Stormwater Management Design Report Bridgeton Landfill

Project 130140.005
April 2013
Revised May 1, 2013

Prepared for:
Bridgeton Landfill, LLC

Adam Larky

Digitally signed by Adam Larky
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Bridgeton Landfill
13570 Saint Charles Rock Road

CORNERSTONE
Environmental Group, LLC

39395 W. Twelve Mile Rd., Farmington Hills, MI 48395

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STORMWATER MANAGEMENT DESIGN REPORT

BRIDGETON LANDFILL

BRIDGETON, MISSOURI

Prepared for

Bridgeton Landfill

April 2013

Revised May 1, 2013

Prepared by

CORNERSTONE
Environmental Group, LLC
39395 W. Twelve Mile Rd.
Farmington Hills, MI

Project: 130140

Stormwater Management Design Report
Bridgeton Landfill
Bridgeton, Missouri

The material and data in this report were prepared under the supervision and direction of the undersigned.

Cornerstone Environmental Group, LLC

James Walker
Senior Client Manager

Adam S. Larky, P.E.
Senior Client Manager

STATE OF MISSOURI
ADAM STEVEN LARKY
NUMBER E-20656
REGISTERED PROFESSIONAL ENGINEER
5/1/13

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Tables

1 INTRODUCTION

The stormwater management system for the proposed temporary cap design of the South Quarry Unit of Bridgeton Landfill has been designed based on the stormwater requirements of Missouri Rules of Natural Resources, Division 80 Solid Waste Management Chapter 3 Sanitary Landfill Section 10 CSR 80-3.010 (8) Water Quality (F). This rule requires:

(I) Areas of the watershed which will be affected by the sanitary landfill shall be specified.

(II) On-site drainage structures and channels shall be designed to prevent flow onto the active portion of the sanitary landfill during at least a twenty-five (25) year storm. The engineering calculations and assumptions shall be included and explained in an engineering report.

(III) On-site drainage structures and channels shall be designed to collect and control at least the water volume from a twenty-four (24) hour, twenty-five (25) year storm.

(IV) On-site drainage channels shall be designed to empty expeditiously after storms to maintain the design capacity of the system.

(V) Contingency plans for on-site management of surface water which comes into contact with solid waste shall be specified.

This report provides a summary of the how the stormwater design meets the MDNR rule requirements listed above and includes corresponding supporting design calculations.

The existing conditions of the south quarry are shown on Sheet 1 of the Stormwater Engineering Plans for the Temporary Cap Design of Bridgeton Landfill (Stormwater Engineering Plans). The solid waste disposal area of the south quarry unit consists of 34.5 acres. Presently 11 acres of the south quarry unit area are under temporary cap including areas outside the solid waste area. The proposed temporary cap design was developed and presented in the Temporary Cap Integrity System plans prepared by Cornerstone Environmental Group, LLC, dated March 2013. For the proposed temporary cap design, the total exposed temporary cap lined area will comprise 42 acres as shown in Sheet 2 of the Stormwater Engineering Plans.

The Bridgeton Landfill has three permitted outfalls (001, 006 and 004) on the north side and two permitted outfalls (003 and 005) on the south side. Stormwater for the South Quarry Unit temporary cap will continue to outfall at the existing southeast permitted outfall 005 however, outfall 003 at the southwest will be relocated to the outlet of the proposed southwest detention basin discharge culvert.

2 STORMWATER MANAGEMENT DESIGN

The temporary cap has been designed to control both stormwater run-on to the landfill and stormwater runoff from the landfill.

Stormwater run-on to the landfill will be prevented by the lined temporary cap and a perimeter drainage channel surrounding (except the connection with the north quarry unit) the south quarry unit.

Stormwater runoff from the south quarry temporary cap area is designed to primarily sheet flow down the landfill slopes to perimeter drainage channels which convey the runoff through culverts to a detention basin before being discharged off-site. Existing benches will be regraded to provide a positive outward slope to facilitate sheet flow. Proposed light-duty access roads which will be constructed above the temporary cap to serve as ballast against wind uplift have been designed generally in an up/down slope orientation so as to not impede sheet flow runoff. Eyebrow diversion berms will be used where it is necessary to protect features such as extraction wells, valves risers, etc. from stormwater runoff. These may be installed both initially during the temporary cap construction and during the subsequent operation and maintenance of the facility. Energy dissipaters will be used in specific locations where stormwater flow concentrates to help dissipate the energy of the concentrated flow. The locations of the eyebrow diversion berms and energy dissipaters will be included in the Temporary Cap certification report which will be submitted to MDNR. Locations of the eyebrow diversion berms and energy dissipaters installed following construction of the Temporary Cap certification report, which will be included in the as-built updates submitted to MDNR quarterly. Specific stormwater management design details for each of the four sides of the south quarry unit are described in Sections 2.11 through 2.14 of this report.

Stormwater runoff flow estimates and channel analyses found in this report, unless otherwise indicated, were calculated using HydroCAD version 10 (HydroCAD). This program is an industry standard program utilizing the TR-20 Methodology developed by the Soil Conservation Service. The program develops runoff hydrographs for subareas based on inputs of drainage area, time of concentration and rainfall. For the Bridgeton Landfill area, the recommended type II rainfall distribution with antecedent moisture condition II was used in the analyses. The program was also used to perform both hydrograph routing and design drainage channels, culverts, and detention basins.

The drainage areas for the south quarry are shown in Sheet 1 of the Stormwater Engineering Plans and summarized in Table 1. All existing and proposed temporary cap areas were analyzed with a runoff curve number of 100 which results in 100 percent of the precipitation generating stormwater runoff. Other surrounding areas were analyzed with curve numbers of either 74 for

grassed areas or 84 to 87 for areas with some percentage of gravel road assuming hydrologic type C soil.

Peak runoff flows for each sub-area were obtained using HydroCAD for the 25-year, 24-hour storm event. The 25-year 24-hour rainfall for Bridgeton Landfill was obtained from Bulletin 71 (MCC Research Report 92-03), Rainfall Frequency Atlas of the Midwest, 1992. A copy of the figure showing this rainfall frequency information is included in Appendix A. The peak flows are based on stormwater slopes developed using the topographic map dated February 13, 2013 prepared by Coop Aerial Surveyors Company and field survey of existing culverts obtained during various dates in March 2013 by Weaver Boos.

Table 1 – Summary of South Quarry Unit Drainage Areas

Area	Proposed Lined Area (acres)	Unlined Area Including Run on to Perimeter Channels (acres)	Total Drainage Area (acres)
North	5.7	0	5.7
East	14.5	17.4	31.9
South	5.4	1.2	6.6
West / Southwest	21.9	41.7	63.6
Total	42.1	59.1	101.2

Note: South Area is included as part of South / Southwest Area

2.1.1 North Drainage Area

The stormwater design features for the north drainage area include the following:

1. Proposed perimeter drainage channel
2. Proposed north detention basin
3. 24-inch inlet culverts to proposed detention basin (CV-1 and CV-2)
4. 18-inch outlet culvert for the proposed north detention basin (CV-3)

The proposed north perimeter channel and north detention basin are shown on Sheet 6 of the Stormwater Engineering Plans. Details of the proposed inlet and outlet culverts are provided on Sheet 7 of the Stormwater Engineering Plans.

The proposed perimeter channel is located between the existing temporary cap and an existing access road. The minimum width between these two existing features is 11 feet located at the

inlet culvert CV-1. The invert of the proposed perimeter channel at the lowest points are designed at elevation 478.5. The channel is designed with a 0.20 % slope (due to the flat nature of existing ground), 2H:1V sideslopes and 3-foot bottom width. If settlement of the channel results in minor temporary ponding after a rain event, evaporation will remove the ponded water. If settlement and ponding becomes significant, such as greater than 6 inches, the channel will be regraded and relined.

The north detention basin will discharge into an existing sedimentation pond used for the landfill borrow area (permitted outfall # 004). The basin has been designed with two 24-inch inlet culverts (CV-1 and CV-2), a 50-foot long low water inlet crossing and one 18-inch outlet culvert (CV-3). Inlet culvert CV-2 has minimal drainage area and was not considered in the stormwater analysis; however, runoff from the entire north drainage area was conservatively modeled as discharging through culvert CV-1. Both the proposed perimeter channel and north detention basin will be lined with a geomembrane consisting of either HDPE or EVOH.

Calculations for the north drainage area are provided in Appendix B. The results of the of the 24-hour 25-year stormwater calculations are summarized below. The peak waster surface elevation is lower than the ground elevation at the solid waste boundary, therefore no run-on to the landfill will occur.

Table 2 – Stormwater Calculation Results for Proposed North Detention Basin

Approximate Basin Dimensions	60 feet x 260 feet
Basin Volume at Peak Elevation	0.883 acre-feet
Detention Time	0.23 hours (14 minutes)
Peak Inflow (cfs)	39.2 cfs
Peak Outflow (cfs)	11.8 cfs
Peak Water Surface Elevation	477.33

2.1.2 East Drainage Area

The stormwater design features for the east drainage area include the following:

1. Existing perimeter drainage channel
2. Existing culverts
3. Proposed east detention basin
4. Inlet culvert CV-4 to proposed detention basin
5. Outlet culvert CV-5 to the proposed detention basin

The existing east perimeter channel is lined with a geomembrane and currently collects and conveys runoff from the eastern slopes to an existing 40-inch corrugated metal pipe culvert at the southeast corner of the facility where permitted outfall #005 exists. A number of existing,

temporary culverts cross the east perimeter channel to provide access to the east slope for maintenance activities.

For the proposed design, the east perimeter channel and existing culverts other than the 40-inch corrugated metal pipe at the permitted outfall will remain undisturbed and continue to collect runoff from the east slope of the South Quarry Unit. A new east detention basin will be constructed as shown on the plans with a 30-inch inlet culvert, CV-4 from the existing east perimeter channel and a new 24-inch outlet culvert, CV-5. The existing outlet culvert at the south side of the east perimeter channel would be blocked with a soil berm or the culvert would be removed to prevent stormwater from discharging without passing though the proposed east detention basin. The outlet culvert for the new east detention basin will serve as permitted outfall # 005 and will convey drainage from the new east detention basin to the existing, twin 30-inch diameter reinforced concrete pipes extending under Old St. Charles Road. The proposed east detention basin will be lined with a geomembrane.

The existing east perimeter channel and proposed east detention basin are shown on Sheet 3 of the Stormwater Engineering Plans. Details of the proposed inlet and outlet culverts are provided on Sheet 7 of the Stormwater Engineering Plans.

Calculations for the east drainage area are provided in Appendix C. The results of the 24-hour 25-year stormwater calculations are summarized below. The peak waster surface elevation is lower than the ground elevation at the solid waste boundary, therefore no run-on to the landfill will occur. All outflow from the east detention basin will outlet and drain through the existing twin 30-inch culverts below Old St. Charles Road.

Table 3 – Stormwater Calculation Results for Proposed East Detention Basin

Approximate Basin Dimensions	50 feet x 540 feet
Basin Volume at Peak Elevation	2.37 acre-feet
Detention Time	0.60 hours (36 minutes)
Peak Inflow (cfs)	93.2 cfs
Peak Outflow (cfs)	38.3 cfs
Peak Water Surface Elevation	480.36

2.1.3 South Drainage Area

The stormwater design features for the south drainage area include the following:

1. Proposed perimeter drainage channel
2. Proposed 36-inch culvert (CV-6) to inlet of proposed box culvert (CV-7)

The proposed south perimeter channel is shown on Sheet 6 of the Stormwater Engineering Plans. Details of culvert CV-6 are provided on Sheet 7 of the Stormwater Engineering Plans.

The proposed south perimeter channel will be a lined channel located at the toe of the south landfill slope. One side of the channel will be formed by the landfill slope while the other side will be formed by a built up landfill access road, resulting in a minimum 2-foot deep v-shaped channel. The perimeter channel will be outleted to the inlet of culvert CV-6 to convey runoff into this culvert.

Calculations for the south drainage area are provided in Appendix D. The results of the 24-hour 25-year stormwater calculations are summarized below. The calculations show that the peak flow depth for the channel is less than the design depth. The inlet ground surface will be raised around the culvert inlet to elevation 461.1 based on the peak elevation of the culvert calculation to prevent overtopping of the culvert.

Table 4 – Stormwater Calculation Results for Proposed South Drainage

Peak Flow South Channel (cfs)	59 cfs
Peak Flow Culvert CV-6 (cfs)	59 cfs
Peak Water Depth of South Channel (ft)	1.3’
Peak Elevation for Culvert CV-6	461.06

2.1.4 West / Southwest Drainage Area

The stormwater design features for the west/southwest drainage area include the following:

1. Existing perimeter drainage channel
2. Proposed perimeter drainage channel
3. Existing culverts
4. Proposed culverts CV-6, CV-7 and CV-8
5. Proposed southwest detention basin and outlet culvert CV-9

The existing west perimeter channel is partially lined with geomembrane and currently collects and conveys runoff from the western slopes of the south quarry unit and run-on from the eastern slopes of an adjacent landfill and amphitheater area. Directions of sheet flow and channel flow are shown on Sheet 2. The existing west perimeter channel drains to twin existing 36-inch reinforced concrete culverts at the southwest corner of the facility where permitted outfall #003 exists. A number of existing, temporary culverts cross the west perimeter channel to provide access to the west slope for maintenance activities.

For the proposed design, the existing west perimeter channel and existing culverts other than the twin 36-inch reinforced concrete pipes at the permitted outfall will remain undisturbed and

continue to collect runoff from the west slope of the South Quarry Unit. In addition, a lined perimeter channel will be constructed along the toe of the landfill to collect runoff from the temporary cap in areas where the temporary cap does not extend to the existing west channel. The new lined perimeter channel will drain to a new 30-inch culvert, CV-8 which will convey the runoff under an existing road to the existing west channel. The ground surface on the downslope side of culvert CV-8 inlet will be raised to the calculated headwater elevation 461.6 to prevent overtopping of the culvert.

A new southwest detention basin will be constructed as shown on the plans. Drainage from the existing west perimeter channel will be directed to the proposed southwest detention basin. The new southwest detention basin will be constructed with a 24-inch culvert, CV-9 which outlets to a 20-foot wide by 1.5-foot deep parabolic grass lined channel which drains to an existing ditch in the wooded area west of the basin. The locations of the outlet structures are shown on revised Sheet 5 and details are shown on revised Sheet 7 of the Engineering Plans..

A new 5-foot by 12-foot wide concrete box culvert is designed to replace the existing twin 36-inch culverts under Old St. Charles Road to prevent overtopping of the easement. The ground surface on the downslope side of culvert CV-7 inlet will be raised to the calculated headwater elevation 452.8 to prevent overtopping of the culvert.

Outfall 003 being decommissioned, the future outfall testing location will be moved to the outlet culvert, CV-9 of the proposed southwest detention basin.

The existing west perimeter channel and proposed west perimeter channel, culverts CV-6, CV-7, CV-8, CV-9 and southwest detention basin are shown on Sheet 5 of the Stormwater Engineering Plans. Details of the structures are provided on Sheet 7 of the Stormwater Engineering Plans.

Calculations for the west drainage area are provided in Appendix C. The results of the 24-hour 25-year stormwater calculations are summarized below.

Table 5 – Stormwater Calculation Results for Proposed West /Southwest Detention Basin

Approximate Basin Dimensions	420 feet x 580 feet (at el. 450)
Basin Volume at Peak Elevation	13.324 acre-feet
Detention Time	1.05 hours (63 minutes)
Peak Inflow (cfs)	321 cfs
Peak Outflow (cfs)	34 cfs
Peak Water Surface Elevation	446.11

3 CONCLUSIONS

Based on the descriptions and calculations included in this engineering report, the proposed stormwater management design for the temporary cap proposed for the South Quarry Unit at the Bridgeton Landfill will meet the requirements of Missouri Rules of Natural Resources, Division 80 Solid Waste Management Chapter 3 Sanitary Landfill Section 10 CSR 80-3.010 (8) Water Quality (F) as described below.

(I) Areas of the watershed that will be affected by the sanitary landfill have been specified in Figure 1.

(II) On-site drainage structures and channels have been designed to prevent flow onto the active portion of the sanitary landfill during at least a twenty-five (25) year storm. The engineering calculations and assumptions are included and explained in this engineering report.

(III) On-site drainage structures and channels have been designed to collect and control at least the water volume from a twenty-hour (24) hour, twenty-five (25) year storm. Perimeter channels either exist or are designed to collect the runoff and direct it to detention basins for discharge off-site.

(IV) On-site drainage channels have been designed to empty expeditiously after storms to maintain the design capacity of the system. Hydrographs included with the design calculations show that the conveyance structures including detention basins will drain in less than 24 hours.

(V) Contingency plans for on-site management of surface water which comes into contact with solid waste shall be specified. The proposed stormwater management system includes detention basins at all offsite discharge locations that can be used as contingency measures for on-site management of stormwater water that may come into contact with solid waste including leachate. In addition, perimeter channels and the north and east detention basins will be lined with a geomembrane to provide additional contingency measures to manage impacted stormwater water and minimize infiltration into the ground around the landfill. Bridgeton Landfill maintains an assortment of equipment on site to address operations and maintenance of the facility. In the event that leachate or gas condensate is detected above the temporary cap, it will be isolated immediately using soil stockpiled onsite and pumped to a storage container for removal as leachate and the temporary cap will be repaired. If leachate or gas condensate is observed in the lined channel or a detention basin, the liquid will be pumped and removed as quickly as possible using high volume pumping equipment and load-out trucks maintained on site to provide this contingency.

LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

LEGEND

- EXISTING SOLID WASTE BOUNDARY
- PHASE BOUNDARY
- EXISTING 10' CONTOUR (1400)
- EXISTING 2' CONTOUR
- EXISTING FENCE
- EXISTING TEMPORARY CAP
- PROPOSED TEMPORARY CAP
- LIGHT-DUTY ACCESS ROADS
- DRAINAGE AREA BOUNDARY
- W2A — DRAINAGE AREA LABEL
- PROPOSED DRAINAGE CHANNEL
- PROPOSED CULVERT

N

0 200 400

SCALE IN FEET

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
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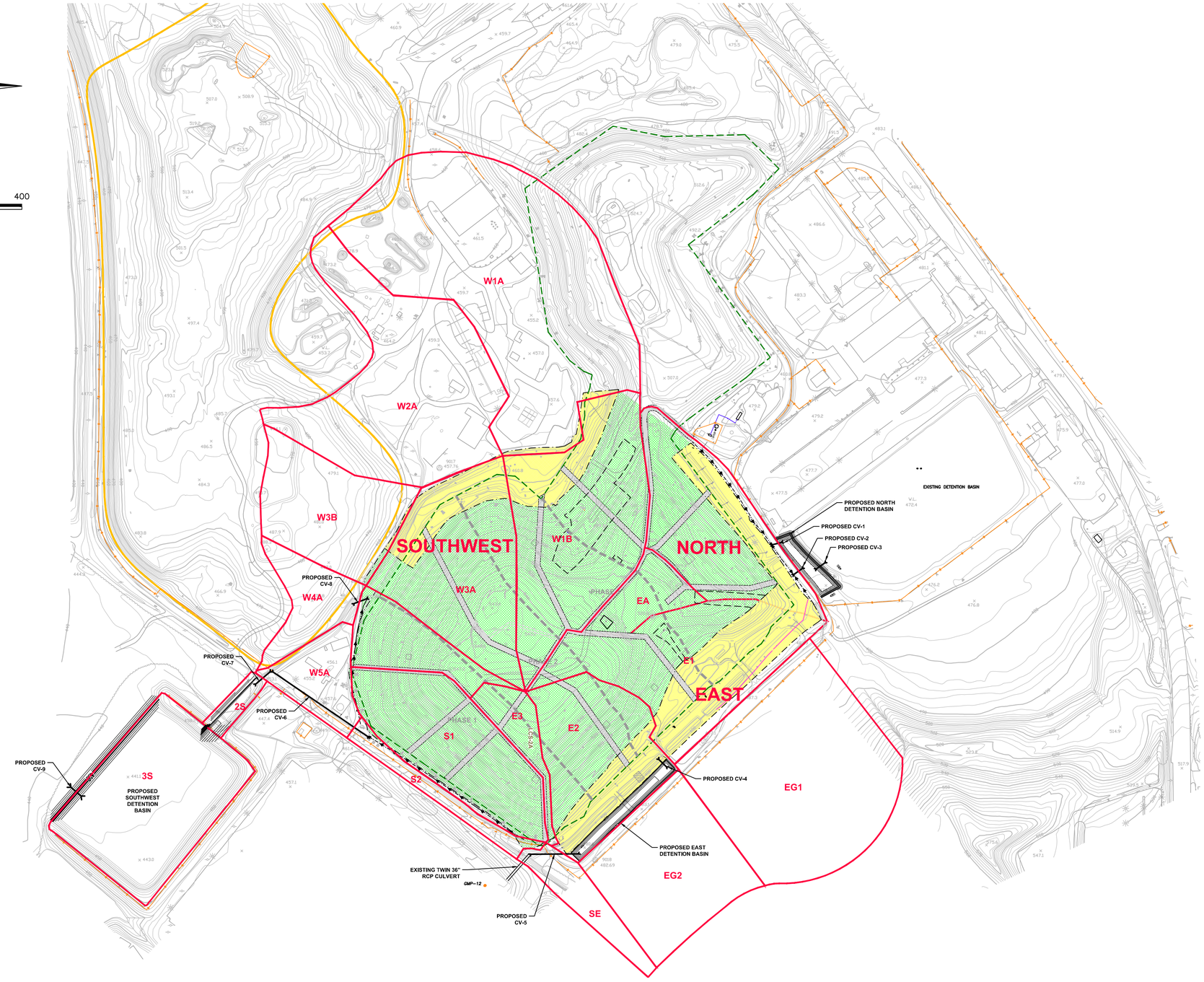

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DESIGNED BY JCO
CHECKED BY JGW
APPROVED BY BOS

CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR TEMPORARY CAP INTEGRITY SYSTEM
OVERALL STORMWATER MANAGEMENT PLAN

FIGURE **1**

PROJECT NO. 130140

1" 1/2" 0" 1"

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STORMWATER ENGINEERING PLANS

STORMWATER MANAGEMENT PLANS FOR THE

TEMPORARY CAP INTEGRITY SYSTEM

BRIDGETON LANDFILL

BRIDGETON, MISSOURI

APRIL 2013
REVISED MAY 1, 2013

PREPARED FOR:

BRIDGETON LANDFILL, LLC

PREPARED BY:

CORNERSTONE
Environmental Group, LLC

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INDEX OF DRAWINGS

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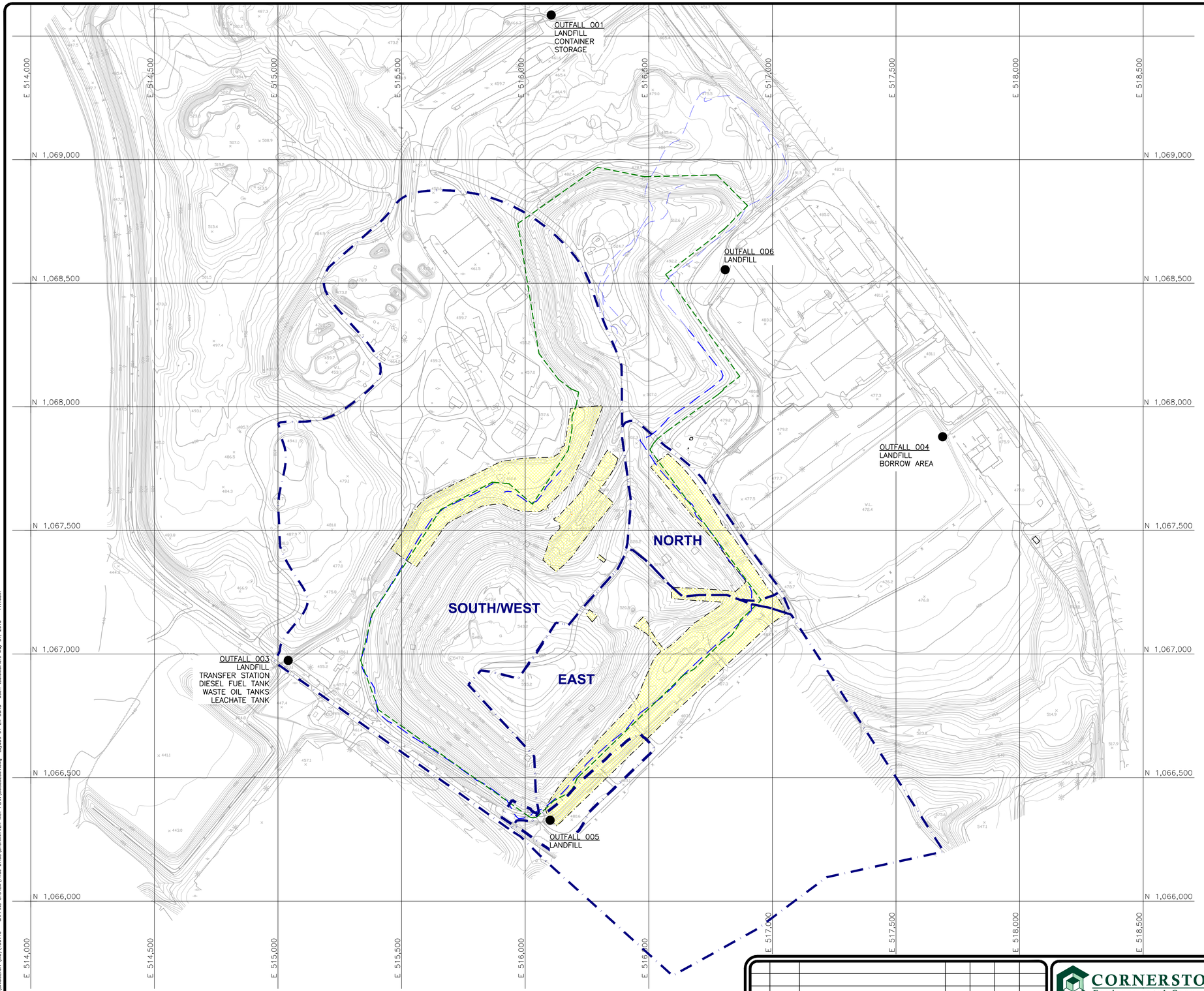
REGISTERED PROFESSIONAL ENGINEER
5/1/13



LEGEND

- EXISTING SOLID WASTE BOUNDARY
- EXISTING QUARRY HIGH WALL
- EXISTING 10' CONTOUR (1400)
- EXISTING 2' CONTOUR
- EXISTING TEMPORARY CAP
- DRAINAGE AREA BOUNDARY

NOTES:

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STATE OF MISSOURI
ADAM STEVEN LANG
NUMBER E-20058
REGISTERED PROFESSIONAL ENGINEER
5/1/13

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CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR TEMPORARY CAP INTEGRITY SYSTEM
EXISTING SITE PLAN

SHEET NO. 1
PROJECT NO. 130140

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- PROPOSED 2' CONTOUR
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- PROPOSED TEMPORARY CAP
- PROPOSED LINED AREA FOR STORMWATER MANAGEMENT FEATURE
- LIGHT-DUTY ACCESS ROADS
- DRAINAGE AREA BOUNDARY
- PROPOSED DRAINAGE CHANNEL
- EXISTING DRAINAGE CHANNEL
- PROPOSED CULVERT

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SCALE IN FEET

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3. SEE SHEETS 3 – 7 FOR CULVERT INLET AND OUTLET INVERT ELEVATIONS.

