

PRELIMINARY STORMWATER QUALITY REPORT

ORTEGA PARK ON-SITE

SANTA BARBARA, CA

February 27, 2020



PREPARED FOR:

City of Santa Barbara, Parks and Recreation

PREPARED BY:

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PURPOSE OF REPORT

The purpose of this report is to assess the project site, identify pre-development and post-development drainage conditions, and identify storm water facilities to meet the requirements of the City of Santa Barbara's Storm Water BMP Guidance Manual. The project consists of the demolition of three existing structures, hardscape and a pool at the site and the construction of two new buildings, a pool, a skate park, a basketball court, play areas and a synthetic turf sports field.

LOCATION

The 4.68 acre park is located on the city block bound by North Quarantina Street, East Cota Street, North Salsipuedes Street, and East Ortega Street. See the project vicinity map in Figure I below.



Figure I. Project Vicinity Map

BACKGROUND

Slopes on the majority of the site are approximately 1-4% percent. Runoff from the site flows from the northwest to the southeast, where it enters the City storm drain system through inlets on North Quarantina Street and East Cota Street. There are no offsite flows directly impacting the project site, so the drainage boundary for this analysis will follow the property line as depicted in the Existing Hydrology Map, Exhibit 1. A separate stormwater quality report addresses the proposed improvements within the public right-of-way as these improvements are part of a separate phase of construction.

METHOD OF ANALYSIS

The approach to analyze the runoff from the project site follows the City of Santa Barbara's Storm Water BMP Guidance Manual. The analysis is a comparison of the pre-project condition to the post-project condition for both hydrologic analysis and storm water quality.

The proposed project will increase the impervious area at the site from 15.9% to approximately 29.5%. See the Proposed Hydrology Map, Exhibit B and the Drainage Area Summary, Attachment 1. Table 1 provides a summary of the proposed changes in impervious area. This increase in impervious area will cause an increase in the amount of storm water peak runoff from the site, requiring BMP's to be designed to both retain and detain storm water as outlined in the City's BMP Guidance Manual.

Table 1. Changes in Impervious Area

Proposed Area	Definition	Area (SF)
New Impervious	Area where new impervious area (hardscape, roof, etc.) is proposed where there is existing pervious area (landscaping, etc.)	39,103
Replaced Impervious	Area where new impervious area (hardscape, roof, etc.) is proposed where there is currently existing impervious area (hardscape, roof, etc.)	21,011
Removed Impervious	Area where new pervious area (landscaping, etc.) is proposed where there is currently existing pervious area (landscaping, etc.)	11,559

Proposed Drainage Management Areas

The proposed project site has been divided into two drainage management areas (DMA): 'A', and 'B'. See Proposed Hydrology Map, Exhibit 2.

- DMA 'A' consists of the northeastern half of the project site where a synthetic turf field is proposed. The turf field will be designed with a drainage layer to retain and infiltrate the one-inch storm. The DMA is 99.8% pervious, with two small concrete walkways that will drain to adjacent turf. Therefore, no treatment is required for this portion of the project site. Runoff will flow to the east and be collected by a series of existing inlets lining the existing bike path on Quarantina Street.
- DMA 'B' consists of the southwestern half of the site where the majority of impervious development will occur. Proposed storm drain inlets throughout the DMA will collect runoff and outlet into a series of Cultec stormwater retention chambers below the proposed basketball court. The Cultec chambers are designed to retain and infiltrate the volume of runoff from the one-inch storm and provide detention for the two- through 25-year storms. The

Cultec chambers will outlet to the municipal storm drain system through a connection to the existing curb inlet at the northern corner of the Cota Street and Salsipuedes Street intersection.

Infiltration Testing

Infiltration testing for the site was performed in February of 2019 by Earth Systems Pacific. Four infiltration borings were hand-excavated throughout the site to depths varying from 2.5 to 3.5 feet. Two of the four test borings were not tested for infiltration rates due to encountered shallow groundwater. The remaining two borings yielded infiltration rates of 0.6 and 1.4 inches per hour. See Infiltration Testing Report, Attachment 4.

PEAK FLOW DETENTION

The proposed Cultec stormwater chambers were designed to decrease the post-project peak flow of runoff to that of the pre-project for the 2-year through 25-year storm events. The program HydroCAD was used to determine the volume of runoff and the peak flow of runoff from the project site for various storm events for both pre- and post-project conditions, see HydroCAD output in Attachment 2. The results are summarized in Table 2.

Table 2. Peak Flow Summary

Storm Event	Peak Flows (CFS)	
	Existing	Proposed
2-year	3.83	3.79
5-year	6.90	6.52
10-year	9.06	8.42
25-year	11.78	10.92

The curve number (CN) used for the synthetic turf was calculated using the SCS equation for potential maximum retention (S, in inches). A gravel section of 8.5" with 32% voids gives a maximum retention depth of

$$8.5" \times 0.32 = 2.72"$$

Thus, the curve number is

$$CN = \frac{1000}{S + 10} = \frac{1000}{2.72 + 10} = 78.6 \cong 79$$

VOLUME RETENTION

Per the City's BMP Guidance Manual, the project is required to retain on-site the volume difference between pre- and post-development conditions for the 25-year storm or the one-inch storm, whichever is larger. For this project the one-inch storm event volume difference of 4,170ft³ is larger as seen in Table 3 below. Retention is provided by the proposed Cultec stormwater chambers and the proposed

synthetic turf field, see Table 4. Calculations for the synthetic turf retention and a stage-storage chart for the Cultec chambers are provided in Attachment 3. Exhibit 3 provides BMP Cross-Section Details.

