# DRAINAGE REPORT

FOR

# TAKE-5 OIL CHANGE

80 Posse Ground Road
Sedona, AZ 86336

**PREPARED FOR:**

Sedona Take Five, LLC
106 Foster Avenue
Charlotte, NC 28203
(704) 496-7120

TIDEWATER
ENGINEERING, INC.

200 Plantation Chase, Suite 14
St. Simons Island, GA 31522
(912) 268-2164

September 30, 2021

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# Take- 5 Oil Change
# Sedona, AZ

**Introduction:**

This project consists of the redevelopment of a portion of lot roughly 0.42 acre in size

The existing condition of the site is vacant land with some existing trees and shrubs which will be removed.

Access will be provided from Posse Ground Road.

The developed site will incorporate an underground retention system to mitigate the stormwater runoff to pre existing peak rates or less. Water quality will also be addressed in the underground stormwater management system.

**Site Information:**

**Total Site Area:** **0.42 ac**

The site is currently vacant and to our best knowledge has never been developed. The site naturally drains to the south towards S.R. 89A.

The existing storm drainage infrastructure within S.R. 89A right-of-way will be used to capture and convey the off-site flows

**Pre-developed drainage basin:**

The pre-developed drainage basin includes the site plus some off-site area from the property to the north. The pre-developed drainage basin is 0.50 ac.

**Post Developed Drainage Basins:**

The Post Developed drainage is split between what is captured and routed through the underground detention system and what is bypass. There is additional runoff from the site to the north. The overall post developed area is slightly larger (0.1 ac) than the pre-developed due to the configuration of the driveway. The post developed basin is 0.51 ac.

**Area to underground retention:** **0.47 acres.**
**Bypass Area:** **0.04 ac**

**Methodology:**

The SCS method was used in the routing calculations using Hydrocad modeling software. Rainfall data for this site is taken from the City of Sedona development manual.

**Assumptions:**

The assumptions used for this project are as follows:

Runoff Curve Number for impervious area=98
Runoff Curve Number for existing conditions: 77

Rainfall Data:

2 year-24 hour storm: 2.36 inches

10 year-24 hour storm: 3.41 inches

25 year-24 hour storm: 4.05 inches

100 year-24 hour storm: 5.08 inches

Time of concentration for this small site is 5 minutes for both pre and post developed conditions.

**Design Summary:**

A Stormtech SC740 underground chamber system was used for this project. Stormwater runoff is collected by inlets which convey the runoff to the chambers.

The system was designed assuming no exfiltration in the underlying soils due to the proximity of the sandstone. Based on the geotechnical boring report, the bottom of the chamber system should be above the existing sandstone, eliminating or at least reducing the amount of rock hammering required.

A pre vs. post developed analysis was performed to demonstrate the post developed peak discharge rate will be less than the existing peak discharge rates for the 2, 10, 25 and 100 year, 24 hour storm events.

**Water Quality:**

The Stormtech SC740 chamber system incorporates an “isolator row” which addresses water quality. The flow rate of the SC740 chamber is 0.26 cfs per chamber. There are 7 isolator row chambers in the system providing 1.82 cfs of flow rate.

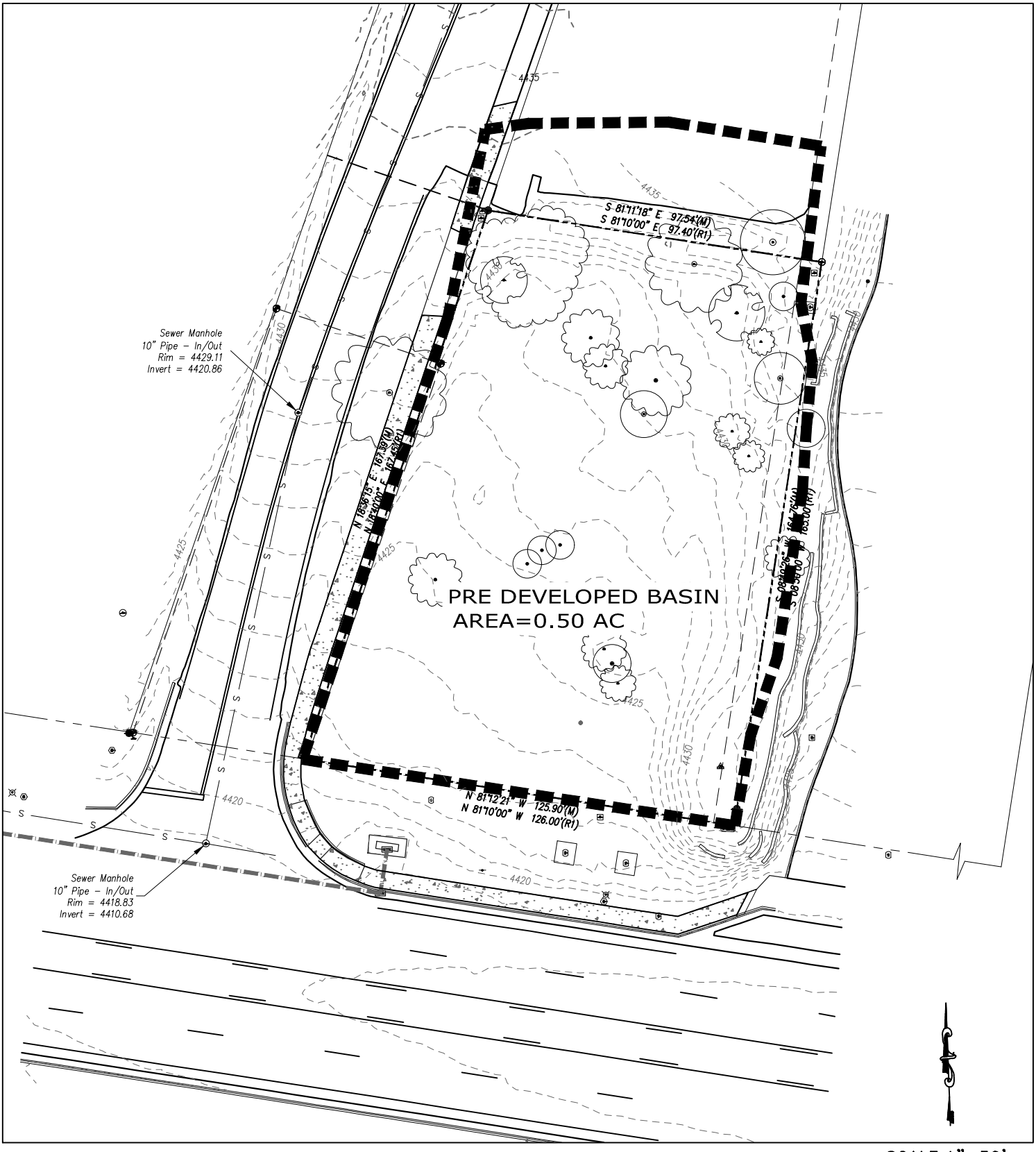
**Analysis Summary:**

| Storm Event | Discharge (cfs) | | | | WSEL |
|---|---|---|---|---|---|
| | Existing Conditions | Post Development | | | |
| | | Bypass | Through Chamber System | Total | |
| 2 Year | **0.69** | 0.33 | 0.32 | **0.65** | **23.99** |
| 10 Year | **1.16** | 0.39 | 0.38 | **0.77** | **24.75** |
| 25 Year | **1.86** | 0.46 | 0.42 | **0.88** | **25.28** |
| 100 Year | **2.63** | 0.50 | 1.27 | **1.77** | **26.06** |

Hydrocad software was used to model the underground retention system. A Stormtech SC740 chamber system was designed to provide adequate volume to support the 2 year, 24 hour storm through the 100 year, 24 hour storm event.

# EXHIBIT-A

# PRE DEVELOPED DRAINAGE BASIN MAP




# SEDONA, AZ TAKE 5

## PRE DEVELOPMENT DRAINAGE BASIN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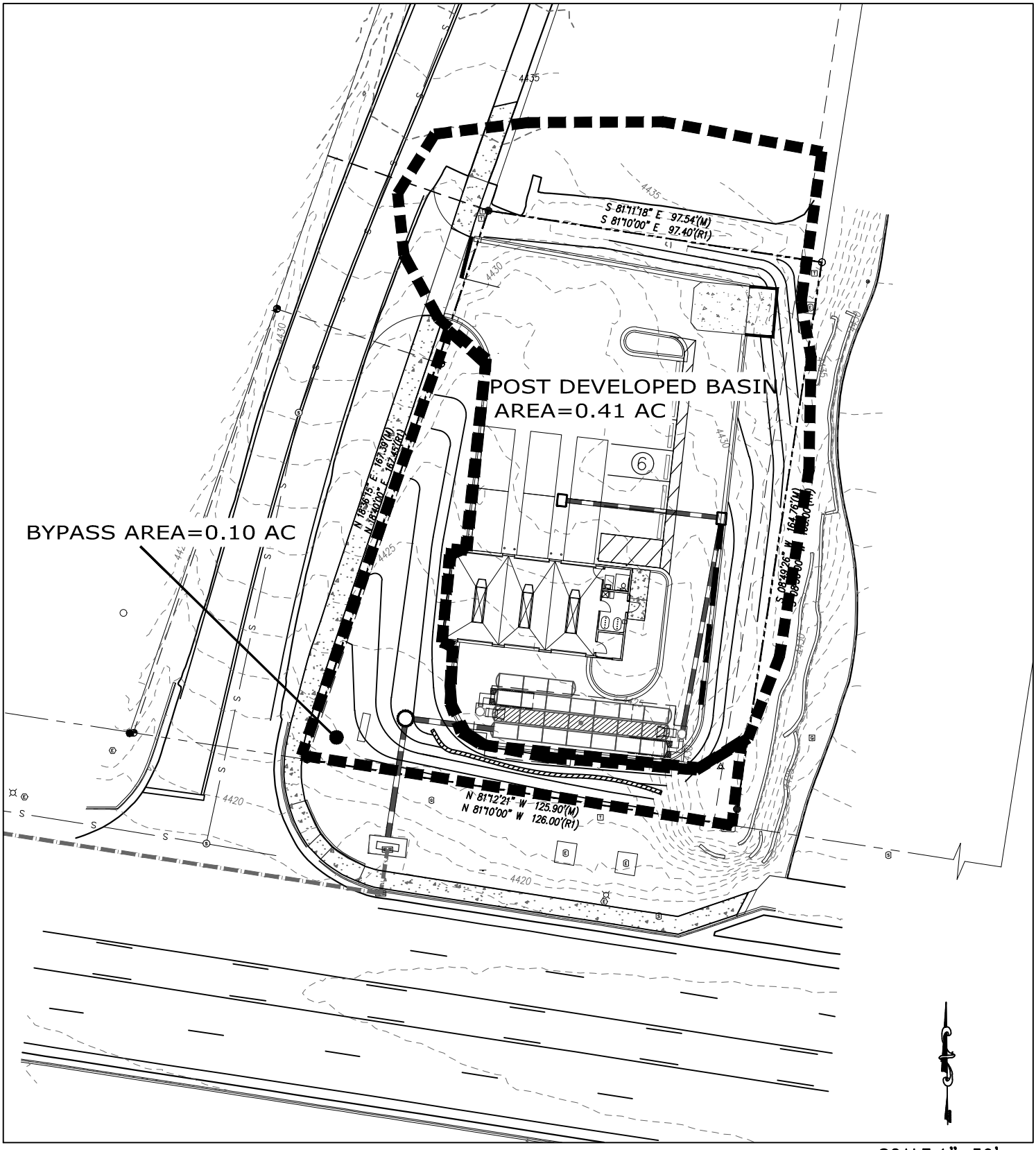
# EXHIBIT-B

# POST DEVELOPED DRAINAGE BASIN MAP




SCALE:1"=50'

# SEDONA, AZ TAKE 5

## POST DEVELOPMENT DRAINAGE BASINS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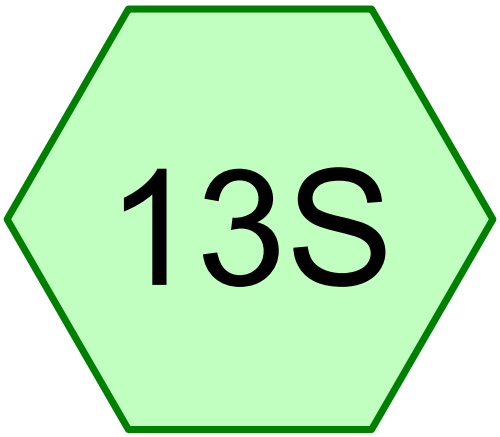
# EXHIBIT-C

# PRE DEVELOPED STORM ROUTINGS




DA 1

Subcat Reach Pond Link

**Routing Diagram for Sedona PRE Dev**
Prepared by {enter your company name here}, Printed 10/6/2021

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 yr | Type II 24-hr | | Default | 24.00 | 1 | 2.36 | 2 |
| 2 | 10 yr | Type II 24-hr | | Default | 24.00 | 1 | 3.08 | 2 |
| 3 | 25 yr | Type II 24-hr | | Default | 24.00 | 1 | 4.05 | 2 |
| 4 | 100 yr | Type II 24-hr | | Default | 24.00 | 1 | 5.08 | 2 |

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.460 | 77 | Natural western desert, HSG B (13S) |
| 0.040 | 98 | Paved parking, HSG A (13S) |
| **0.500** | **79** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.040 | HSG A | 13S |
| 0.460 | HSG B | 13S |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **0.500** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.460 | 0.000 | 0.000 | 0.000 | 0.460 | Natural western desert | 13S |
| 0.040 | 0.000 | 0.000 | 0.000 | 0.000 | 0.040 | Paved parking | 13S |
| **0.040** | **0.460** | **0.000** | **0.000** | **0.000** | **0.500** | **TOTAL AREA** | |

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.500 ac 8.00% Impervious Runoff Depth=0.75"
Tc=5.0 min CN=79 Runoff=0.69 cfs 0.031 af

**Total Runoff Area = 0.500 ac Runoff Volume = 0.031 af Average Runoff Depth = 0.75"**
**92.00% Pervious = 0.460 ac 8.00% Impervious = 0.040 ac**

## Summary for Subcatchment 13S: DA 1

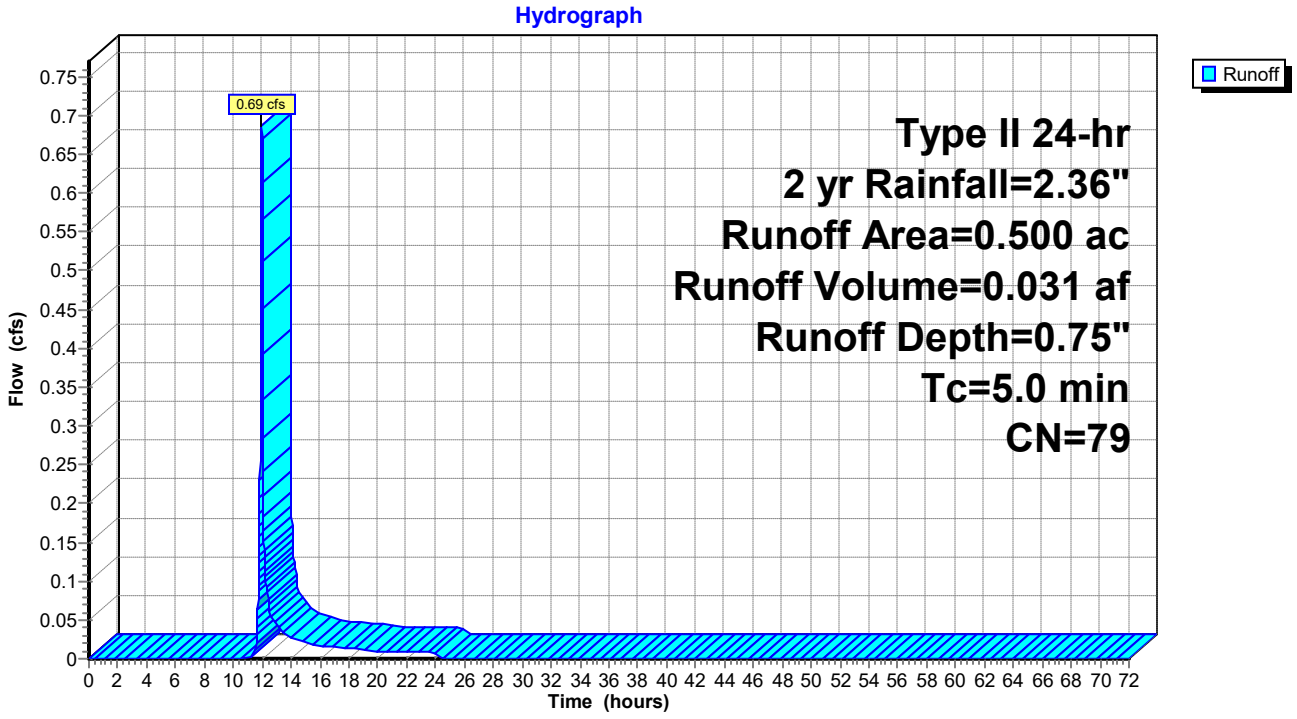
Runoff = 0.69 cfs @ 11.97 hrs, Volume= 0.031 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr Rainfall=2.36"

| Area (ac) | CN | Description |
|---|---|---|
| 0.460 | 77 | Natural western desert, HSG B |
| 0.040 | 98 | Paved parking, HSG A |
| 0.500 | 79 | Weighted Average |
| 0.460 | | 92.00% Pervious Area |
| 0.040 | | 8.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.500 ac 8.00% Impervious Runoff Depth=1.25"
Tc=5.0 min CN=79 Runoff=1.16 cfs 0.052 af