PROPOSED LEACHATE STORAGE TANK
PROPOSED CONTAINMENT PAD
EXISTING WEST DRAINAGE CHANNEL
AMPHITHEATER AREA
PROPOSED SWALE
PROPOSED 12" CULVERT
PROPOSED 15" CULVERT
EXISTING 30" CMP CULVERT
SHEET FLOW
PZ-109-SS
PZ-201A-SS
PROPOSED NORTH DETENTION BASIN
CV-1
DETENTION BASIN OVERFLOW SEE DETAIL 2/8
CV-3 PROPOSED DISCHARGE CULVERT TO EXISTING DETENTION BASIN
CV-2
PHASE 4 NORTH
SOUTHWEST
PHASE 3
PHASE 2
PHASE 1
EAST
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PZ-107-SS
EXISTING WEST DRAINAGE CHANNEL
CV-7 PROPOSED BOX CULVERT OR CHANNEL CROSSING IF ROAD EASEMENT CAN BE ABANDONED
PROPOSED CHANNEL TO PROPOSED SOUTHWEST DETENTION BASIN
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TMP-2
GMP-9
EXTEND EXISTING CULVERT BELOW PROPOSED INLET CHANNEL
DETENTION BASIN OVERFLOW SEE DETAIL 2/8
CV-9 DISCHARGE CULVERT
PROPOSED SOUTHWEST DETENTION BASIN
GMP-10
GMP-2
PZ-204-B-SS
PZ-204-AS
PZ-204-SS
MW-204
PZ-116-SS
PZ-105-SS
GMP-11
EXISTING TWIN 36" RCP CULVERTS
GMP-12
CV-5 PROPOSED OUTLET PIPE TO DISCHARGE TO EXISTING TWIN 36" RCP CULVERTS
EXISTING EAST DRAINAGE CHANNEL TO DRAIN TO PROPOSED EAST DETENTION BASIN
PZ-203-SS
CV-4 PROPOSED INLET PIPE
PROPOSED EAST DETENTION BASIN

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STATE OF MISSOURI
ADAM STEVEN SIMMONS
NUMBER E-28056
REGISTERED PROFESSIONAL ENGINEER
5/1/13

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SHEET NO. 2
PROJECT NO. 130140

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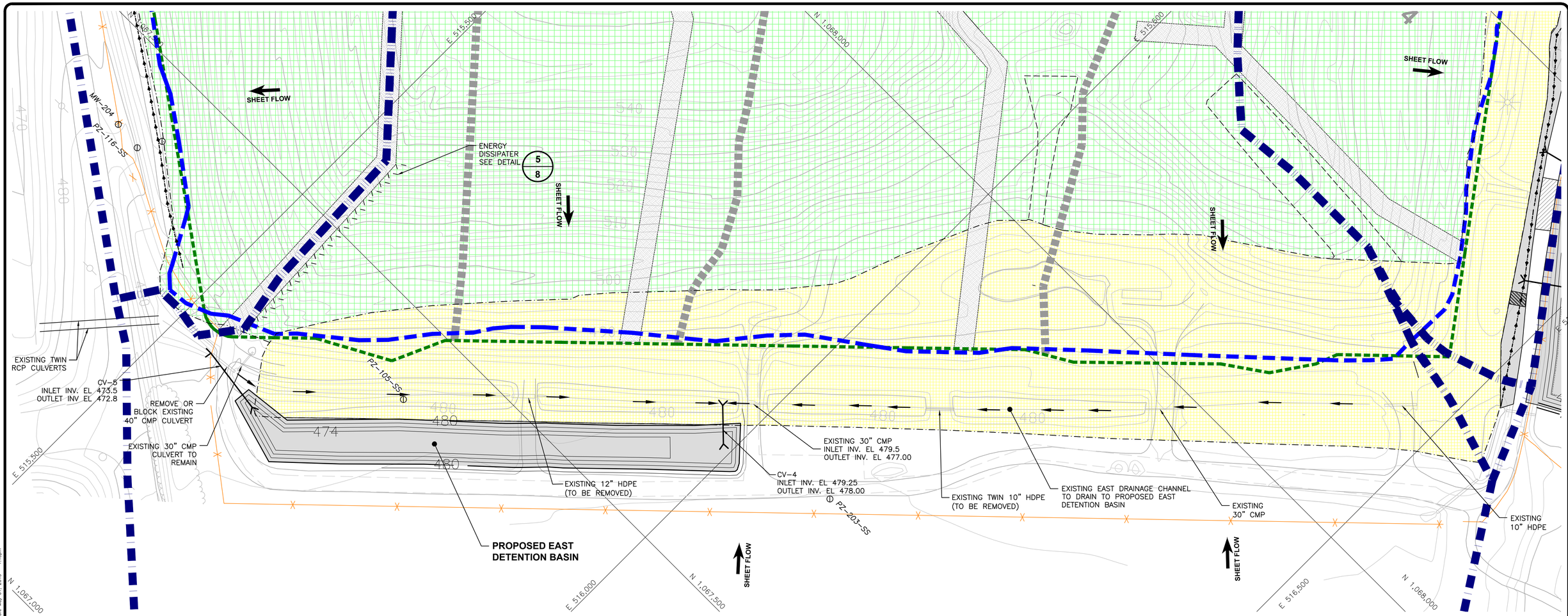

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CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR TEMPORARY CAP INTEGRITY SYSTEM EAST STORMWATER MANAGEMENT PLAN

SHEET NO. 3
PROJECT NO. 130140

STATE OF MISSOURI
ADAM STEVEN LANG
NUMBER E-28056
REGISTERED PROFESSIONAL ENGINEER
5/1/13

File: X:\PROJECTS\BRIDGETON (MO)\130140 - CAPPING SYSTEM\PROJ DWGS\STORMWATER MGT PLAN\BRIDLSSW-01 TAD.dwg Layout: 03-STORMWATER east User: tad.skidmore May 01, 2013 - 1:13pm

EXISTING 48" CMP
INLET INV. EL 451.68
OUTLET INV. EL 451.48
CV-8
INLET INV. EL 453.70
OUTLET INV. EL 453.50

EXISTING 30" BOX CULVERT
INLET INV. EL 450.42
OUTLET INV. EL 450.17

EXISTING 27" CMP
INLET INV. EL 450.19
OUTLET INV. EL 450.50
CV-6
INLET INV. EL 456.60
OUTLET INV. EL 449.20

CV-7
INLET INV. EL 449.20
OUTLET INV. EL 448.10

PHASE 1

SHEET FLOW

DETENTION BASIN OVERFLOW SEE DETAIL 2/8

CV-5
INLET INV. EL 473.50
OUTLET INV. EL 472.80

REMOVE OR BLOCK EXISTING CULVERT

EXISTING TWIN 30" RCP's
INLET INV. EL 472.88/473.05
OUTLET INV. EL 472.07/472.17

3/8 PROPOSED SOUTH/SOUTHWEST PERIMETER CHANNEL

PZ-107-SS
PZ-105-SS
PZ-116-SS
PZ-204-SS
PZ-204-B-SS
PZ-204-AS
MW-204
GMP-2
GMP-10
GMP-11
GMP-12
TMP-2
B-9

E 515,000
E 515,500
E 516,000
N 1,068,000
N 1,068,500
N 1,067,500

LEGEND

- EXISTING SOLID WASTE BOUNDARY
- PHASE BOUNDARY
- EXISTING QUARRY HIGH WALL
- EXISTING 10' CONTOUR (1400)
- EXISTING 2' CONTOUR
- EXISTING FENCE
- PROPOSED 10' CONTOUR (1400)
- PROPOSED 2' CONTOUR
- EXISTING TEMPORARY CAP
- PROPOSED TEMPORARY CAP
- LIGHT-DUTY ACCESS ROADS
- DRAINAGE AREA BOUNDARY
- PROPOSED DRAINAGE CHANNEL
- EXISTING DRAINAGE CHANNEL
- PROPOSED CULVERT

N

0 50 100
SCALE IN FEET

NOTES:

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STATE OF MISSOURI
ADAM STEVEN LOVAN
NUMBER E-26056
LICENSED PROFESSIONAL ENGINEER
5/1/13

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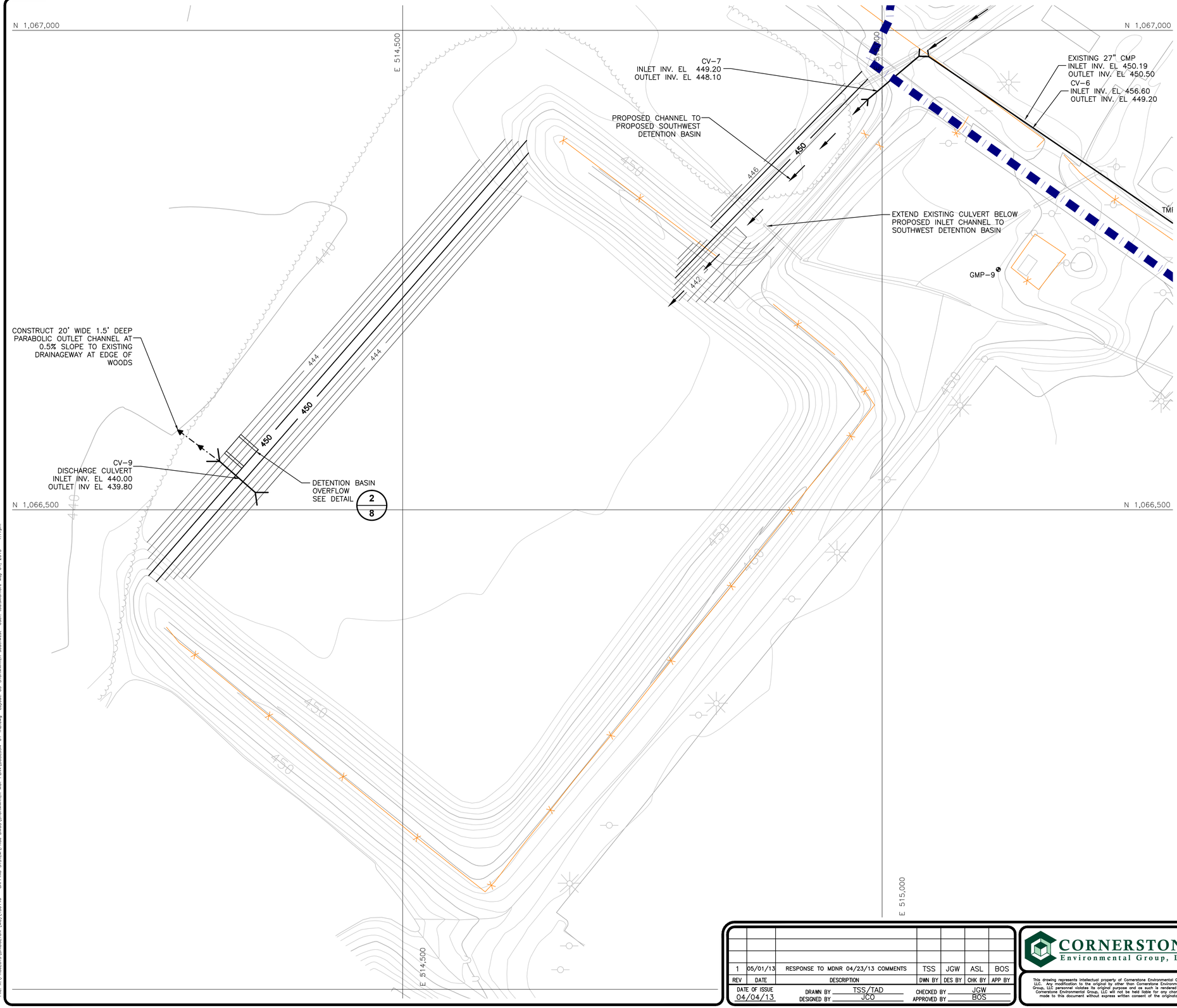
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR TEMPORARY CAP INTEGRITY SYSTEM SOUTH STORMWATER MANAGEMENT PLAN

SHEET NO. 4
PROJECT NO. 130140

File: X:\PROJECTS\BRIDGETON (MO)\130140 - CAPPING SYSTEM\PROJ_DWGS\STORMWATER MGT PLAN\BGBLSSW-01 TAD.dwg Layout: 04-STORMWATER south User: tad.skidmore May 01, 2013 - 1:15pm



LEGEND

- EXISTING SOLID WASTE BOUNDARY
- PHASE BOUNDARY
- EXISTING QUARRY HIGH WALL
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING FENCE
- PROPOSED 10' CONTOUR
- PROPOSED 2' CONTOUR
- EXISTING TEMPORARY CAP
- PROPOSED TEMPORARY CAP
- LIGHT-DUTY ACCESS ROADS
- DRAINAGE AREA BOUNDARY
- PROPOSED DRAINAGE CHANNEL
- EXISTING DRAINAGE CHANNEL
- PROPOSED CULVERT

NOTES:

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STATE OF MISSOURI
ROAD WESTEN
NUMBER
E-26056
REGISTERED PROFESSIONAL ENGINEER
5/1/13

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DATE OF ISSUE 04/04/13
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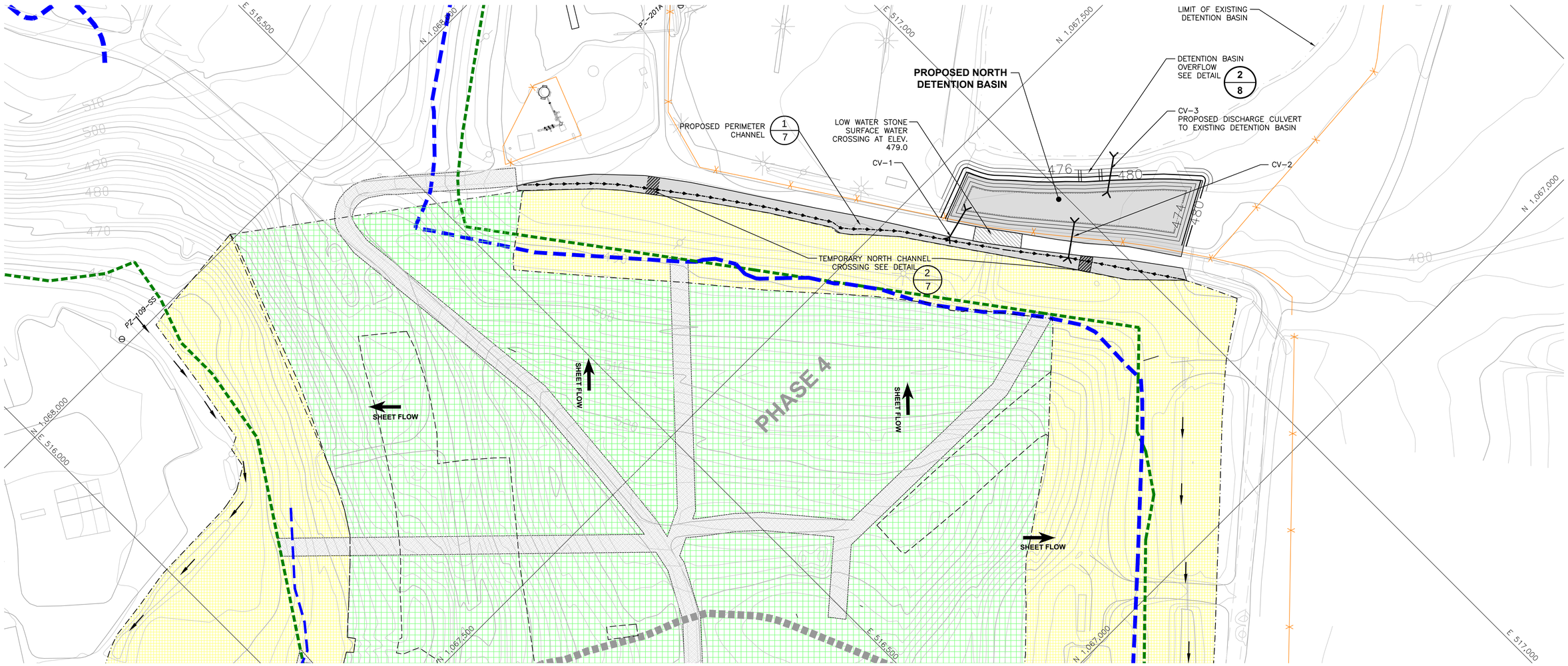
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR
TEMPORARY CAP INTEGRITY SYSTEM
SOUTHWEST STORMWATER MANAGEMENT PLAN

SHEET NO. **5**
PROJECT NO. 130140



LEGEND

- EXISTING SOLID WASTE BOUNDARY
- PHASE BOUNDARY
- EXISTING QUARRY HIGH WALL
- EXISTING 10' CONTOUR (1400)
- EXISTING 2' CONTOUR
- EXISTING FENCE
- PROPOSED 10' CONTOUR (1400)
- PROPOSED 2' CONTOUR
- EXISTING TEMPORARY CAP
- PROPOSED TEMPORARY CAP
- PROPOSED LINED AREA FOR STORMWATER MANAGEMENT FEATURE
- LIGHT-DUTY ACCESS ROADS
- DRAINAGE AREA BOUNDARY
- PROPOSED DRAINAGE CHANNEL
- EXISTING DRAINAGE CHANNEL
- PROPOSED CULVERT

N

0 50 100
SCALE IN FEET

NOTES:

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STATE OF MISSOURI
ADAM STEVEN LANGER
NUMBER E-26056
REGISTERED PROFESSIONAL ENGINEER
5/1/13

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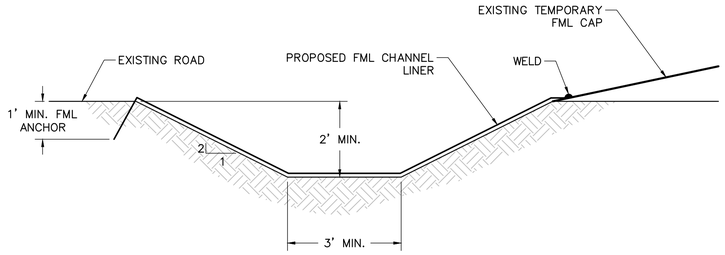
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR TEMPORARY CAP INTEGRITY SYSTEM NORTH STORMWATER MANAGEMENT PLAN

SHEET NO. 6
PROJECT NO. 130140

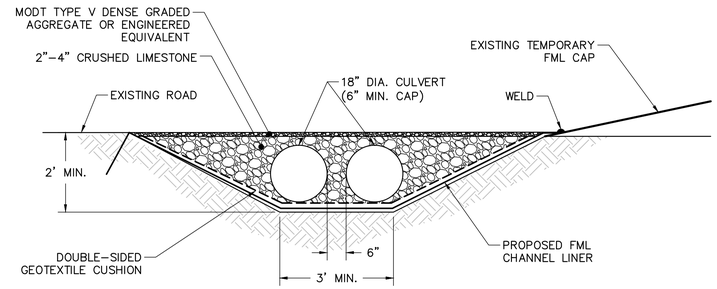
1" 1/2" 0" 1"

File: X:\PROJECTS\BRIDGETON (MO)\130140 - CAPPING SYSTEM\PROJ DWGS\STORMWATER MGT PLAN\BOBLSSW-01 TAD.dwg Layout: 06-STORMWATER north User: tsd.skidmore May 01, 2013 - 1:17pm



NORTH DRAINAGE CHANNEL

DETAIL 1/7
SCALE: NOT TO SCALE



TEMPORARY NORTH CHANNEL CROSSING

DETAIL 2/7
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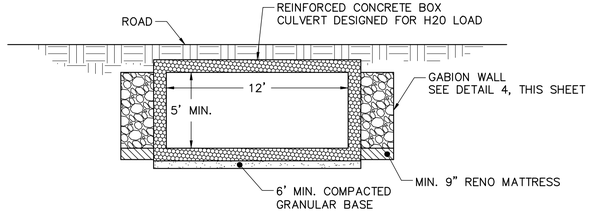
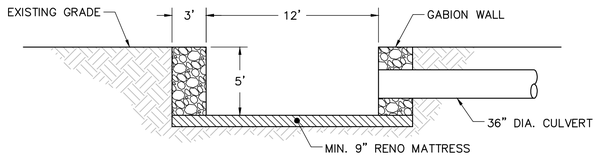
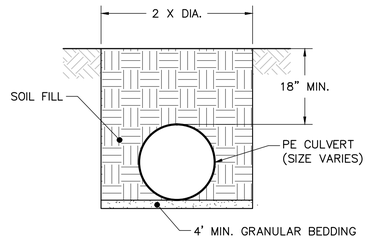


CONCRETE BOX CULVERT

DETAIL 3/7
SCALE: NOT TO SCALE

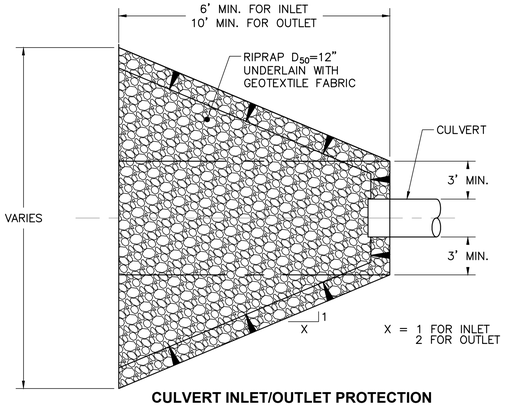


SECTION A-A'



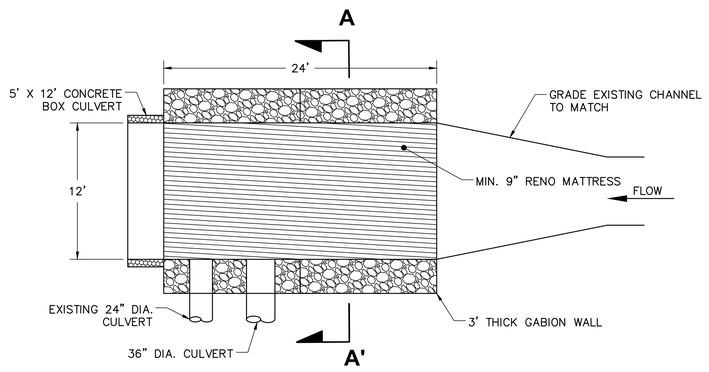
TYPICAL CULVERT

DETAIL 5/7
SCALE: NOT TO SCALE



CULVERT INLET/OUTLET PROTECTION

DETAIL 6/7
SCALE: NOT TO SCALE



EROSION PROTECTION AT
CONCRETE BOX CULVERT INLET

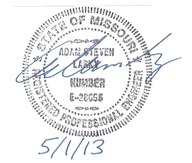
DETAIL 4/7
SCALE: NOT TO SCALE

CULVERT SCHEDULE									
ID	TYPE	SIZE	LENGTH (FT)	INLET ELEV.	OUTLET ELEV.	SLOPE (%)	INLET PROTECTION	OUTLET PROTECTION	SEE NOTE
CV-1	PE	24" DIA.	40	478.50	473.50	12.50	N	N	
CV-2	PE	24" DIA.	40	478.50	473.50	12.50	N	N	
CV-3	PE	18" DIA.	40	473.50	472.00	3.75	N	Y	
CV-4	PE	30" DIA.	24	479.25	478.00	5.20	N	N	
CV-5	PE	24" DIA.	70	473.50	472.80	0.10	N	Y	
CV-6	PE	36" DIA.	400	456.60	449.20	1.85	Y	Y	1
CV-7	BOX	5' X 12'	50	449.20	448.10	2.20	Y	Y	2
CV-8	PE	30" DIA.	50	453.70	453.50	0.40	Y	Y	3
CV-9	PE	24" DIA.	50	440.00	439.80	0.40	Y	Y	

NOTES:
1. MOUND SOIL ALONG DOWNSLOPE SIDE OF CULVERT ENTRANCE TO A MINIMUM ELEVTION OF 461.1 TO PREVENT OVERTOPPING.
2. MOUND SOIL ALONG DOWNSLOPE SIDE OF CULVERT ENTRANCE TO A MINIMUM ELEVTION OF 452.8 TO PREVENT OVERTOPPING.
3. MOUND SOIL ALONG DOWNSLOPE SIDE OF CULVERT ENTRANCE TO A MINIMUM ELEVTION OF 461.6 TO PREVENT OVERTOPPING.
4. PE CULVERTS TO HAVE SMOOTH INTERIOR WALL.
5. LARGE HEIGHT BOX CULVERT MAY BE USED BASED ON MATERIAL AVAILABILITY WITH BOTTOM SUNK INTO CHANNEL.

NOTE:

SEE CULVERT SCHEDULE FOR APPLICABLE CULVERTS.