Table 3. Runoff Volume Summary

Storm Event	Runoff Volume (CF) (Before Retention)	
	Existing	Proposed
1-inch	2,826	496
2-year	24,669	21,943
5-year	42,940	39,543
10-year	55,873	52,022
25-year	72,260	67,901

Table 4. Volume Retention Summary

Retention BMP	Depth of Gravel Storage (in)	Area of Storage (SF)	Provided Retention Volume (CF)
Synthetic Turf	4	93,452	13,706
Cultec Chambers	-	2,884	3,597
Total			10,450

STORM WATER QUALITY

The City of Santa Barbara Storm Water BMP Guidance Manual was used to design storm water quality features to treat the one-inch 24-hour storm. The proposed Cultec stormwater chambers will provide treatment by infiltrating the full retention volume described above. A stage-storage chart for the Cultec chambers is provided in Attachment 3. Exhibit 3 provides BMP Cross-Section Details.

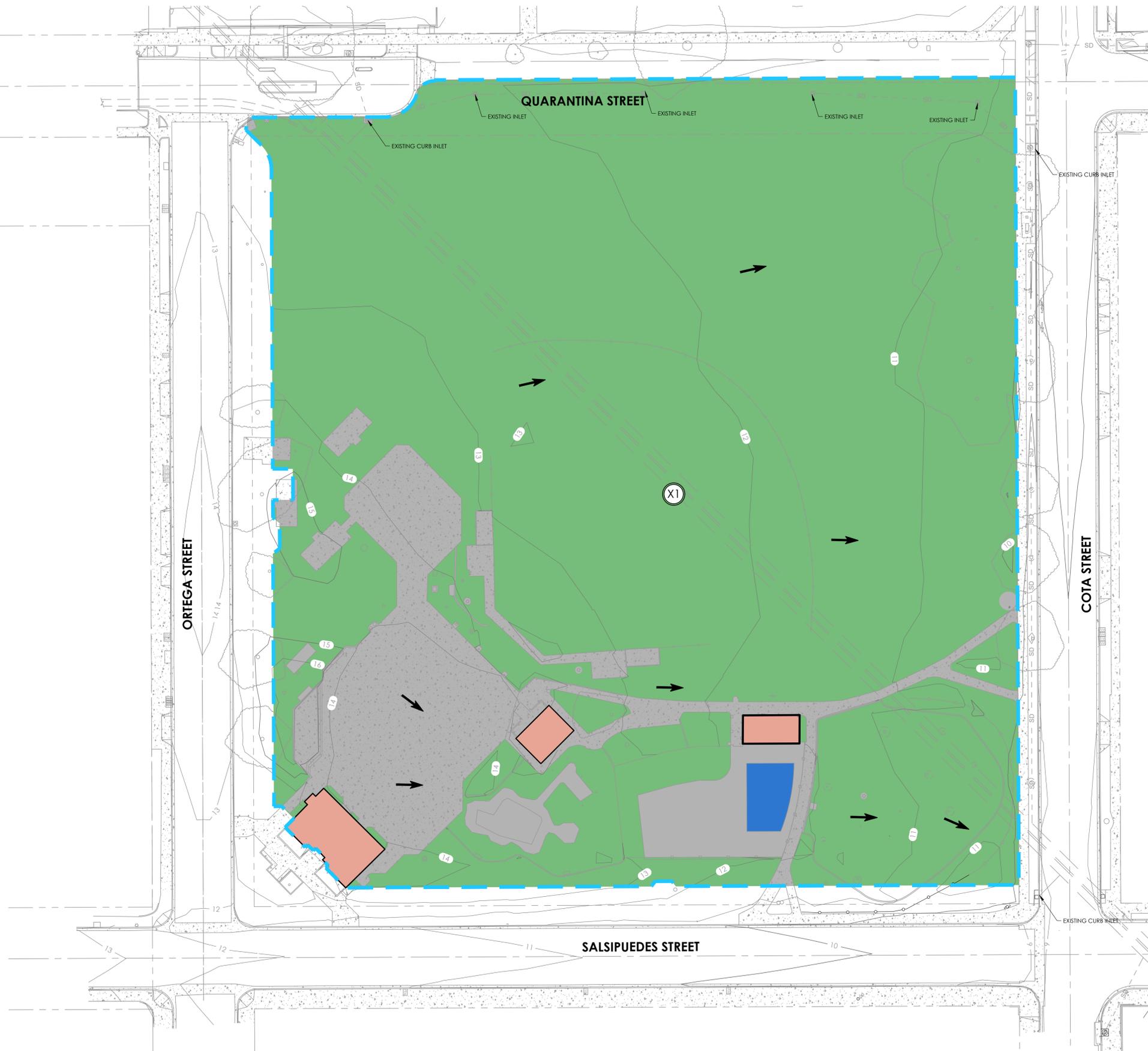
CONCLUSIONS

Based on the findings of this report, the proposed drainage design for this project meets the applicable standards and requirements for the City of Santa Barbara. The proposed drainage plan is consistent with the City's Storm Water Management Program (SWMP) design criteria for development. In summary, the proposed design:

- Reduces the post-development peak flow of runoff to below the pre-development rate for the 2- through 25-year storm events
- Reduces the post-development volume of runoff to below the pre-development rate for the 2- through 25-year storm events
- Treats the runoff from the site for the 1-inch 24-hour storm event.