**Total Runoff Area = 0.500 ac Runoff Volume = 0.052 af Average Runoff Depth = 1.25"**
**92.00% Pervious = 0.460 ac 8.00% Impervious = 0.040 ac**

## Summary for Subcatchment 13S: DA 1

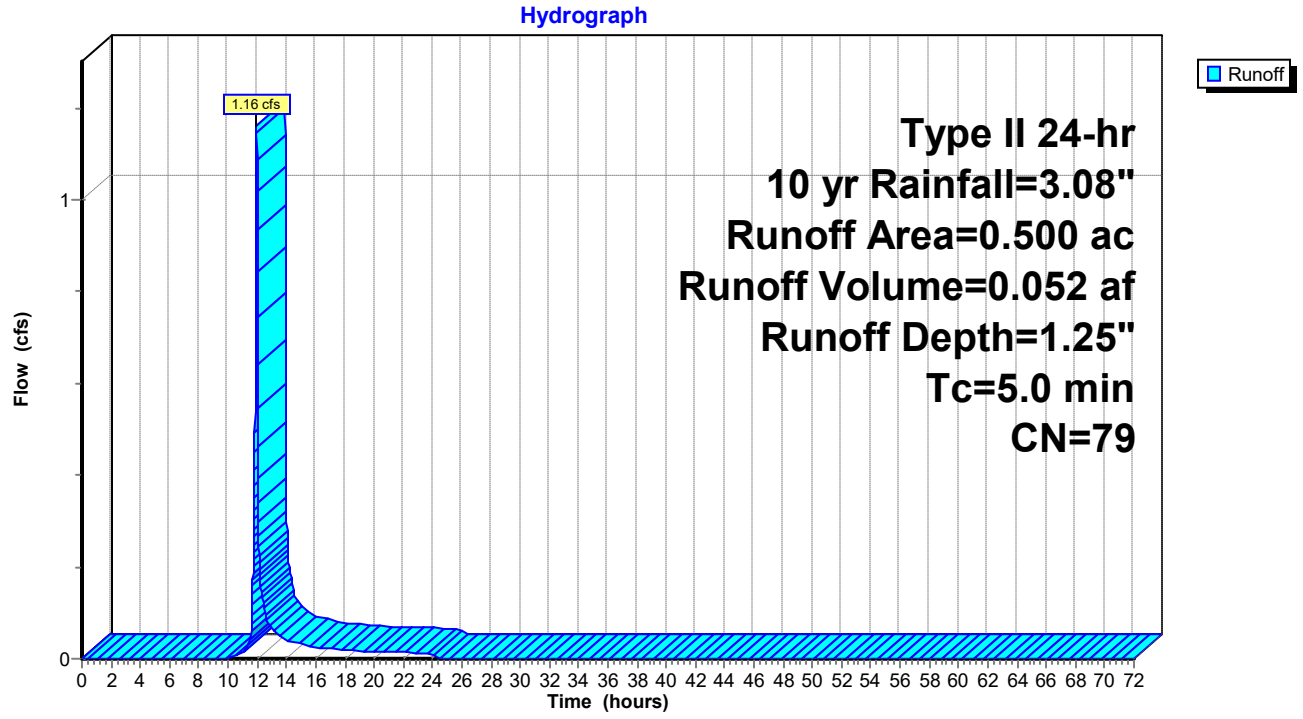
Runoff = 1.16 cfs @ 11.96 hrs, Volume= 0.052 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr Rainfall=3.08"

| Area (ac) | CN | Description |
|---|---|---|
| 0.460 | 77 | Natural western desert, HSG B |
| 0.040 | 98 | Paved parking, HSG A |
| 0.500 | 79 | Weighted Average |
| 0.460 | | 92.00% Pervious Area |
| 0.040 | | 8.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.500 ac 8.00% Impervious Runoff Depth=2.00"
Tc=5.0 min CN=79 Runoff=1.86 cfs 0.084 af

**Total Runoff Area = 0.500 ac Runoff Volume = 0.084 af Average Runoff Depth = 2.00"**
**92.00% Pervious = 0.460 ac 8.00% Impervious = 0.040 ac**

## Summary for Subcatchment 13S: DA 1

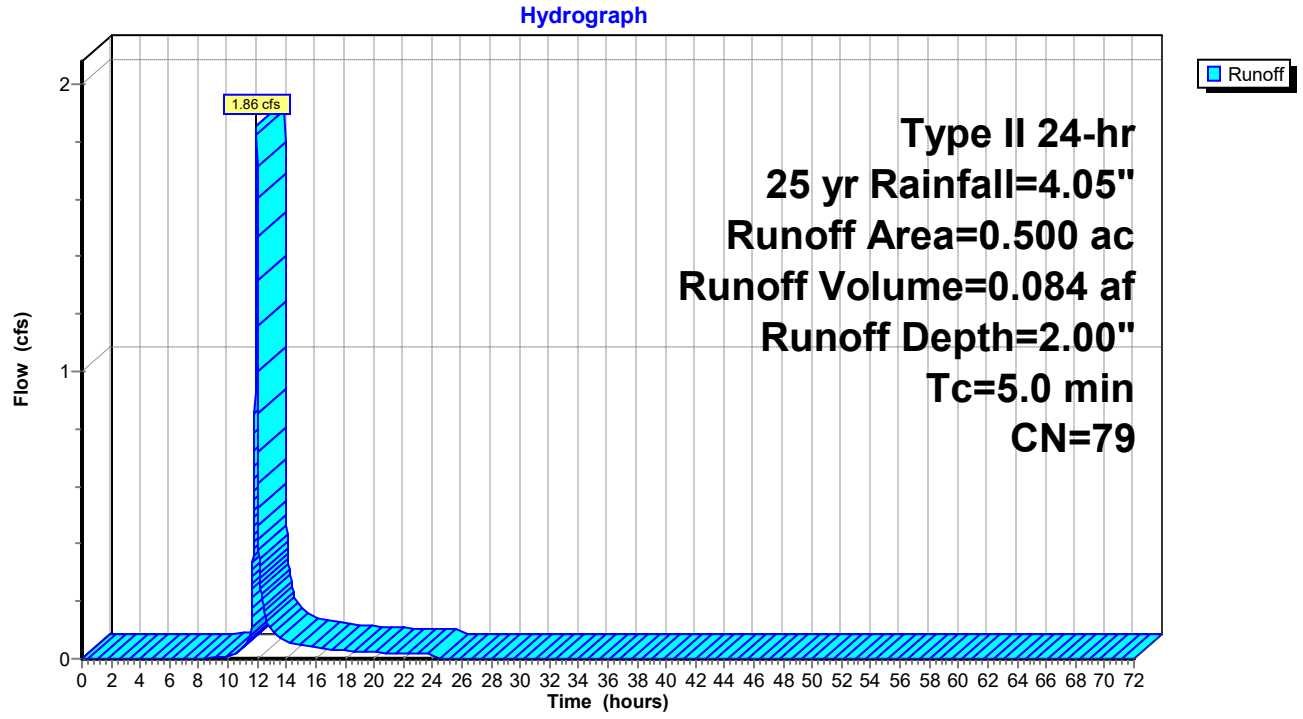
Runoff = 1.86 cfs @ 11.96 hrs, Volume= 0.084 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr Rainfall=4.05"

| Area (ac) | CN | Description |
|---|---|---|
| 0.460 | 77 | Natural western desert, HSG B |
| 0.040 | 98 | Paved parking, HSG A |
| 0.500 | 79 | Weighted Average |
| 0.460 | | 92.00% Pervious Area |
| 0.040 | | 8.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.500 ac 8.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=79 Runoff=2.63 cfs 0.120 af

**Total Runoff Area = 0.500 ac Runoff Volume = 0.120 af Average Runoff Depth = 2.87"**
**92.00% Pervious = 0.460 ac 8.00% Impervious = 0.040 ac**

## Summary for Subcatchment 13S: DA 1

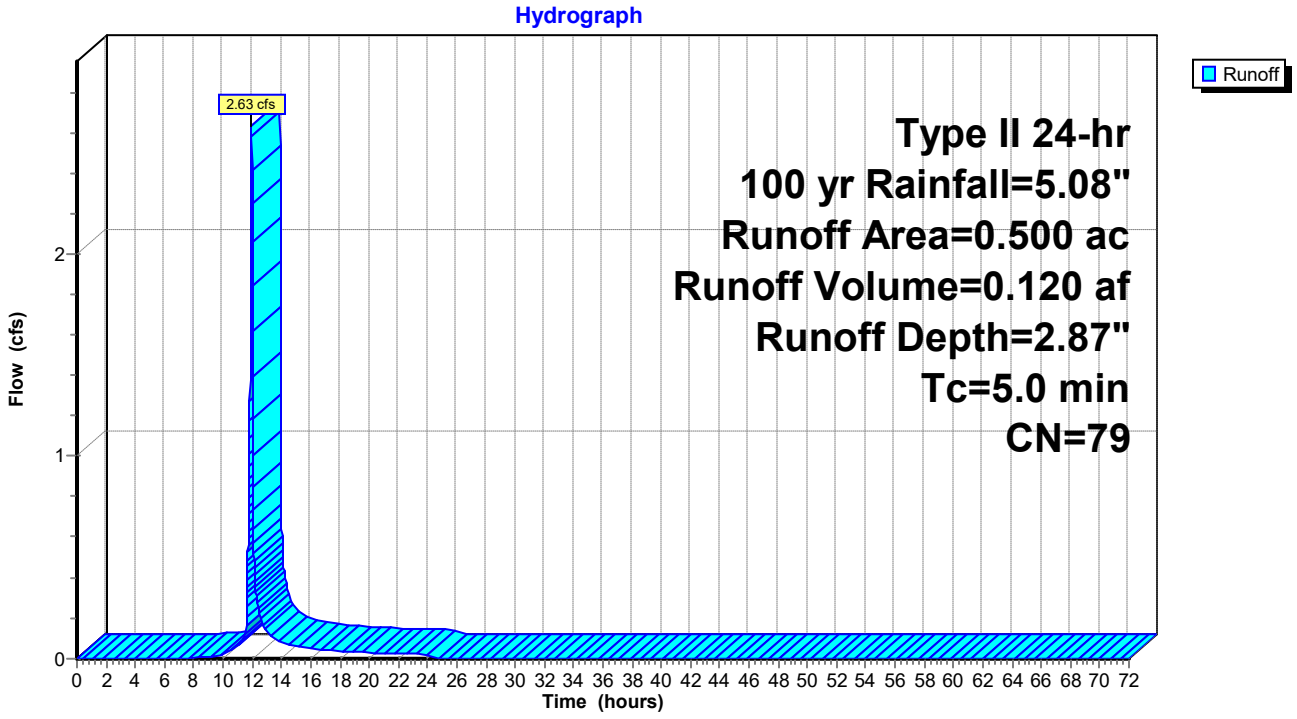
Runoff = 2.63 cfs @ 11.96 hrs, Volume= 0.120 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr Rainfall=5.08"

| Area (ac) | CN | Description |
|---|---|---|
| 0.460 | 77 | Natural western desert, HSG B |
| 0.040 | 98 | Paved parking, HSG A |
| 0.500 | 79 | Weighted Average |
| 0.460 | | 92.00% Pervious Area |
| 0.040 | | 8.00% Impervious Area |

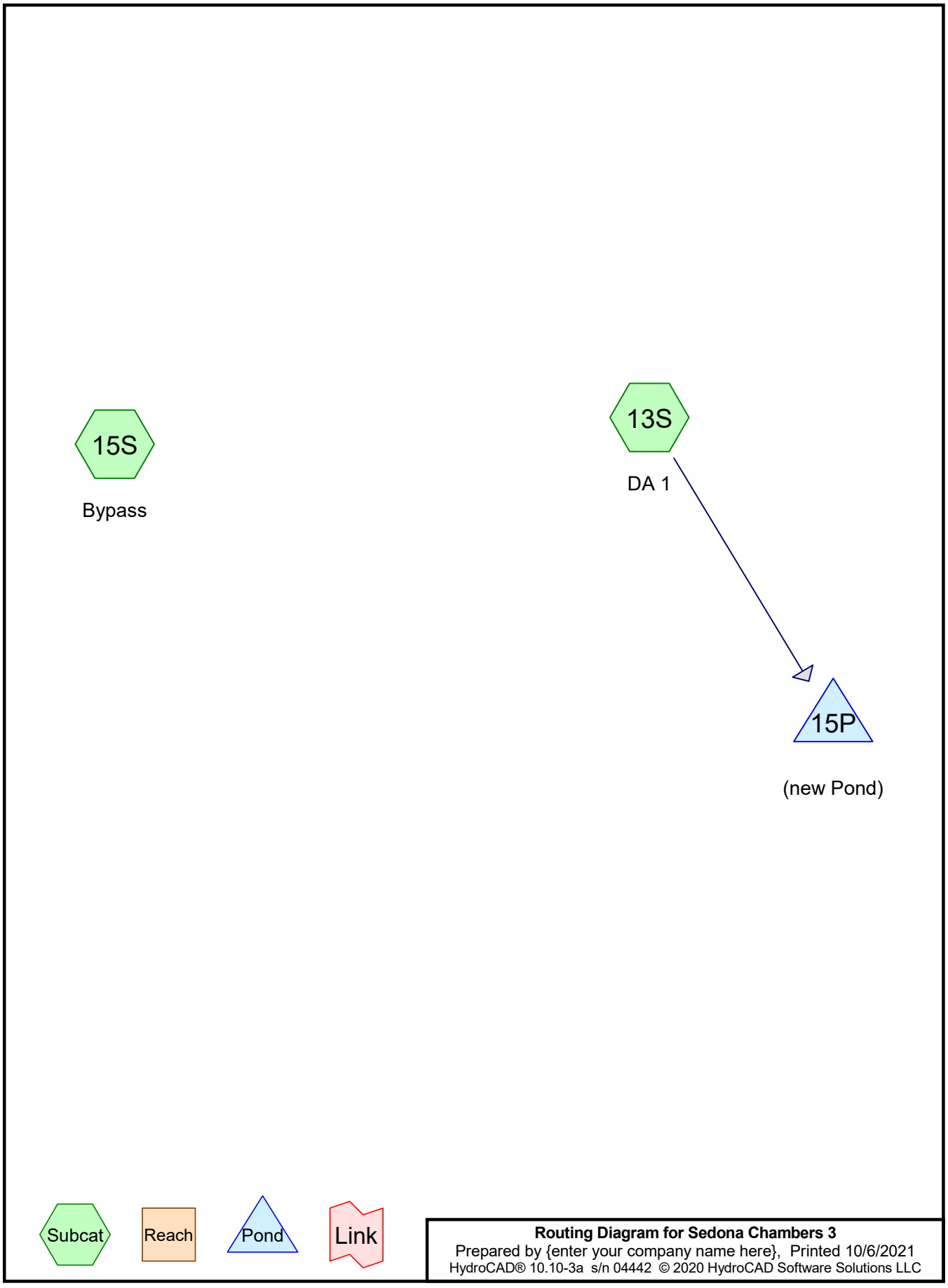
| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



# EXHIBIT-D

# POST DEVELOPED STORM ROUTINGS




**Routing Diagram for Sedona Chambers 3**
Prepared by {enter your company name here}, Printed 10/6/2021

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 yr | Type II 24-hr | | Default | 24.00 | 1 | 2.36 | 2 |
| 2 | 10 yr | Type II 24-hr | | Default | 24.00 | 1 | 3.41 | 2 |
| 3 | 25 yr | Type II 24-hr | | Default | 24.00 | 1 | 4.05 | 2 |
| 4 | 100 yr | Type II 24-hr | | Default | 24.00 | 1 | 5.08 | 2 |

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.220 | 77 | Natural western desert, HSG B (13S, 15S) |
| 0.290 | 98 | Paved parking, HSG A (13S) |
| **0.510** | **89** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.290 | HSG A | 13S |
| 0.220 | HSG B | 13S, 15S |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **0.510** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.220 | 0.000 | 0.000 | 0.000 | 0.220 | Natural western desert | 13S, 15S |
| 0.290 | 0.000 | 0.000 | 0.000 | 0.000 | 0.290 | Paved parking | 13S |
| **0.290** | **0.220** | **0.000** | **0.000** | **0.000** | **0.510** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 15P | 4,422.00 | 4,416.00 | 34.0 | 0.1765 | 0.012 | 15.0 | 0.0 | 0.0 |

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.410 ac 70.73% Impervious Runoff Depth=1.56"
Tc=5.0 min CN=92 Runoff=1.15 cfs 0.053 af

**Subcatchment 15S: Bypass** Runoff Area=0.100 ac 0.00% Impervious Runoff Depth=0.65"
Tc=5.0 min CN=77 Runoff=0.12 cfs 0.005 af

**Pond 15P: (new Pond)** Peak Elev=4,423.99' Storage=0.013 af Inflow=1.15 cfs 0.053 af
Outflow=0.32 cfs 0.053 af

**Total Runoff Area = 0.510 ac Runoff Volume = 0.059 af Average Runoff Depth = 1.39"**
**43.14% Pervious = 0.220 ac 56.86% Impervious = 0.290 ac**