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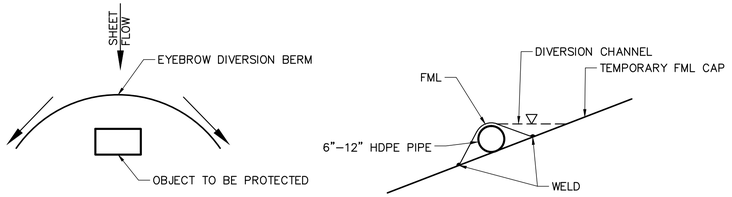
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR TEMPORARY CAP INTEGRITY SYSTEM
DETAILS

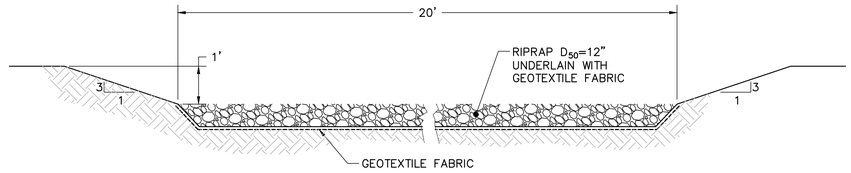
SHEET NO. 7
PROJECT NO. 130140

1" 1/2" 0" 1"



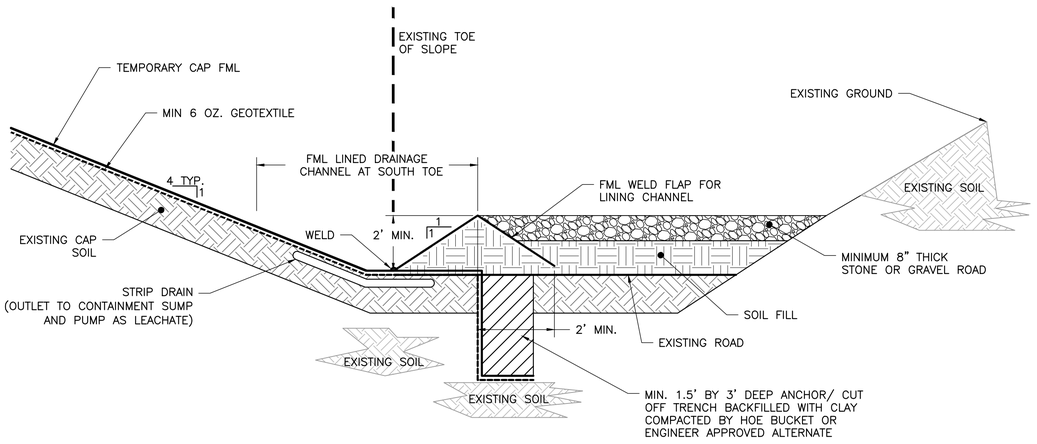
EYEBROW DIVERSION BERM

DETAIL 1/8
SCALE: NOT TO SCALE



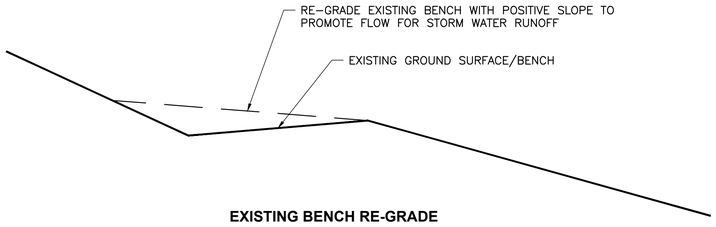
DETENTION BASIN OVERFLOW

DETAIL 2/8
SCALE: NOT TO SCALE



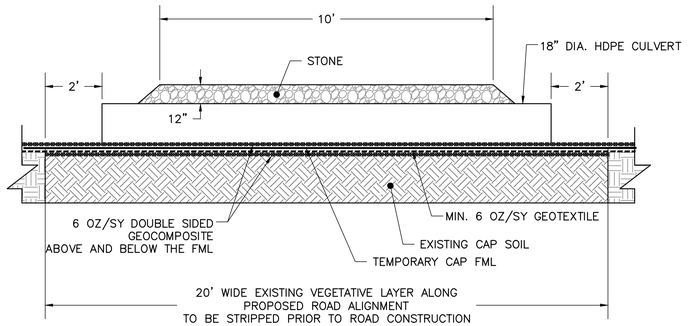
SOUTH/SOUTHWEST PERIMETER CHANNEL AT TEMPORARY CAP TERMINATION

DETAIL 3/8
SCALE: NOT TO SCALE



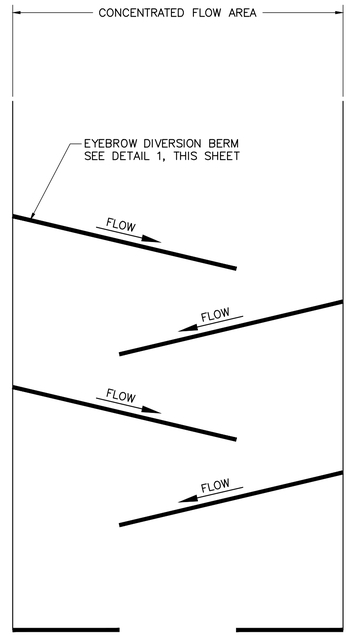
EXISTING BENCH RE-GRADE

DETAIL 6/8
SCALE: NOT TO SCALE



CULVERT CROSSING AT LIGHT-DUTY ACCESS ROAD

DETAIL 4/8
SCALE: NOT TO SCALE



ENERGY DISSIPATER FOR CONCENTRATED FLOW AREAS

DETAIL 5/8
SCALE: NOT TO SCALE

NOTE:

THIS DETAIL MAY BE USED WHERE CONCENTRATED FLOW IS OBSERVED UPON CONSTRUCTION OF TEMPORARY CAP TO DISSIPATE FLOW.

STATE OF MISSOURI
ADAM STEVEN GUM
NUMBER E-26056
REGISTERED PROFESSIONAL ENGINEER
5/1/13

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CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
STORMWATER MANAGEMENT PLAN FOR TEMPORARY CAP INTEGRITY SYSTEM
DETAILS

SHEET NO. **8**
PROJECT NO. 130140

1" 1/2" 0" 1"

APPENDIX A

25-YEAR 24-HOUR RAINFALL AND RAINFALL INTENSITY DURATION

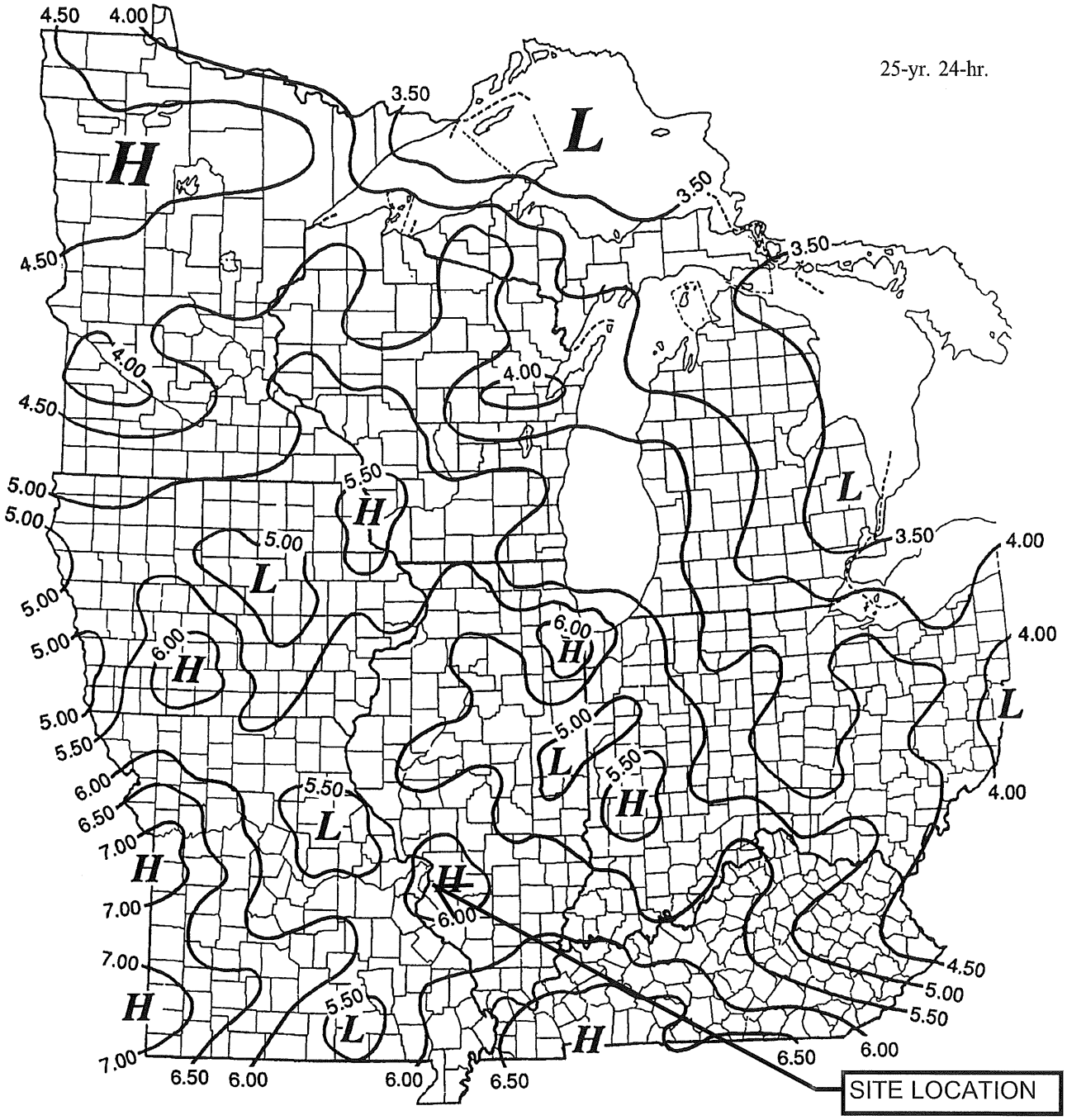


Figure 6. Continued

APPENDIX B

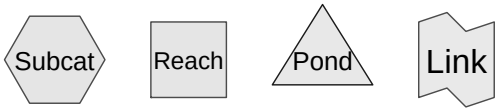
STORMWATER CALCULATIONS FOR NORTH DRAINAGE AREA

NORTH DRAINAGE AREA

North Channel

North Basin Inlet Culvert, CV-1 & CV-2

North Basin Outlet Culvert, CV-3



Routing Diagram for North Stormwater Model rev1
Prepared by Cornerstone, Printed 5/1/2013

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	CV-1 & 2	478.50	473.50	40.0	0.1250	0.012	24.0	0.0	0.0
2	CV-2	473.50	472.00	40.0	0.0375	0.012	18.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment N: NORTH DRAINAGE Runoff Area=5.760 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=620' Tc=13.2 min CN=100 Runoff=39.53 cfs 2.880 af

Reach N2: North Channel Avg. Flow Depth=1.37' Max Vel=5.01 fps Inflow=39.53 cfs 2.880 af
n=0.012 L=320.0' S=0.0020 '/' Capacity=86.19 cfs Outflow=39.24 cfs 2.880 af

Pond CV-1 & 2: North Basin Inlet Culvert, Peak Elev=479.41' Storage=292 cf Inflow=39.24 cfs 2.880 af
Primary=3.58 cfs 1.548 af Secondary=35.65 cfs 1.332 af Outflow=39.23 cfs 2.880 af

Pond CV-2: North Basin Outlet Culvert, Peak Elev=477.33' Storage=0.883 af Inflow=39.23 cfs 2.880 af
Primary=11.80 cfs 2.879 af Secondary=0.00 cfs 0.000 af Outflow=11.80 cfs 2.879 af

Total Runoff Area = 5.760 ac Runoff Volume = 2.880 af Average Runoff Depth = 6.00"
0.00% Pervious = 0.000 ac 100.00% Impervious = 5.760 ac

Summary for Subcatchment N: NORTH DRAINAGE AREA

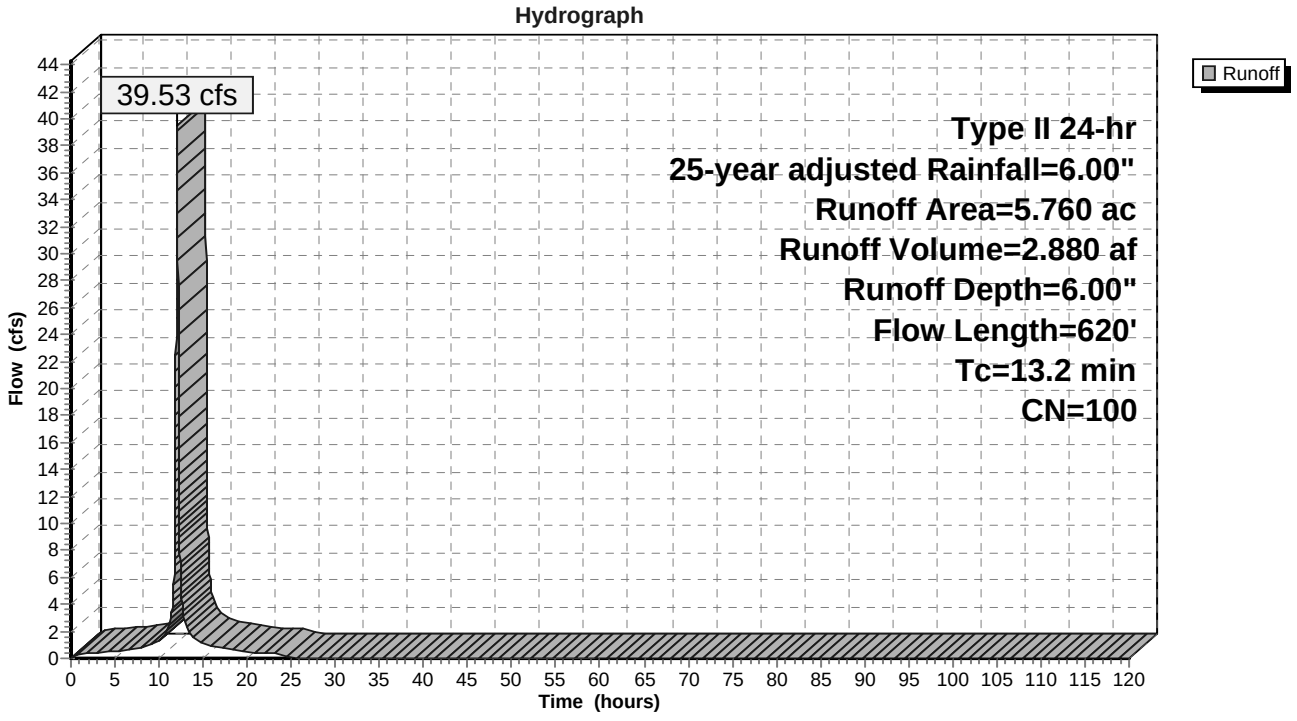
Runoff = 39.53 cfs @ 12.04 hrs, Volume= 2.880 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	5.760	100	
	5.760		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	300	0.1500	3.74		**Sheet Flow, North** n= 0.012 P2= 3.50"
11.9	320	0.0020	0.45		**Shallow Concentrated Flow, Concentrated Channel Flow** Nearly Bare & Untilled Kv= 10.0 fps
13.2	620	Total			

Subcatchment N: NORTH DRAINAGE AREA



Summary for Reach N2: North Channel

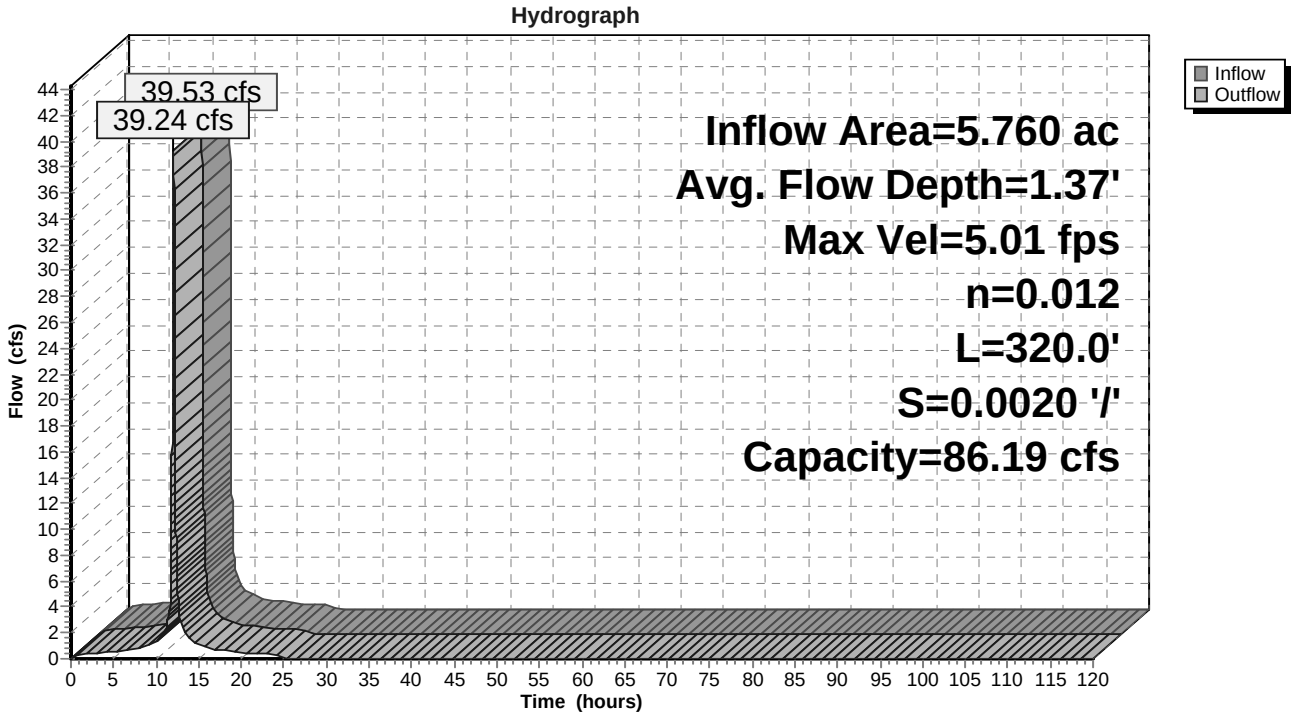
Inflow Area = 5.760 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 39.53 cfs @ 12.04 hrs, Volume= 2.880 af
Outflow = 39.24 cfs @ 12.05 hrs, Volume= 2.880 af, Atten= 1%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.01 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.47 fps, Avg. Travel Time= 3.6 min

Peak Storage= 2,507 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.37'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 86.19 cfs

3.00' x 2.00' deep channel, n= 0.012
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 320.0' Slope= 0.0020 '/'
Inlet Invert= 479.14', Outlet Invert= 478.50'

Reach N2: North Channel



Summary for Pond CV-1 & 2: North Basin Inlet Culvert, CV-1 & CV-2

Inflow Area = 5.760 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 39.24 cfs @ 12.05 hrs, Volume= 2.880 af
Outflow = 39.23 cfs @ 12.06 hrs, Volume= 2.880 af, Atten= 0%, Lag= 0.1 min
Primary = 3.58 cfs @ 12.06 hrs, Volume= 1.548 af
Secondary = 35.65 cfs @ 12.06 hrs, Volume= 1.332 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 479.41' @ 12.06 hrs Surf.Area= 0 sf Storage= 292 cf

Plug-Flow detention time= 0.7 min calculated for 2.880 af (100% of inflow)
Center-of-Mass det. time= 0.5 min (730.7 - 730.2)

Volume	Invert	Avail.Storage	Storage Description
#1	478.50'	4,828 cf	**Custom Stage Data** Listed below

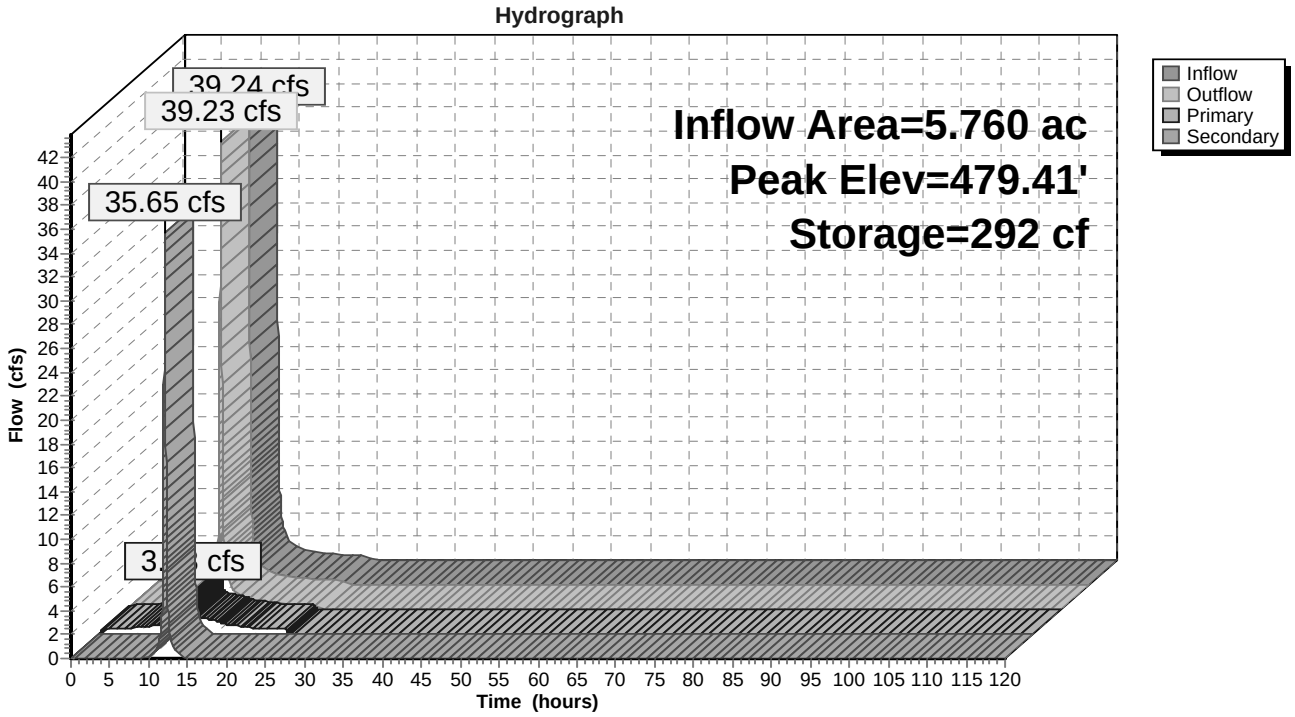
Elevation (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
478.50	0	0
478.70	8	8
479.10	68	76
479.70	416	492
480.50	1,568	2,060
481.00	2,768	4,828

Device	Routing	Invert	Outlet Devices
#1	Primary	478.50'	**24.0" Round Culvert** L= 40.0' Ke= 0.900 Inlet / Outlet Invert= 478.50' / 473.50' S= 0.1250 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Secondary	479.00'	**50.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=3.58 cfs @ 12.06 hrs HW=479.41' TW=476.32' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 3.58 cfs @ 2.57 fps)

Secondary OutFlow Max=35.62 cfs @ 12.06 hrs HW=479.41' TW=476.32' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 35.62 cfs @ 1.73 fps)

Pond CV-1 & 2: North Basin Inlet Culvert, CV-1 & CV-2



Summary for Pond CV-2: North Basin Outlet Culvert, CV-3

Inflow Area = 5.760 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 39.23 cfs @ 12.06 hrs, Volume= 2.880 af
Outflow = 11.80 cfs @ 12.29 hrs, Volume= 2.879 af, Atten= 70%, Lag= 13.8 min
Primary = 11.80 cfs @ 12.29 hrs, Volume= 2.879 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 477.33' @ 12.29 hrs Surf.Area= 0.282 ac Storage= 0.883 af

Plug-Flow detention time= 64.1 min calculated for 2.879 af (100% of inflow)
Center-of-Mass det. time= 63.9 min (794.5 - 730.7)

Volume	Invert	Avail.Storage	Storage Description
#1	473.50'	1.738 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

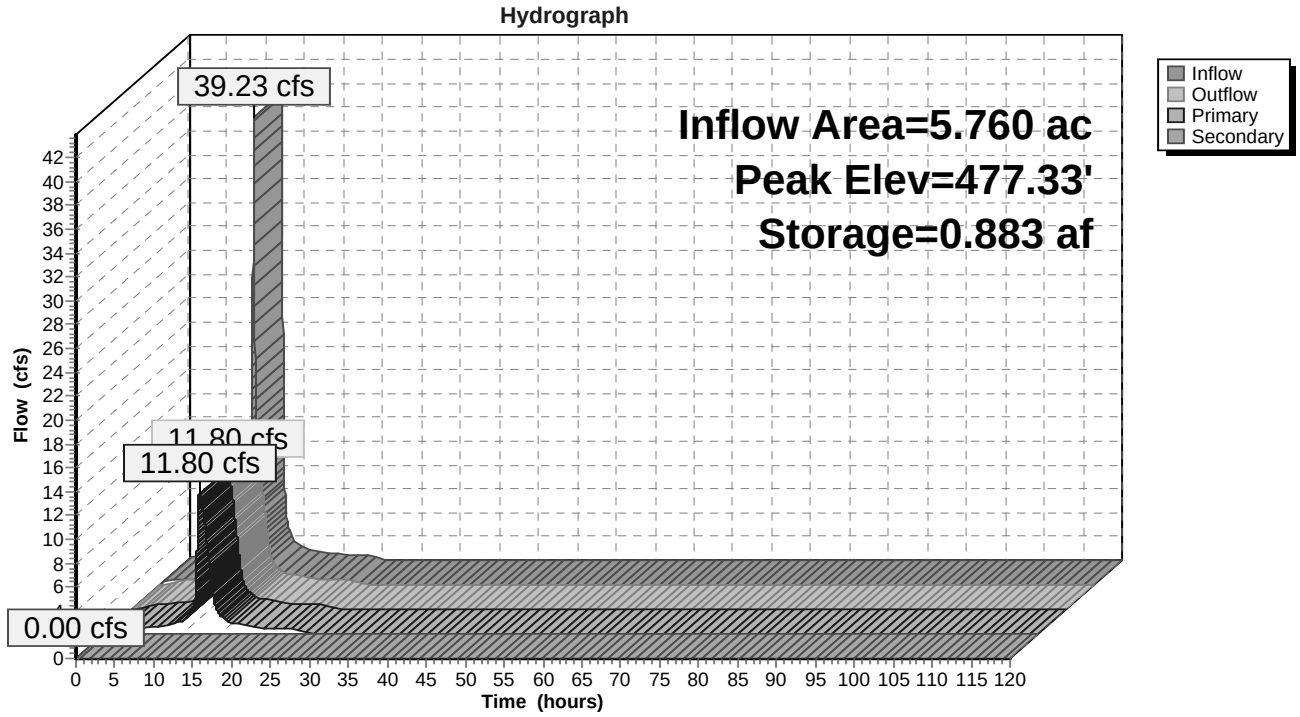
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
473.50	0.180	0.000	0.000
474.00	0.193	0.093	0.093
476.00	0.245	0.438	0.531
478.00	0.301	0.546	1.077
480.00	0.360	0.661	1.738