EXHIBITS

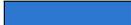
EXHIBIT 1
EXISTING HYDROLOGY MAP



LEGEND

-  DRAINAGE AREA BOUNDARY
-  SURFACE FLOW DIRECTION
-  DRAINAGE AREA NAME

HATCH LEGEND

DESIGNATION	FACILITY	AREA (SF)
	HARDSCAPE	29,832
	LANDSCAPE	171,435
	BUILDING	2,738
	POOL	1,011
	TOTAL AREA	205,016
	TOTAL IMPERVIOUS AREA	32,570 (15.9%)



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EXHIBIT 2
PROPOSED HYDROLOGY MAP



LEGEND

-  DRAINAGE AREA BOUNDARY
-  SURFACE FLOW DIRECTION
-  DRAINAGE AREA NAME

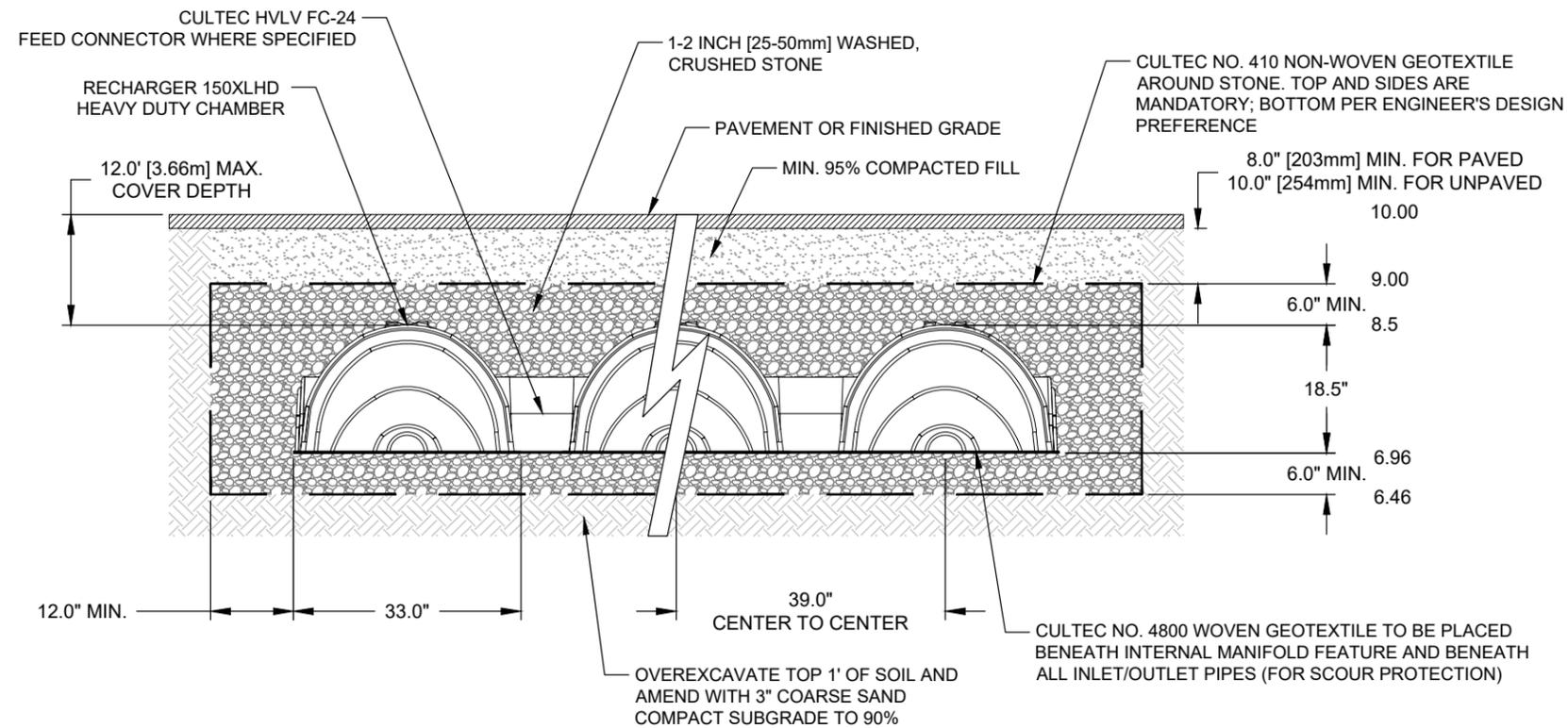
HATCH LEGEND

DESIGNATION	FACILITY	AREA (SF)
	HARDSCAPE	55,184
	LANDSCAPE/PERMEABLE AREA	45,969
	BUILDING	4,930
	POOL	5,481
	ARTIFICIAL TURF FIELD	93,452
TOTAL AREA		205,016
TOTAL IMPERVIOUS		60,114 (29.3%)