## Summary for Subcatchment 13S: DA 1

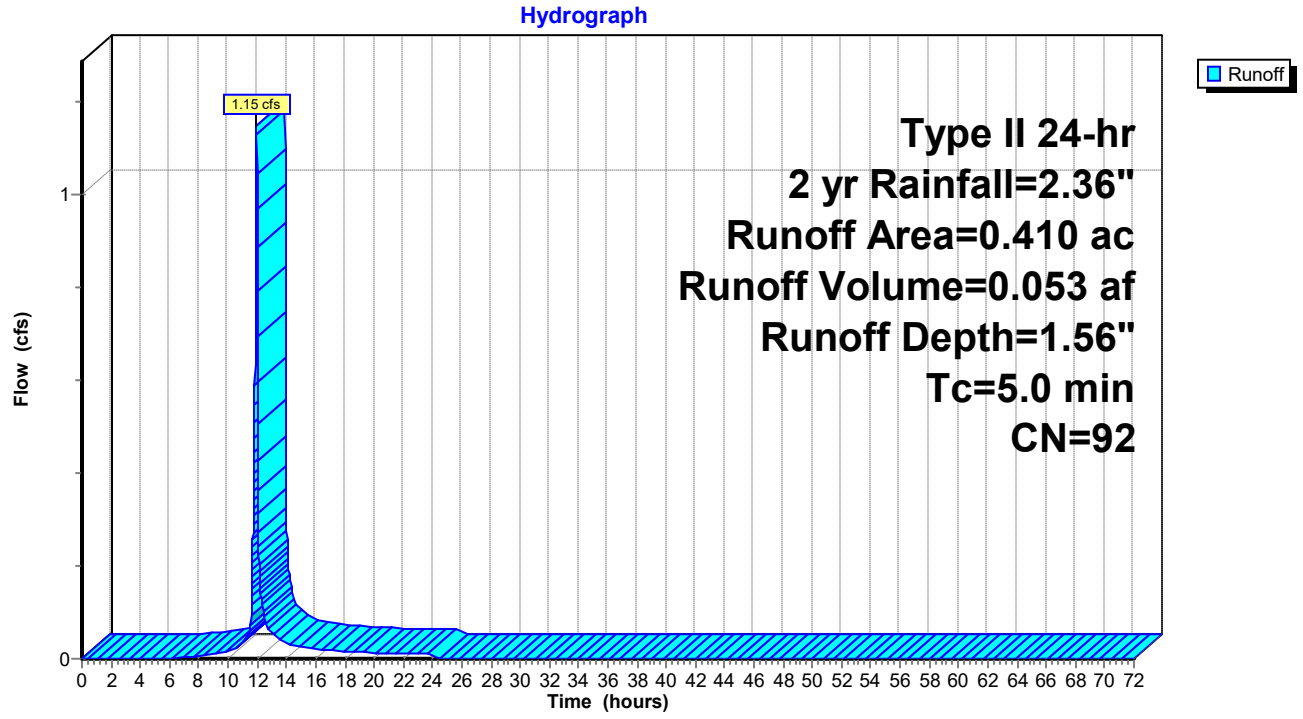
Runoff = 1.15 cfs @ 11.96 hrs, Volume= 0.053 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr Rainfall=2.36"

| Area (ac) | CN | Description |
|---|---|---|
| 0.120 | 77 | Natural western desert, HSG B |
| 0.290 | 98 | Paved parking, HSG A |
| 0.410 | 92 | Weighted Average |
| 0.120 | | 29.27% Pervious Area |
| 0.290 | | 70.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



## Summary for Subcatchment 15S: Bypass

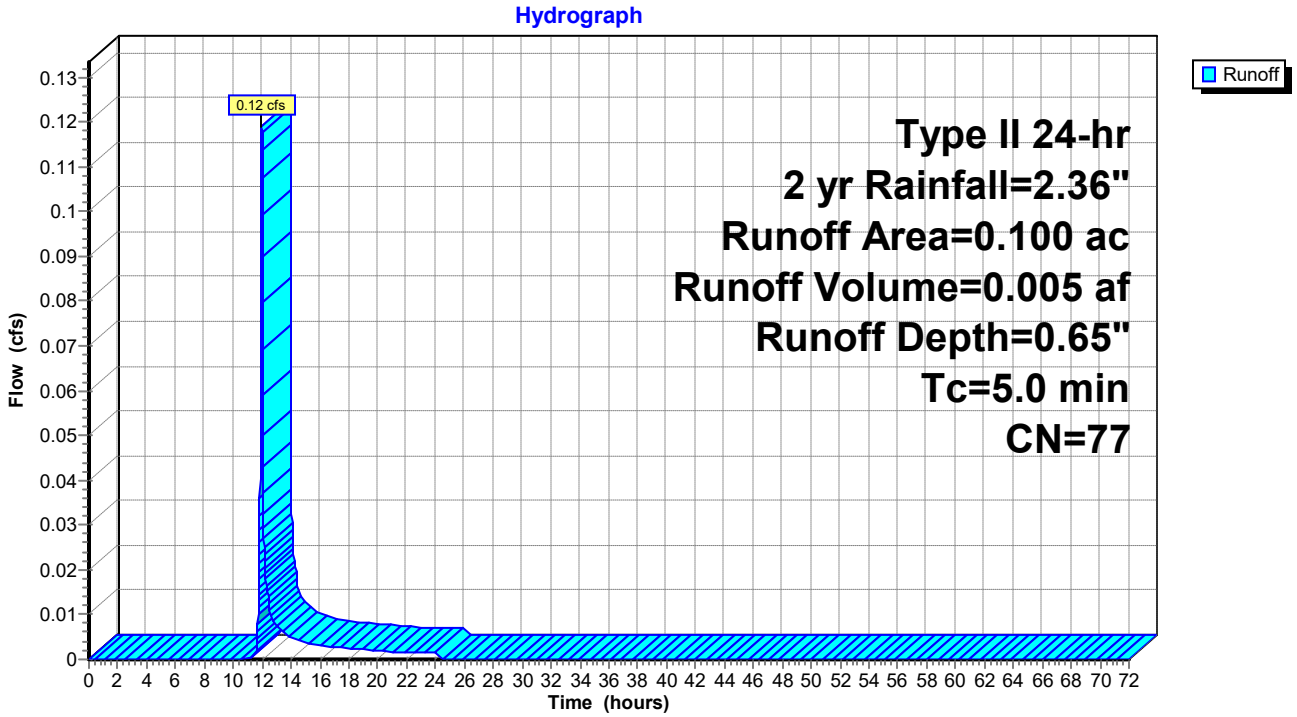
Runoff = 0.12 cfs @ 11.97 hrs, Volume= 0.005 af, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr Rainfall=2.36"

| Area (ac) | CN | Description |
|---|---|---|
| 0.100 | 77 | Natural western desert, HSG B |
| 0.100 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment 15S: Bypass



## Summary for Pond 15P: (new Pond)

Inflow Area = 0.410 ac, 70.73% Impervious, Inflow Depth = 1.56" for 2 yr event
Inflow = 1.15 cfs @ 11.96 hrs, Volume= 0.053 af
Outflow = 0.32 cfs @ 12.08 hrs, Volume= 0.053 af, Atten= 72%, Lag= 7.1 min
Primary = 0.32 cfs @ 12.08 hrs, Volume= 0.053 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,423.99' @ 12.08 hrs Surf.Area= 0.022 ac Storage= 0.013 af

Plug-Flow detention time= 9.2 min calculated for 0.053 af (100% of inflow)
Center-of-Mass det. time= 9.2 min ( 814.4 - 805.2 )

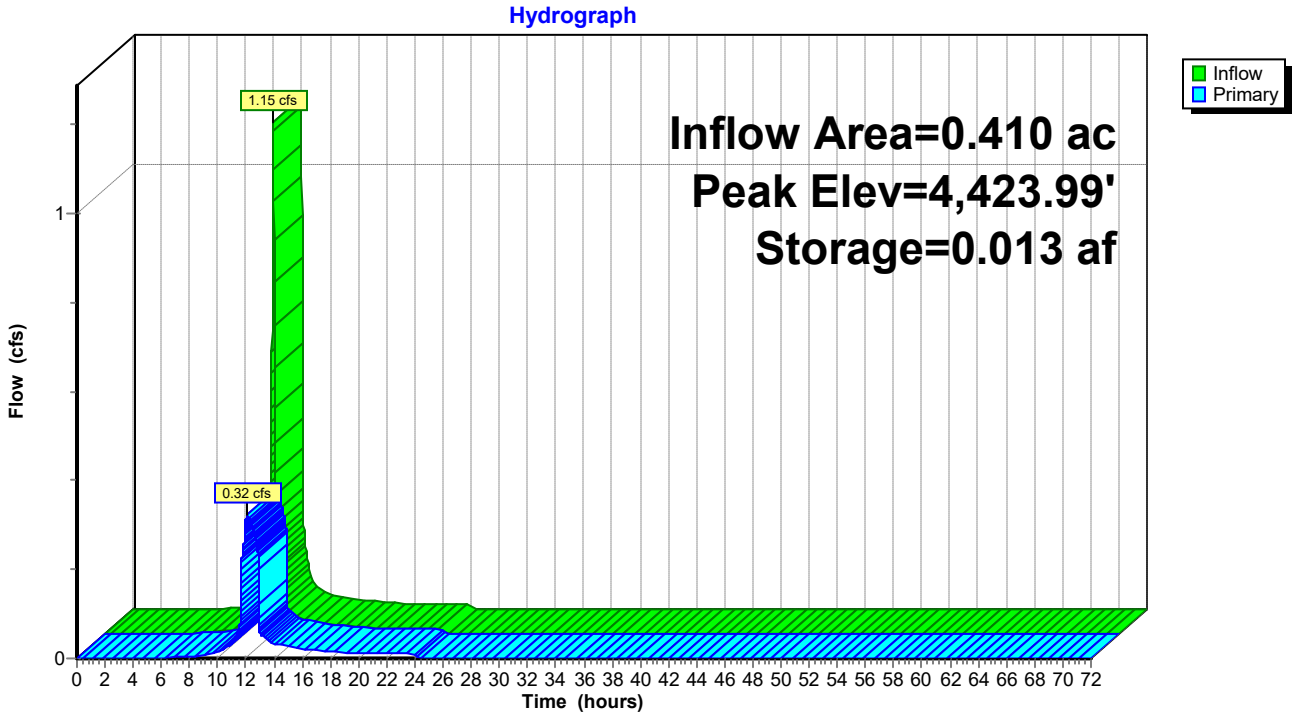
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 4,423.00' | 0.020 af | **20.50'W x 46.34'L x 3.50'H Field A**<br>0.076 af Overall - 0.025 af Embedded = 0.051 af x 40.0% Voids |
| #2A | 4,423.50' | 0.025 af | **ADS_StormTech SC-740 +Cap** x 24 Inside #1<br>Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf<br>Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap<br>24 Chambers in 4 Rows |
| | | 0.046 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 4,422.00' | **15.0" Round Culvert**<br>L= 34.0' RCP, groove end w/headwall, Ke= 0.200<br>Inlet / Outlet Invert= 4,422.00' / 4,416.00' S= 0.1765 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf |
| #2 | Device 1 | 4,422.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 4,425.50' | **Custom Weir/Orifice, Cv= 2.62 (C= 3.28)**<br>Head (feet) 0.00 1.00<br>Width (feet) 0.58 0.58 |

**Primary OutFlow** Max=0.32 cfs @ 12.08 hrs HW=4,423.99' (Free Discharge)
└**1=Culvert** (Passes 0.32 cfs of 8.62 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 6.57 fps)
  └**3=Custom Weir/Orifice** ( Controls 0.00 cfs)

## Pond 15P: (new Pond)



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.410 ac 70.73% Impervious Runoff Depth=2.55"
Tc=5.0 min CN=92 Runoff=1.82 cfs 0.087 af

**Subcatchment 15S: Bypass** Runoff Area=0.100 ac 0.00% Impervious Runoff Depth=1.36"
Tc=5.0 min CN=77 Runoff=0.25 cfs 0.011 af

**Pond 15P: (new Pond)** Peak Elev=4,424.75' Storage=0.025 af Inflow=1.82 cfs 0.087 af
Outflow=0.38 cfs 0.087 af

**Total Runoff Area = 0.510 ac Runoff Volume = 0.099 af Average Runoff Depth = 2.32"**
**43.14% Pervious = 0.220 ac 56.86% Impervious = 0.290 ac**

## Summary for Subcatchment 13S: DA 1

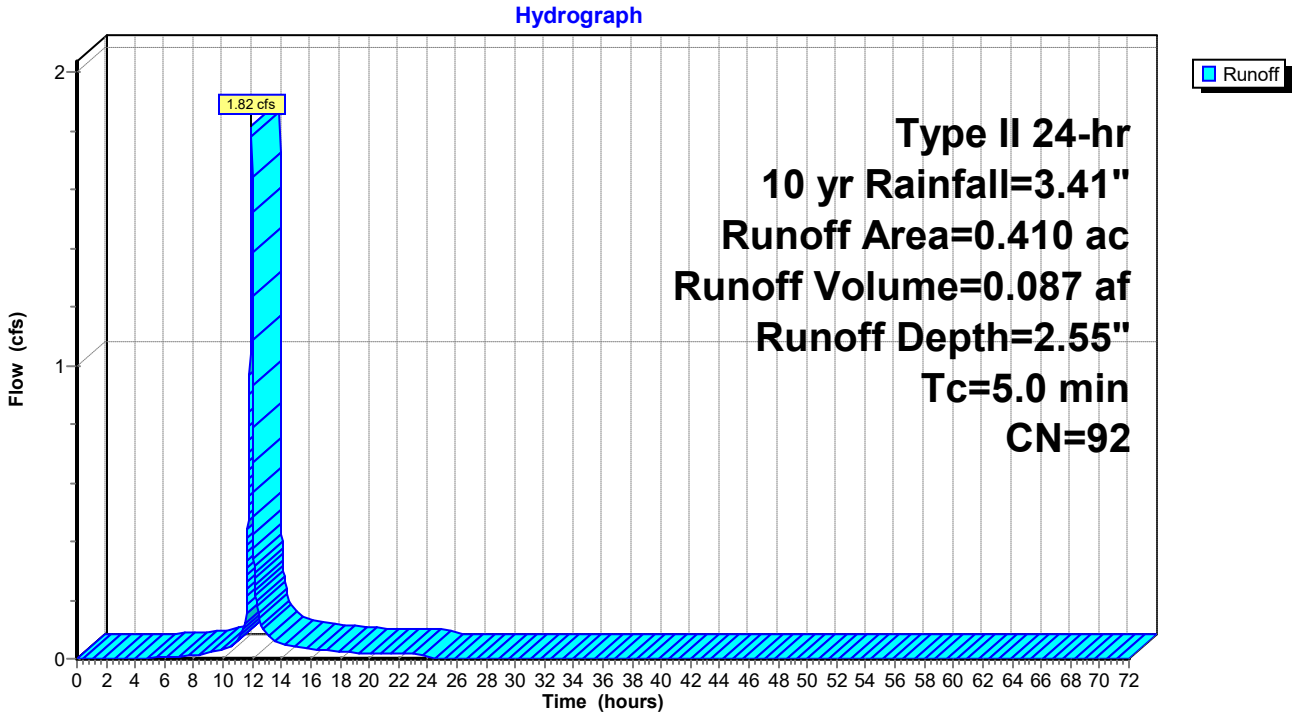
Runoff = 1.82 cfs @ 11.96 hrs, Volume= 0.087 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr Rainfall=3.41"

| Area (ac) | CN | Description |
|---|---|---|
| 0.120 | 77 | Natural western desert, HSG B |
| 0.290 | 98 | Paved parking, HSG A |
| 0.410 | 92 | Weighted Average |
| 0.120 | | 29.27% Pervious Area |
| 0.290 | | 70.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



## Summary for Subcatchment 15S: Bypass

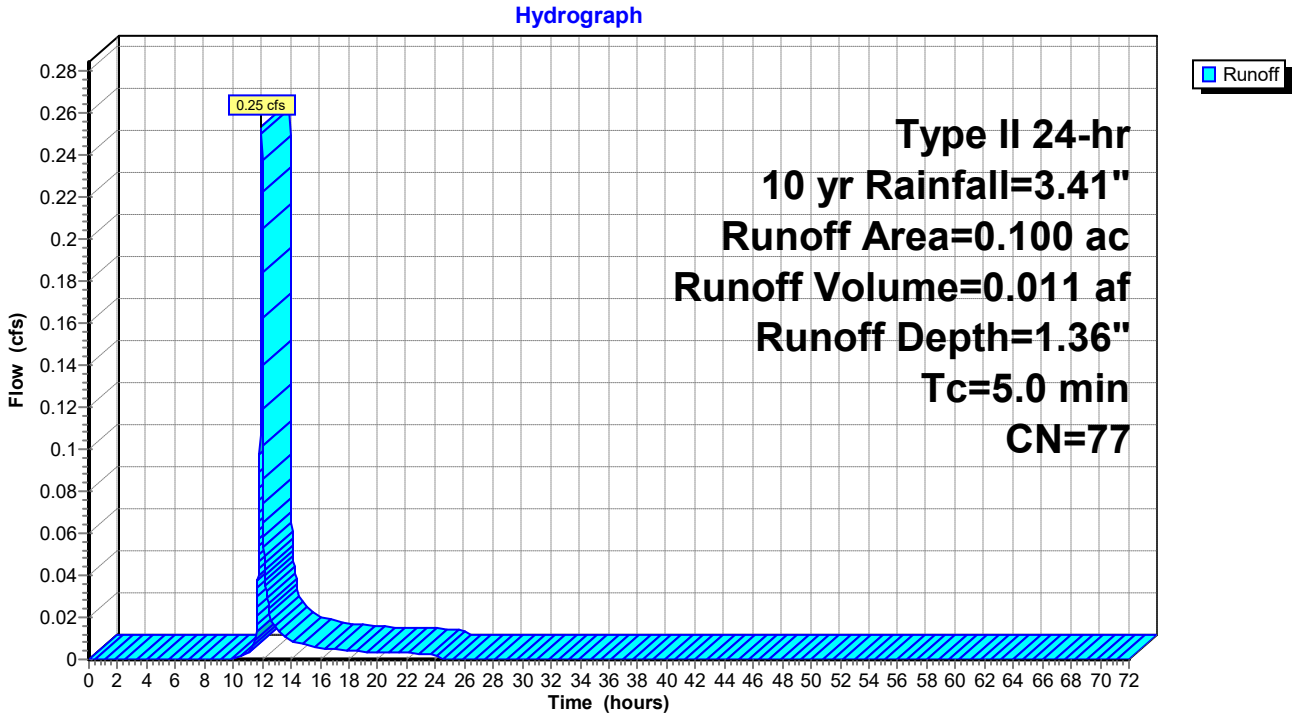
Runoff = 0.25 cfs @ 11.97 hrs, Volume= 0.011 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr Rainfall=3.41"

| Area (ac) | CN | Description |
|---|---|---|
| 0.100 | 77 | Natural western desert, HSG B |
| 0.100 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment 15S: Bypass