Device	Routing	Invert	Outlet Devices
#1	Primary	473.50'	**18.0" Round Culvert** L= 40.0' Ke= 0.900 Inlet / Outlet Invert= 473.50' / 472.00' S= 0.0375 '/' Cc= 0.900 n= 0.012 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Secondary	479.00'	**20.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=11.80 cfs @ 12.29 hrs HW=477.33' (Free Discharge)
└**1=Culvert** (Inlet Controls 11.80 cfs @ 6.67 fps)

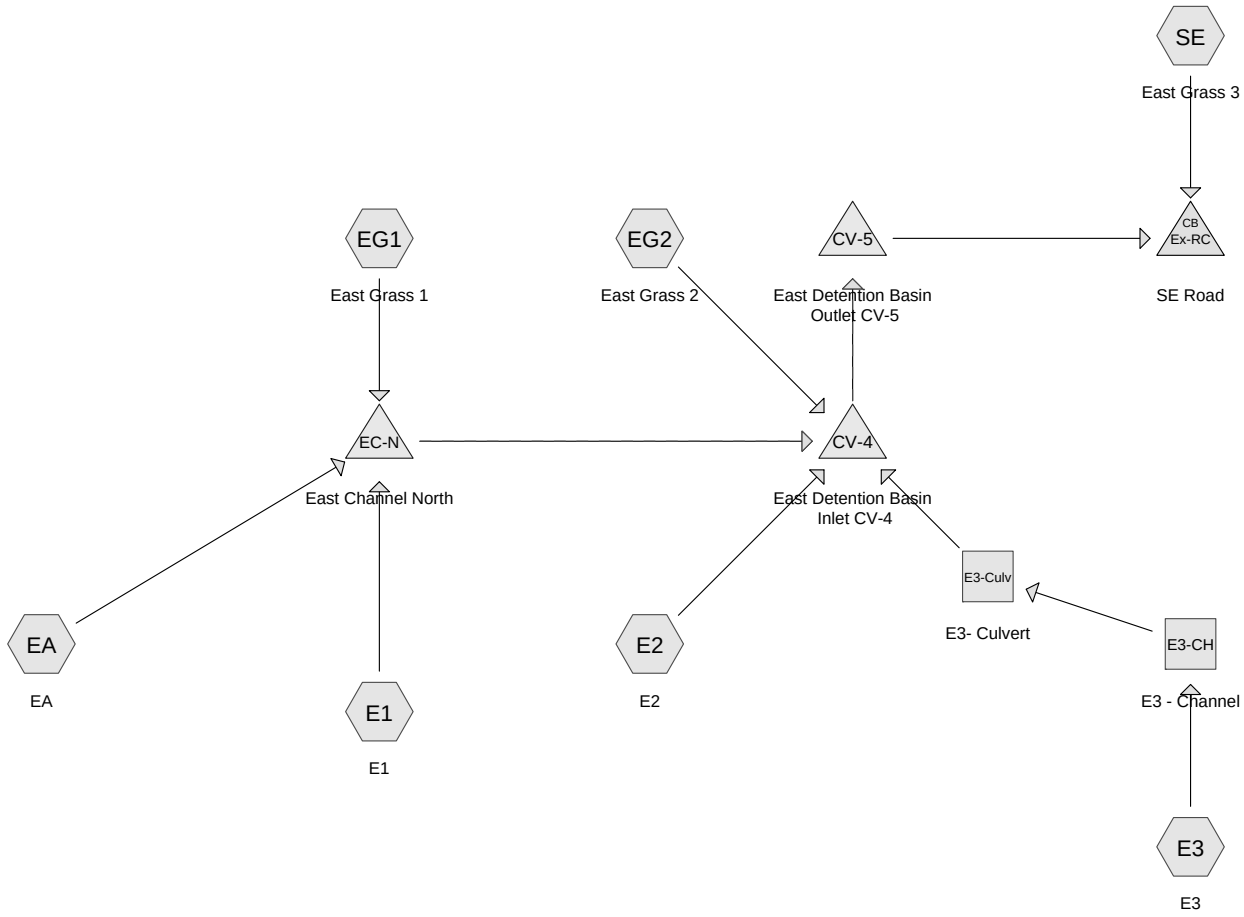
Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=473.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond CV-2: North Basin Outlet Culvert, CV-3



APPENDIX C

STORMWATER CALCULATIONS FOR EAST DRAINAGE AREA



Subcat Reach Pond Link

Routing Diagram for East Stormwater Model rev1
Prepared by Cornerstone, Printed 5/1/2013

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	E3-Culv	479.50	477.00	30.0	0.0833	0.025	30.0	0.0	0.0
2	CV-4	479.25	478.00	24.0	0.0521	0.012	30.0	0.0	0.0
3	CV-5	473.50	472.80	70.0	0.0100	0.012	24.0	0.0	0.0
4	EC-N	478.07	477.70	30.5	0.0121	0.020	30.0	0.0	0.0
5	Ex-RC	472.88	472.07	123.0	0.0066	0.020	36.0	0.0	0.0
6	Ex-RC	473.05	472.17	123.0	0.0072	0.020	36.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: E1 Runoff Area=6.780 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=700' Tc=2.7 min CN=100 Runoff=64.49 cfs 3.390 af

Subcatchment E2: E2 Runoff Area=5.260 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=462' Tc=1.6 min CN=100 Runoff=51.69 cfs 2.630 af

Subcatchment E3: E3 Runoff Area=1.000 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=632' Tc=2.6 min CN=100 Runoff=9.54 cfs 0.500 af

Subcatchment EA: EA Runoff Area=1.470 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=150' Slope=0.0470 '/' Tc=1.2 min CN=100 Runoff=14.57 cfs 0.735 af

Subcatchment EG1: East Grass 1 Runoff Area=10.290 ac 0.00% Impervious Runoff Depth=3.18"
Flow Length=1,120' Tc=30.2 min CN=74 Runoff=28.30 cfs 2.731 af

Subcatchment EG2: East Grass 2 Runoff Area=5.580 ac 0.00% Impervious Runoff Depth=3.18"
Flow Length=480' Tc=19.3 min CN=74 Runoff=20.20 cfs 1.481 af

Subcatchment SE: East Grass 3 Runoff Area=1.460 ac 0.00% Impervious Runoff Depth=3.18"
Flow Length=620' Tc=15.4 min CN=74 Runoff=5.95 cfs 0.387 af

Reach E3-CH: E3 - Channel Avg. Flow Depth=0.10' Max Vel=11.64 fps Inflow=9.54 cfs 0.500 af
n=0.012 L=320.0' S=0.1944 '/' Capacity=136.55 cfs Outflow=9.50 cfs 0.500 af

Reach E3-Culv: E3- Culvert Avg. Flow Depth=0.66' Max Vel=9.09 fps Inflow=9.50 cfs 0.500 af
30.0" Round Pipe n=0.025 L=30.0' S=0.0833 '/' Capacity=61.57 cfs Outflow=9.50 cfs 0.500 af

Pond CV-4: East Detention Basin Inlet Peak Elev=480.39' Storage=1.553 af Inflow=95.96 cfs 11.441 af
Outflow=93.20 cfs 10.603 af

Pond CV-5: East Detention Basin Outlet Peak Elev=480.36' Storage=2.370 af Inflow=93.20 cfs 10.603 af
Outflow=38.30 cfs 10.603 af

Pond EC-N: East Channel North Peak Elev=482.08' Storage=1.095 af Inflow=85.79 cfs 6.856 af
Primary=31.69 cfs 6.830 af Secondary=0.00 cfs 0.000 af Outflow=31.69 cfs 6.830 af

Pond Ex-RC: SE Road Peak Elev=475.12' Inflow=39.31 cfs 10.991 af
Primary=39.31 cfs 10.991 af Secondary=0.00 cfs 0.000 af Outflow=39.31 cfs 10.991 af

Total Runoff Area = 31.840 ac Runoff Volume = 11.854 af Average Runoff Depth = 4.47"
54.43% Pervious = 17.330 ac 45.57% Impervious = 14.510 ac

Summary for Subcatchment E1: E1

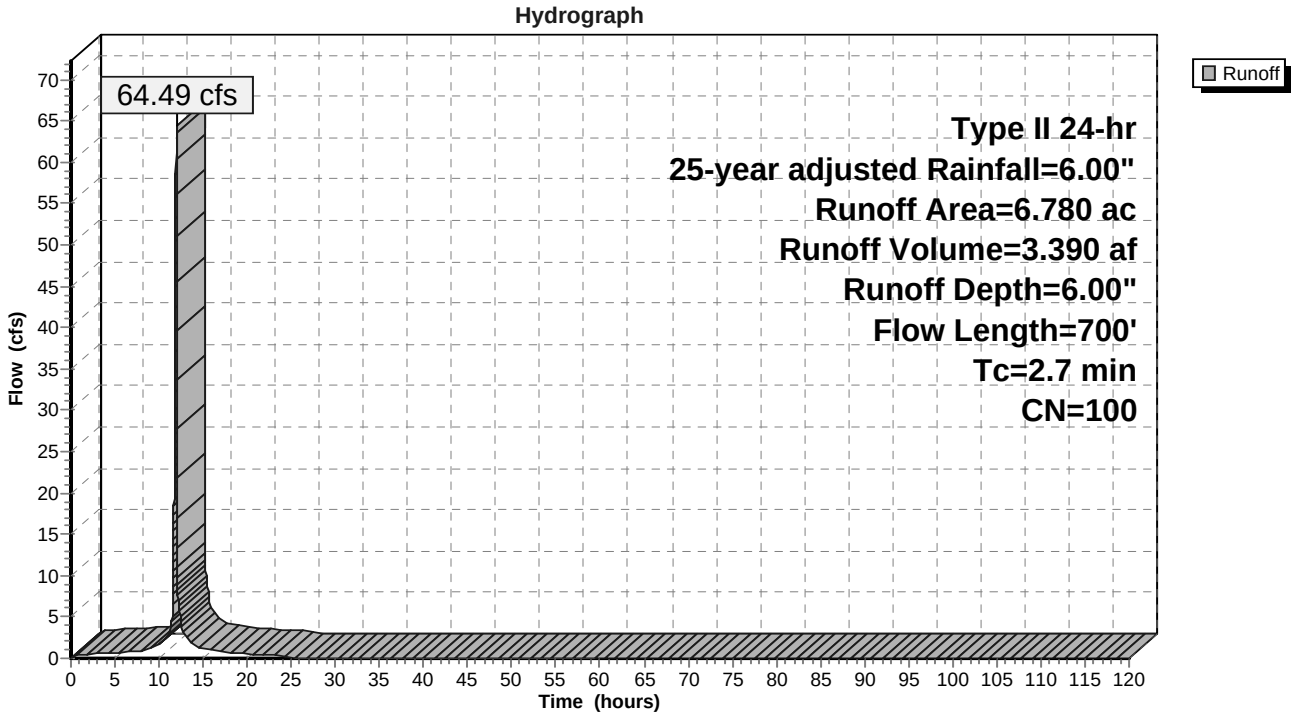
Runoff = 64.49 cfs @ 11.93 hrs, Volume= 3.390 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	6.780	100	
	6.780		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	300	0.0690	2.74		**Sheet Flow,** n= 0.012 P2= 3.50"
0.9	400	0.1325	7.39		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.7	700	Total			

Subcatchment E1: E1



Summary for Subcatchment E2: E2

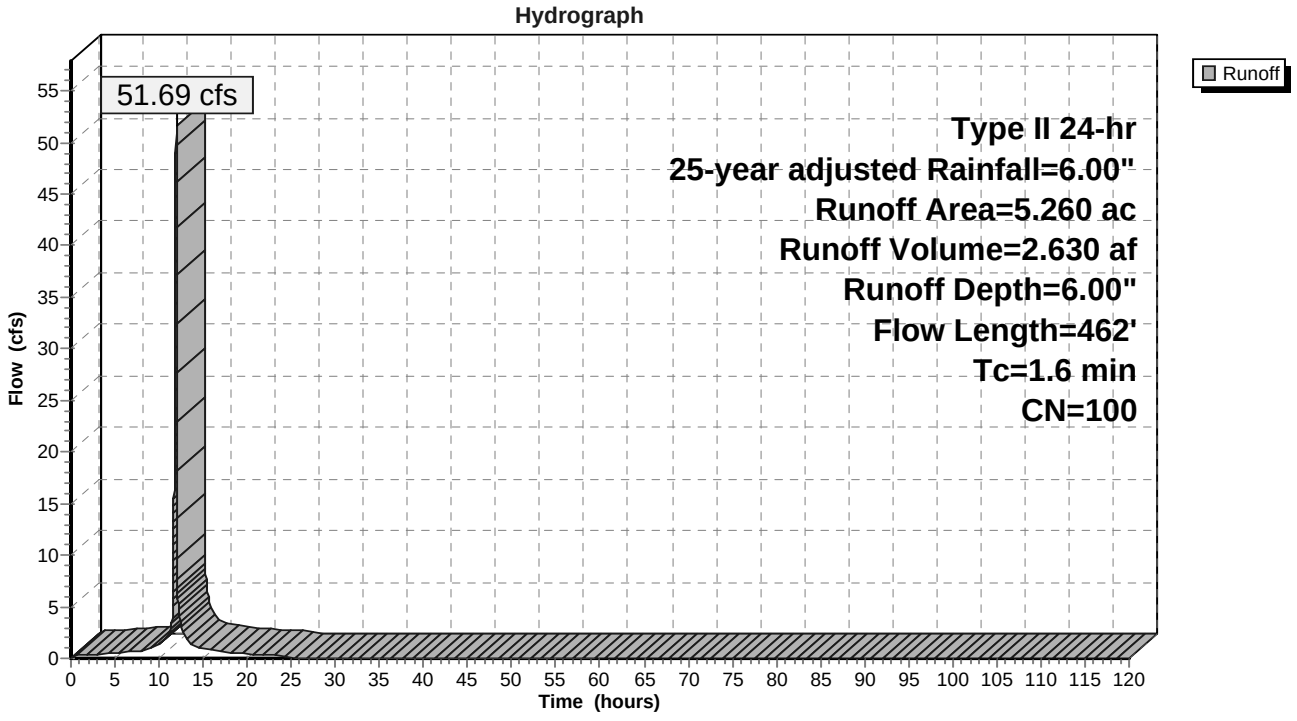
Runoff = 51.69 cfs @ 11.92 hrs, Volume= 2.630 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	5.260	100	
	5.260		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	300	0.1500	3.74		**Sheet Flow,** n= 0.012 P2= 3.50"
0.3	162	0.1728	8.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.6	462	Total			

Subcatchment E2: E2



Summary for Subcatchment E3: E3

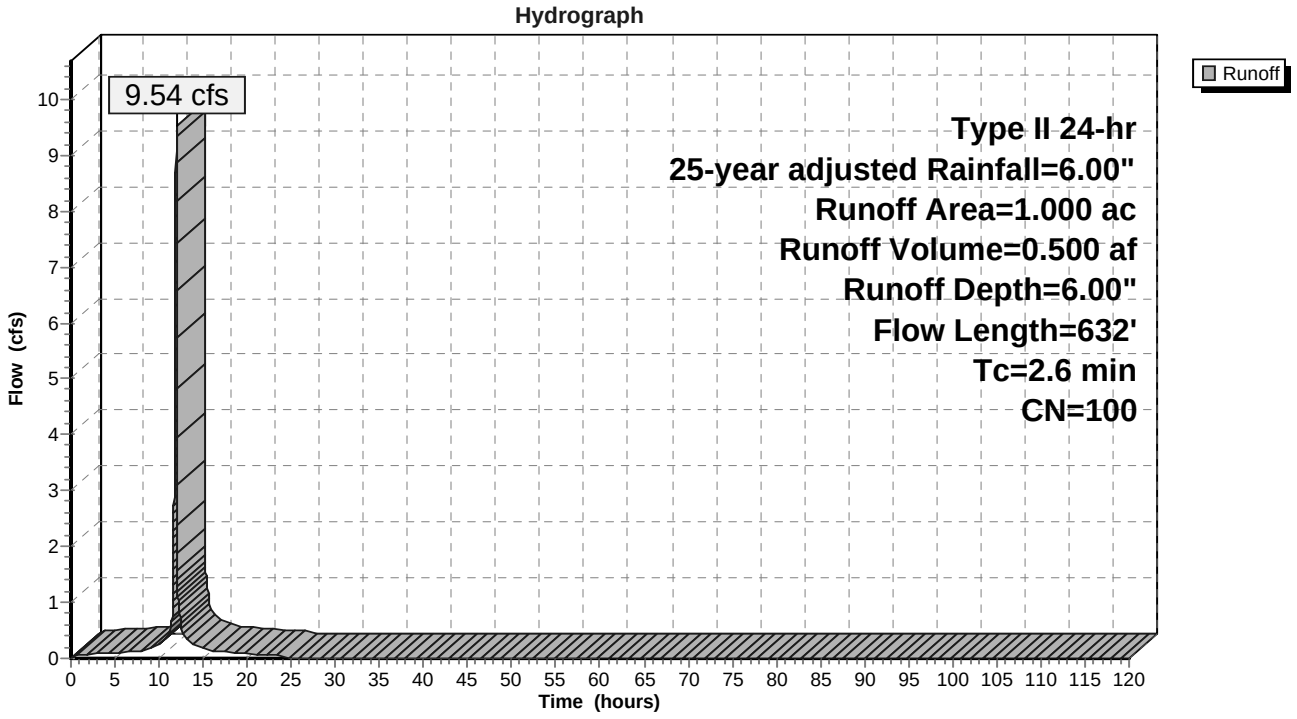
Runoff = 9.54 cfs @ 11.93 hrs, Volume= 0.500 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	1.000	100	
	1.000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	140	0.0671	2.33		**Sheet Flow,** n= 0.012 P2= 3.50"
1.0	172	0.0209	2.93		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	320	0.1944	8.95		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.6	632	Total			

Subcatchment E3: E3



Summary for Subcatchment EA: EA

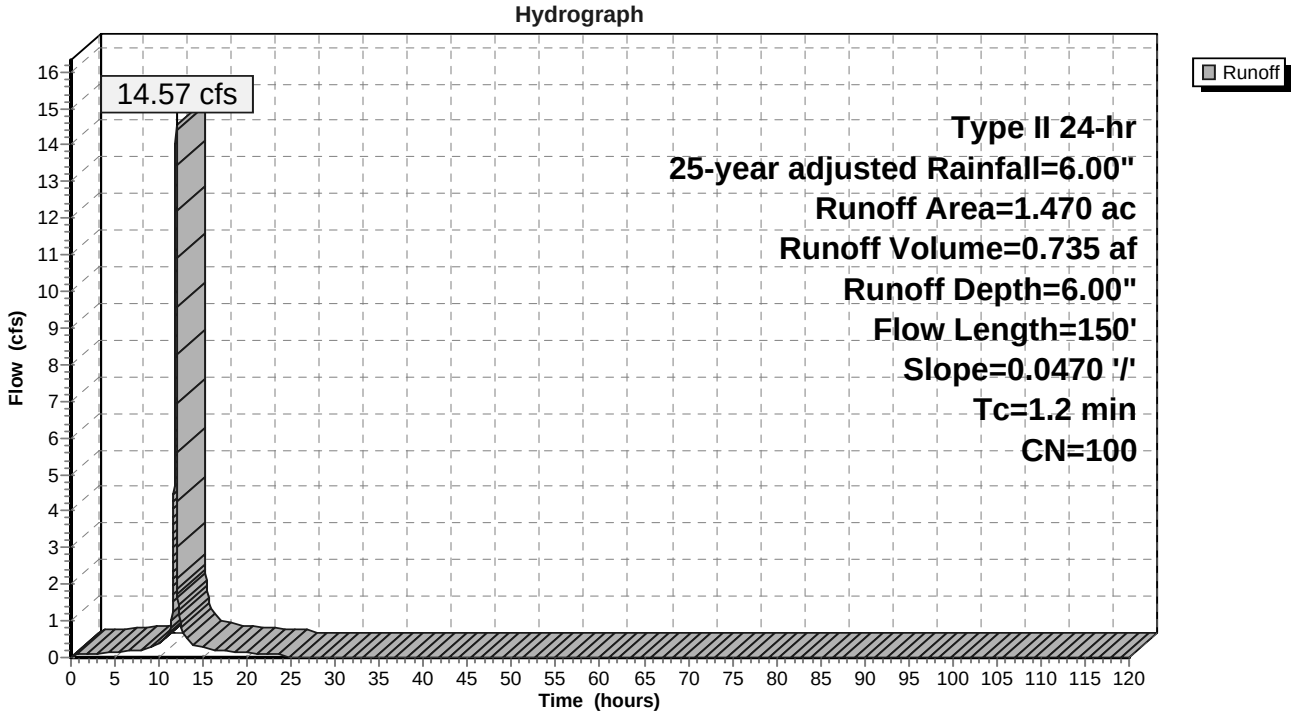
Runoff = 14.57 cfs @ 11.91 hrs, Volume= 0.735 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	1.470	100	
	1.470		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	150	0.0470	2.05		**Sheet Flow,** n= 0.012 P2= 3.50"

Subcatchment EA: EA



Summary for Subcatchment EG1: East Grass 1

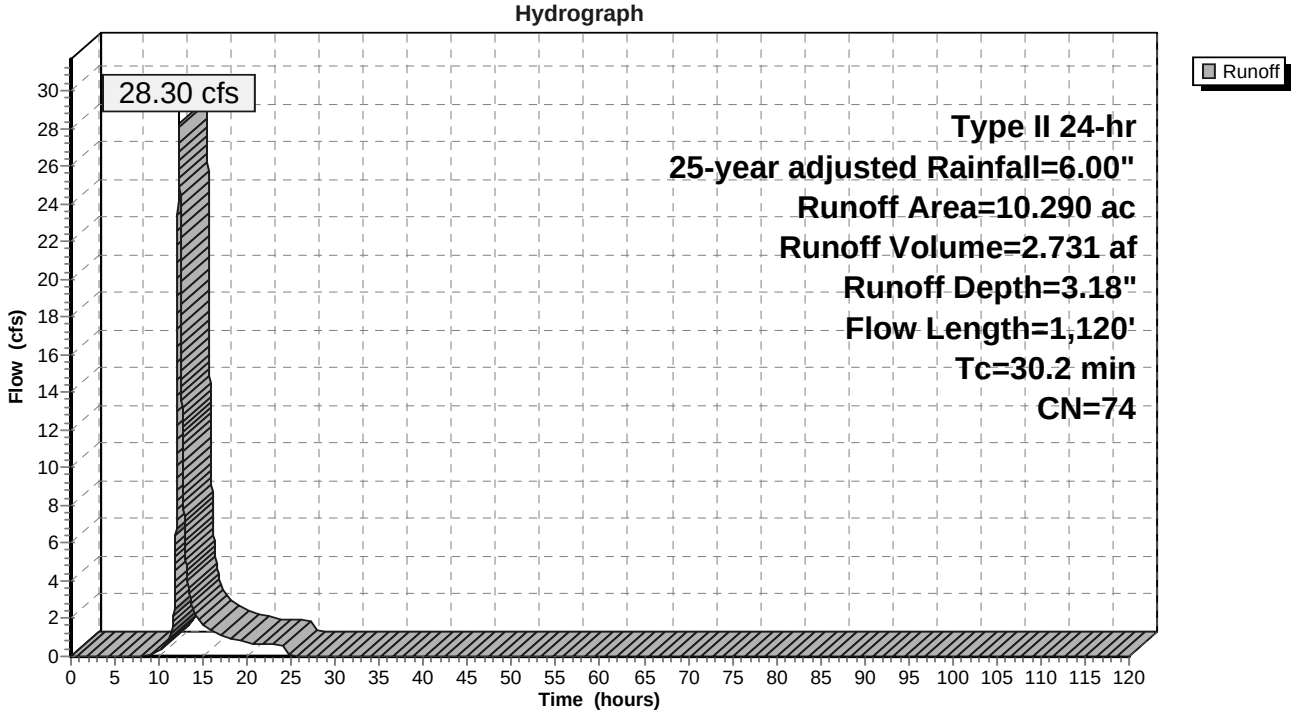
Runoff = 28.30 cfs @ 12.25 hrs, Volume= 2.731 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	10.290	74	
	10.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	300	0.1333	0.47		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
4.0	385	0.0519	1.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.6	435	0.0044	0.46		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
30.2	1,120	Total			

Subcatchment EG1: East Grass 1



Summary for Subcatchment EG2: East Grass 2

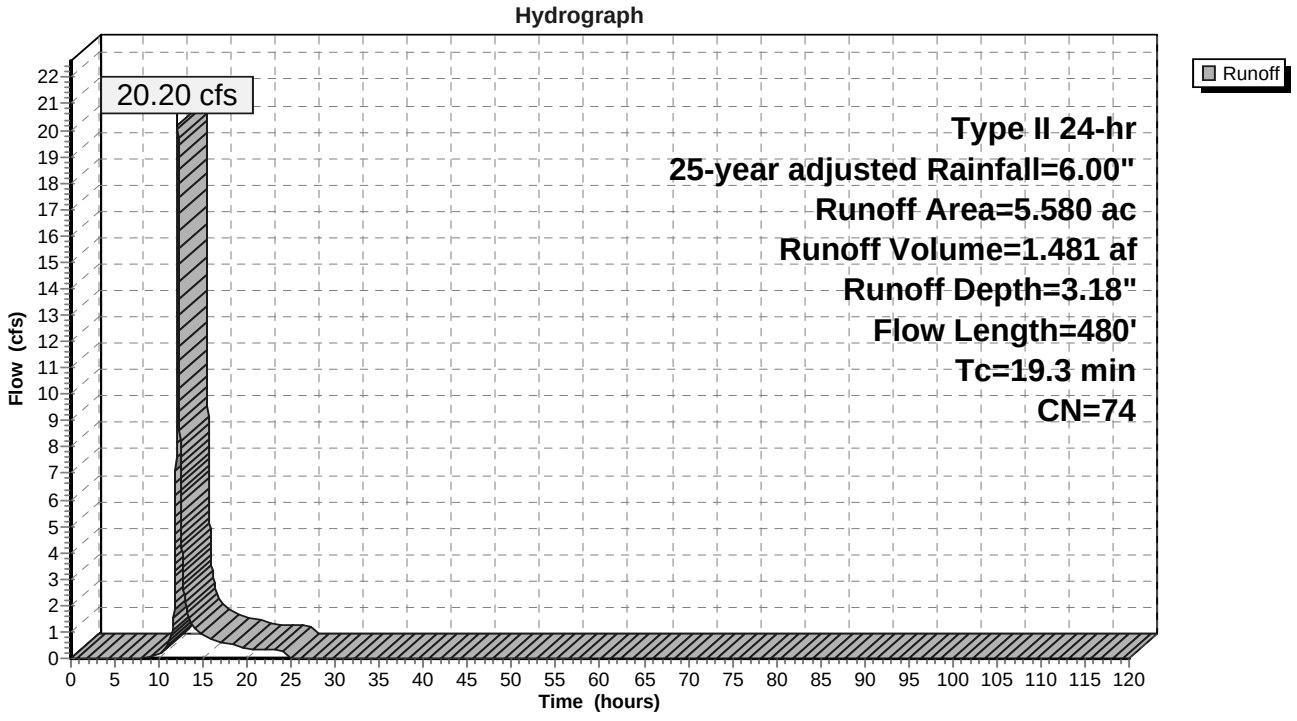
Runoff = 20.20 cfs @ 12.12 hrs, Volume= 1.481 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	5.580	74	
	5.580		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	300	0.0400	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
2.2	180	0.0389	1.38		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
19.3	480	Total			