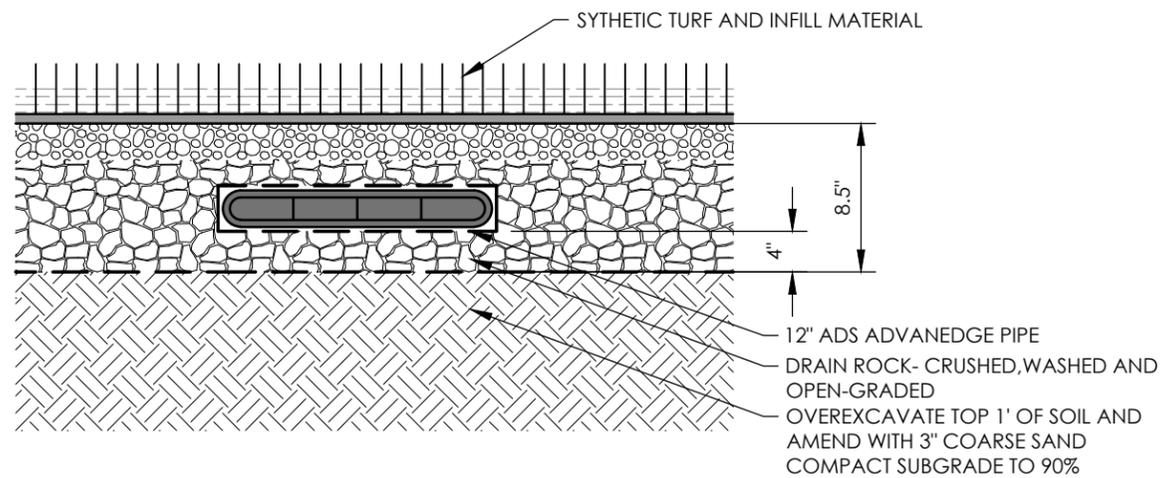


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EXHIBIT 3
BMP CROSS-SECTION DETAILS



A CULTEC STORMWATER CHAMBERS
SCALE: N.T.S.



B SYNETIC TURF SECTION
SCALE: N.T.S.

ATTACHMENTS

ATTACHMENT 1
DRAINAGE AREA SUMMARY

EXISTING DRAINAGE AREA SUMMARY

ORTEGA PARK - ON-SITE EXISTING CONDITION

DMA	Total Area (SF)	Roof (SF)	Hardscape (SF)	Pool (SF)	Landscape (SF)	Total Impervious (SF)	Total Pervious (SF)	Percent Impervious
X1	205,016	2,738	29,832	1,011	171,435	32,570	172,446	15.9%
Total	205,016	2,738	29,832	1,011	171,435	32,570	172,446	15.9%

PROPOSED DRAINAGE AREA SUMMARY

ORTEGA PARK - ON-SITE PROPOSED IMPROVEMENTS

DMA	Total Area (SF)	Roof (SF)	Hardscape (SF)	DG (SF)	Pool (SF)	Synthetic Turf (SF)	Landscape (SF)	Total Impervious (SF)	Total Pervious (SF)	Percent Impervious	1" 24-Hour Runoff Volume (CF)
A	112,909	0	231	0	0	93,452	19,226	231	112,678	0.2%	602
B	92,107	4,930	54,953	2,532	5,481	0	24,211	59,883	32,224	65.0%	3,545
Total	205,016	4,930	55,184	2,532	5,481	93,452	43,437	60,114	144,902	29.3%	4,147

Project Statistics

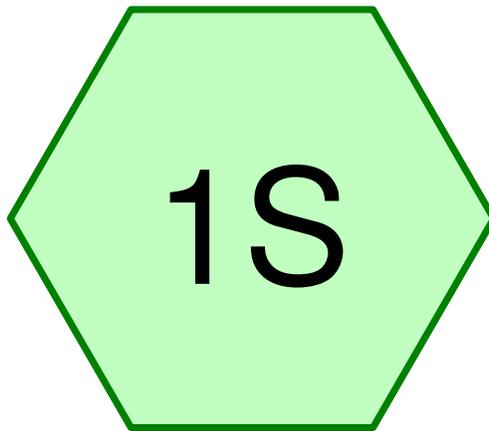
New Impervious Area	39,103
Replaced Impervious Area	21,011
New Pervious Area	11,559

*Proposed New Impervious Area – area where new impervious area (hardscape, roof, etc.) is proposed where there is existing pervious area (landscaping, etc.)

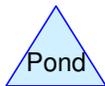
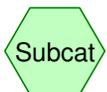
**Proposed Replaced Impervious Area – area where new impervious area (hardscape, roof, etc.) is proposed where there is currently existing impervious area (hardscape, roof, etc.)

*** Proposed New Pervious Area - area where new pervious area (landscaping, etc.) is proposed where there is currently existing pervious area (landscaping, etc.)

ATTACHMENT 2
HYDROCAD OUTPUT



X1



Existing

Prepared by RRM Design Group
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Summary for Subcatchment 1S: X1

Runoff = 0.32 cfs @ 10.02 hrs, Volume= 2,826 cf, Depth> 0.17"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
32,570	98	Paved parking, HSG D
171,435	80	>75% Grass cover, Good, HSG D
* 1,011	1	Pool
205,016	82	Weighted Average
172,446	80	84.11% Pervious Area
32,570	98	15.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Existing

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Summary for Subcatchment 1S: X1

Runoff = 3.83 cfs @ 10.03 hrs, Volume= 24,669 cf, Depth> 1.44"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 2-year Rainfall=3.20"

Area (sf)	CN	Description
32,570	98	Paved parking, HSG D
171,435	80	>75% Grass cover, Good, HSG D
* 1,011	1	Pool
205,016	82	Weighted Average
172,446	80	84.11% Pervious Area
32,570	98	15.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Existing

Prepared by RRM Design Group
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Summary for Subcatchment 1S: X1

Runoff = 6.90 cfs @ 10.03 hrs, Volume= 42,940 cf, Depth> 2.51"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 5-Year Rainfall=4.61"