## Summary for Pond 15P: (new Pond)

Inflow Area = 0.410 ac, 70.73% Impervious, Inflow Depth = 2.55" for 10 yr event
Inflow = 1.82 cfs @ 11.96 hrs, Volume= 0.087 af
Outflow = 0.38 cfs @ 12.10 hrs, Volume= 0.087 af, Atten= 79%, Lag= 8.5 min
Primary = 0.38 cfs @ 12.10 hrs, Volume= 0.087 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,424.75' @ 12.10 hrs Surf.Area= 0.022 ac Storage= 0.025 af

Plug-Flow detention time= 17.3 min calculated for 0.087 af (100% of inflow)
Center-of-Mass det. time= 17.3 min ( 808.7 - 791.4 )

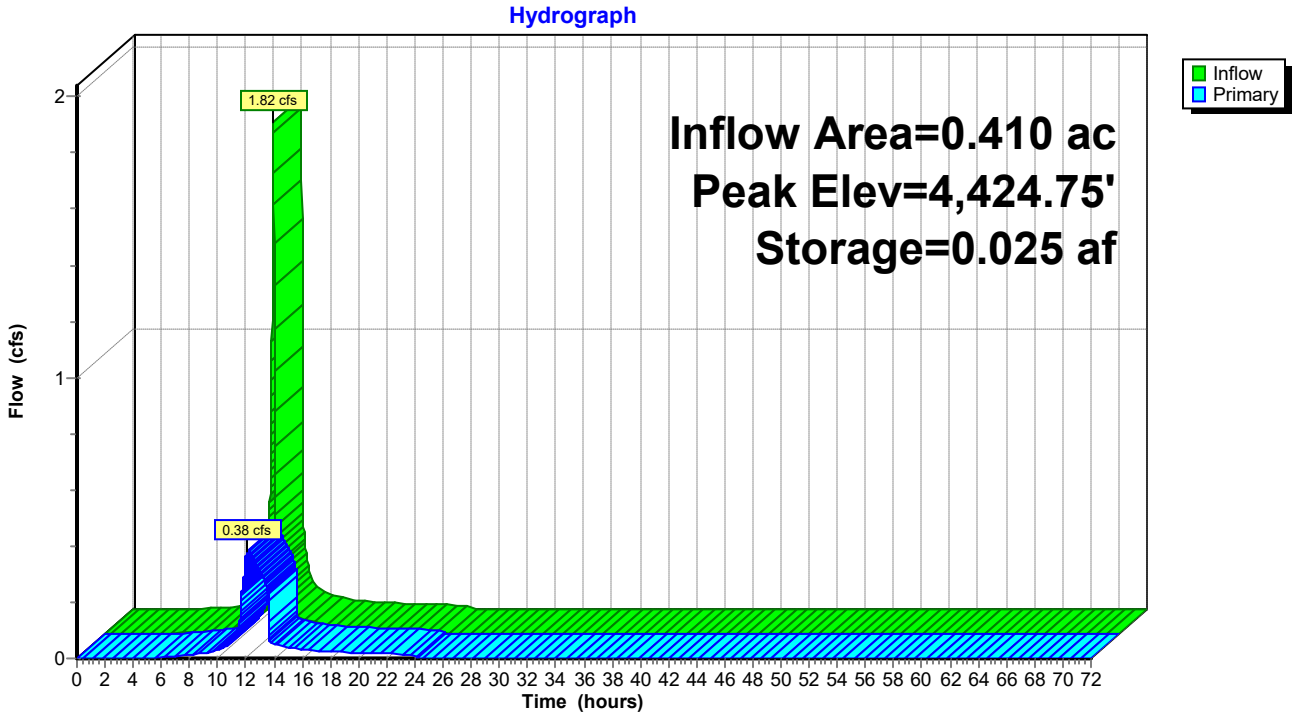
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 4,423.00' | 0.020 af | **20.50'W x 46.34'L x 3.50'H Field A**<br>0.076 af Overall - 0.025 af Embedded = 0.051 af x 40.0% Voids |
| #2A | 4,423.50' | 0.025 af | **ADS_StormTech SC-740 +Cap** x 24 Inside #1<br>Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf<br>Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap<br>24 Chambers in 4 Rows |
| | | 0.046 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 4,422.00' | **15.0" Round Culvert**<br>L= 34.0' RCP, groove end w/headwall, Ke= 0.200<br>Inlet / Outlet Invert= 4,422.00' / 4,416.00' S= 0.1765 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf |
| #2 | Device 1 | 4,422.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 4,425.50' | **Custom Weir/Orifice, Cv= 2.62 (C= 3.28)**<br>Head (feet) 0.00 1.00<br>Width (feet) 0.58 0.58 |

**Primary OutFlow** Max=0.38 cfs @ 12.10 hrs HW=4,424.75' (Free Discharge)
└**1=Culvert** (Passes 0.38 cfs of 10.76 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.38 cfs @ 7.80 fps)
  └**3=Custom Weir/Orifice** ( Controls 0.00 cfs)

## Pond 15P: (new Pond)



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.410 ac 70.73% Impervious Runoff Depth=3.17"
Tc=5.0 min CN=92 Runoff=2.23 cfs 0.108 af

**Subcatchment 15S: Bypass** Runoff Area=0.100 ac 0.00% Impervious Runoff Depth=1.85"
Tc=5.0 min CN=77 Runoff=0.34 cfs 0.015 af

**Pond 15P: (new Pond)** Peak Elev=4,425.28' Storage=0.033 af Inflow=2.23 cfs 0.108 af
Outflow=0.42 cfs 0.108 af

**Total Runoff Area = 0.510 ac Runoff Volume = 0.124 af Average Runoff Depth = 2.91"**
**43.14% Pervious = 0.220 ac 56.86% Impervious = 0.290 ac**

## Summary for Subcatchment 13S: DA 1

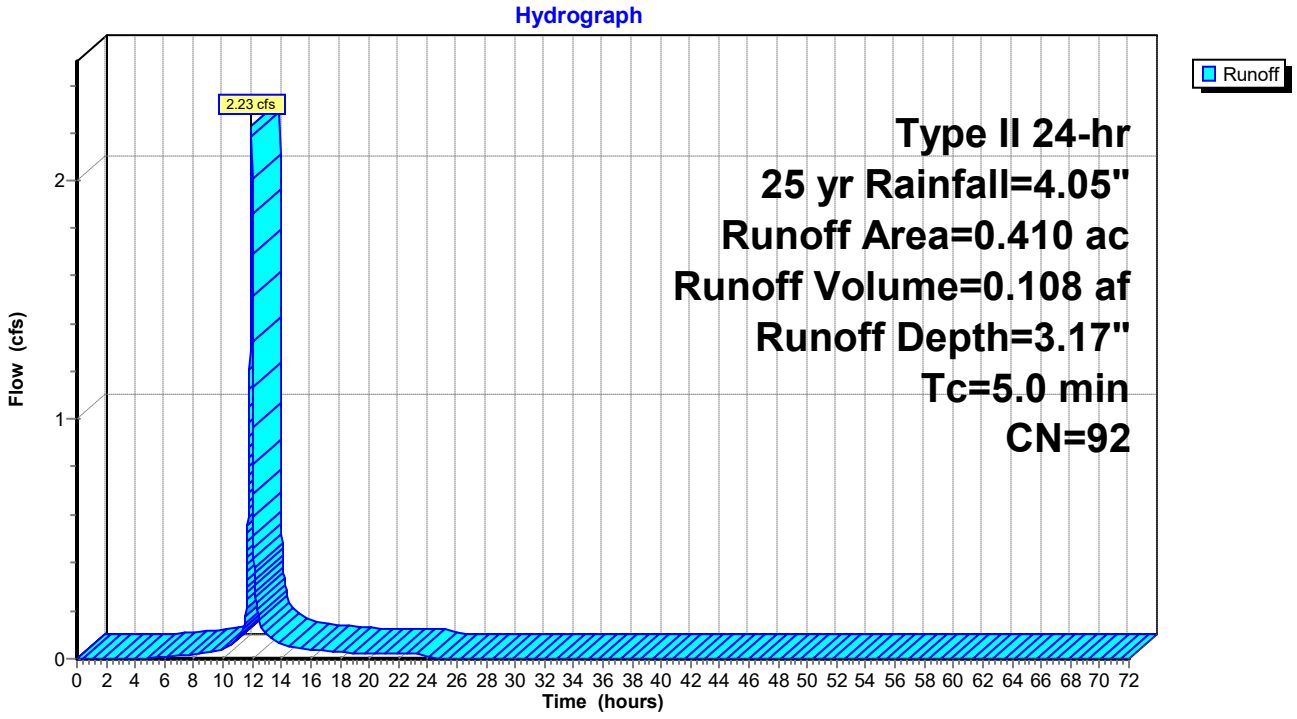
Runoff = 2.23 cfs @ 11.96 hrs, Volume= 0.108 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr Rainfall=4.05"

| Area (ac) | CN | Description |
|---|---|---|
| 0.120 | 77 | Natural western desert, HSG B |
| 0.290 | 98 | Paved parking, HSG A |
| 0.410 | 92 | Weighted Average |
| 0.120 | | 29.27% Pervious Area |
| 0.290 | | 70.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



## Summary for Subcatchment 15S: Bypass

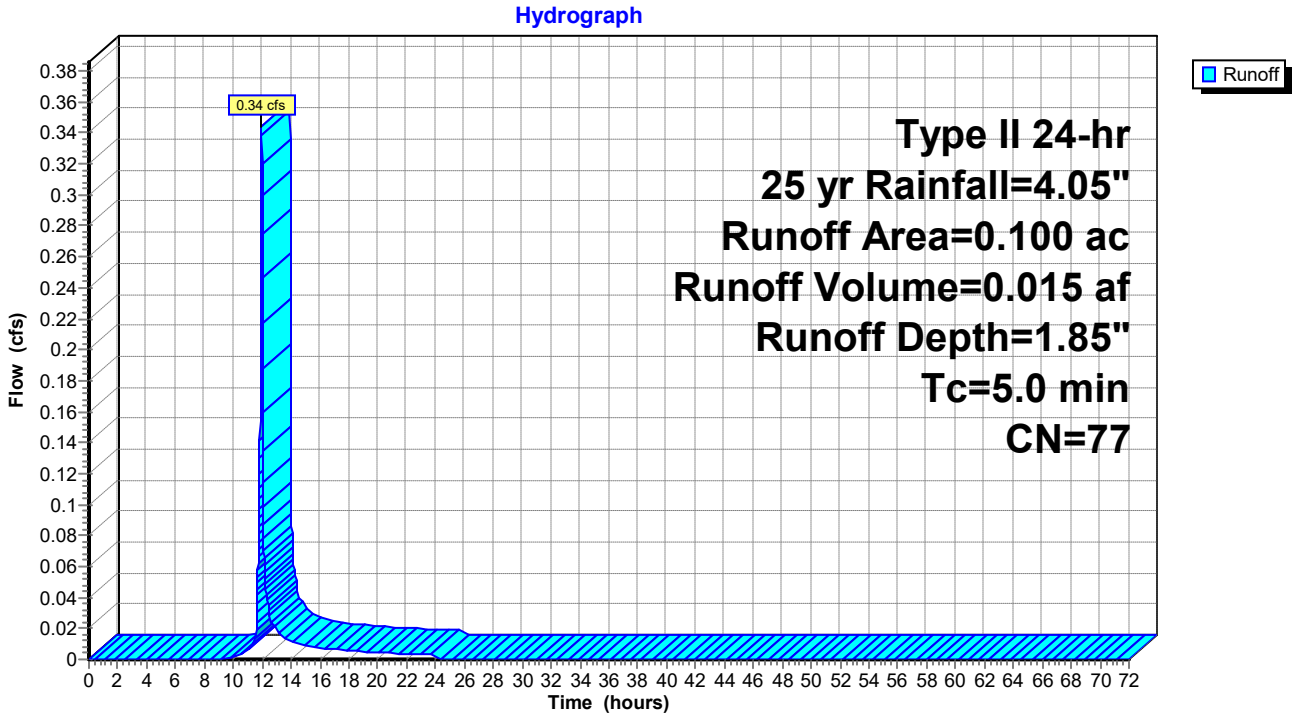
Runoff = 0.34 cfs @ 11.96 hrs, Volume= 0.015 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 yr Rainfall=4.05"

| Area (ac) | CN | Description |
|---|---|---|
| 0.100 | 77 | Natural western desert, HSG B |
| 0.100 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment 15S: Bypass



## Summary for Pond 15P: (new Pond)

Inflow Area = 0.410 ac, 70.73% Impervious, Inflow Depth = 3.17" for 25 yr event
Inflow = 2.23 cfs @ 11.96 hrs, Volume= 0.108 af
Outflow = 0.42 cfs @ 12.11 hrs, Volume= 0.108 af, Atten= 81%, Lag= 9.1 min
Primary = 0.42 cfs @ 12.11 hrs, Volume= 0.108 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,425.28' @ 12.11 hrs Surf.Area= 0.022 ac Storage= 0.033 af

Plug-Flow detention time= 21.8 min calculated for 0.108 af (100% of inflow)
Center-of-Mass det. time= 21.8 min ( 807.2 - 785.4 )

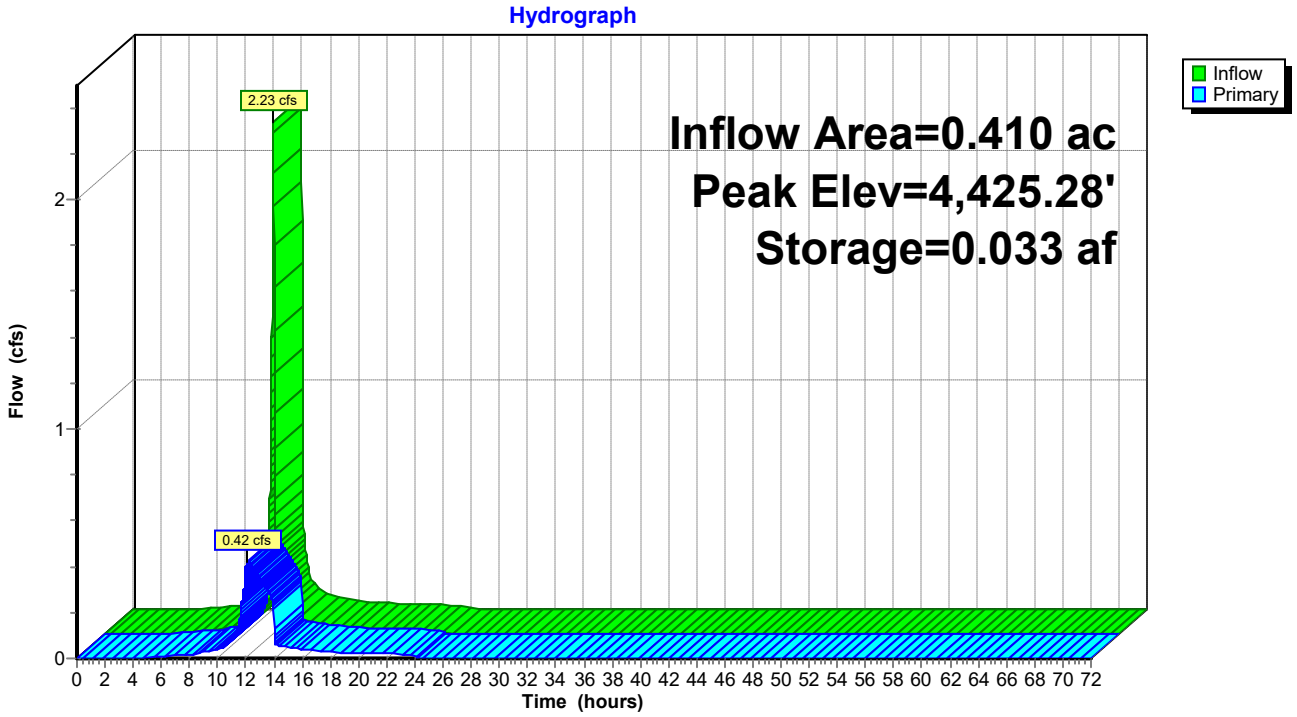
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 4,423.00' | 0.020 af | **20.50'W x 46.34'L x 3.50'H Field A**<br>0.076 af Overall - 0.025 af Embedded = 0.051 af x 40.0% Voids |
| #2A | 4,423.50' | 0.025 af | **ADS_StormTech SC-740 +Cap** x 24 Inside #1<br>Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf<br>Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap<br>24 Chambers in 4 Rows |
| | | 0.046 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 4,422.00' | **15.0" Round Culvert**<br>L= 34.0' RCP, groove end w/headwall, Ke= 0.200<br>Inlet / Outlet Invert= 4,422.00' / 4,416.00' S= 0.1765 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf |
| #2 | Device 1 | 4,422.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 4,425.50' | **Custom Weir/Orifice, Cv= 2.62 (C= 3.28)**<br>Head (feet) 0.00 1.00<br>Width (feet) 0.58 0.58 |