Subcatchment EG2: East Grass 2



Summary for Subcatchment SE: East Grass 3

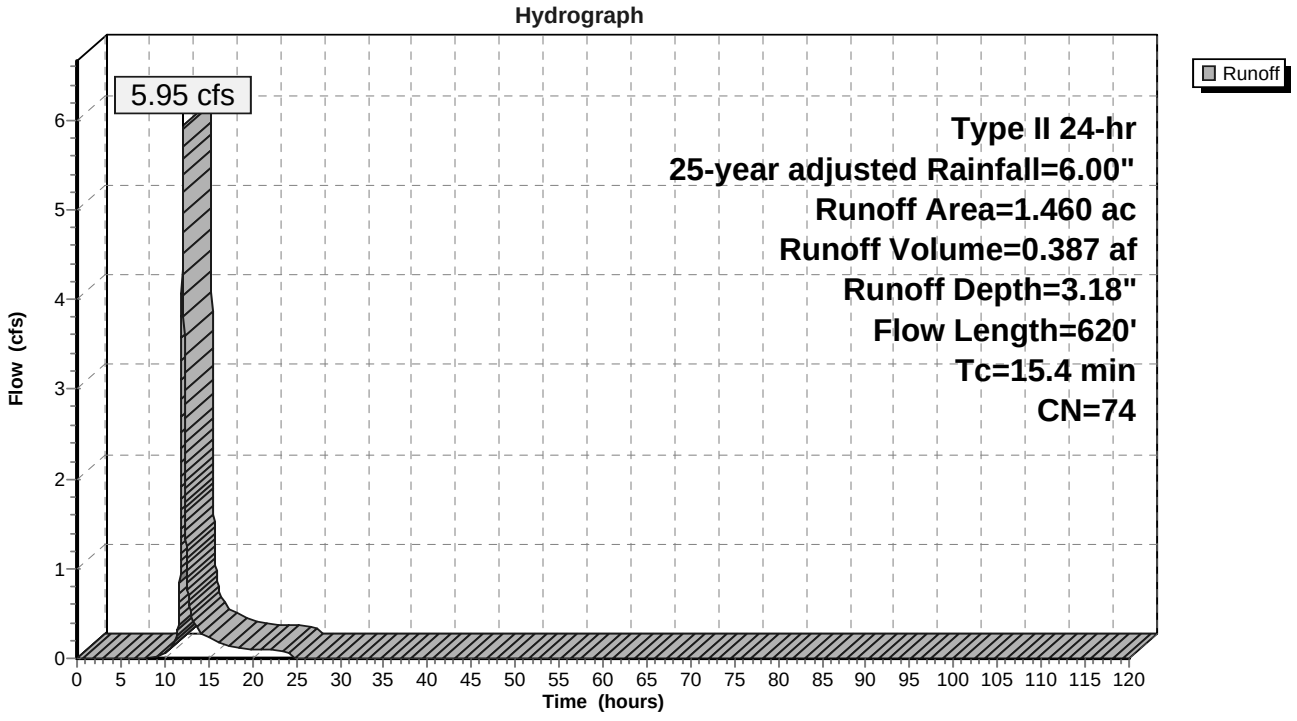
Runoff = 5.95 cfs @ 12.08 hrs, Volume= 0.387 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	1.460	74	
	1.460		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	300	0.1067	0.43		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
3.9	320	0.0375	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.4	620	Total			

Subcatchment SE: East Grass 3



Summary for Reach E3-CH: E3 - Channel

Inflow Area = 1.000 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 9.54 cfs @ 11.93 hrs, Volume= 0.500 af
Outflow = 9.50 cfs @ 11.93 hrs, Volume= 0.500 af, Atten= 0%, Lag= 0.3 min

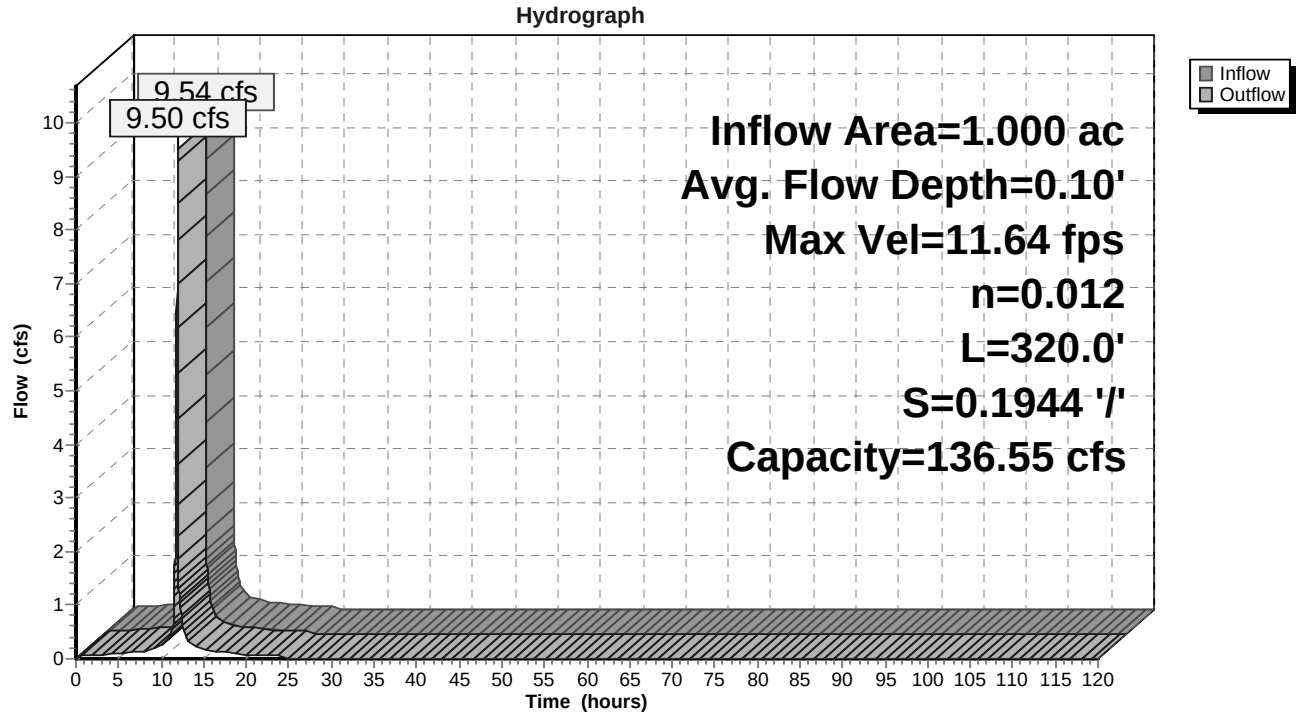
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 11.64 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.32 fps, Avg. Travel Time= 2.3 min

Peak Storage= 261 cf @ 11.93 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 0.50' Flow Area= 4.3 sf, Capacity= 136.55 cfs

8.00' x 0.50' deep channel, n= 0.012
Side Slope Z-value= 1.0 '/' Top Width= 9.00'
Length= 320.0' Slope= 0.1944 '/'
Inlet Invert= 542.20', Outlet Invert= 480.00'

‡

Reach E3-CH: E3 - Channel



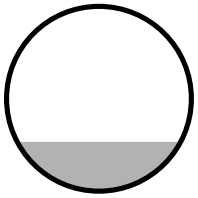
Summary for Reach E3-Culv: E3- Culvert

Inflow Area = 1.000 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 9.50 cfs @ 11.93 hrs, Volume= 0.500 af
Outflow = 9.50 cfs @ 11.93 hrs, Volume= 0.500 af, Atten= 0%, Lag= 0.0 min

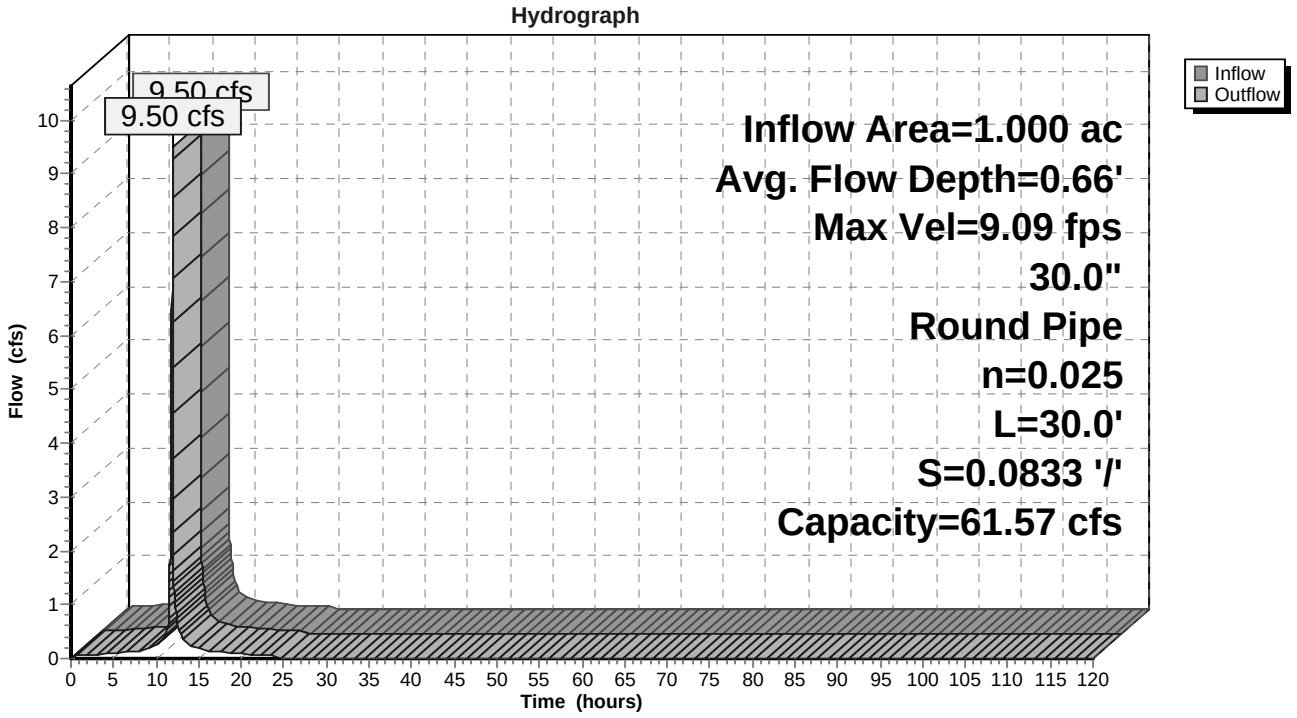
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.09 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.62 fps, Avg. Travel Time= 0.2 min

Peak Storage= 31 cf @ 11.93 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 61.57 cfs

30.0" Round Pipe
n= 0.025 Corrugated metal
Length= 30.0' Slope= 0.0833 '/'
Inlet Invert= 479.50', Outlet Invert= 477.00'



Reach E3-Culv: E3- Culvert



Summary for Pond CV-4: East Detention Basin Inlet CV-4

Inflow Area = 30.380 ac, 47.76% Impervious, Inflow Depth = 4.52" for 25-year adjusted event
Inflow = 95.96 cfs @ 11.92 hrs, Volume= 11.441 af
Outflow = 93.20 cfs @ 11.94 hrs, Volume= 10.603 af, Atten= 3%, Lag= 1.0 min
Primary = 93.20 cfs @ 11.94 hrs, Volume= 10.603 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 480.39' @ 12.54 hrs Surf.Area= 0.000 ac Storage= 1.553 af

Plug-Flow detention time= 136.8 min calculated for 10.603 af (93% of inflow)
Center-of-Mass det. time= 94.3 min (867.6 - 773.3)

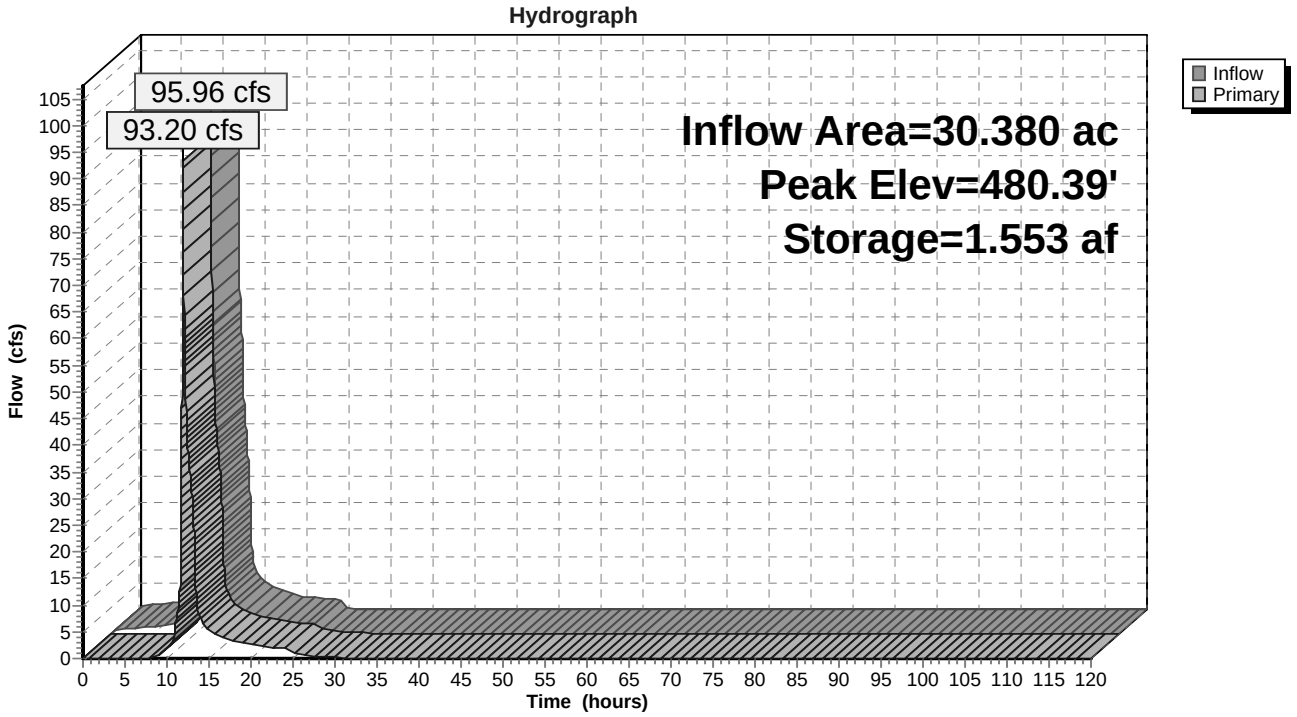
Volume	Invert	Avail.Storage	Storage Description
#1	475.00'	1.870 af	**Custom Stage Data** Listed below

Elevation (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
475.00	0.000	0.000
476.00	0.012	0.012
477.00	0.068	0.080
478.00	0.175	0.255
479.00	0.401	0.656
480.00	0.693	1.349
481.00	0.521	1.870

Device	Routing	Invert	Outlet Devices
#1	Primary	479.25'	**30.0" Round CMP_Round 30"** L= 24.0' Ke= 0.500 Inlet / Outlet Invert= 479.25' / 478.00' S= 0.0521 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf
#2	Primary	480.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 3.00 110.00 113.00 Height (feet) 1.00 0.00 0.00 1.00

Primary OutFlow Max=93.19 cfs @ 11.94 hrs HW=480.39' TW=477.96' (Dynamic Tailwater)
└─**1=CMP_Round 30"** (Inlet Controls 7.90 cfs @ 3.63 fps)
└─**2=Asymmetrical Weir** (Weir Controls 85.29 cfs @ 2.01 fps)

Pond CV-4: East Detention Basin Inlet CV-4



Summary for Pond CV-5: East Detention Basin Outlet CV-5

Inflow Area = 30.380 ac, 47.76% Impervious, Inflow Depth = 4.19" for 25-year adjusted event
Inflow = 93.20 cfs @ 11.94 hrs, Volume= 10.603 af
Outflow = 38.30 cfs @ 12.54 hrs, Volume= 10.603 af, Atten= 59%, Lag= 36.0 min
Primary = 38.30 cfs @ 12.54 hrs, Volume= 10.603 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 480.36' @ 12.54 hrs Surf.Area= 0.524 ac Storage= 2.370 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 37.6 min (905.2 - 867.6)

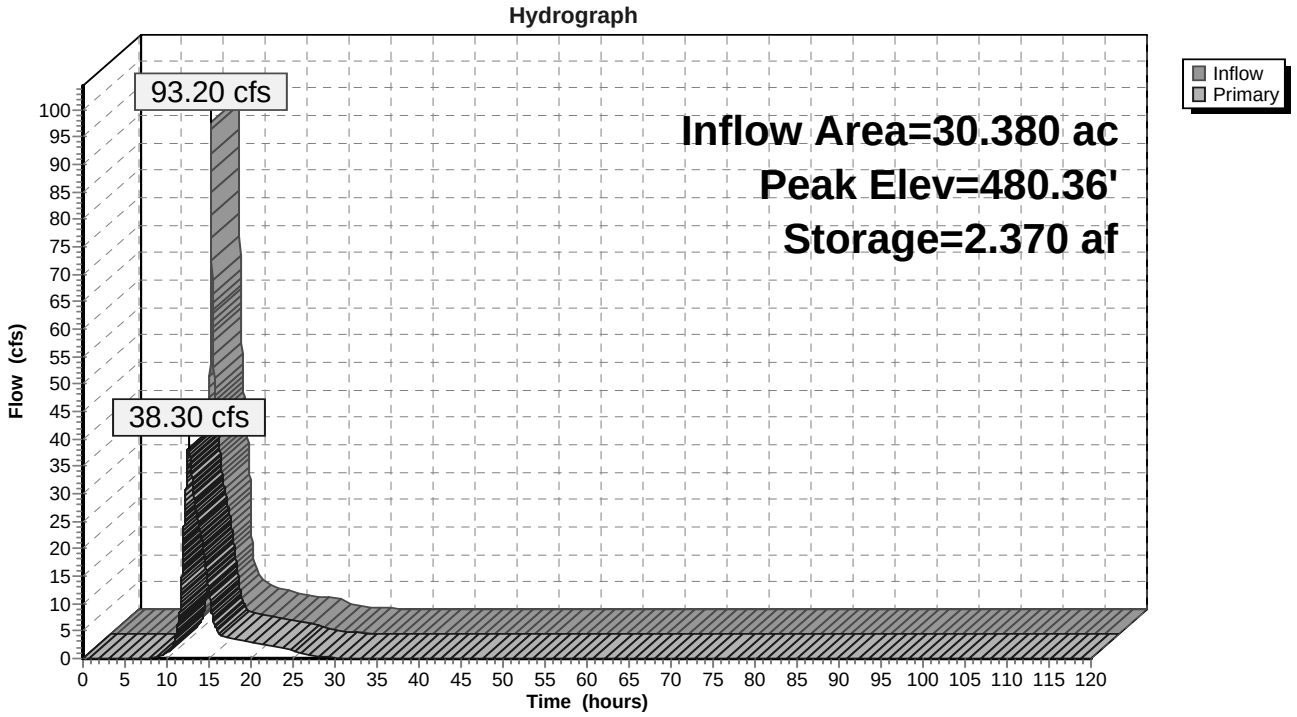
Volume	Invert	Avail.Storage	Storage Description
#1	473.50'	3.864 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
473.50	0.000	0.0	0.000	0.000	0.000
474.00	0.196	846.0	0.033	0.033	1.308
476.00	0.318	1,000.0	0.509	0.542	1.829
478.00	0.411	1,031.0	0.727	1.269	1.953
480.00	0.507	1,062.0	0.916	2.185	2.081
481.00	0.556	1,077.0	0.531	2.716	2.144
482.00	1.867	1,682.0	1.147	3.864	5.194

Device	Routing	Invert	Outlet Devices
#1	Primary	473.50'	**24.0" Round Culvert** L= 70.0' Ke= 0.900 Inlet / Outlet Invert= 473.50' / 472.80' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Primary	480.00'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=38.30 cfs @ 12.54 hrs HW=480.36' TW=475.12' (Dynamic Tailwater)
1=Culvert (Inlet Controls 27.33 cfs @ 8.70 fps)
2=Broad-Crested Rectangular Weir (Weir Controls 10.97 cfs @ 1.53 fps)

Pond CV-5: East Detention Basin Outlet CV-5



Summary for Pond EC-N: East Channel North

Inflow Area = 18.540 ac, 44.50% Impervious, Inflow Depth = 4.44" for 25-year adjusted event
Inflow = 85.79 cfs @ 11.93 hrs, Volume= 6.856 af
Outflow = 31.69 cfs @ 12.26 hrs, Volume= 6.830 af, Atten= 63%, Lag= 20.1 min
Primary = 31.69 cfs @ 12.26 hrs, Volume= 6.830 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 482.08' @ 12.36 hrs Surf.Area= 0.000 ac Storage= 1.095 af

Plug-Flow detention time= 17.6 min calculated for 6.830 af (100% of inflow)
Center-of-Mass det. time= 15.2 min (784.9 - 769.7)

Volume	Invert	Avail.Storage	Storage Description
#1	478.07'	4.101 af	**Custom Stage Data** Listed below

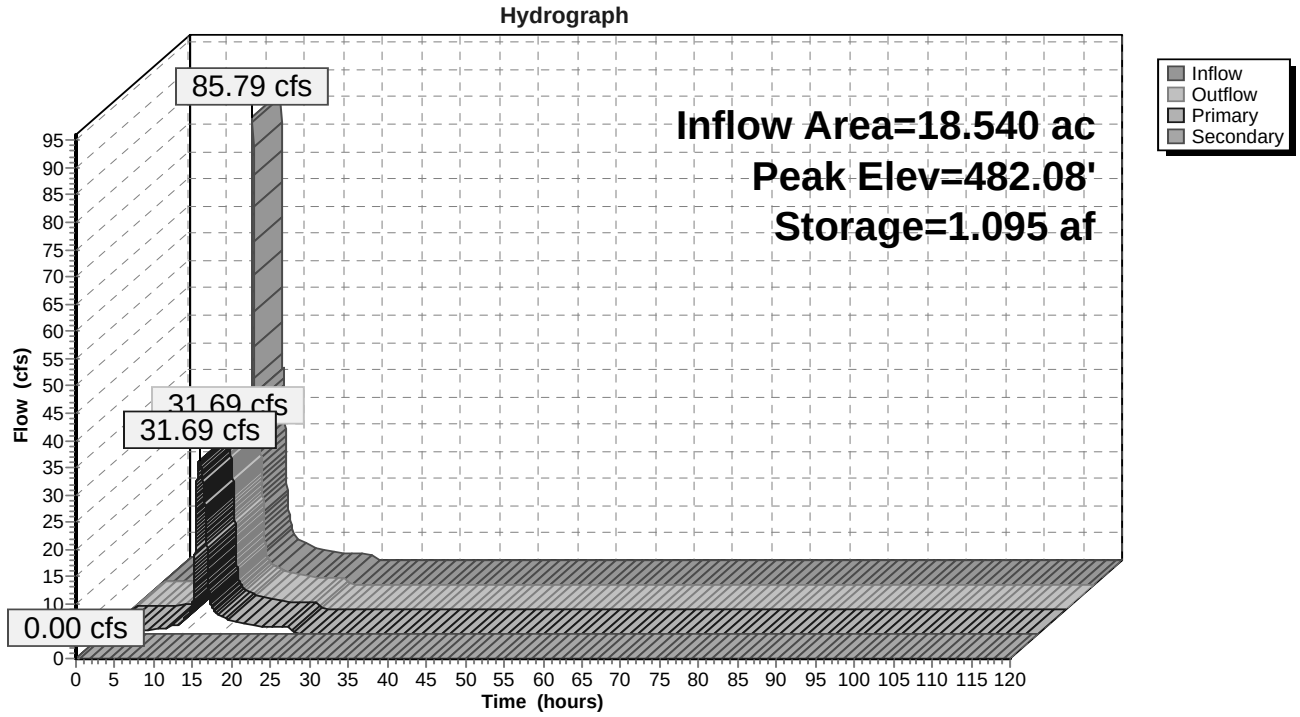
Elevation (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
478.07	0.000	0.000
480.00	0.042	0.042
481.00	0.252	0.294
482.00	0.673	0.967
484.00	3.134	4.101

Device	Routing	Invert	Outlet Devices
#1	Primary	478.07'	**30.0" Round Culvert** L= 30.5' Ke= 0.500 Inlet / Outlet Invert= 478.07' / 477.70' S= 0.0121 '/' Cc= 0.900 n= 0.020, Flow Area= 4.91 sf
#2	Secondary	483.50'	**15.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=31.66 cfs @ 12.26 hrs HW=482.07' TW=480.28' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 31.66 cfs @ 6.45 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=478.07' TW=475.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond EC-N: East Channel North