Area (sf)	CN	Description
32,570	98	Paved parking, HSG D
171,435	80	>75% Grass cover, Good, HSG D
* 1,011	1	Pool
205,016	82	Weighted Average
172,446	80	84.11% Pervious Area
32,570	98	15.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Existing

Prepared by RRM Design Group

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Summary for Subcatchment 1S: X1

Runoff = 9.06 cfs @ 10.02 hrs, Volume= 55,873 cf, Depth> 3.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
Type I 24-hr 10-Year Rainfall=5.55"

Area (sf)	CN	Description
32,570	98	Paved parking, HSG D
171,435	80	>75% Grass cover, Good, HSG D
* 1,011	1	Pool
205,016	82	Weighted Average
172,446	80	84.11% Pervious Area
32,570	98	15.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Existing

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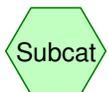
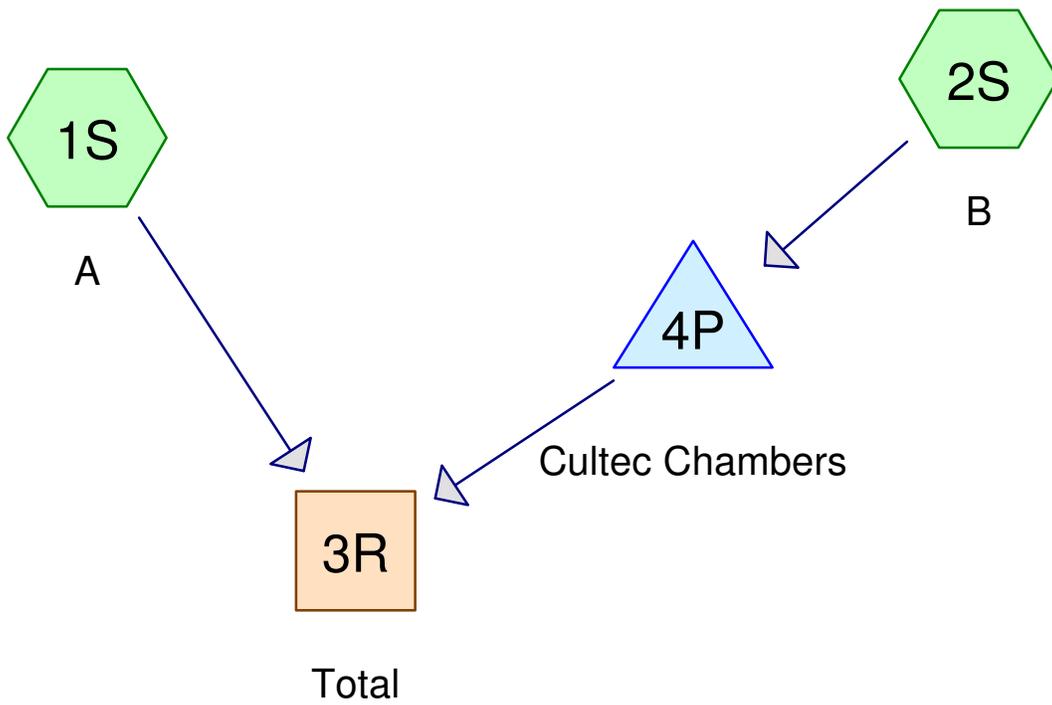
Summary for Subcatchment 1S: X1

Runoff = 11.78 cfs @ 10.02 hrs, Volume= 72,260 cf, Depth> 4.23"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 25-Year Rainfall=6.71"

Area (sf)	CN	Description
32,570	98	Paved parking, HSG D
171,435	80	>75% Grass cover, Good, HSG D
* 1,011	1	Pool
205,016	82	Weighted Average
172,446	80	84.11% Pervious Area
32,570	98	15.89% Impervious Area

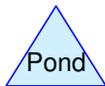
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			



Subcat



Reach



Pond



Link

Proposed

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Page 2

Summary for Subcatchment 1S: A

Runoff = 0.02 cfs @ 12.96 hrs, Volume= 496 cf, Depth> 0.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
Type I 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
231	98	Paved parking, HSG D
19,226	80	>75% Grass cover, Good, HSG D
* 93,452	79	Synthetic Turf
112,909	79	Weighted Average
112,678	79	99.80% Pervious Area
231	98	0.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Summary for Subcatchment 2S: B

Runoff = 0.58 cfs @ 10.02 hrs, Volume= 3,545 cf, Depth> 0.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
Type I 24-hr 1-inch Rainfall=1.00"

Area (sf)	CN	Description
54,953	98	Paved parking, HSG D
24,211	80	>75% Grass cover, Good, HSG D
4,930	98	Roofs, HSG D
* 5,481	1	Pool
* 2,532	80	Decomposed Granite
92,107	87	Weighted Average
32,224	67	34.99% Pervious Area
59,883	98	65.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

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Summary for Subcatchment 1S: A

Runoff = 1.66 cfs @ 10.04 hrs, Volume= 10,995 cf, Depth> 1.17"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 2-year Rainfall=3.20"

Area (sf)	CN	Description
231	98	Paved parking, HSG D
19,226	80	>75% Grass cover, Good, HSG D
* 93,452	79	Synthetic Turf
112,909	79	Weighted Average
112,678	79	99.80% Pervious Area
231	98	0.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Summary for Subcatchment 2S: B

Runoff = 2.24 cfs @ 10.02 hrs, Volume= 14,478 cf, Depth> 1.89"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 2-year Rainfall=3.20"