**Primary OutFlow** Max=0.42 cfs @ 12.11 hrs HW=4,425.28' (Free Discharge)
└**1=Culvert** (Passes 0.42 cfs of 12.04 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.42 cfs @ 8.56 fps)
  └**3=Custom Weir/Orifice** ( Controls 0.00 cfs)

## Pond 15P: (new Pond)



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

**Subcatchment 13S: DA 1** Runoff Area=0.410 ac 70.73% Impervious Runoff Depth=4.17"
Tc=5.0 min CN=92 Runoff=2.88 cfs 0.142 af

**Subcatchment 15S: Bypass** Runoff Area=0.100 ac 0.00% Impervious Runoff Depth=2.69"
Tc=5.0 min CN=77 Runoff=0.50 cfs 0.022 af

**Pond 15P: (new Pond)** Peak Elev=4,426.06' Storage=0.042 af Inflow=2.88 cfs 0.142 af
Outflow=1.27 cfs 0.142 af

**Total Runoff Area = 0.510 ac Runoff Volume = 0.165 af Average Runoff Depth = 3.88"**
**43.14% Pervious = 0.220 ac 56.86% Impervious = 0.290 ac**

## Summary for Subcatchment 13S: DA 1

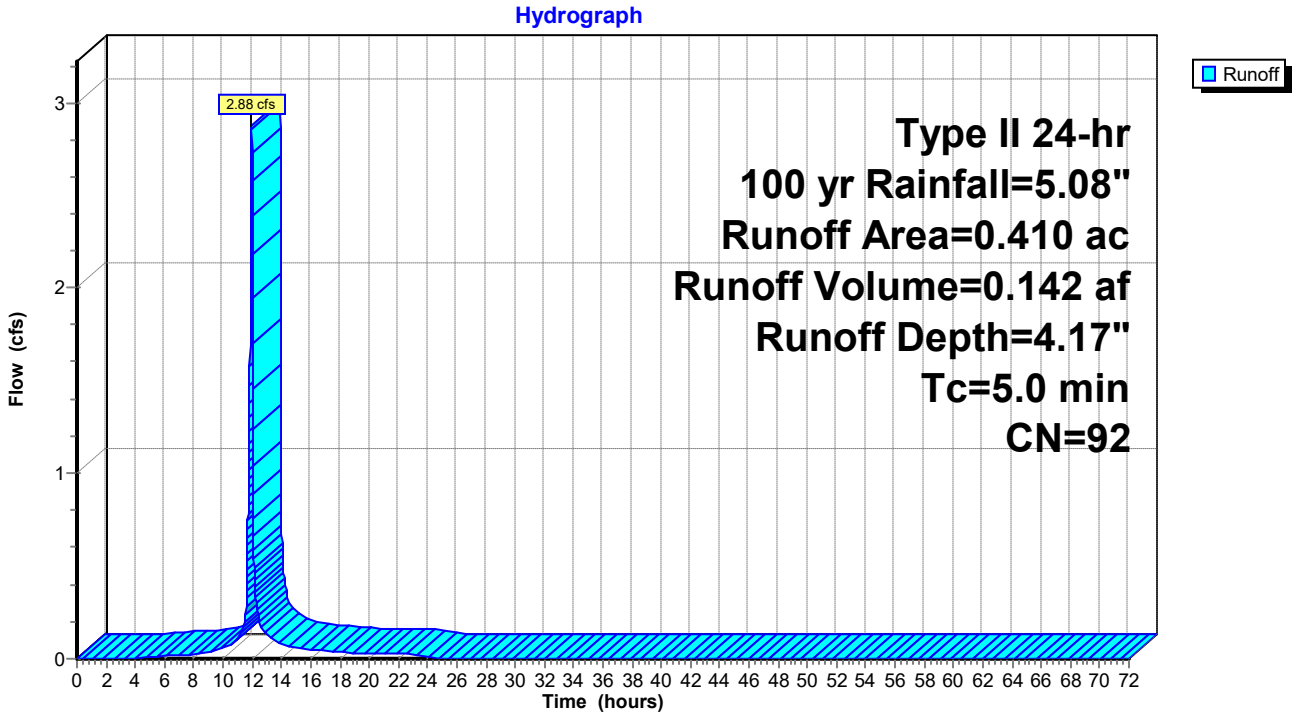
Runoff = 2.88 cfs @ 11.96 hrs, Volume= 0.142 af, Depth= 4.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr Rainfall=5.08"

| Area (ac) | CN | Description |
|---|---|---|
| 0.120 | 77 | Natural western desert, HSG B |
| 0.290 | 98 | Paved parking, HSG A |
| 0.410 | 92 | Weighted Average |
| 0.120 | | 29.27% Pervious Area |
| 0.290 | | 70.73% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

### Subcatchment 13S: DA 1



## Summary for Subcatchment 15S: Bypass

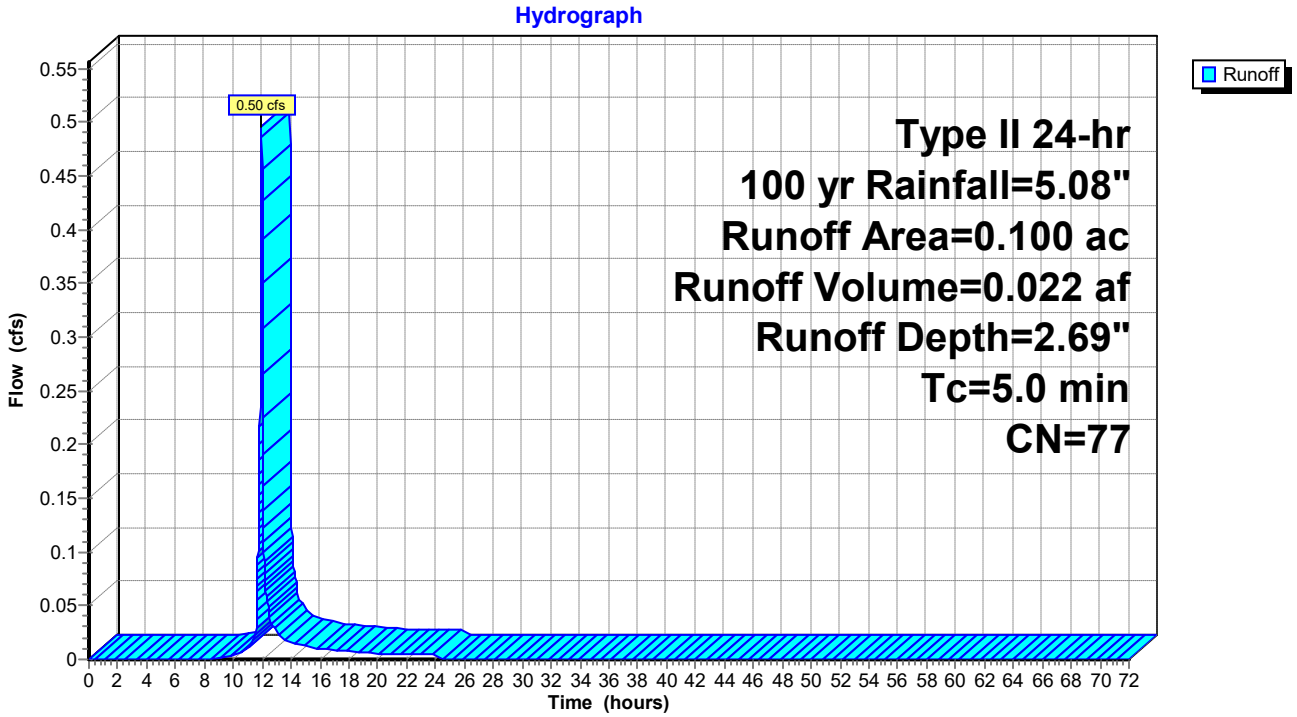
Runoff = 0.50 cfs @ 11.96 hrs, Volume= 0.022 af, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr Rainfall=5.08"

| Area (ac) | CN | Description |
|---|---|---|
| 0.100 | 77 | Natural western desert, HSG B |
| 0.100 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment 15S: Bypass



## Summary for Pond 15P: (new Pond)

Inflow Area = 0.410 ac, 70.73% Impervious, Inflow Depth = 4.17" for 100 yr event
Inflow = 2.88 cfs @ 11.96 hrs, Volume= 0.142 af
Outflow = 1.27 cfs @ 12.05 hrs, Volume= 0.142 af, Atten= 56%, Lag= 5.5 min
Primary = 1.27 cfs @ 12.05 hrs, Volume= 0.142 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 4,426.06' @ 12.05 hrs Surf.Area= 0.022 ac Storage= 0.042 af

Plug-Flow detention time= 22.8 min calculated for 0.142 af (100% of inflow)
Center-of-Mass det. time= 22.8 min ( 800.7 - 777.9 )

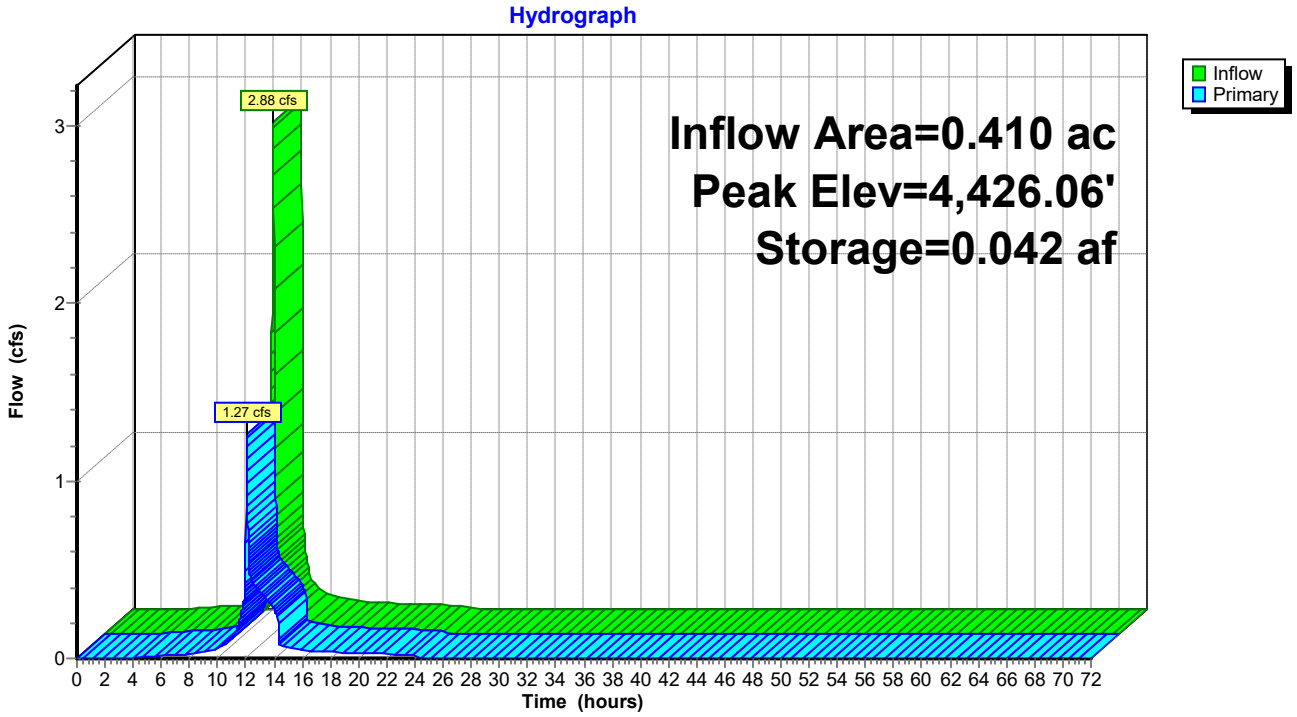
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 4,423.00' | 0.020 af | **20.50'W x 46.34'L x 3.50'H Field A**<br>0.076 af Overall - 0.025 af Embedded = 0.051 af x 40.0% Voids |
| #2A | 4,423.50' | 0.025 af | **ADS_StormTech SC-740 +Cap** x 24 Inside #1<br>Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf<br>Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap<br>24 Chambers in 4 Rows |
| | | 0.046 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 4,422.00' | **15.0" Round Culvert**<br>L= 34.0' RCP, groove end w/headwall, Ke= 0.200<br>Inlet / Outlet Invert= 4,422.00' / 4,416.00' S= 0.1765 '/' Cc= 0.900<br>n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf |
| #2 | Device 1 | 4,422.00' | **3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 4,425.50' | **Custom Weir/Orifice, Cv= 2.62 (C= 3.28)**<br>Head (feet) 0.00 1.00<br>Width (feet) 0.58 0.58 |

**Primary OutFlow** Max=1.26 cfs @ 12.05 hrs HW=4,426.06' (Free Discharge)
└**1=Culvert** (Passes 1.26 cfs of 13.69 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.47 cfs @ 9.55 fps)
  └**3=Custom Weir/Orifice** (Weir Controls 0.80 cfs @ 2.45 fps)

## Pond 15P: (new Pond)



# EXHIBIT-C

# Geotechnical Report

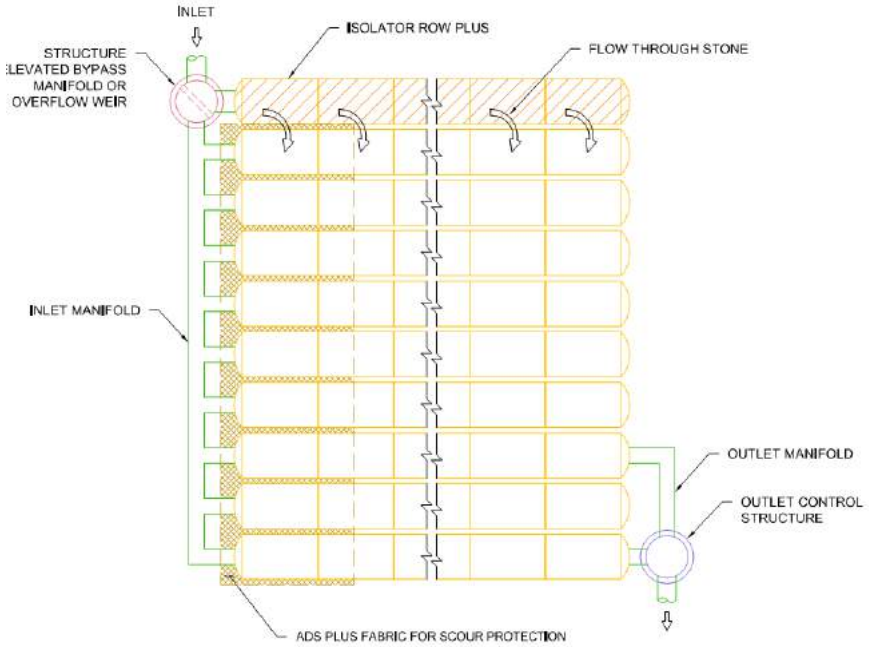
**StormTech Isolator Row PLUS – Pollutant Removal**

The following information is intended to provide a general overview of the pollutant removal capability of the StormTech Isolator™ Row PLUS, which is a patented filtration type BMP manufactured by StormTech, LLC. The StormTech Isolator Row PLUS is covered under several US and International patents.

I. Description:

The StormTech Isolator Row PLUS is a row or rows of thermoplastic chambers that sit on a layer of ADS PLUS fabric and are connected to a closely located structure for easy access. The chambers provide for settling and filtration of sediment and other contaminants as stormwater rises in the Isolator Row PLUS and ultimately passes through the fabric. The open-bottom chambers allow stormwater to flow out of the chambers. Sediment is captured in the Isolator Row PLUS, protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

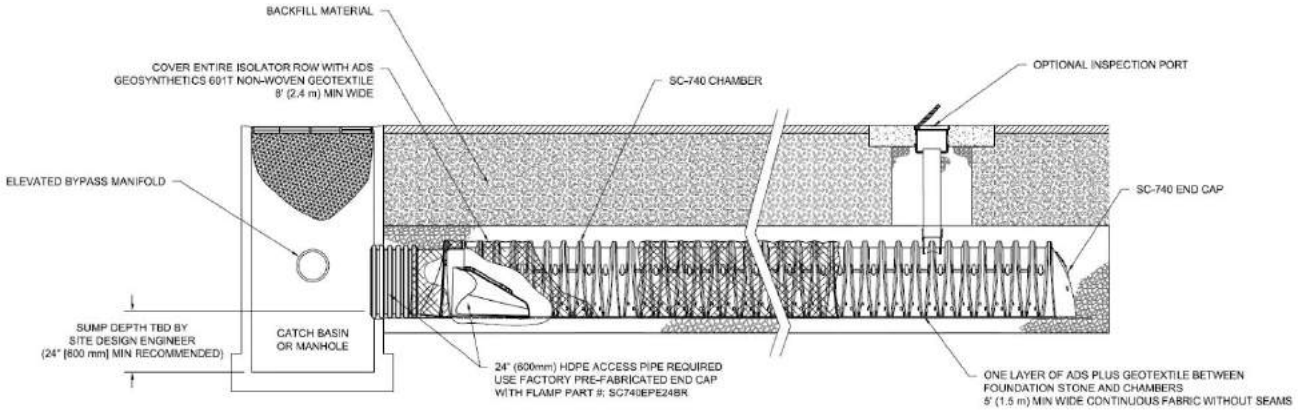
The StormTech Isolator Row PLUS is designed to capture the "first flush" and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole not only provides access to the Isolator Row but includes a high low/concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row bypass through a manifold to the other chambers. This is achieved with either a high-flow weir or an elevated manifold. This creates a differential between the Isolator Row PLUS and the manifold, thus allowing for settlement time in the Isolator Row PLUS.