Summary for Pond Ex-RC: SE Road

Inflow Area = 31.840 ac, 45.57% Impervious, Inflow Depth = 4.14" for 25-year adjusted event
Inflow = 39.31 cfs @ 12.51 hrs, Volume= 10.991 af
Outflow = 39.31 cfs @ 12.51 hrs, Volume= 10.991 af, Atten= 0%, Lag= 0.0 min
Primary = 39.31 cfs @ 12.51 hrs, Volume= 10.991 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

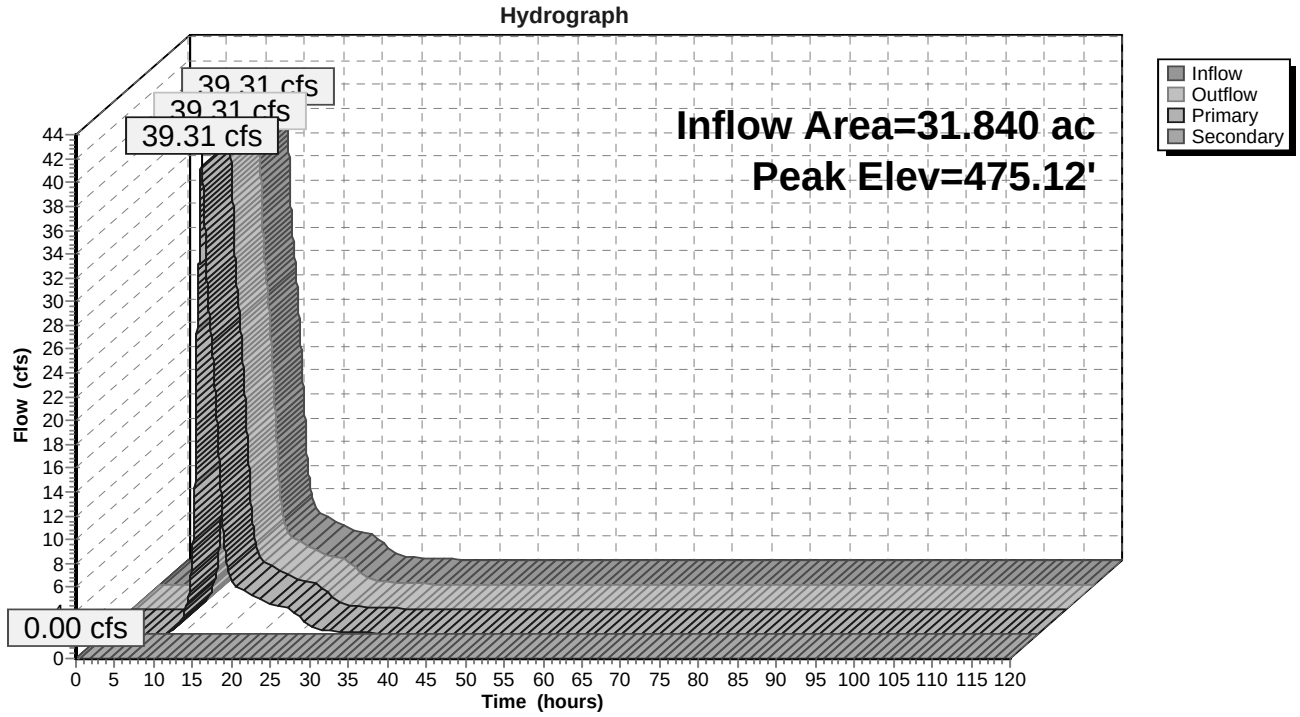
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 475.12' @ 12.51 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	472.88'	**36.0" Round 36" RCP** L= 123.0' Ke= 0.500 Inlet / Outlet Invert= 472.88' / 472.07' S= 0.0066 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 7.07 sf
#2	Primary	473.05'	**36.0" Round 36" RCP** L= 123.0' Ke= 0.500 Inlet / Outlet Invert= 473.05' / 472.17' S= 0.0072 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 7.07 sf
#3	Secondary	481.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 5.00 11.00 20.00 57.00 71.00 Height (feet) 3.50 1.50 0.00 1.50 1.50 3.50

Primary OutFlow Max=39.31 cfs @ 12.51 hrs HW=475.12' (Free Discharge)
└─**1=36" RCP** (Barrel Controls 20.69 cfs @ 5.07 fps)
└─**2=36" RCP** (Barrel Controls 18.62 cfs @ 5.04 fps)

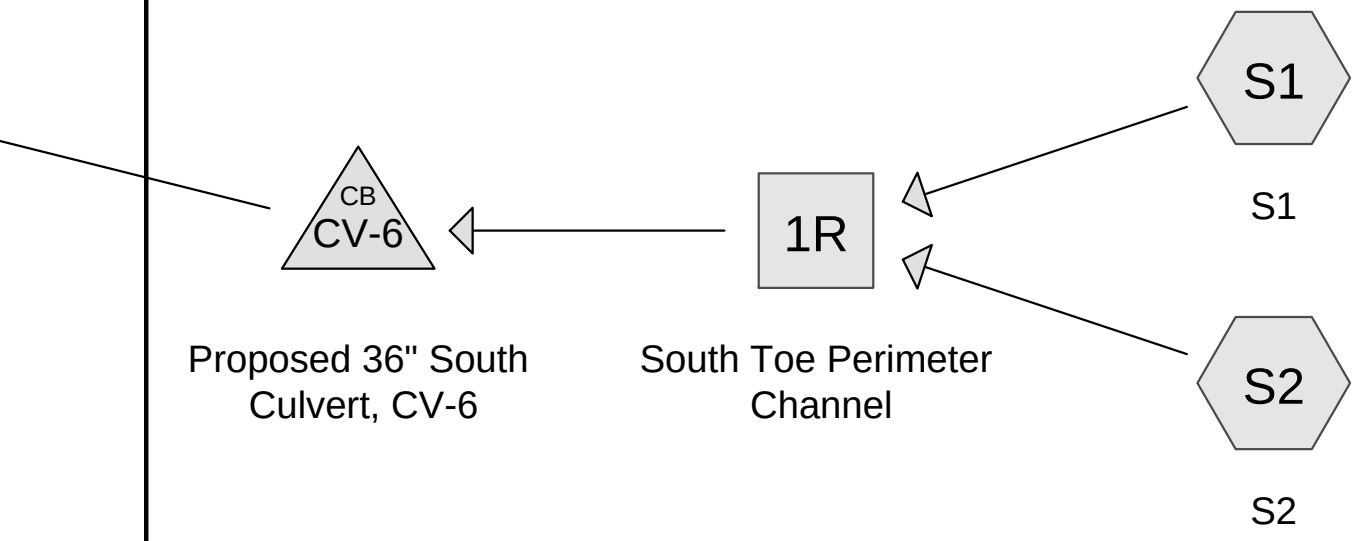
Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=472.88' (Free Discharge)
└─**3=Asymmetrical Weir** (Controls 0.00 cfs)

Pond Ex-RC: SE Road



APPENDIX D

STORMWATER CALCULATIONS FOR SOUTH DRAINAGE AREA



Subcat Reach Pond Link

Routing Diagram for WSW Stormwater Model rev1
Prepared by Cornerstone, Printed 5/1/2013

Pipe Listing (selected 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	CV-6	456.60	449.20	400.0	0.0185	0.012	36.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment S1: S1 Runoff Area=5.440 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=325' Slope=0.2400 '/' Tc=1.1 min CN=100 Runoff=54.11 cfs 2.720 af

Subcatchment S2: S2 Runoff Area=1.220 ac 0.00% Impervious Runoff Depth=4.20"
Flow Length=630' Tc=8.5 min CN=84 Runoff=8.06 cfs 0.427 af

Reach 1R: South Toe Perimeter Avg. Flow Depth=1.28' Max Vel=14.22 fps Inflow=59.75 cfs 3.147 af
n=0.013 L=730.0' S=0.0321 '/' Capacity=191.19 cfs Outflow=58.55 cfs 3.147 af

Pond CV-6: Proposed 36" South Culvert, CV-6 Peak Elev=461.06' Inflow=58.55 cfs 3.147 af
Primary=58.55 cfs 3.147 af Secondary=0.00 cfs 0.000 af Outflow=58.55 cfs 3.147 af

Total Runoff Area = 6.660 ac Runoff Volume = 3.147 af Average Runoff Depth = 5.67"
18.32% Pervious = 1.220 ac 81.68% Impervious = 5.440 ac

Summary for Subcatchment S1: S1

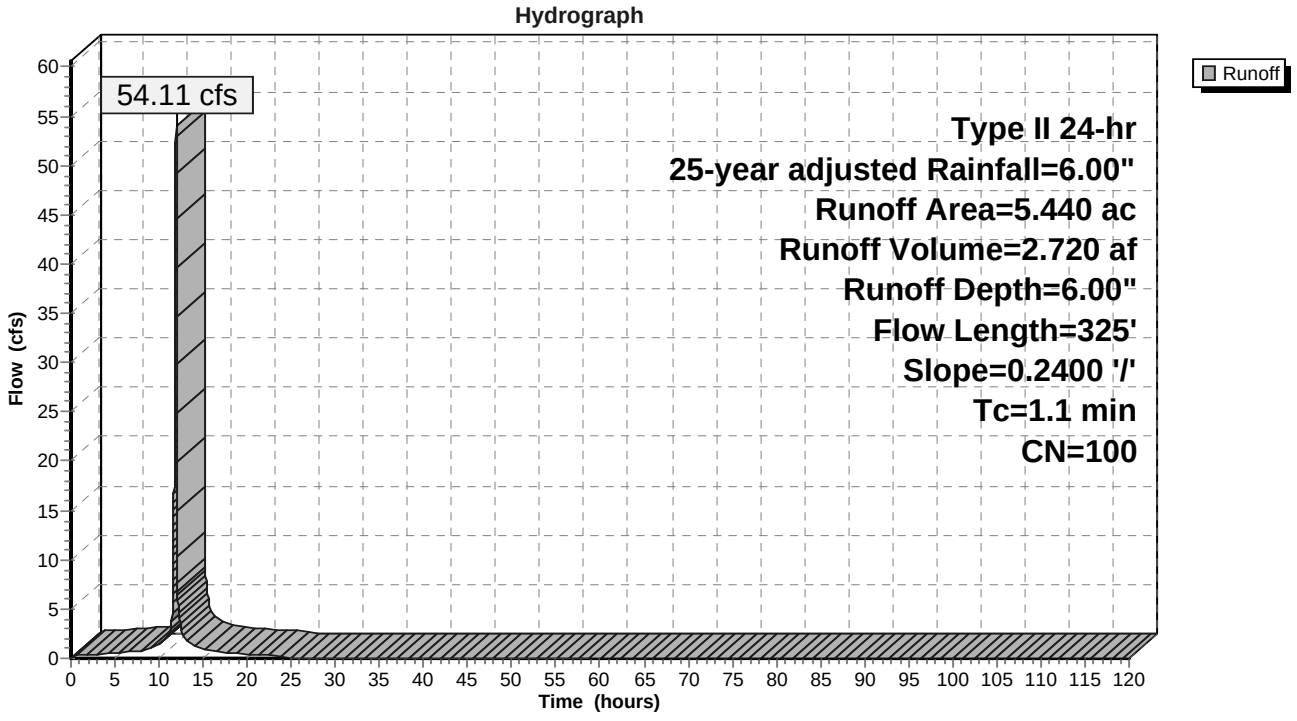
Runoff = 54.11 cfs @ 11.91 hrs, Volume= 2.720 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	5.440	100	
	5.440		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	300	0.2400	4.52		**Sheet Flow,** n= 0.012 P2= 3.50"
0.0	25	0.2400	9.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.1	325	Total			

Subcatchment S1: S1



Summary for Subcatchment S2: S2

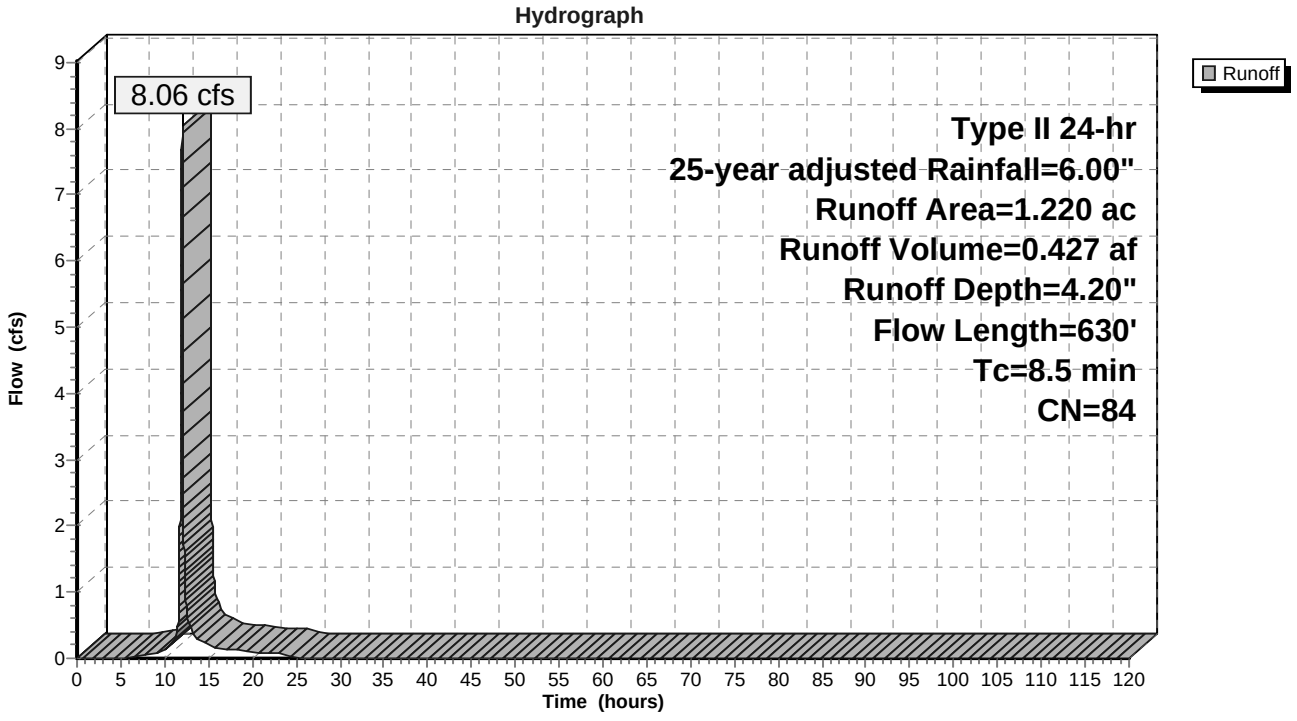
Runoff = 8.06 cfs @ 12.00 hrs, Volume= 0.427 af, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	1.220	84	
	1.220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	30	0.2000	0.35		**Sheet Flow, sheet flow** Grass: Short n= 0.150 P2= 3.50"
7.1	600	0.0200	1.41		**Shallow Concentrated Flow, shallow concentrated** Nearly Bare & Untilled Kv= 10.0 fps
8.5	630	Total			

Subcatchment S2: S2



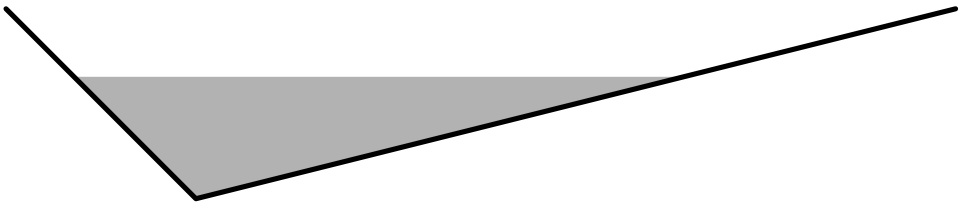
Summary for Reach 1R: South Toe Perimeter Channel

Inflow Area = 6.660 ac, 81.68% Impervious, Inflow Depth = 5.67" for 25-year adjusted event
Inflow = 59.75 cfs @ 11.91 hrs, Volume= 3.147 af
Outflow = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af, Atten= 2%, Lag= 0.5 min

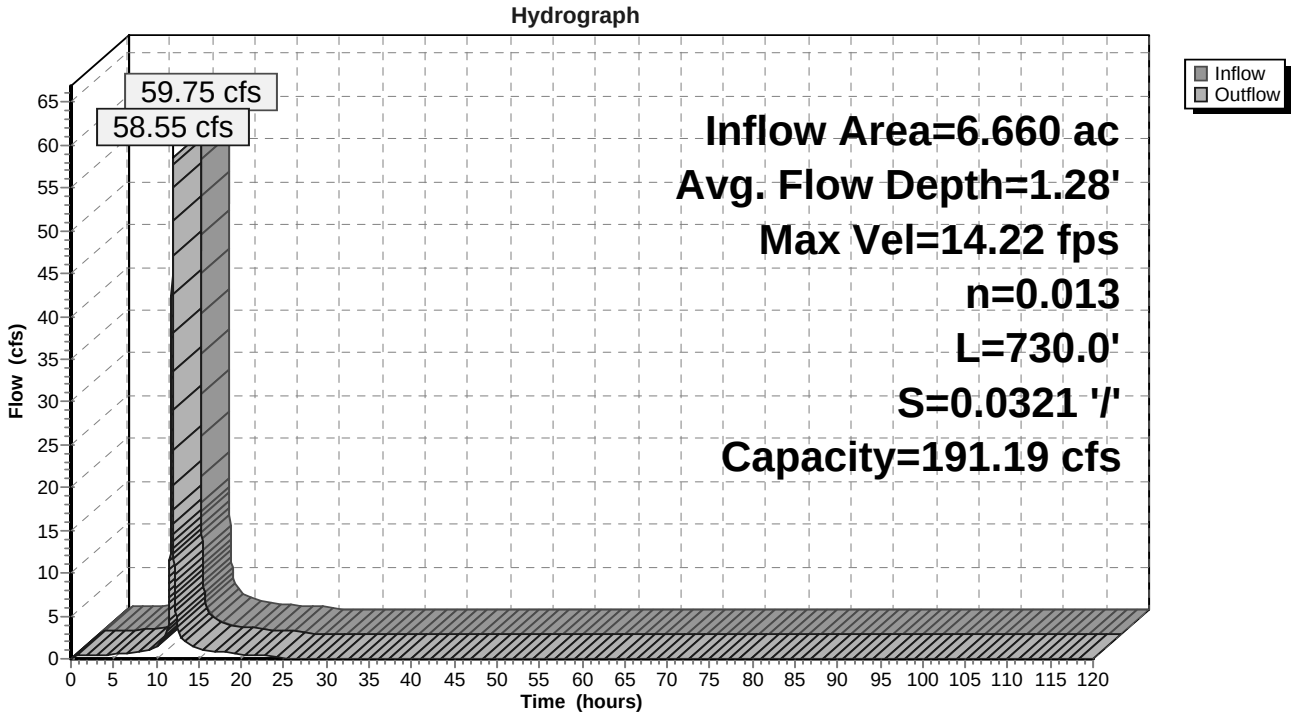
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 14.22 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 4.86 fps, Avg. Travel Time= 2.5 min

Peak Storage= 3,005 cf @ 11.92 hrs
Average Depth at Peak Storage= 1.28'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 191.19 cfs

0.00' x 2.00' deep channel, n= 0.013 Corrugated PE, smooth interior
Side Slope Z-value= 1.0 4.0 '/' Top Width= 10.00'
Length= 730.0' Slope= 0.0321 '/'
Inlet Invert= 480.00', Outlet Invert= 456.60'



Reach 1R: South Toe Perimeter Channel



Summary for Pond CV-6: Proposed 36" South Culvert, CV-6

Inflow Area = 6.660 ac, 81.68% Impervious, Inflow Depth = 5.67" for 25-year adjusted event
Inflow = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af
Outflow = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af, Atten= 0%, Lag= 0.0 min
Primary = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

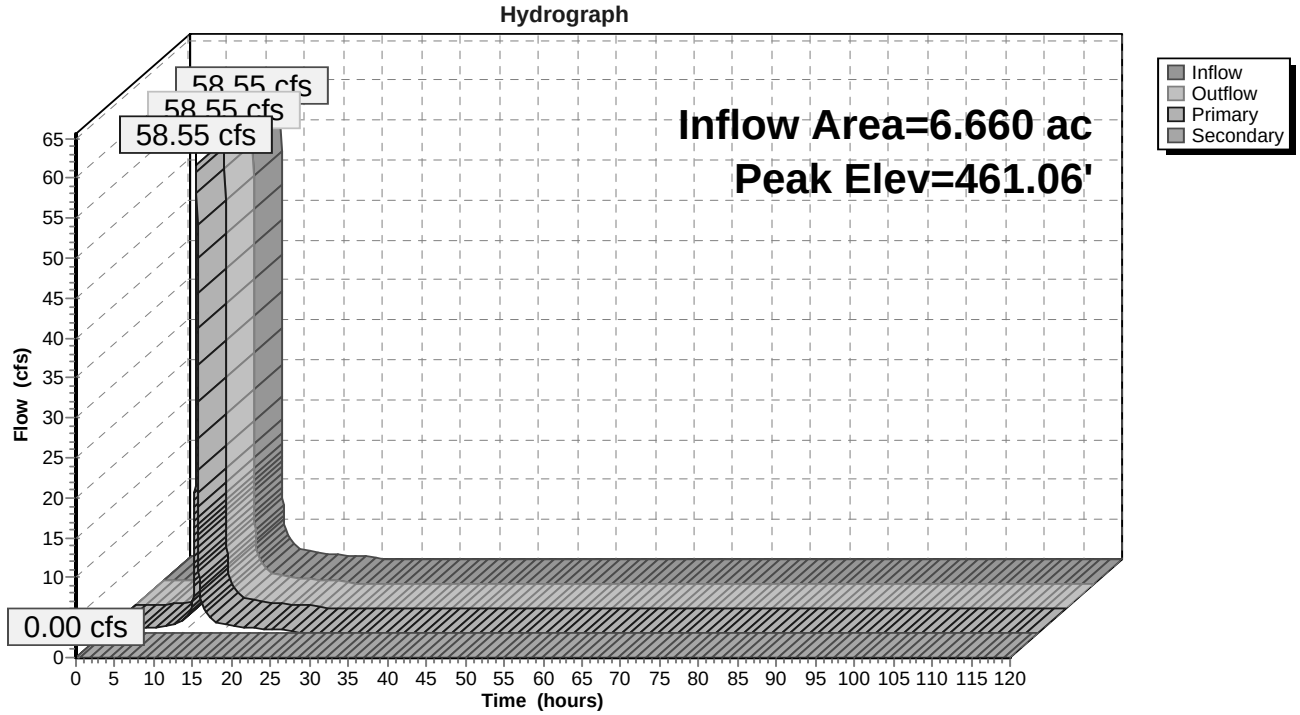
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 461.06' @ 11.92 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	456.60'	**36.0" Round Culvert** L= 400.0' Ke= 0.500 Inlet / Outlet Invert= 456.60' / 449.20' S= 0.0185 '/' Cc= 0.900 n= 0.012, Flow Area= 7.07 sf
#2	Secondary	464.00'	**20.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=58.43 cfs @ 11.92 hrs HW=461.05' TW=452.64' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 58.43 cfs @ 8.27 fps)

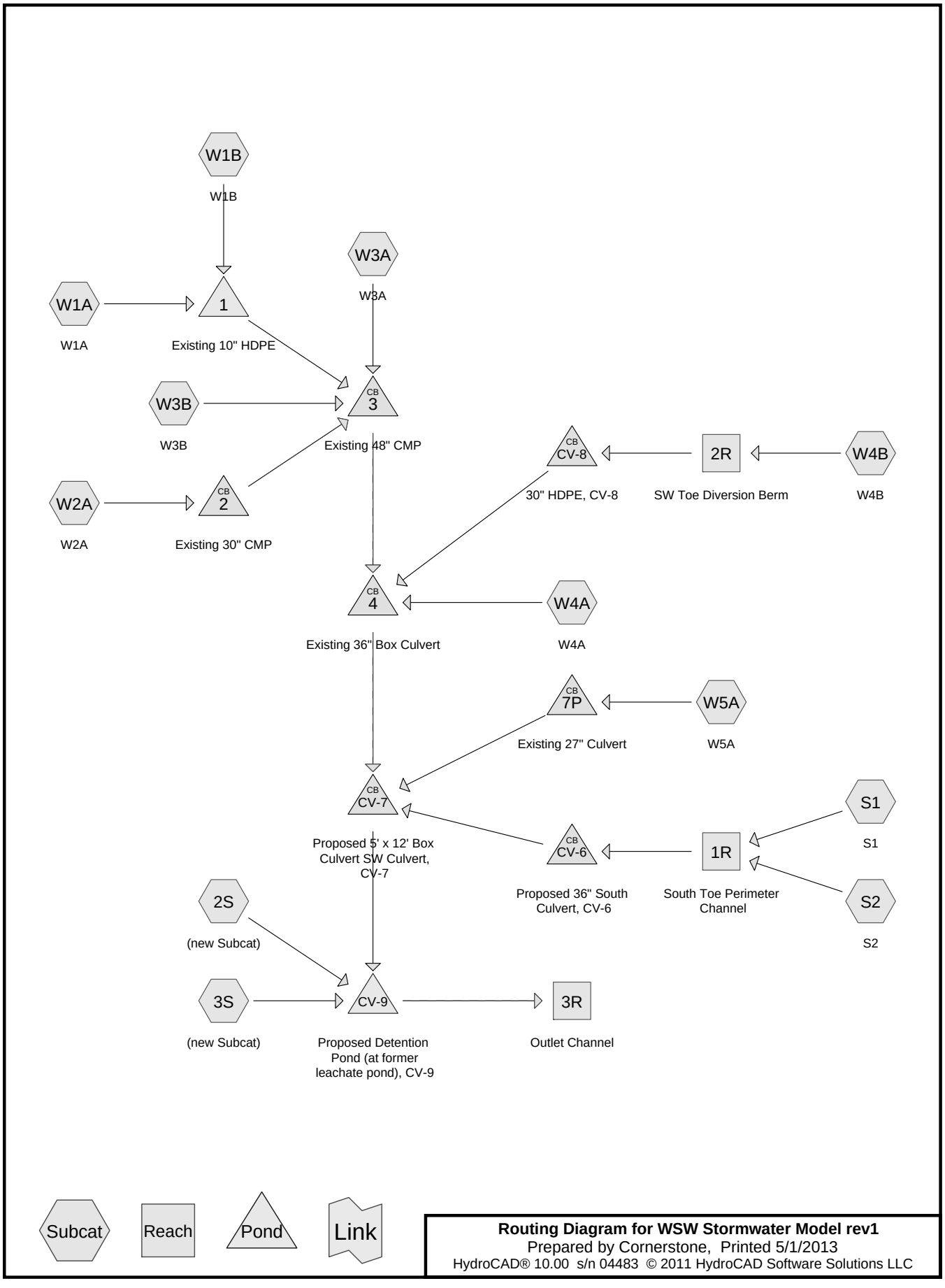
Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=456.60' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond CV-6: Proposed 36" South Culvert, CV-6