Area (sf)	CN	Description
54,953	98	Paved parking, HSG D
24,211	80	>75% Grass cover, Good, HSG D
4,930	98	Roofs, HSG D
* 5,481	1	Pool
* 2,532	80	Decomposed Granite
92,107	87	Weighted Average
32,224	67	34.99% Pervious Area
59,883	98	65.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Proposed

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Ortega Park On-Site Improvements
Type I 24-hr 2-year Rainfall=3.20"
Printed 2/27/2020
Page 3

Summary for Reach 3R: Total

Inflow Area = 205,016 sf, 29.32% Impervious, Inflow Depth > 1.28" for 2-year event
Inflow = 3.79 cfs @ 10.04 hrs, Volume= 21,936 cf
Outflow = 3.79 cfs @ 10.04 hrs, Volume= 21,936 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs

Summary for Pond 4P: Cultec Chambers

Inflow Area = 92,107 sf, 65.01% Impervious, Inflow Depth > 1.89" for 2-year event
Inflow = 2.24 cfs @ 10.02 hrs, Volume= 14,478 cf
Outflow = 2.11 cfs @ 10.06 hrs, Volume= 10,940 cf, Atten= 6%, Lag= 2.1 min
Primary = 2.11 cfs @ 10.06 hrs, Volume= 10,940 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 8.36' @ 10.06 hrs Surf.Area= 2,894 sf Storage= 3,706 cf

Plug-Flow detention time= 162.4 min calculated for 10,935 cf (76% of inflow)
Center-of-Mass det. time= 66.8 min (768.0 - 701.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	6.29'	2,067 cf	27.50'W x 105.25'L x 2.54'H Field A 7,357 cf Overall - 2,188 cf Embedded = 5,168 cf x 40.0% Voids
#2A	6.79'	2,188 cf	Cultec R-150XLHD x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 8 rows
		4,255 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	7.10'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=2.06 cfs @ 10.06 hrs HW=8.35' TW=8.23' (Fixed TW Elev= 8.23')
↑ **1=Orifice/Grate** (Orifice Controls 2.06 cfs @ 1.68 fps)

Proposed

Prepared by RRM Design Group
 HydroCAD® 10.00-24 s/n 10829 © 2018 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: A

Runoff = 3.30 cfs @ 10.03 hrs, Volume= 20,641 cf, Depth> 2.19"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 5-Year Rainfall=4.61"

Area (sf)	CN	Description
231	98	Paved parking, HSG D
19,226	80	>75% Grass cover, Good, HSG D
* 93,452	79	Synthetic Turf
112,909	79	Weighted Average
112,678	79	99.80% Pervious Area
231	98	0.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Summary for Subcatchment 2S: B

Runoff = 3.53 cfs @ 10.02 hrs, Volume= 22,446 cf, Depth> 2.92"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 5-Year Rainfall=4.61"

Area (sf)	CN	Description
54,953	98	Paved parking, HSG D
24,211	80	>75% Grass cover, Good, HSG D
4,930	98	Roofs, HSG D
* 5,481	1	Pool
* 2,532	80	Decomposed Granite
92,107	87	Weighted Average
32,224	67	34.99% Pervious Area
59,883	98	65.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

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Ortega Park On-Site Improvements
Type I 24-hr 5-Year Rainfall=4.61"
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Page 5

Summary for Reach 3R: Total

Inflow Area = 205,016 sf, 29.32% Impervious, Inflow Depth > 2.32" for 5-Year event
Inflow = 6.52 cfs @ 10.05 hrs, Volume= 39,565 cf
Outflow = 6.52 cfs @ 10.05 hrs, Volume= 39,565 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs

Summary for Pond 4P: Cultec Chambers

Inflow Area = 92,107 sf, 65.01% Impervious, Inflow Depth > 2.92" for 5-Year event
Inflow = 3.53 cfs @ 10.02 hrs, Volume= 22,446 cf
Outflow = 3.27 cfs @ 10.08 hrs, Volume= 18,924 cf, Atten= 7%, Lag= 3.3 min
Primary = 3.27 cfs @ 10.08 hrs, Volume= 18,924 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 8.54' @ 10.08 hrs Surf.Area= 2,894 sf Storage= 3,913 cf

Plug-Flow detention time= 113.1 min calculated for 18,791 cf (84% of inflow)
Center-of-Mass det. time= 46.7 min (747.7 - 701.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	6.29'	2,067 cf	27.50'W x 105.25'L x 2.54'H Field A 7,357 cf Overall - 2,188 cf Embedded = 5,168 cf x 40.0% Voids
#2A	6.79'	2,188 cf	Cultec R-150XLHD x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 8 rows
		4,255 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	7.10'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=3.21 cfs @ 10.08 hrs HW=8.53' TW=8.23' (Fixed TW Elev= 8.23')
↑ **1=Orifice/Grate** (Orifice Controls 3.21 cfs @ 2.62 fps)

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Summary for Subcatchment 1S: A

Runoff = 4.48 cfs @ 10.03 hrs, Volume= 27,602 cf, Depth> 2.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 10-Year Rainfall=5.55"

Area (sf)	CN	Description
231	98	Paved parking, HSG D
19,226	80	>75% Grass cover, Good, HSG D
* 93,452	79	Synthetic Turf
112,909	79	Weighted Average
112,678	79	99.80% Pervious Area
231	98	0.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Summary for Subcatchment 2S: B