**Schematic of the StormTech Isolator Row PLUS System**

Some of the unique features of the Isolator Row that contribute to its effectiveness and practicality include:

- Vast filtration surface area
- Large sediment storage volume
- Easily maintainable by most pipe and sewer maintenance companies
- Large network of ADS personnel that can help with designs and provide onsite guidance
- A state-of-the-art structural design that meets ASTM standards and incorporates AASHTO safety factors for both live loads and permanent dead loads




**Isolator Row PLUS Cross Section Detail**

II. Applicable Sites:

The Isolator Row PLUS can be effectively used for essentially all developed sites. The most common applications are highly impervious sites such as paved parking areas, roads as well as developed sites that include grassy or other landscaped areas. It is not intended to be used for construction sediments.

III. StormTech System & Isolator Row Testing:

October 2006 – Tennessee Tech University's Civil and Environmental Department prepared the "Performance Evaluation of Sediment Removal Efficiency – StormTech Isolator Row". Testing on a full-scale Isolator Row in a laboratory was done to determine the sediment removal efficiency with two different silica-water slurries in accordance with NJCAT protocols. In August of 2007, the technology was verified by NJCAT. Results are shown in Table 1.

September 2010 – The University of New Hampshire Stormwater Center released the "Final Report on Field Verification Testing of the StormTech Isolator Row Treatment Unit". Testing consisted of determining the water quality performance for multiple stormwater pollutants in accordance with TARP Tier II protocol. Testing was done for a system only consisting of the StormTech Isolator Row. Data was recorded for 23 storm events. Results are shown in Table 1.

January 2020 – BaySaver Technologies prepared the "NJCAT Technology Verification of Isolator Row PLUS". Testing on a full-scale Isolator Row PLUS in a laboratory was done to determine the sediment removal efficiency with a silica-water slurry in accordance with the updated NJCAT protocols. In July of 2020, the technology was verified by NJCAT. Results are shown in Table 1.

June 2020 – North Carolina State University Department of Biological and Agricultural Engineering prepared the technical report "An Evaluation of the StormTech Isolator Row and Subsurface Stormwater Management System at Capital Oaks Retirement Resort, Raleigh, North Carolina". 14 months of monitoring and over 73 precipitation events were completed to study the hydrologic and water quality performance of a StormTech MC-4500 system in Raleigh, NC. Results are shown in Table 1.

**Table 1: StormTech Isolator Row 3rd Party Pollutant Removal Efficiency Data**

| Pollutant | University of New Hampshire (Isolator Row Only) Median | Raleigh, North Carolina (StormTech system with Isolator Row) | Tennessee Tech University (Isolator Row Only) | NJCAT Verification (Isolator Row PLUS only) |
|---|---|---|---|---|
| Total Suspended Solids | 83%* | 91%* | 84%* | 81%** |
| Total Phosphorus | 33% | 68% | Not Tested | Not Tested |
| Total Nitrogen | Not Tested | 35% | Not Tested | Not Tested |
| Total Zinc | 81% | Not Tested | Not Tested | Not Tested |
| Total Petroleum Hydrocarbons | 91% | Not Tested | Not Tested | Not Tested |

*Based on a flow rate of 2.5 gpm/sf (Isolator Row)
** Based on a flow rate of 4.1 gpm/sf (Isolator Row PLUS)

IV. Product Performance and Design

Minimum 80% TSS removal is achieved by sizing the Isolator Row PLUS to treat the water quality at a specific flow rate per chamber floor area using a single layer of ADS PLUS fabric. The design flow rates for each chamber size are listed below.

| Model | Specific Flow Rate | Bottom Area | Flow Per Model |
|---|---|---|---|
| StormTech SC-160LP | 4.1 gpm/sf | 11.45 sf | 0.11 cfs |
| StormTech SC-310 | 4.1 gpm/sf | 17.7 sf | 0.16 cfs |
| StormTech SC-740 | 4.1 gpm/sf | 27.8 sf | 0.26 cfs |
| StormTech DC-780 | 4.1 gpm/sf | 27.8 sf | 0.26 cfs |
| StormTech MC-3500 | 4.1 gpm/sf | 42.9 sf | 0.40 cfs |
| StormTech MC-4500 | 4.1 gpm/sf | 30.1 sf | 0.28 cfs |

V. StormTech Isolator Row Approvals:

The StormTech Isolator Row and Isolator Row PLUS have been approved on a project by project basis for tens of thousands of projects around the world. Following are some examples:

- The Isolator Row PLUS is a verified filtration manufactured treatment device by the New Jersey Corporation for Advanced Testing (NJCAT) in accordance with NJDEP Filter Protocols.
- In Ohio, the Isolator Row is approved per the Ohio EPA as a pretreatment to underground storage and can be used for both storage volume and pretreatment as the water quality volume all passes through the Isolator Row.
- The Metropolitan St. Louis Sewer District (MSD) has approved the StormTech Isolator Row as a standalone post-construction stormwater Best Management Practice.
- In Massachusetts, approvals for the State DEP requirement of 80% TSS removal on an annual load basis are issued at the Conservation Commission level, and the Isolator Row is commonly used to meet these criteria.
- In Oregon, the Rogue Valley Storm Water Advisory Team (SWAT) has incorporated the StormTech Isolator Row into their Stormwater Design Manual as a pre-approved proprietary device for stormwater quality treatment.
- The Kansas City Metro Chapter of the American Public Works have included the StormTech Isolator Row wit a value rating of 3.0 in their Manual of Best Management Practices for Stormwater Quality.
- Maine DEP has approved the Isolator Row pollutant removal efficiency based on laboratory testing of 110 micron (US Silica OK-110) particle size
- In Texas, the City of Houston PWE as well as Harris county, has recognized the Isolator Row as an official water quality device.
- Under the New Environmental Technology Evaluation program, the Ontario (Canada) Ministry of the Environment has evaluated the Isolator row and issued a Certificate of Technology Assessment
- The Isolator Row PLUS has been evaluated and approved for Canadian Environment Technology Verification (ETV) by VerifiGlobal.

V. Isolator Row Maintenance:

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location, based upon site-specific variables. The type of land use (i.e. industrial, commercial, public, residential), anticipated pollutant load, percent imperviousness, climate, rainfall data, etc., all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection schedule should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If, upon visual inspection, it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediment to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout.

Maintenance is accomplished with the jetvac process. The jetvac process utilizes a high-pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediment. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/jetvac combination vehicles. Selection of an appropriate jetvac nozzle will improve maintenance efficiency.

Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear-facing jets with an effective spread of at least 45" are best. Most jetvac reels have 200 feet of hose, allowing maintenance of an Isolator Row up to 50 chambers long. The jetvac process shall only be performed on StormTech Isolator Rows that have fabric specified by StormTech over their angular base stone.

Complete details of the design, operation, and maintenance of the Isolator Row PLUS can be found in the StormTech Isolator Row and Isolator Row PLUS O&M Manuals.

# EXHIBIT-C

# Geotechnical Report

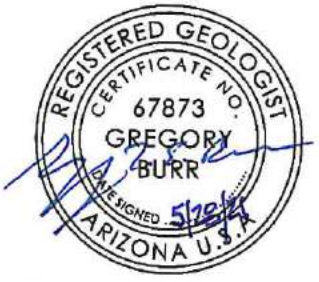
Western Technologies Inc.

# GEOTECHNICAL EVALUATION REPORT

**COMMERCIAL LUBE CENTER**
80 Posse Ground Road
Sedona, Arizona
WT Reference No. 2521JW085

**PREPARED FOR:**
Sedona Take Five, LLC
106 Foster Avenue
Charlotte, North Carolina 28203

May 28, 2021




Gregory L. E. Burr, R.G., E.I.T.
Geotechnical Project Manager


Craig P. Wiedeman, P.E.
Senior Geotechnical Engineer

**Western Technologies Inc.**
The Quality People
Since 1955

2400 East Huntington Drive
Flagstaff, Arizona 86004-8934
(928) 774-8700 • fax 774-6469

May 28, 2021

Sedona Take Five, LLC
106 Foster Avenue
Charlotte, North Carolina 28203

Attn: Mr. Bill Burwood

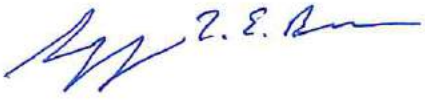
Re: Geotechnical Evaluation
Commercial Lube Center
80 Posse Ground Road
Sedona, Arizona

Job No. 2521JW085

Western Technologies Inc. has completed the geotechnical evaluation for the proposed commercial lube center to be located in Sedona, Arizona. This study was performed in general accordance with our proposal number 2521PW022 dated January 25, 2021. The results of our study, including the boring location diagram, laboratory test results, boring logs, and the geotechnical recommendations are attached.

We have appreciated being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. If design conditions change, or if you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us. We look forward to working with you on future projects.

Sincerely,
WESTERN TECHNOLOGIES, INC.
Geotechnical Engineering Services



Gregory L. E. Burr, R.G., E.I.T.
Geotechnical Project Manager

Copies to: Addressee (emailed)

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## TABLE OF CONTENTS (Continued)

# GEOTECHNICAL EVALUATION
# COMMERCIAL LUBE CENTER
# 80 POSSE GROUND ROAD
# SEDONA, ARIZONA
# JOB NO. 2521JW085

## 1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the proposed commercial lube center to be located at 80 Posse Ground Road in Sedona, Arizona. The purpose of these services is to provide information and recommendations regarding:

- foundation design parameters
- floor slab support
- lateral earth pressures
- earthwork
- drainage
- corrosivity to concrete
- on-site pavements

Results of the field exploration, field tests, and laboratory testing program are presented in the Appendices.

## 2.0 PROJECT DESCRIPTION

Based on information provided by Bill Burdwood with Durban Development, the proposed project will consist of a single-story commercial building with a plan area of approximately 1,500 square feet to be constructed on a 0.43-acre lot. It is assumed the structure will use wood frame and/or masonry construction with a slab-on-grade floor. Maximum wall and column loads for the structure are assumed to be 2.5 kips per linear foot and 35 kips, respectively. We anticipate no extraordinary slab-on-grade criteria and that the finished floor level will be within about 2 feet of the existing site grade. On-site pavement will be included as part of the development. Should any of our information or assumptions not be correct, we request that the Client notify Western Technologies (WT) immediately.

# 3.0 SCOPE OF SERVICES

## 3.1 Field Exploration

Six borings were drilled to depths of about 2 to 5 feet below existing site grades at the approximate locations shown on the attached boring location diagram. Logs of the borings are presented in Appendix A. Subsoils encountered during drilling were examined visually and sampled at selected depth intervals. A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs, included in Appendix A, represent our interpretation of the field logs and include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thicknesses, and the locations where samples were obtained. The Unified Soil Classification System was used to classify soils. The soil classification symbols appear on the boring logs and are briefly described in Appendix A. Local and regional geologic characteristics were used to estimate the seismic design criteria and liquefaction potential.

## 3.2 Laboratory Analyses

Laboratory analyses were performed on representative soil samples to aid in material classification and to estimate pertinent engineering properties of the on-site soils for preparation of this report. Testing was performed in general accordance with applicable standard test methods. The following tests were performed and the results are presented in Appendix B.

- Water content
- Dry density
- Compression
- Remolded expansion potential
- Gradation
- Plasticity
- Water-soluble salt/sulfate/chloride content

Test results were utilized in the development of the recommendations contained in this report.

### 3.3 Analyses and Report

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and design recommendations as appropriate to the purpose. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site, discovery of underground storage tanks or other underground structures, or identification of contaminated or hazardous materials or conditions. If there is concern about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

## 4.0 SITE CONDITIONS

### 4.1 Surface

At the time of our field exploration, the site was an undeveloped commercial lot. The site is bordered on the north and east by developed commercial lots, on the west by Posse Ground Road, and on the south by Arizona Route 89A. The ground surface was smooth and exhibited a gentle, near-flat slope down to the south. Site surface drainage appeared to be fair to poor by means of sheet flow to the south. Evidence of previous surface water ponding was observed on the site at the time of our field exploration. Vegetation on the site consisted of a sparse to moderate growth of native juniper trees, cacti, grasses and weeds.

### 4.2 Subsurface

As presented on the boring logs, shallow surface soils extending to the full depth of exploration were found to be very dense, non-plastic Silty SANDS and hard, medium plasticity CLAYS, both with variable amounts of gravel, cobbles and boulders. Refusal to auger penetration occurred in all borings at depths of about 2 to 5 feet on SANDSTONE. Groundwater was not encountered in any boring at the time of exploration. The logs in Appendix A show details of the subsurface conditions encountered during the field exploration.

The boring logs included in this report are indicators of subsurface conditions only at the specific location and date noted. Variations from the field conditions represented by the

borings may become evident during construction. If variations appear, we should be contacted to re-evaluate our recommendations.

## 5.0 GEOTECHNICAL PROPERTIES AND ANALYSIS

### 5.1 Laboratory Tests

Laboratory test results (see Appendix B) indicate that native subsoils exhibit moderate compressibility at existing water contents. Moderately high additional compression occurs when the water content is increased.

Near-surface native soils are of nil to medium plasticity. These soils exhibit low to no expansion potential when recompacted, confined by loads approximating floor loads and saturated in accordance with standard Arizona test methods. Slabs-on-grade supported on recompacted native soils have a low potential for heaving if the water content of the soil increases. Densification of the soil by the passage of construction equipment will increase the expansion potential of the native soil.

### 5.2 Field Tests

Native subsoils exhibited high resistance to penetration using test method ASTM D3550.

## 6.0 RECOMMENDATIONS

### 6.1 General

Recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0 and the assumption that the soil and subsurface conditions are those disclosed by the explorations. Others may change the plans, final elevations, number and type of structures, foundation loads, and floor levels during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

## 6.2 Design Considerations

Laboratory test results indicate that the site soils become weaker and more compressible with an increase in moisture content. These soils are not considered suitable for support of foundations and concrete slabs in their present state and should be over-excavated and/or recompacted as recommended in the **EARTHWORK** section of this report. Proper drainage should be provided to help prevent infiltration of moisture below the foundations and concrete slabs.

Cobbles and boulders were encountered in the borings. These oversized materials, greater than 6 inches, could present construction difficulties for foundation, utility trench, and other excavations. In cut areas and excavations, exposed oversized materials should be removed.

## 6.3 Foundations

The proposed structure can be supported by conventional shallow spread footings bearing on dense sandstone and/or lean mix (2-sack) concrete backfill extending to dense sandstone. Footings should bear at least 2 feet below the lowest adjacent finished grade. Footings may be designed to impose a maximum dead plus live-load pressure of up to 3500 pounds per square foot.

Total and differential settlement of foundation elements bearing on dense sandstone or on lean mix concrete backfill extending to dense sandstone should be nominal. Finished grade is the lowest adjacent grade for perimeter footings and floor slab level for interior footings. The design bearing capacity applies to dead loads plus design live load conditions. Recommended minimum widths of column and wall footings are 24 inches and 16 inches, respectively. The bearing value given is a net bearing value and the weight of the concrete in the footings may be ignored. All footings, stem walls and masonry walls should be reinforced to reduce the potential for distress caused by differential foundation movements. The use of joints at openings or other discontinuities in masonry walls is recommended.

We recommend that the geotechnical engineer or his representative observe the footing excavations before reinforcing steel and concrete are placed. It should be determined whether the rock materials exposed are similar to those anticipated for support of the footings. Any soft, loose or unacceptable materials should be undercut to suitable materials and backfilled with either lean mix or structural concrete.

## 6.4 Lateral Design Criteria

For retaining walls located above any free water surface with no surcharge loads, recommended equivalent fluid pressures and coefficients of base friction for unrestrained elements are:

- Active:
  Undisturbed subsoil .....36 psf/ft
  Compacted granular backfill .....30 psf/ft
  Compacted site soils .....36 psf/ft

- Passive:
  Shallow wall footings .....225 psf/ft
  Shallow column footings.....325 psf/ft

- Coefficient of base friction.....0.35*

  * The coefficient of base friction should be reduced to 0.25 when used in conjunction with passive pressure.

Where the design includes restrained elements, the following equivalent fluid pressures are recommended:

- At-rest:
  Undisturbed subsoil .....62 psf/ft
  Compacted granular backfill .....55 psf/ft

These lateral earth pressures are not applicable for submerged soils. We should be consulted for additional recommendations if such conditions are to be included in the design. Any surcharge from adjacent loadings must also be considered. Walls below grade should be waterproofed.

We recommend a free-draining soil layer or manufactured geocomposite material, be constructed adjacent to the back of the retaining wall. A filter may be required between the soil backfill and drainage layer. This drainage zone should help prevent hydrostatic pressure buildup. This vertical drain should be tied into a gravity drainage system at the base of the retaining wall. It is important that all backfill be properly placed and compacted. Backfill should be mechanically compacted in layers. Flooding or jetting

should not be permitted. Care should be taken not to damage the walls when placing the backfill. Backfills should be inspected and tested during placement.