APPENDIX E

STORMWATER CALCULATIONS FOR WEST / SOUTHWEST DRAINAGE AREA



Routing Diagram for WSW Stormwater Model rev1
Prepared by Cornerstone, Printed 5/1/2013

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	2	454.52	454.44	27.0	0.0030	0.020	30.0	0.0	0.0
2	3	451.68	451.48	50.0	0.0040	0.020	48.0	0.0	0.0
3	4	450.42	450.17	12.0	0.0208	0.020	36.0	36.0	0.0
4	7P	450.19	450.50	127.0	-0.0024	0.025	27.0	0.0	0.0
5	CV-6	456.60	449.20	400.0	0.0185	0.012	36.0	0.0	0.0
6	CV-7	449.20	448.10	50.0	0.0220	0.011	144.0	60.0	0.0
7	CV-8	453.70	453.50	50.0	0.0040	0.012	30.0	0.0	0.0
8	CV-9	440.00	439.80	50.0	0.0040	0.012	24.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: (new Subcat) Runoff Area=0.480 ac 0.00% Impervious Runoff Depth=4.85"
Tc=2.0 min CN=90 Runoff=4.33 cfs 0.194 af

Subcatchment 3S: (new Subcat) Runoff Area=6.790 ac 100.00% Impervious Runoff Depth=6.00"
Tc=2.0 min CN=100 Runoff=65.90 cfs 3.395 af

Subcatchment S1: S1 Runoff Area=5.440 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=325' Slope=0.2400 '/' Tc=1.1 min CN=100 Runoff=54.11 cfs 2.720 af

Subcatchment S2: S2 Runoff Area=1.220 ac 0.00% Impervious Runoff Depth=4.20"
Flow Length=630' Tc=8.5 min CN=84 Runoff=8.06 cfs 0.427 af

Subcatchment W1A: W1A Runoff Area=15.410 ac 0.00% Impervious Runoff Depth=4.41"
Flow Length=1,200' Slope=0.0190 '/' Tc=38.5 min CN=86 Runoff=49.32 cfs 5.662 af

Subcatchment W1B: W1B Runoff Area=7.910 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=882' Tc=4.7 min CN=100 Runoff=70.74 cfs 3.955 af

Subcatchment W2A: W2A Runoff Area=9.510 ac 0.00% Impervious Runoff Depth=4.41"
Flow Length=823' Tc=21.8 min CN=86 Runoff=43.61 cfs 3.494 af

Subcatchment W3A: W3A Runoff Area=6.410 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=1,085' Tc=2.9 min CN=100 Runoff=60.60 cfs 3.205 af

Subcatchment W3B: W3B Runoff Area=4.420 ac 0.00% Impervious Runoff Depth=3.18"
Flow Length=817' Tc=24.5 min CN=74 Runoff=13.90 cfs 1.173 af

Subcatchment W4A: W4A Runoff Area=1.930 ac 0.00% Impervious Runoff Depth=3.18"
Flow Length=400' Slope=0.0900 '/' Tc=13.2 min CN=74 Runoff=8.46 cfs 0.512 af

Subcatchment W4B: W4B Runoff Area=2.180 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=658' Tc=2.8 min CN=100 Runoff=20.67 cfs 1.090 af

Subcatchment W5A: W5A Runoff Area=1.850 ac 0.00% Impervious Runoff Depth=4.52"
Tc=18.8 min CN=87 Runoff=9.37 cfs 0.696 af

Reach 1R: South Toe Perimeter Avg. Flow Depth=1.28' Max Vel=14.22 fps Inflow=59.75 cfs 3.147 af
n=0.013 L=730.0' S=0.0321 '/' Capacity=191.19 cfs Outflow=58.55 cfs 3.147 af

Reach 2R: SW Toe Diversion Berm Avg. Flow Depth=1.60' Max Vel=3.15 fps Inflow=20.67 cfs 1.090 af
n=0.012 L=260.0' S=0.0010 '/' Capacity=36.58 cfs Outflow=20.06 cfs 1.090 af

Reach 3R: Outlet Channel Avg. Flow Depth=1.08' Max Vel=2.80 fps Inflow=34.20 cfs 26.463 af
n=0.030 L=50.0' S=0.0050 '/' Capacity=69.37 cfs Outflow=34.20 cfs 26.463 af

Pond 1: Existing 10" HDPE Inflow=85.29 cfs 9.617 af
Primary=85.29 cfs 9.617 af

Pond 2: Existing 30" CMP Peak Elev=460.51' Inflow=43.61 cfs 3.494 af
Primary=27.49 cfs 2.766 af Secondary=29.45 cfs 0.728 af Outflow=43.61 cfs 3.494 af

Pond 3: Existing 48" CMP Peak Elev=460.50' Inflow=170.04 cfs 17.490 af
Primary=82.34 cfs 13.088 af Secondary=153.93 cfs 4.402 af Outflow=170.04 cfs 17.490 af

Pond 4: Existing 36" Box Culvert Peak Elev=460.43' Inflow=195.68 cfs 19.092 af
Primary=121.38 cfs 18.370 af Secondary=75.99 cfs 0.722 af Outflow=195.68 cfs 19.092 af

Pond 7P: Existing 27" Culvert Peak Elev=452.90' Inflow=9.37 cfs 0.696 af
Primary=9.37 cfs 0.696 af Secondary=0.00 cfs 0.000 af Outflow=9.37 cfs 0.696 af

Pond CV-6: Proposed 36" South Culvert, CV-6 Peak Elev=461.06' Inflow=58.55 cfs 3.147 af
Primary=58.55 cfs 3.147 af Secondary=0.00 cfs 0.000 af Outflow=58.55 cfs 3.147 af

Pond CV-7: Proposed 5' x 12' Box Culvert SW Culvert, Peak Elev=452.72' Inflow=254.19 cfs 22.935 af
Primary=254.19 cfs 22.935 af Secondary=0.00 cfs 0.000 af Outflow=254.19 cfs 22.935 af

Pond CV-8: 30" HDPE, CV-8 Peak Elev=461.57' Inflow=20.06 cfs 1.090 af
30.0" Round Culvert n=0.012 L=50.0' S=0.0040 '/' Outflow=20.06 cfs 1.090 af

Pond CV-9: Proposed Detention Pond Peak Elev=446.11' Storage=13.324 af Inflow=321.73 cfs 26.524 af
Primary=34.20 cfs 26.463 af Secondary=0.00 cfs 0.000 af Outflow=34.20 cfs 26.463 af

Total Runoff Area = 63.550 ac Runoff Volume = 26.524 af Average Runoff Depth = 5.01"
54.79% Pervious = 34.820 ac 45.21% Impervious = 28.730 ac

Summary for Subcatchment 2S: (new Subcat)

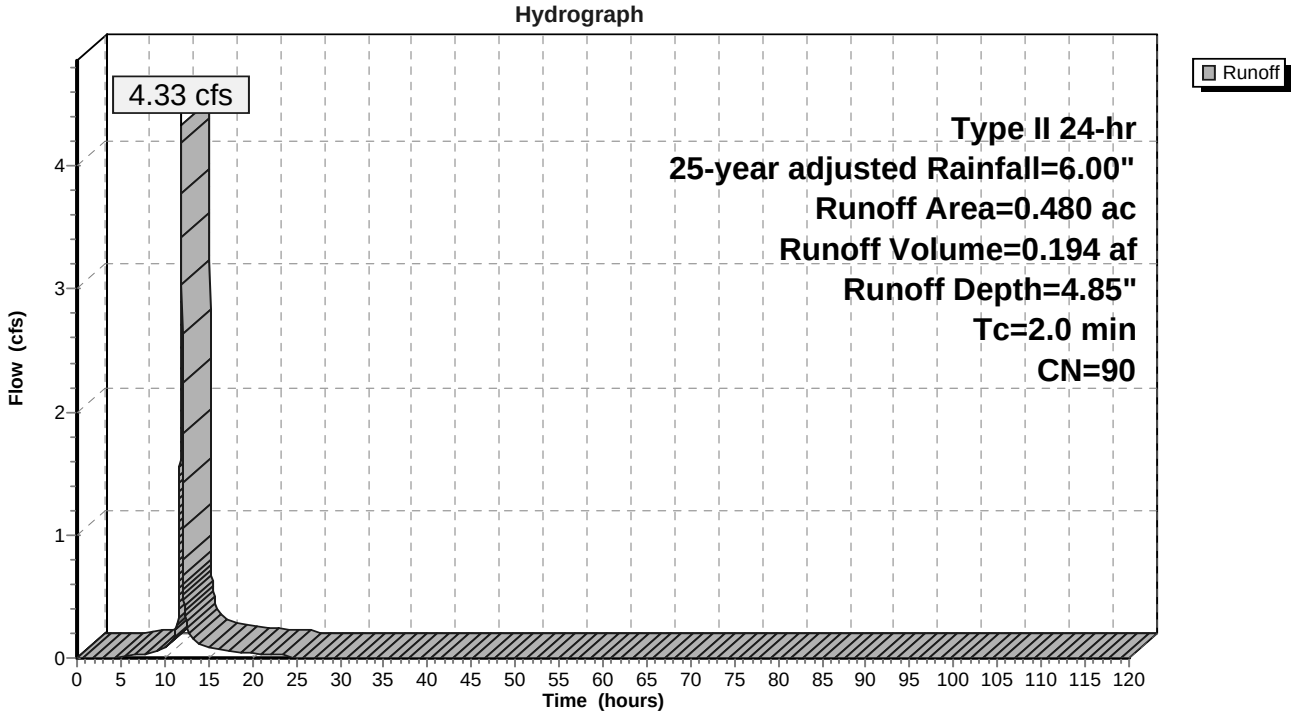
Runoff = 4.33 cfs @ 11.92 hrs, Volume= 0.194 af, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	0.480	90	
	0.480		100.00% Pervious Area

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

Subcatchment 2S: (new Subcat)



Summary for Subcatchment 3S: (new Subcat)

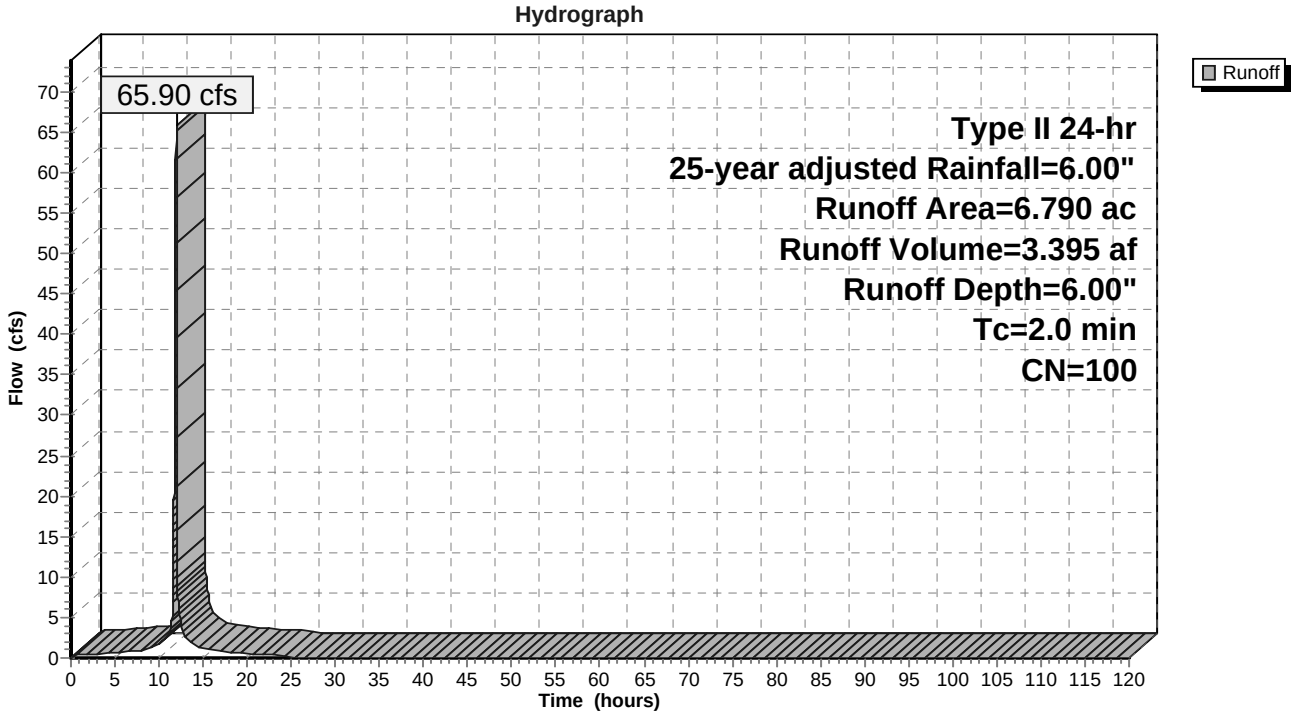
Runoff = 65.90 cfs @ 11.92 hrs, Volume= 3.395 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	6.790	100	
	6.790		100.00% Impervious Area

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

Subcatchment 3S: (new Subcat)



Summary for Subcatchment S1: S1

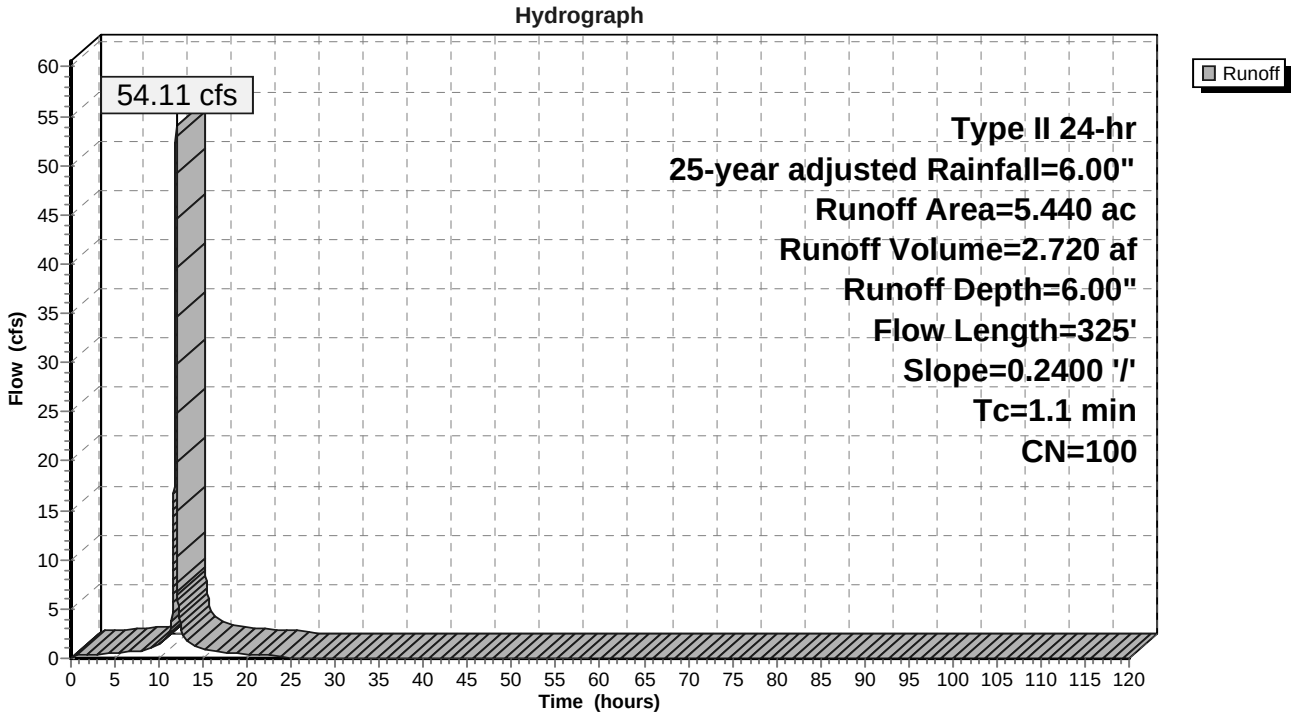
Runoff = 54.11 cfs @ 11.91 hrs, Volume= 2.720 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	5.440	100	
	5.440		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	300	0.2400	4.52		**Sheet Flow,** n= 0.012 P2= 3.50"
0.0	25	0.2400	9.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.1	325	Total			

Subcatchment S1: S1



Summary for Subcatchment S2: S2

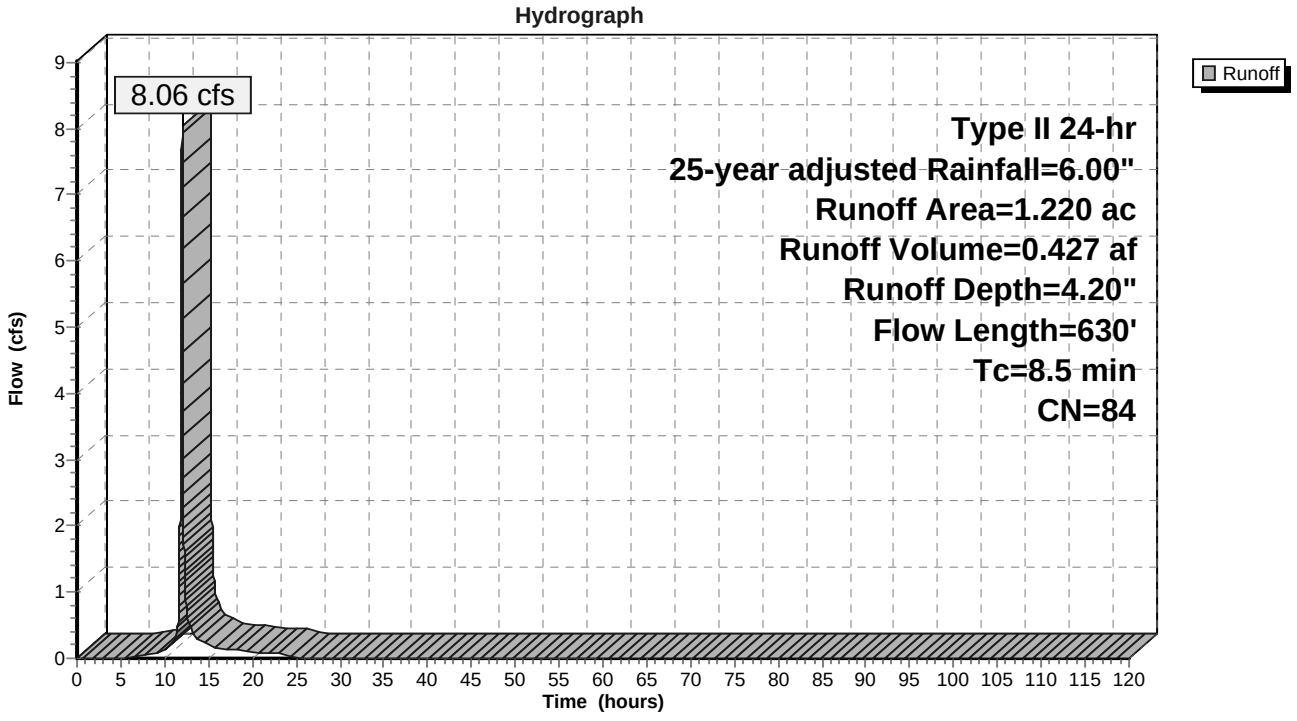
Runoff = 8.06 cfs @ 12.00 hrs, Volume= 0.427 af, Depth= 4.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	1.220	84	
	1.220		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	30	0.2000	0.35		**Sheet Flow, sheet flow** Grass: Short n= 0.150 P2= 3.50"
7.1	600	0.0200	1.41		**Shallow Concentrated Flow, shallow concentrated** Nearly Bare & Untilled Kv= 10.0 fps
8.5	630	Total			

Subcatchment S2: S2



Summary for Subcatchment W1A: W1A

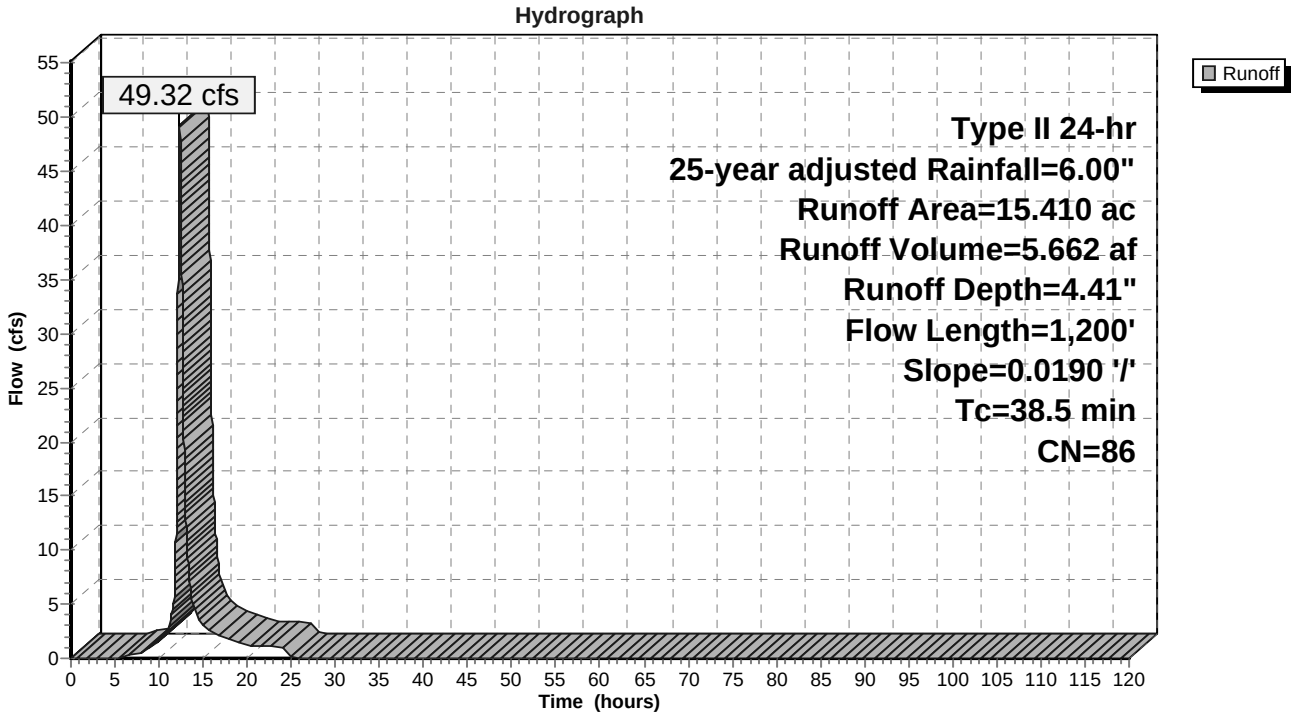
Runoff = 49.32 cfs @ 12.33 hrs, Volume= 5.662 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	15.410	86	<50% Grass cover, Poor, HSG B
	15.410		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	300	0.0190	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.50"
15.5	900	0.0190	0.96		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
38.5	1,200	Total			

Subcatchment W1A: W1A



Summary for Subcatchment W1B: W1B

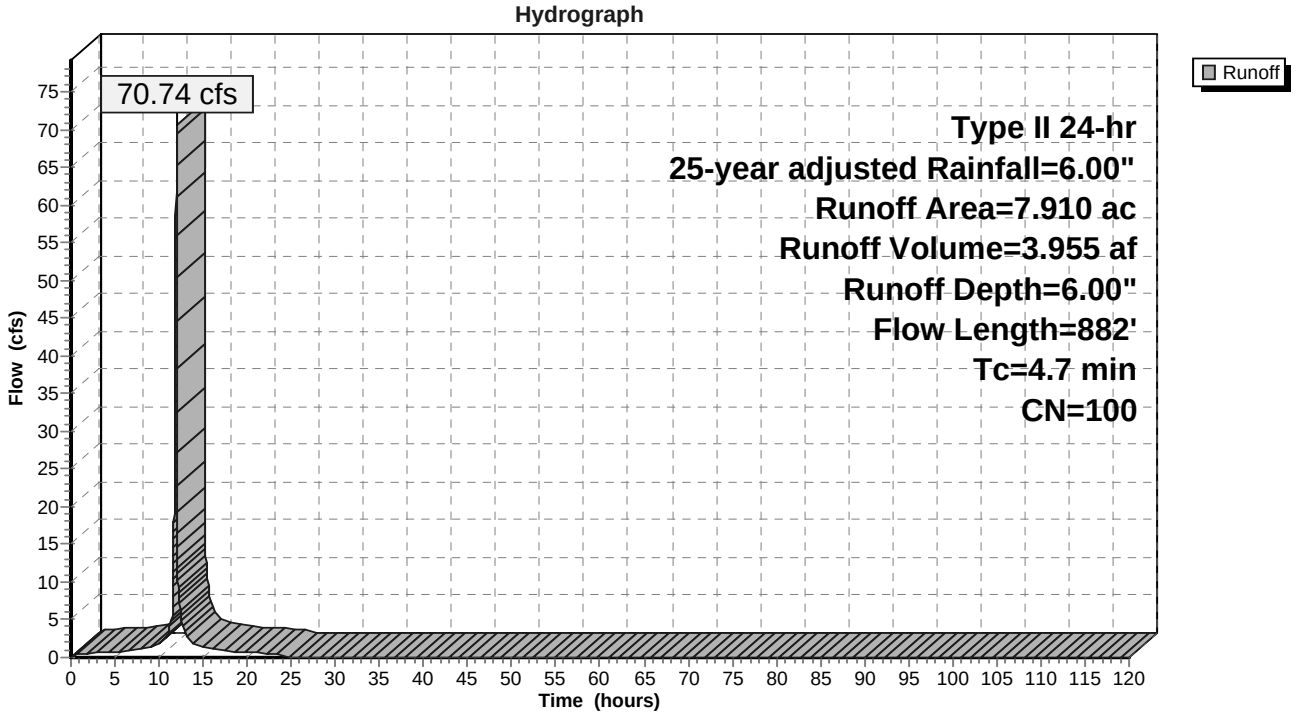
Runoff = 70.74 cfs @ 11.95 hrs, Volume= 3.955 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	7.910	100	
	7.910		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	283	0.0180	1.58		**Sheet Flow,** n= 0.012 P2= 3.50"
0.2	17	0.0440	1.29		**Sheet Flow,** n= 0.012 P2= 3.50"
0.1	28	0.0440	4.26		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	122	0.0570	4.85		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	249	0.2450	10.05		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	183	0.0550	4.76		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.7	882	Total			

