
RS	49 50/3	9/9		2				
				3				
				4				
SS	50/3	3/3		5				
				6				
				7		AUGER REFUSAL AT 7 FEET *No Free Water Encountered*		
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				
				23				
				24				
				25				
				26				
				27				
				28				
				29				
				30				

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC	*Geotechnical Engineering* *Construction Inspection* *Materials Testing*	BORING NUMBER **B-14** SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: **SEE SITE PLAN**

Elevation: | Datum:
Logged By: | Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0–2	CL	SANDY, LEAN CLAY, with gravel, reddish brown, slightly damp, low plasticity		
				2–30		AUGER REFUSAL AT 2 FEET *No Free Water Encountered*		

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC	*Geotechnical Engineering* *Construction Inspection* *Materials Testing*	BORING NUMBER **B-15** SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0	SC-SM	SILTY CLAYEY SAND, with gravel, reddish brown-dark red, slightly damp, low plasticity, medium dense		
RS	11 21			2				
SS	50/4	4/4		10		Very dense		
				10.3		AUGER REFUSAL AT 10.3 FEET *No Free Water Encountered*		
				30				

Sample Type Key:	Drilling Equipment:
SS = Split Spoon RS = Ring Sample H = Hand Sample	CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-16
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: **SEE SITE PLAN**

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0–1.5	SC-SM	SILTY, CLAYEY SAND, red-dark red, slightly damp, low plasticity, cobbles and boulders		
						AUGER REFUSAL AT 1.5 FEET *No Free Water Encountered*		

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC	*Geotechnical Engineering* *Construction Inspection* *Materials Testing*	BORING NUMBER **B-17** SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0		3" of cobbles, then bedrock		
				1		AUGER REFUSAL AT 0.2 FEET *No Free Water Encountered*		
				2				
				3				
				4				
				5				
				6				
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				
				23				
				24				
				25				
				26				
				27				
				28				
				29				
				30				

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-18
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0	SC-SM	CLAYEY SAND, with gravel, red, slightly damp, low plasticity, very dense		
RS	50/5	5/5		2				
SS	26 50/3	9/9		5	SM	SILT WITH SILTSTONE GRAVEL, reddish purple, slightly damp, low plasticity, dense		
				6		AUGER REFUSAL AT 6 FEET *No Free Water Encountered*		

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Sample Type Key:
- SS = Split Spoon
- RS = Ring Sample
- H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-19
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
H				0	SC-SM	SILTY, CLAYEY SAND, with gravel, red, slightly damp, low plasticity, medium dense		
RS	20 28	12/12		2			134	2.9
SS	13 24 50/4	16/16		5	CL-ML	SILTY LEAN CLAY, trace gravel, red, slightly damp, low plasticity, very hard		
				9		AUGER REFUSAL AT 9 FEET *No Free Water Encountered*		

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

Project Number 17-101

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER
B-20
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: **SEE SITE PLAN**

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0–1	SC-SM	SILTY, CLAYEY SAND, with gravel, red, slightly damp, low plasticity		
						AUGER REFUSAL AT 1 FEET *No Free Water Encountered*		

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger

PATTISON ENGINEERING, LLC

Geotechnical Engineering
Construction Inspection
Materials Testing

BORING NUMBER **B-21**
SHEET 1 OF 1

Client: Miramonte Homes

Project: Park Place Sedona
Location: West Highway 89, Sedona, AZ

Location of Boring: SEE SITE PLAN

Elevation: Datum:
Logged By: Date: 8/10/2017
Subsurface Conditions or Remarks:

SAMPLE TYPE	BLOWS PER 6"	INCHES DRIVEN/ INCHES RECOV'D	BULLNOSE BLOWS/FT	DEPTH (FEET)	USCS CODE	DESCRIPTION OF SUBSURFACE CONDITIONS	DRY DENSITY (PCF)	MOISTURE (%)
				0	CL-ML	SILTY LEAN CLAY, trace gravel, red, slightly damp, low plasticity, very hard		
SS	50/5	5/5		2		Drilling on siltstone		
SS	50/2	2/2		5		AUGER REFUSAL AT 5 FEET *No Free Water Encountered*		

Depth scale: 0–30 feet

Sample Type Key:
SS = Split Spoon
RS = Ring Sample
H = Hand Sample

Drilling Equipment:
CME 55 Drill Rig equipped with 6-5/8" OD x 3-1/4" ID hollow-stem, continuous-flight auger