Runoff = 4.43 cfs @ 10.02 hrs, Volume= 27,981 cf, Depth> 3.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 10-Year Rainfall=5.55"

Area (sf)	CN	Description
54,953	98	Paved parking, HSG D
24,211	80	>75% Grass cover, Good, HSG D
4,930	98	Roofs, HSG D
* 5,481	1	Pool
* 2,532	80	Decomposed Granite
92,107	87	Weighted Average
32,224	67	34.99% Pervious Area
59,883	98	65.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

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Summary for Reach 3R: Total

Inflow Area = 205,016 sf, 29.32% Impervious, Inflow Depth > 3.05" for 10-Year event
 Inflow = 8.42 cfs @ 10.05 hrs, Volume= 52,036 cf
 Outflow = 8.42 cfs @ 10.05 hrs, Volume= 52,036 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs

Summary for Pond 4P: Cultec Chambers

Inflow Area = 92,107 sf, 65.01% Impervious, Inflow Depth > 3.65" for 10-Year event
 Inflow = 4.43 cfs @ 10.02 hrs, Volume= 27,981 cf
 Outflow = 4.05 cfs @ 10.09 hrs, Volume= 24,434 cf, Atten= 8%, Lag= 3.9 min
 Primary = 4.05 cfs @ 10.09 hrs, Volume= 24,434 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs / 3
 Peak Elev= 8.70' @ 10.09 hrs Surf.Area= 2,894 sf Storage= 4,103 cf

Plug-Flow detention time= 94.9 min calculated for 24,262 cf (87% of inflow)
 Center-of-Mass det. time= 39.5 min (740.0 - 700.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	6.29'	2,067 cf	27.50'W x 105.25'L x 2.54'H Field A 7,357 cf Overall - 2,188 cf Embedded = 5,168 cf x 40.0% Voids
#2A	6.79'	2,188 cf	Cultec R-150XLHD x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 8 rows
		4,255 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	7.10'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=4.00 cfs @ 10.09 hrs HW=8.69' TW=8.23' (Fixed TW Elev= 8.23')
 ↑ **1=Orifice/Grate** (Orifice Controls 4.00 cfs @ 3.26 fps)

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Summary for Subcatchment 1S: A

Runoff = 5.97 cfs @ 10.02 hrs, Volume= 36,520 cf, Depth> 3.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 25-Year Rainfall=6.71"

Area (sf)	CN	Description
231	98	Paved parking, HSG D
19,226	80	>75% Grass cover, Good, HSG D
* 93,452	79	Synthetic Turf
112,909	79	Weighted Average
112,678	79	99.80% Pervious Area
231	98	0.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

Summary for Subcatchment 2S: B

Runoff = 5.57 cfs @ 10.02 hrs, Volume= 34,982 cf, Depth> 4.56"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.10 hrs
 Type I 24-hr 25-Year Rainfall=6.71"

Area (sf)	CN	Description
54,953	98	Paved parking, HSG D
24,211	80	>75% Grass cover, Good, HSG D
4,930	98	Roofs, HSG D
* 5,481	1	Pool
* 2,532	80	Decomposed Granite
92,107	87	Weighted Average
32,224	67	34.99% Pervious Area
59,883	98	65.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	120	0.0120	1.16		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.20"
1.7	120	Total, Increased to minimum Tc = 12.0 min			

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Summary for Reach 3R: Total

Inflow Area = 205,016 sf, 29.32% Impervious, Inflow Depth > 3.97" for 25-Year event
 Inflow = 10.92 cfs @ 10.06 hrs, Volume= 67,865 cf
 Outflow = 10.92 cfs @ 10.06 hrs, Volume= 67,865 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs

Summary for Pond 4P: Cultec Chambers

Inflow Area = 92,107 sf, 65.01% Impervious, Inflow Depth > 4.56" for 25-Year event
 Inflow = 5.57 cfs @ 10.02 hrs, Volume= 34,982 cf
 Outflow = 5.31 cfs @ 10.09 hrs, Volume= 31,345 cf, Atten= 5%, Lag= 4.3 min
 Primary = 5.31 cfs @ 10.09 hrs, Volume= 31,345 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.10 hrs / 3
 Peak Elev= 9.04' @ 10.09 hrs Surf.Area= 2,894 sf Storage= 4,255 cf

Plug-Flow detention time= 81.0 min calculated for 31,333 cf (90% of inflow)
 Center-of-Mass det. time= 33.8 min (733.5 - 699.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	6.29'	2,067 cf	27.50'W x 105.25'L x 2.54'H Field A 7,357 cf Overall - 2,188 cf Embedded = 5,168 cf x 40.0% Voids
#2A	6.79'	2,188 cf	Cultec R-150XLHD x 80 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 8 rows
		4,255 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	7.10'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=5.25 cfs @ 10.09 hrs HW=9.02' TW=8.23' (Fixed TW Elev= 8.23')
 ↑ **1=Orifice/Grate** (Orifice Controls 5.25 cfs @ 4.28 fps)

ATTACHMENT 3
RETENTION CALCULATIONS



CULTEC Stormwater Design Calculator

Date:	February 27, 2020
Project Information:	
Ortega Park	

Calculations Performed By:	
RRM Design Group	

RECHARGER 150XLHD

Recharger 150XLHD Chamber Specifications		
Height	18.5	inches
Width	33.0	inches
Length	11.00	feet
Installed Length	10.25	feet
Bare Chamber Volume	27.19	cu. feet
Installed Chamber Volume	50.18	cu. feet