Fill against footings, stem walls and retaining walls should be compacted to densities specified in **EARTHWORK**. Medium to high plasticity clay soils should not be used as backfill against retaining walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause excessive lateral earth pressures which could result in wall movements.

## 6.5 Seismic Considerations

Structures should be designed in accordance with applicable building codes. The seismic design parameters presented in the following table, in accordance with the 2018 International Building Code and ASCE 7-16, are applicable to the project site:

| Seismic Design Parameters<br>International Building Code 2018, ASCE 7-16 | |
|---|---|
| Soil Site Class | C |
| Mapped Spectral Response Acceleration at 0.2 sec period ($S_s$) | 0.295g |
| Mapped Spectral Response Acceleration at 1.0 sec period ($S_1$) | 0.093g |
| Site Coefficient for 0.2 sec period ($F_a$) | 1.3 |
| Site Coefficient for 1.0 sec period ($F_v$) | 1.5 |
| Design Spectral Response Acceleration at 0.2 sec period ($S_{DS}$) | 0.255g |
| Design Spectral Response Acceleration at 1.0 sec period ($S_{D1}$) | 0.093g |

The soil site class is based upon conditions identified in shallow exploratory borings and local knowledge of the geotechnical conditions in the vicinity of the site. Conditions extending beyond the depth of our borings to a depth of 100 feet were assumed for the purposes of providing the information presented in the table. Based upon the density of the on-site soils, the shallow rock conditions and lack of groundwater, the potential settlement and lateral spread due to liquefaction is not a considered to be a significant concern on this site.

## 6.6 Conventional Slab-on-Grade Support

Floor slabs can be supported on properly placed and compacted fill or approved, properly recompacted, low expansive potential native soils. For design of interior slabs-on-grade, we recommend using a modulus of subgrade reaction (k) of 225 pounds per cubic inch (pci) for the on-site soils or imported fill material, based on a 30-inch diameter plate. The slab subgrade should be prepared by the procedures outlined in this report. A minimum 4-inch thick layer of base course should be provided beneath all slabs to help prevent capillary rise and a damp slab. The use of vapor retarders is desirable for any slab-on-grade where the floor will be covered by products using water based adhesives, wood, vinyl backed carpet, impermeable floor coatings (urethane, epoxy, acrylic terrazzo, etc.) or where the floor will be in contact with moisture sensitive equipment or product. When used, the design and installation should be in accordance with the guidance provided in ACI 302.1R and 302.2R. Final determination on the use of a vapor retarder should be left to the slab designer.

All concrete placement and curing operations should follow the American Concrete Institute manual recommendations. Improper curing techniques and/or high slump (water-cement ratio) could cause excessive shrinkage, cracking or curling. The plastic properties of the concrete should be documented at the time of placement and specimens should also be prepared for strength testing to verify compliance with project specifications. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture sensitive floor covering.

## 6.7 Drainage

The major cause of soil-related foundation and slab-on-ground problems is moisture increase in soils below structures. Properly functioning conventional foundations and floor slabs-on-ground require appropriately constructed and maintained site drainage conditions. Therefore, it is extremely important that positive drainage be provided during construction and maintained throughout the life of the structure. It is also important that proper planning and control of landscape and irrigation practices be performed.

Infiltration of water into utility or foundation excavations must be prevented during construction. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to minimize the possibility of moisture infiltration. If utility line trenches are backfilled with a granular

material, then a clay or concrete plug should be placed in the trench adjacent to the structure to prevent water from following the trench back under the structure.

In areas where sidewalks, patios or driveways do not immediately adjoin the structure, protective slopes should be provided with an outfall of about 5 percent for at least 10 feet from perimeter walls. Scuppers and drain pipes should be designed to provide drainage away from the structure for a minimum distance of 10 feet. Planters or other surface features that could retain water adjacent to the structure should be avoided if at all possible. If planters and/or landscaping are adjacent to or near the structure, there will be a greater potential for moisture infiltration, soil movement and structure distress. As a minimum, we recommend the following:

- Grades should slope away from the structure.
- Planters should slope away from the structure and should not pond water. Drains should be installed in enclosed planters to facilitate flow out of the planters.
- Only shallow rooted landscaping should be used.
- Watering should be kept to a minimum. Irrigation systems should be situated on the far side of any planting and away from the structure to minimize infiltration beneath foundations from possible leaks.
- Trees should be planted no closer than a distance equal to three-quarters of their mature height or 15 feet, whichever is greater.

It should be understood that these recommendations will help minimize the potential for soil movement and resulting distress, but will not eliminate this potential.

## 6.8 Corrosivity to Concrete

The chemical test results indicate that the site soils are negligibly corrosive to concrete. However, in order to be consistent with standard local practice and for reasons of material availability, we recommend that Type II portland cement be used for all concrete on and below grade.

## 6.9 Pavements

Based on existing subgrade conditions, the following pavement sections are recommended for the areas indicated:

| Traffic Area | Asphalt Concrete (in.) | Base Course (in.) |
|---|---|---|
| Passenger car parking/drives (low traffic frequency) | 3 | 4 |
| Major access drives (medium traffic frequency) | 4 | 5 |

Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphalt concrete. Base course and asphalt concrete should conform with City of Sedona or Yavapai County specifications.

Material and compaction requirements should conform to recommendations presented under **EARTHWORK**. The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections. The native subgrade soils will soften and lose stability if subjected to conditions which result in an increase in water content.

Due to the high static loads imposed by parked trucks in loading and unloading areas and at dumpster locations, we recommend that a rigid pavement section be considered for these areas. A minimum 6-inch thick concrete pavement over 4 inches of aggregate base course material is recommended.

### 6.9.1 Pavement Analyses

The recommended pavement sections are based on the following conditions. This firm should be contacted if any of these conditions change so that revised recommendations can be provided, if necessary.

a. A correlated R-value of 30 for the on-site soils which corresponds to a resilient modulus of approximately 10,500 pounds per square inch. Any required fills should be constructed using on-site or imported materials with subgrade support characteristics equal to or greater than the subgrade soils in the area being filled.

b. Structural coefficients of 0.40 for asphalt concrete and 0.12 for aggregate base course material.

c. A present serviceability index of 4.5, a terminal serviceability index of 2.5, an overall standard deviation of 0.35, a reliability factor of 85 percent, a drainage coefficient of 0.85, a seasonal variation factor of 2.4, and a design life of 20 years.

d. An assumed total 18-kip equivalent single axle load (ESAL) of 25,000 for the passenger car parking areas and 50,000 for the major access drives areas.

## 7.0 EARTHWORK

### 7.1 General

The conclusions contained in this report for the proposed construction are contingent upon compliance with recommendations presented in this section. Any excavating, trenching, or disturbance that occurs after completion of the earthwork must be backfilled, compacted and tested in accordance with the recommendations contained herein. It is not reasonable to rely upon our conclusions and recommendations if any future unobserved and untested trenching, earthwork activities or backfilling occurs.

### 7.2 Site Clearing

Strip and remove all vegetation, debris, and any other deleterious materials from the building and pavement areas. The building area is defined as that area within the building footprint plus 5 feet beyond the perimeter of that footprint. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

### 7.3 Excavation

We anticipate that excavations into the site soils for the proposed construction can be accomplished with conventional equipment. Excavations penetrating the underlying sandstone will require the use of heavy-duty, specialized equipment to facilitate rock break up and removal.

On-site soils may pump or become unworkable at high water contents. Workability may be improved by scarifying and drying. Overexcavation of wet zones and replacement with drier granular materials may be necessary. The use of lightweight excavation and compaction equipment may be required to minimize subgrade pumping.

## 7.4 Foundation Preparation

Specialized treatment of dense sandstone within foundation areas is not required. Remove all loose or disturbed materials from the bottoms and sides of the excavations prior to the placement of foundation concrete. If desired, lean mix (2-sack) concrete backfill may be used between the design bottom of footing elevation and the top of the dense rock.

## 7.5 Conventional Interior Slab Preparation

Scarify, moisten or dry as required, and compact all subgrade soils to a minimum depth of 8 inches. The subgrade preparation should be accomplished in a manner that will result in uniform water contents and densities after compaction. All subgrade preparation in the building area should extend a minimum of 5 feet beyond perimeter footings.

## 7.6 Pavement Preparation

Prior to placement of fill and/or pavement materials, the exposed subgrade soils should be proof-rolled and observed by the geotechnical engineer or his qualified representative to verify that stable subgrade conditions exist. Any loose, soft, disturbed, or otherwise unsuitable materials should be over-excavated and replaced with engineered fill. The subgrade should then be scarified, moisture conditioned as required, and recompacted for a minimum depth of 8 inches.

## 7.7 Materials

a. Clean on-site soils with low expansive potentials and maximum dimension of 6 inches or imported materials may be used as fill material for the following:

- Interior slab areas
- Backfill
- Pavement areas

b. Frozen soils should not be used as fill or backfill.

c. Lean mix (2-sack) concrete backfill should consist of aggregate base course type material combined with 2 sacks of cement per cubic yard. A coarse rock mix should not be used.

d. Imported soils should conform to the following:

- Gradation (ASTM C136): percent finer by weight

| | |
|---|---|
| 6" | 100 |
| 4" | 85-100 |
| ¾" | 70-100 |
| No. 4 Sieve | 50-100 |
| No. 200 Sieve | 40 (max) |

- Maximum expansive potential (%)[1] ..... 1.5

- Maximum soluble sulfates (%) ..... 0.10

e. Base course should conform to current City of Sedona or Yavapai County specifications.

## 7.8 Placement and Compaction

a. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

b. Uncompacted lift thickness should not exceed 8 inches.

c. No fill should be placed over frozen ground.

[1] Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about 3 percent below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

c. Materials should be compacted to the following:

| Material Compaction (ASTM D698) | Minimum Percent |
|---|---|
| • On-site or imported soil, reworked and fill: | |
| Below slabs-on-grade | 90 |
| Pavement areas | 95 |
| • Aggregate base: | |
| Below slabs-on-grade | 95 |
| Pavement areas | 100 |
| • Structural backfill | 95 |
| • Nonstructural backfill | 90 |

d. On-site and imported soils with low expansive potential and aggregate base course materials should be compacted with a moisture content in the range of 3 percent below to 3 percent above optimum.

### 7.9 Compliance

Recommendations for foundations and slabs-on-grade supported on compacted fills or prepared subgrade depend upon compliance with the **EARTHWORK** recommendations. To assess compliance, observation and testing should be performed under the direction of a WT geotechnical engineer. Please contact us to provide these observation and testing services.

## 8.0 ADDITIONAL SERVICES

The recommendations provided in this report are based on the assumption that a sufficient schedule of tests and observations will be performed during construction to verify compliance. At a minimum, these tests and observations should be comprised of the following:

- Observations and testing during site preparation and earthwork,

- Observation of foundation excavations, and
- Consultation as may be required during construction.

Retaining the geotechnical engineer who developed your report to provide construction observation is the best way to verify compliance and to help you manage the risks associated with unanticipated conditions.

## 9.0 LIMITATIONS

This report has been prepared assuming the project criteria described in **2.0 PROJECT DESCRIPTION**. If changes in the project criteria occur, or if different subsurface conditions are encountered or become known, the conclusions and recommendations presented herein shall become invalid. In any such event, WT should be contacted in order to assess the effect that such variations may have on our conclusions and recommendations. If WT is not retained for the construction observation and testing services to determine compliance with this report, our professional responsibility is accordingly limited.

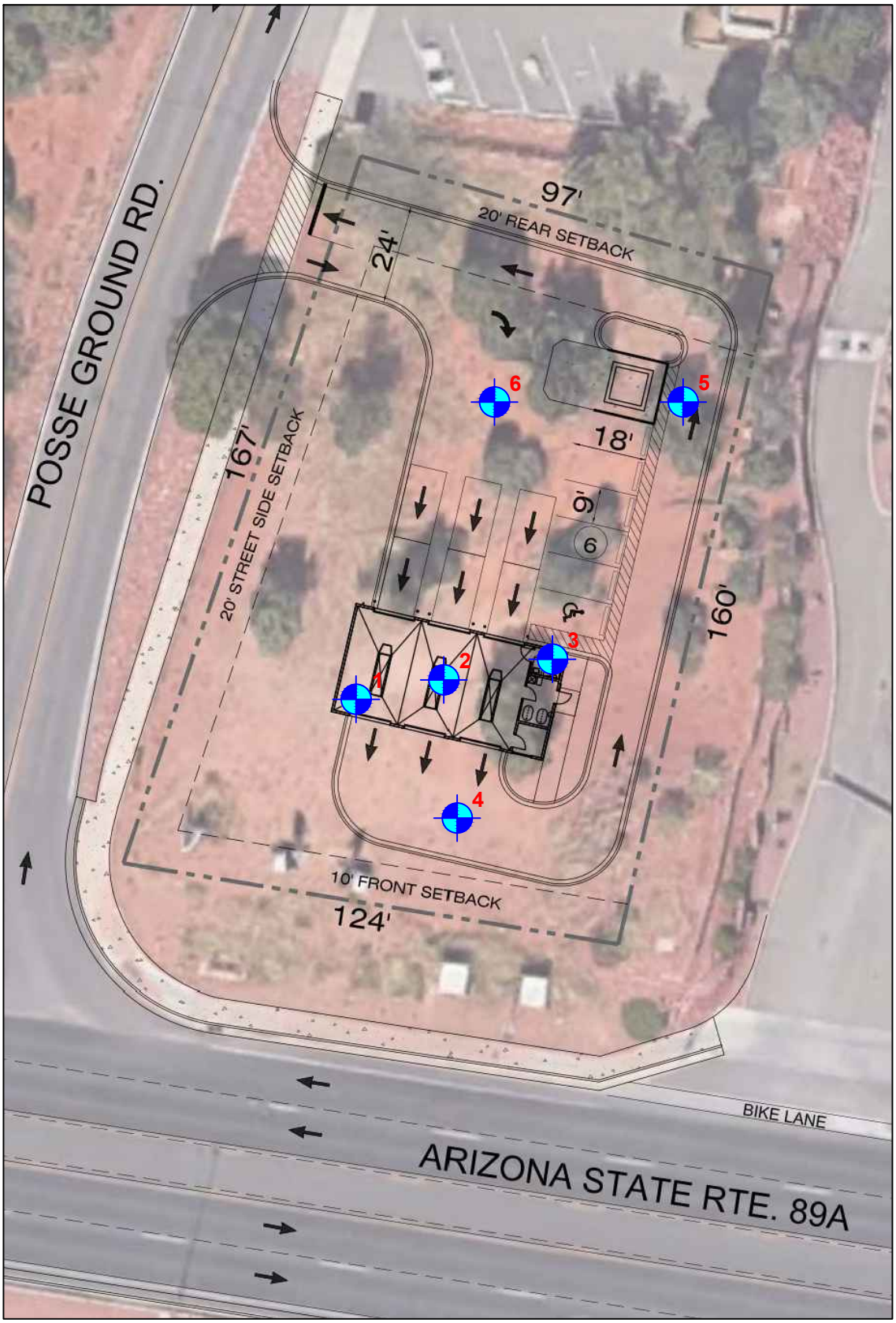
The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced explorations. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure between explorations, however variations can and often do exist. Whenever any deviation, difference, or change is encountered or becomes known, WT should be contacted.

This report is for the exclusive benefit of our client alone. There are no intended third-party beneficiaries of our contract with the client or this report, and nothing contained in the contract or this report shall create any express or implied contractual or any other relationship with, or claim or cause of action for, any third party against WT.

This report is valid for the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall rely on this report without the express written authorization of WT.

## 10.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon data obtained at the location of the explorations, and from laboratory tests. Work on your project was performed in accordance with generally accepted standards and practices utilized by professionals providing similar services in this locality. No other warranty, express or implied, is made.