Breakdown of Storage Provided by Recharger 150XLHD Stormwater System		
Within Chambers	2,191.38	cu. feet
Within Feed Connectors	3.19	cu. feet
Within Stone	2,064.79	cu. feet
Total Storage Provided	4,259.4	cu. feet
Total Storage Required	4200.00	cu. feet

Materials List

Recharger 150XLHD		
Total Number of Chambers Required	80	pieces
Starter Chambers	8	pieces
Intermediate Chambers	64	pieces
End Chambers	8	pieces
HVLV FC-24 Feed Connectors	7	pieces
CULTEC No. 410 Non-Woven Geotextile	898	sq. yards
CULTEC No. 4800 Woven Geotextile	28	feet
Stone	191	cu. yards

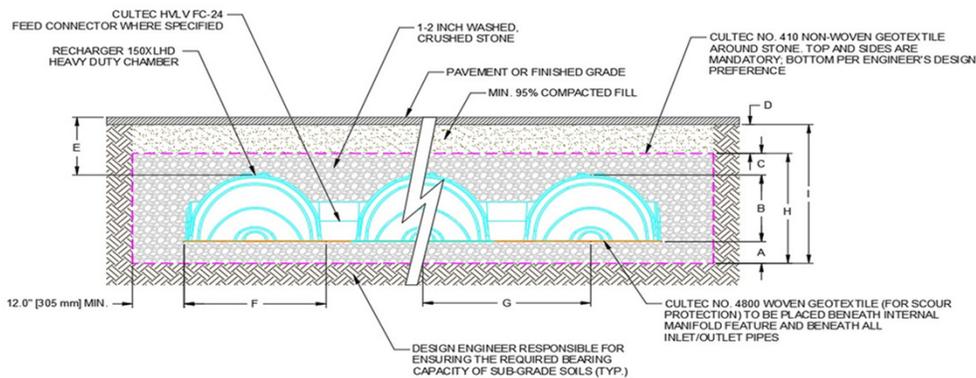
Based on 1 Internal Manifold

Bed Detail



Bed Layout Information		
Number of Rows Wide	8	pieces
Number of Chambers Long	10	pieces
Chamber Row Width	25.50	feet
Chamber Row Length	103.25	feet
Bed Width	27.50	feet
Bed Length	105.25	feet
Bed Area Required	2894.38	sq. feet
Length of Separator Row	N/A	feet

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference		
A	Depth of Stone Base	6.0 inches
B	Chamber Height	18.5 inches
C	Depth of Stone Above Units	6.0 inches
D	Depth of 95% Compacted Fill	8.0 inches
E	Max. Depth Allowed Above the Chamber	12.00 feet
F	Chamber Width	33.0 inches
G	Center to Center Spacing	3.25 feet
H	Effective Depth	2.54 feet
I	Bed Depth	3.21 feet

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Type I 24-hr 1-inch Rainfall=1.00"

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Stage-Area-Storage for Pond 4P: Cultec Chambers

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
6.29	0	7.33	1,828	8.37	3,721
6.31	23	7.35	1,873	8.39	3,744
6.33	46	7.37	1,918	8.41	3,767
6.35	69	7.39	1,962	8.43	3,790
6.37	93	7.41	2,007	8.45	3,814
6.39	116	7.43	2,051	8.47	3,837
6.41	139	7.45	2,095	8.49	3,860
6.43	162	7.47	2,139	8.51	3,883
6.45	185	7.49	2,183	8.53	3,906
6.47	208	7.51	2,227	8.55	3,929
6.49	232	7.53	2,270	8.57	3,953
6.51	255	7.55	2,313	8.59	3,976
6.53	278	7.57	2,356	8.61	3,999
6.55	301	7.59	2,399	8.63	4,022
6.57	324	7.61	2,442	8.65	4,045
6.59	347	7.63	2,484	8.67	4,068
6.61	370	7.65	2,526	8.69	4,091
6.63	394	7.67	2,568	8.71	4,115
6.65	417	7.69	2,609	8.73	4,138
6.67	440	7.71	2,650	8.75	4,161
6.69	463	7.73	2,691	8.77	4,184
6.71	486	7.75	2,732	8.79	4,207
6.73	509	7.77	2,772	8.81	4,230
6.75	533	7.79	2,812	8.83	4,254
6.77	556	7.81	2,852		
6.79	579	7.83	2,891		
6.81	627	7.85	2,930		
6.83	674	7.87	2,968		
6.85	722	7.89	3,006		
6.87	769	7.91	3,044		
6.89	816	7.93	3,081		
6.91	863	7.95	3,118		
6.93	910	7.97	3,154		
6.95	956	7.99	3,189		
6.97	1,003	8.01	3,224		
6.99	1,049	8.03	3,259		
7.01	1,096	8.05	3,293		
7.03	1,142	8.07	3,325		
7.05	1,188	8.09	3,357		
7.07	1,234	8.11	3,388		
7.09	1,280	8.13	3,418		
7.11	1,326	8.15	3,447		
7.13	1,372	8.17	3,475		
7.15	1,418	8.19	3,502		
7.17	1,464	8.21	3,528		
7.19	1,510	8.23	3,554		
7.21	1,556	8.25	3,579		
7.23	1,601	8.27	3,604		
7.25	1,647	8.29	3,628		
7.27	1,692	8.31	3,651		
7.29	1,738	8.33	3,675		
7.31	1,783	8.35	3,698		