N Not to Scale

Approximate Test Boring Location

Geotechnical Environmental Inspections Materials

Western Technologies Inc. The Quality People Since 1955

| | |
|---|---|
| COMMERCIAL LUBE CENTER | |
| Boring Location Diagram | |
| **Western Technologies Inc.** | |
| Job No.: 2521JW085 | Plate: 1 |

| | |
|---|---|
| **Allowable Soil Bearing Capacity** | The recommended maximum contact stress developed at the interface of the foundation element and the supporting material. |
| **Backfill** | A specified material placed and compacted in a confined area. |
| **Base Course** | A layer of specified aggregate material placed on a subgrade or subbase. |
| **Base Course Grade** | Top of base course. |
| **Bench** | A horizontal surface in a sloped deposit. |
| **Caisson/Drilled Shaft** | A concrete foundation element cast in a circular excavation which may have an enlarged base (or belled caisson). |
| **Concrete Slabs-On-Grade** | A concrete surface layer cast directly upon base course, subbase or subgrade. |
| **Crushed Rock Base Course** | A base course composed of crushed rock of a specified gradation. |
| **Differential Settlement** | Unequal settlement between or within foundation elements of a structure. |
| **Engineered Fill** | Specified soil or aggregate material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer. |
| **Existing Fill** | Materials deposited through the action of man prior to exploration of the site. |
| **Existing Grade** | The ground surface at the time of field exploration. |
| **Expansive Potential** | The potential of a soil to expand (increase in volume) due to absorption of moisture. |
| **Fill** | Materials deposited by the actions of man. |
| **Finished Grade** | The final grade created as a part of the project. |
| **Gravel Base Course** | A base course composed of naturally occurring gravel with a specified gradation. |
| **Heave** | Upward movement. |
| **Native Grade** | The naturally occurring ground surface. |
| **Native Soil** | Naturally occurring on-site soil. |
| **Rock** | A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation. |
| **Sand and Gravel Base Course** | A base course of sand and gravel of a specified gradation. |
| **Sand Base Course** | A base course composed primarily of sand of a specified gradation. |
| **Scarify** | To mechanically loosen soil or break down existing soil structure. |
| **Settlement** | Downward movement. |
| **Soil** | Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water. |
| **Strip** | To remove from present location. |
| **Subbase** | A layer of specified material placed to form a layer between the subgrade and base course. |
| **Subbase Grade** | Top of subbase. |
| **Subgrade** | Prepared native soil surface. |

## COARSE-GRAINED SOILS

LESS THAN 50% FINES

| GROUP SYMBOLS | DESCRIPTION | MAJOR DIVISIONS |
|---|---|---|
| **GW** | WELL-GRADED GRAVEL OR WELL-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES | GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE |
| **GP** | POORLY-GRADED GRAVEL OR POORLY-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES | |
| **GM** | SILTY GRAVEL OR SILTY GRAVEL WITH SAND, MORE THAN 12% FINES | |
| **GC** | CLAYEY GRAVEL OR CLAYEY GRAVEL WITH SAND, MORE THAN 12% FINES | |
| **SW** | WELL-GRADED SAND OR WELL-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES | SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE |
| **SP** | POORLY-GRADED SAND OR POORLY-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES | |
| **SM** | SILTY SAND OR SILTY SAND WITH GRAVEL, MORE THAN 12% FINES | |
| **SC** | CLAYEY SAND OR CLAYEY SAND WITH GRAVEL, MORE THAN 12% FINES | |

**NOTE:** Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

## FINE-GRAINED SOILS

MORE THAN 50% FINES

| GROUP SYMBOLS | DESCRIPTION | MAJOR DIVISIONS |
|---|---|---|
| **ML** | SILT, SILT WITH SAND OR GRAVEL, SANDY SILT, OR GRAVELLY SILT | SILTS AND CLAYS LIQUID LIMIT LESS THAN 50 |
| **CL** | LEAN CLAY OF LOW TO MEDIUM PLASTICITY, SANDY CLAY, OR GRAVELLY CLAY | |
| **OL** | ORGANIC SILT OR ORGANIC CLAY OF LOW TO MEDIUM PLASTICITY | |
| **MH** | ELASTIC SILT, SANDY ELASTIC SILT, OR GRAVELLY ELASTIC SILT | SILTS AND CLAYS LIQUID LIMIT MORE THAN 50 |
| **CH** | FAT CLAY OF HIGH PLASTICITY, SANDY FAT CLAY, OR GRAVELLY FAT CLAY | |
| **OH** | ORGANIC SILT OR ORGANIC CLAY OF HIGH PLASTICITY | |
| **PT** | PEAT AND OTHER HIGHLY ORGANIC SOILS | HIGHLY ORGANIC SOILS |

**NOTE:** Fine-grained soils may receive dual classification based upon plasticity characteristics (e.g. CL-ML).

### SOIL SIZES

| COMPONENT | SIZE RANGE |
|---|---|
| BOULDERS | Above 12 in. |
| COBBLES | 3 in. – 12 in. |
| GRAVEL | No. 4 – 3 in. |
| Coarse | ¾ in. – 3 in. |
| Fine | No. 4 – ¾ in. |
| SAND | No. 200 – No. 4 |
| Coarse | No. 10 – No. 4 |
| Medium | No. 40 – No. 10 |
| Fine | No. 200 – No. 40 |
| Fines (Silt or Clay) | Below No. 200 |

**NOTE:** Only sizes smaller than three inches are used to classify soils

### CONSISTENCY

| CLAYS & SILTS | BLOWS PER FOOT |
|---|---|
| VERY SOFT | 0 – 2 |
| SOFT | 3 – 4 |
| FIRM | 5 – 8 |
| STIFF | 9 – 15 |
| VERY STIFF | 16 – 30 |
| HARD | OVER 30 |

### RELATIVE DENSITY

| SANDS & GRAVELS | BLOWS PER FOOT |
|---|---|
| VERY LOOSE | 0 – 4 |
| LOOSE | 5 – 10 |
| MEDIUM DENSE | 11 – 30 |
| DENSE | 31 – 50 |
| VERY DENSE | OVER 50 |

**NOTE:** Number of blows using 140-pound hammer falling 30 inches to drive a 2-inch-OD (1⅜-inch ID) split-barrel sampler (ASTM D1586).

### PLASTICITY OF FINE GRAINED SOILS

| PLASTICITY INDEX | TERM |
|---|---|
| 0 | NON-PLASTIC |
| 1 – 7 | LOW |
| 8 – 20 | MEDIUM |
| Over 20 | HIGH |

### DEFINITION OF WATER CONTENT

| |
|---|
| DRY |
| SLIGHTLY DAMP |
| DAMP |
| MOIST |
| WET |
| SATURATED |

The number shown in **"BORING NO."** refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing or measurement from property lines and/or existing features.

**"DRILLING TYPE"** refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger**, and the dimension presented is the outside diameter of the HSA used.

**"R" in "BLOW COUNTS"** refers to a 3-inch outside diameter ring-lined split barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 12 inches is achieved or until refusal. The number of blows required to advance the sampler 12 inches is defined as the "**R**" blow count. The "**R**" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows per foot. A double vertical line within the symbol indicates no sample recovery. A circle within the symbol indicates sample disturbance.

**"SAMPLE TYPE"** refers to the form of sample recovery, in which **R** = Ring-lined sample and **G** = Grab sample.

**"DRY DENSITY (LBS/CU FT)"** refers to the laboratory-determined dry density in pounds per cubic foot.

**"WATER (MOISTURE) CONTENT"** (% of Dry Wt.) refers to the laboratory-determined water content in percent using the standard test method ASTM D2216.

**"USCS"** refers to the "Unified Soil Classification System" Group Symbol for the soil type as defined by ASTM D2487 and D2488. The soils were classified visually in the field, and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

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 nor as defining construction conditions.

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

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil or rock types based upon visual field classification at the boring location. The transition between materials is approximate and may be more or less gradual than indicated.

DATE DRILLED: **5-4-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

# BORING NO. 1

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | G | | | | SM | | Silty SAND; with gravel, cobbles and boulders, red, very dense, damp |
| 15.6 | 98 | R | | 50/4" | | | | |
| | | | | | | | | **Auger Refusal at 3 Feet on SANDSTONE** |
| | | | | | 5 | | | |

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

**WESTERN TECHNOLOGIES INC.**
**2400 Huntington Drive**
**Flagstaff, AZ 86004-8934**

PROJECT: **COMMERCIAL LUBE CENTER**
PROJECT NO.: **2521JW085**

PLATE **A-4**

## BORING LOG

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DATE DRILLED: **5-4-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

# BORING NO. 2

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | G | | | | SM | | Silty SAND; some gravel, cobbles and boulders, red, very dense, slightly damp |
| | | R | | 50/2" | | | | |
| | | | | | 5 | | | **Auger Refusal at 3 Feet on SANDSTONE** |

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

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PROJECT: **COMMERCIAL LUBE CENTER**
PROJECT NO.: **2521JW085**

PLATE **A-5**

## BORING LOG

DATE DRILLED: **5-4-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

# BORING NO. 3

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | G | | | | SM | | Silty SAND; some gravel, cobbles and boulders, red, very dense, slightly damp |
| | | R | | 50/2" | | | | |
| | | | | | 5 | | | **Auger Refusal at 3 Feet on SANDSTONE** |

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

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PROJECT: **COMMERCIAL LUBE CENTER**
PROJECT NO.: **2521JW085**

PLATE **A-6**

## BORING LOG

DATE DRILLED: **5-4-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

# BORING NO. 4

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | G | | | | SM | | Silty SAND; some gravel, cobbles and boulders, red, very dense, slightly damp |
| | | N | | 50/1" | | | | |
| | | | | | | | | **Auger Refusal at 2 Feet on SANDSTONE** |
| | | | | | 5 | | | |

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

**WESTERN TECHNOLOGIES INC.**
**2400 Huntington Drive**
**Flagstaff, AZ 86004-8934**

PROJECT: **COMMERCIAL LUBE CENTER**
PROJECT NO.: **2521JW085**

PLATE **A-7**

## BORING LOG

DATE DRILLED: **5-4-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

# BORING NO. 5

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | G | | | | CL | | Gravelly Lean CLAY; some sand, cobbles and boulders, red, hard, slightly damp |
| 2.9 | 124 | R | | 50/10" | | | | |
| 3.4 | 107 | R | | 50/5" | | | | |
| | | | | | 5 | | | **Boring Stopped at 5 Feet** |

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

**WESTERN TECHNOLOGIES INC.**
**2400 Huntington Drive**
**Flagstaff, AZ 86004-8934**

PROJECT: **COMMERCIAL LUBE CENTER**
PROJECT NO.: **2521JW085**

PLATE **A-8**

## BORING LOG

DATE DRILLED: **5-4-21**
LOCATION: **See Location Diagram**
ELEVATION: **Not Determined**

# BORING NO. 6

EQUIPMENT TYPE: **CME-75**
DRILLING TYPE: **7"HSA**
FIELD ENGINEER: **C. Senior**

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| | | G | | | | SM | | Silty SAND; some gravel, cobbles and boulders, red, very dense, slightly damp |
| | | N | | 50/3" | | | | |
| | | | | | | | | **Auger Refusal at 3 Feet on SANDSTONE** |
| | | | | | 5 | | | |

N- STANDARD PENETRATION TEST
R- RING SAMPLE
CA- CALIFORNIA MODIFIED SAMPLER
G- GRAB SAMPLE
B- BUCKET SAMPLE

NOTES: **Groundwater Not Encountered**

**WESTERN TECHNOLOGIES INC.**
**2400 Huntington Drive**
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PROJECT: **COMMERCIAL LUBE CENTER**
PROJECT NO.: **2521JW085**

PLATE **A-9**

## BORING LOG

| Boring No. | Depth (ft) | USCS Class. | Particle Size Distribution (%) Passing by Weight | | | | | | | Atterberg Limits | | Laboratory Compaction Characteristics | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3" | ¾" | #4 | #10 | #40 | #200 | 2µ | LL | PI | Dry Density (pcf) | Optimum Moisture (%) | Method | |
| 1 | 0-3 | SM | 100 | 88 | 74 | 64 | 53 | 41.2 | | 21 | 3 | | | | 2 |
| 3 | 0-3 | SM | 100 | 98 | 89 | 82 | 65 | 45.3 | | | NP | | | | 2 |
| 5 | 0-5 | CL | 100 | 92 | 79 | 72 | 68 | 58.3 | | 26 | 9 | | | | 2 |

**NOTE:** NP = Non-plastic
µ = microns (2µ = 0.002mm)

**REMARKS**

Classification / Particle Size / Moisture-Density Relationship

1. Visual
2. Laboratory Tested
3. Minus #200 Only
4. Test Method ASTM D698/AASHTO T99
5. Test Method ASTM D1557/AASHTO T180
6. From the ADOT Family of Curves

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PROJECT: COMMERCIAL LUBE CENTER

JOB NO.: 2521JW085

PLATE

**B-1**

## SOIL PROPERTIES

| Boring No. | Depth (ft.) | USCS Class. | Initial Dry Density (pcf) | Initial Water Content (%) | Compression Properties | | | Expansion Properties | | Plasticity | | Percent Passing #200 | Soluble | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Surcharge (ksf) | Total Compression (%) | | Surcharge (ksf) | Expansion (%) | LL | PI | | Salts (ppm) | Sulfate (ppm) | |
| | | | | | | In-Situ | After Saturation | | | | | | | | |
| 1 | 0-3 | SM | 122.8 | 9.7 | | | | 0.1 | 0.1 | | | | | | 1,2 |
| 3 | 0-3 | SM | 125.4 | 9.0 | | | | 0.1 | 0.3 | | | | | | 1,2 |
| 5 | 0-5 | CL | 122.8 | 9.7 | | | | 0.1 | 1.9 | | | | | | 1,2 |

**Notes**: Initial Dry Density and Initial Water Content are remolded.

**Remarks**

1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum.)
2. Submerged to approximate saturation.

Geotechnical Environmental Inspections Materials

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PROJECT: COMMERCIAL LUBE CENTER

JOB NO.: 2521JW085

**SOIL PROPERTIES**

PLATE

**B-2**

MOTZZ LABORATORY, INC.

# Laboratory Analysis Report

Western Technologies - Flagstaff
Gregory L. E. Burr
2400 East Huntington
Flagstaff, AZ 86004-8934

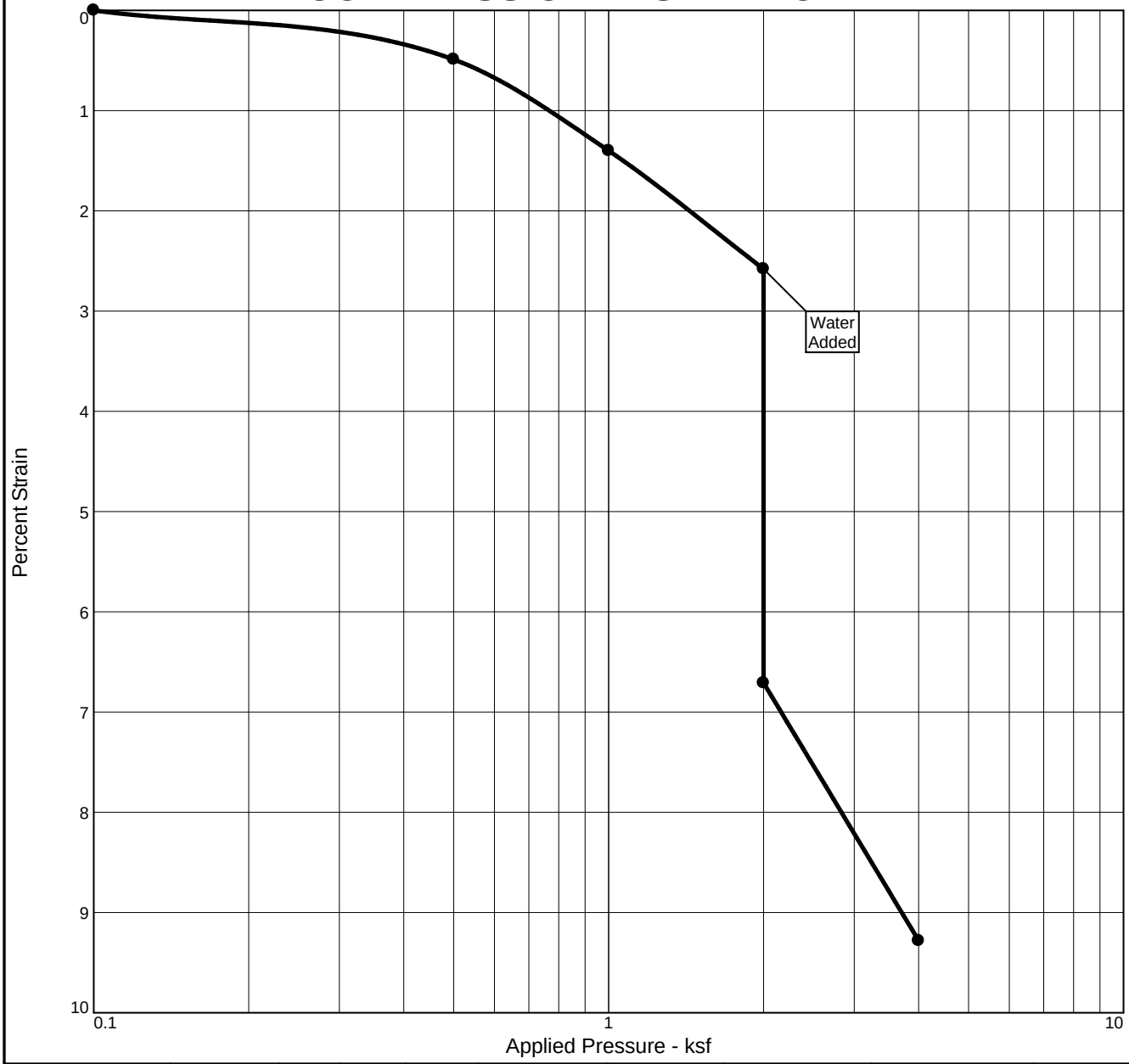
Project: 2521JW085
Date Received: 5/10/2021
Date Reported: 5/12/2021
PO Number: 2521P015

**Lab Number: 936757-1** **1 (0-3)**

| *Test Parameter* | Method | Result | Units | Levels |
|---|---|---|---|---|
| Soluble Salts | ARIZ 237b | 217 | ppm | |
| Sulfate | ARIZ 733b | < 3 | ppm | |
| Chloride | ARIZ 736b | 3 | ppm | |

Plate B-3

# COMPRESSION TEST REPORT




| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (ksf) | $e_o$ | Swell Press. (ksf) | Clpse. % | $C_r$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Sat. | Moist. | | | | | | | | | |
| 59.7 % | 15.6 % | 97.8 | | | 2.65 | | 0.691 | | 4.1 | |

| MATERIAL DESCRIPTION | USCS | AASHTO |
|---|---|---|
| SILTY SAND WITH GRAVEL | SM | |

**Project No.** 2521JW085 **Client:** SEDONA TAKE 5, LLC

**Project:** COMMERCIAL LUBE CENTER

**Source:** RING SAMPLE **Depth:** 2-3 FEET **Sample No.:** BORING 1

**Remarks:**

**Western Technologies, Inc.**

**Flagstaff, AZ**

**Figure** B-4