Subcatchment W1B: W1B



Summary for Subcatchment W2A: W2A

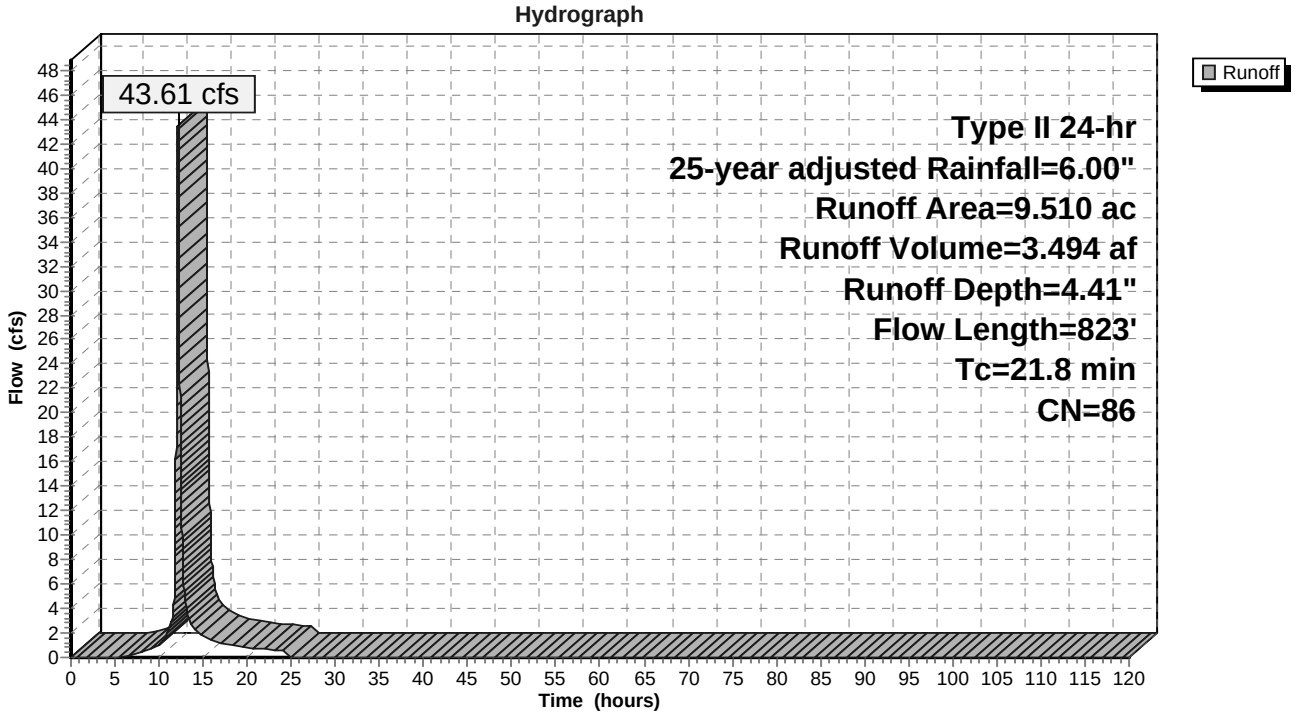
Runoff = 43.61 cfs @ 12.14 hrs, Volume= 3.494 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	9.510	86	<50% Grass cover, Poor, HSG B
	9.510		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	156	0.0510	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
8.6	144	0.0520	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
0.9	88	0.0520	1.60		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	249	0.2450	3.46		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.9	186	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
21.8	823	Total			

Subcatchment W2A: W2A



Summary for Subcatchment W3A: W3A

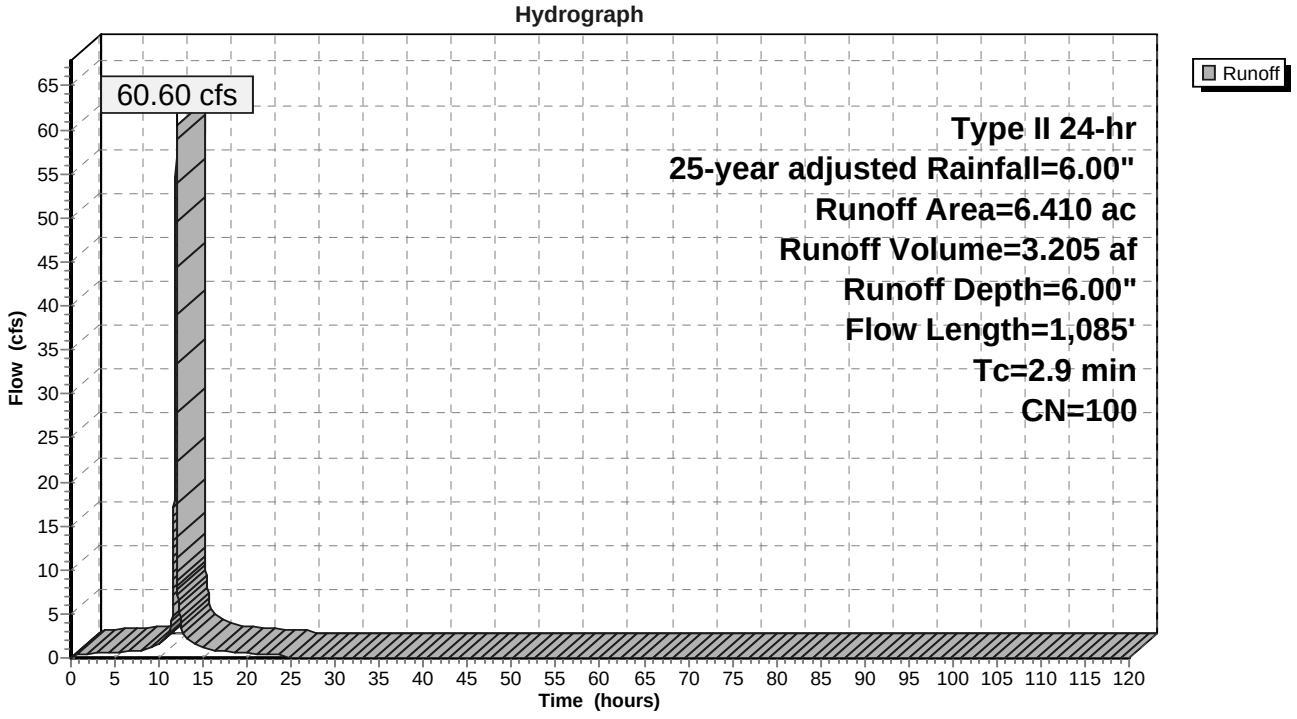
Runoff = 60.60 cfs @ 11.93 hrs, Volume= 3.205 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	6.410	100	
	6.410		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	200	0.1000	3.15		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.50"
1.5	585	0.1000	6.42		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	300	0.0060	16.91	2,789.97	**Channel Flow,** Area= 165.0 sf Perim= 28.4' r= 5.81' n= 0.022 Earth, clean & straight
2.9	1,085	Total			

Subcatchment W3A: W3A



Summary for Subcatchment W3B: W3B

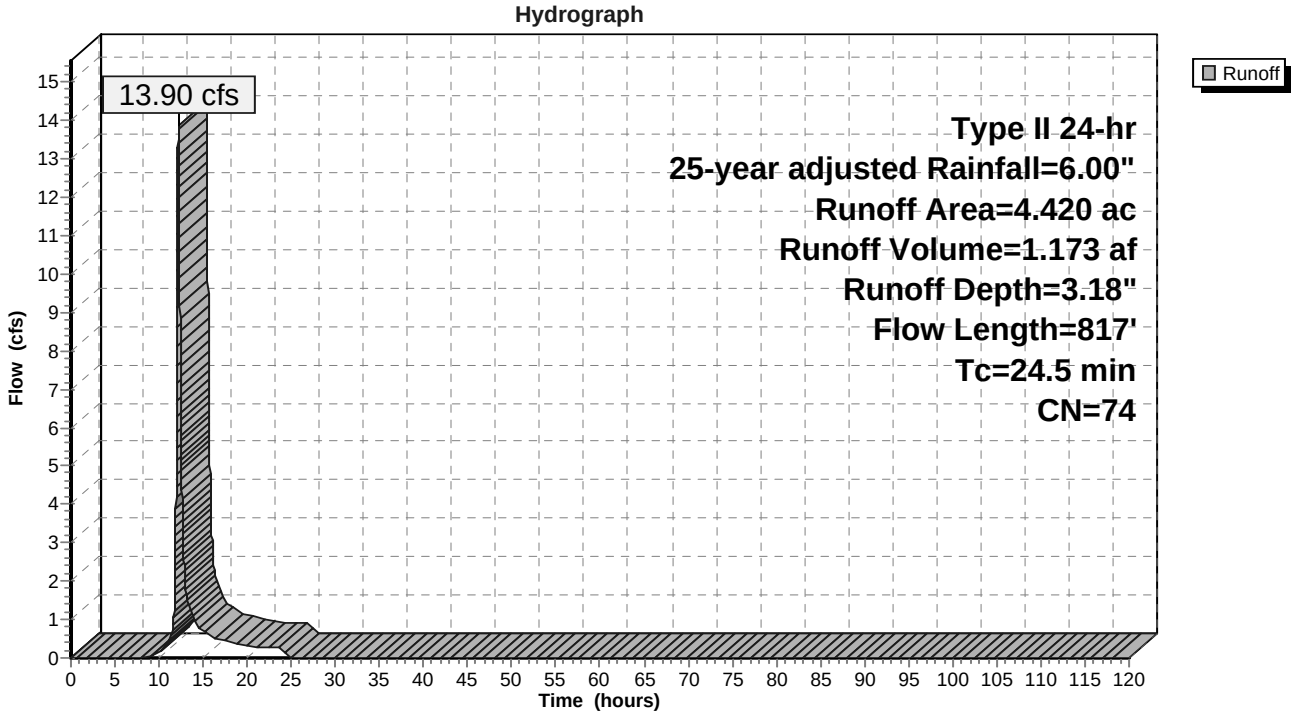
Runoff = 13.90 cfs @ 12.17 hrs, Volume= 1.173 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	4.420	74	<50% Grass cover, Poor, HSG B
	4.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	300	0.0280	0.25		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
3.0	209	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	206	0.0970	2.18		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	102	0.0030	8.41	1,009.44	**Channel Flow,** Area= 120.0 sf Perim= 35.0' r= 3.43' n= 0.022 Earth, clean & straight
24.5	817	Total			

Subcatchment W3B: W3B



Summary for Subcatchment W4A: W4A

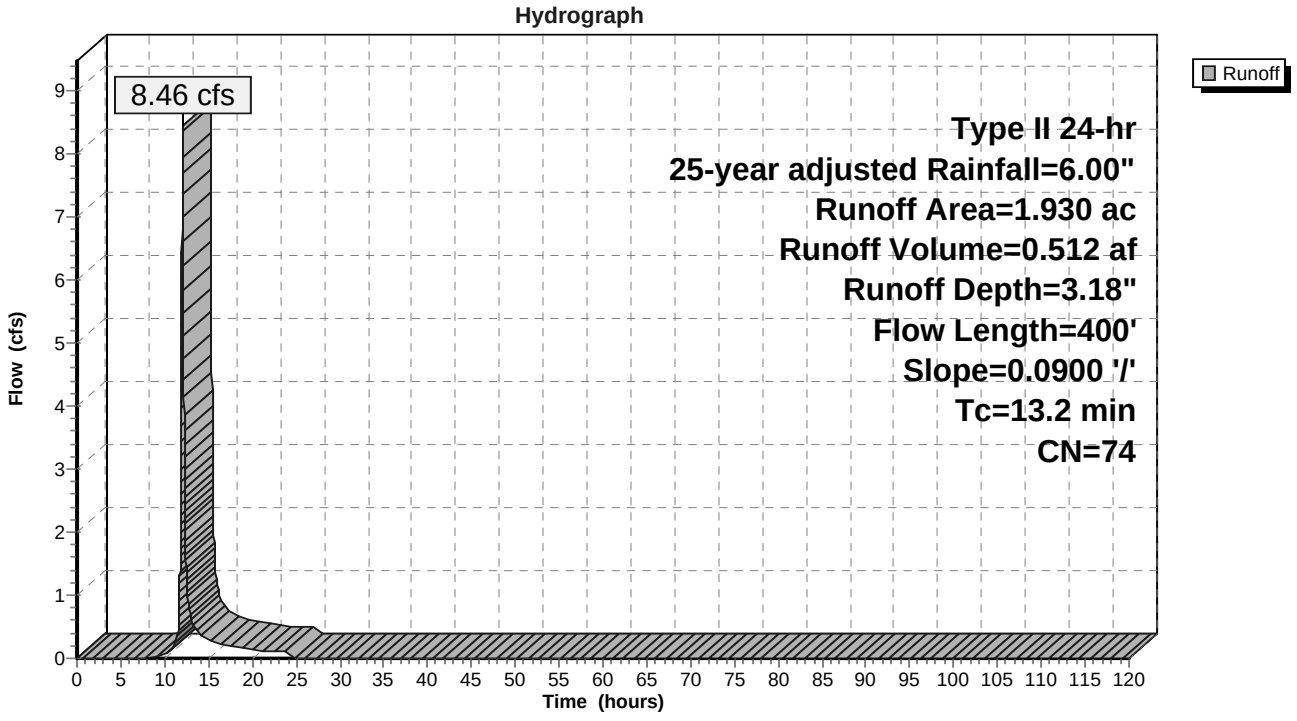
Runoff = 8.46 cfs @ 12.05 hrs, Volume= 0.512 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	1.930	74	
	1.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	300	0.0900	0.40		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
0.8	100	0.0900	2.10		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.2	400	Total			

Subcatchment W4A: W4A



Summary for Subcatchment W4B: W4B

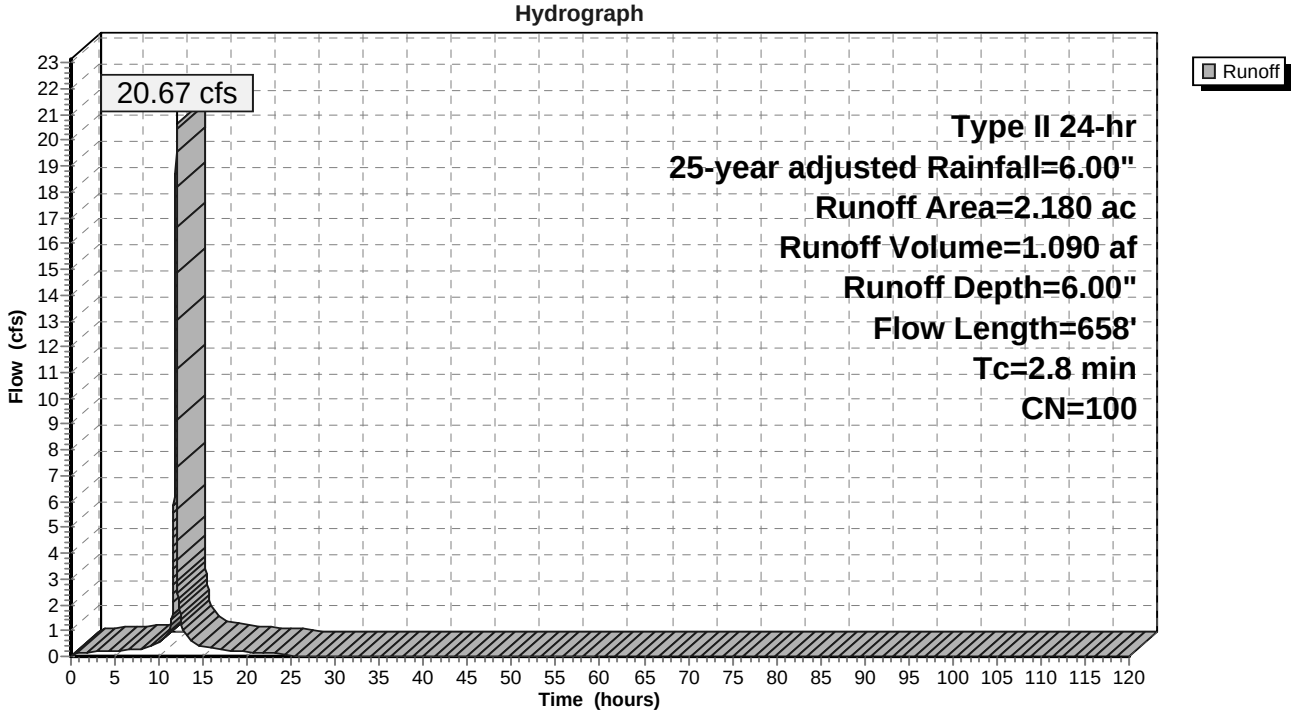
Runoff = 20.67 cfs @ 11.93 hrs, Volume= 1.090 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	2.180	100	
	2.180		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	288	0.0450	2.29		**Sheet Flow,** n= 0.012 P2= 3.50"
0.1	12	0.2220	2.30		**Sheet Flow,** n= 0.012 P2= 3.50"
0.6	358	0.2220	9.56		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.8	658	Total			

Subcatchment W4B: W4B



Summary for Subcatchment W5A: W5A

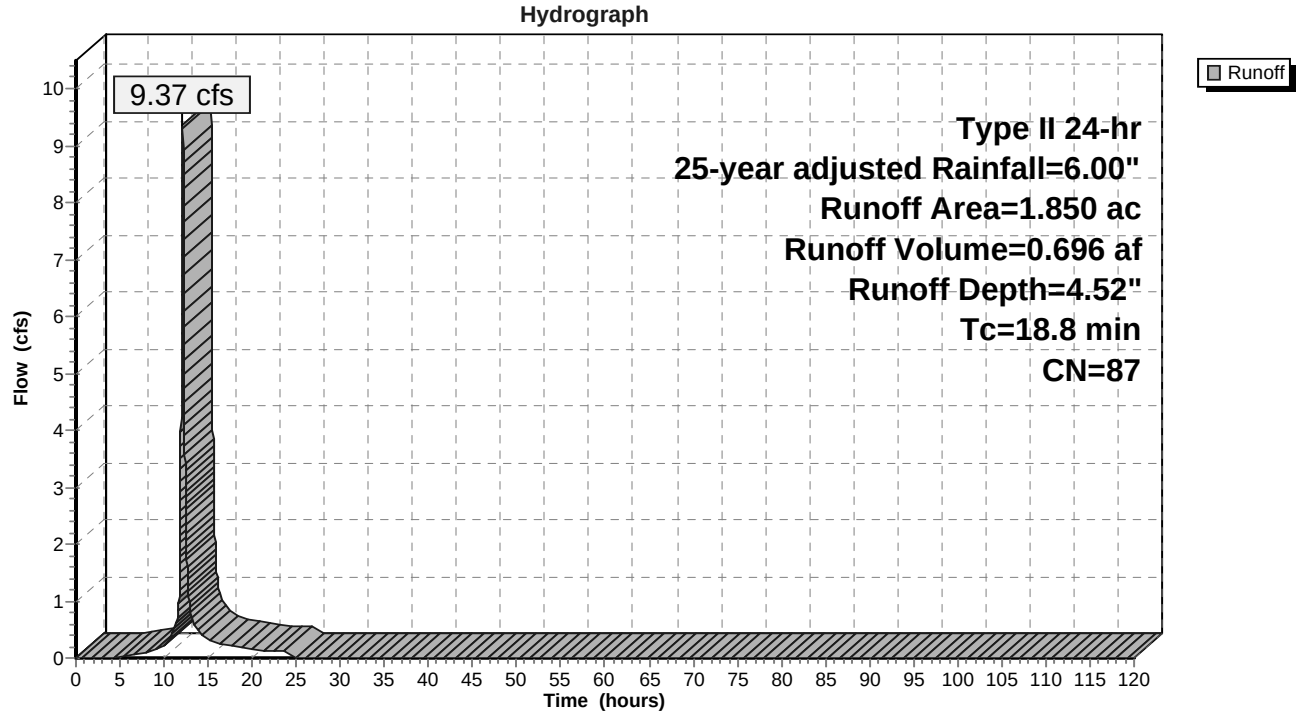
Runoff = 9.37 cfs @ 12.10 hrs, Volume= 0.696 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

Area (ac)	CN	Description
1.850	87	Dirt roads, HSG C
1.850		100.00% Pervious Area

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

Subcatchment W5A: W5A



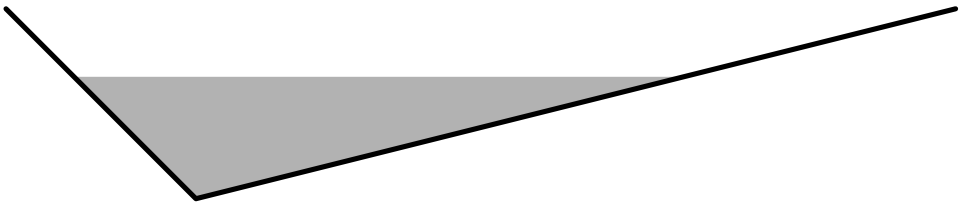
Summary for Reach 1R: South Toe Perimeter Channel

Inflow Area = 6.660 ac, 81.68% Impervious, Inflow Depth = 5.67" for 25-year adjusted event
Inflow = 59.75 cfs @ 11.91 hrs, Volume= 3.147 af
Outflow = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af, Atten= 2%, Lag= 0.5 min

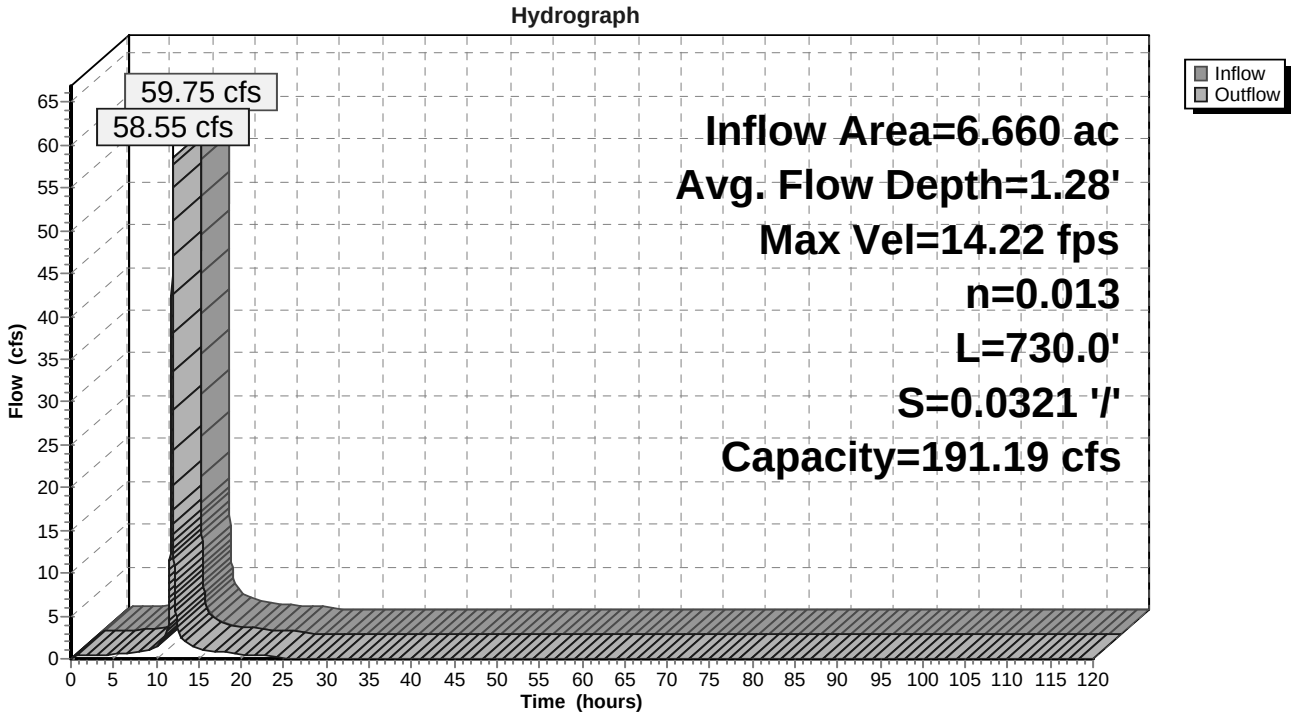
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 14.22 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 4.86 fps, Avg. Travel Time= 2.5 min

Peak Storage= 3,005 cf @ 11.92 hrs
Average Depth at Peak Storage= 1.28'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 191.19 cfs

0.00' x 2.00' deep channel, n= 0.013 Corrugated PE, smooth interior
Side Slope Z-value= 1.0 4.0 '/' Top Width= 10.00'
Length= 730.0' Slope= 0.0321 '/'
Inlet Invert= 480.00', Outlet Invert= 456.60'



Reach 1R: South Toe Perimeter Channel



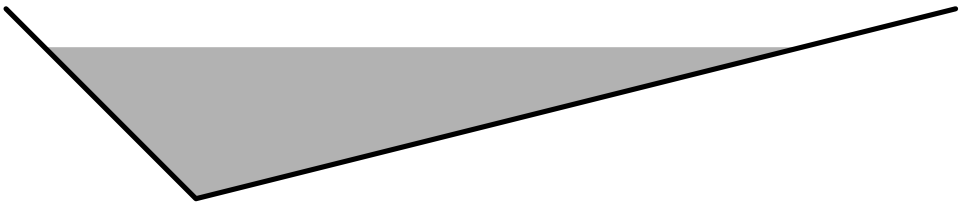
Summary for Reach 2R: SW Toe Diversion Berm

Inflow Area = 2.180 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 20.67 cfs @ 11.93 hrs, Volume= 1.090 af
Outflow = 20.06 cfs @ 11.94 hrs, Volume= 1.090 af, Atten= 3%, Lag= 0.8 min

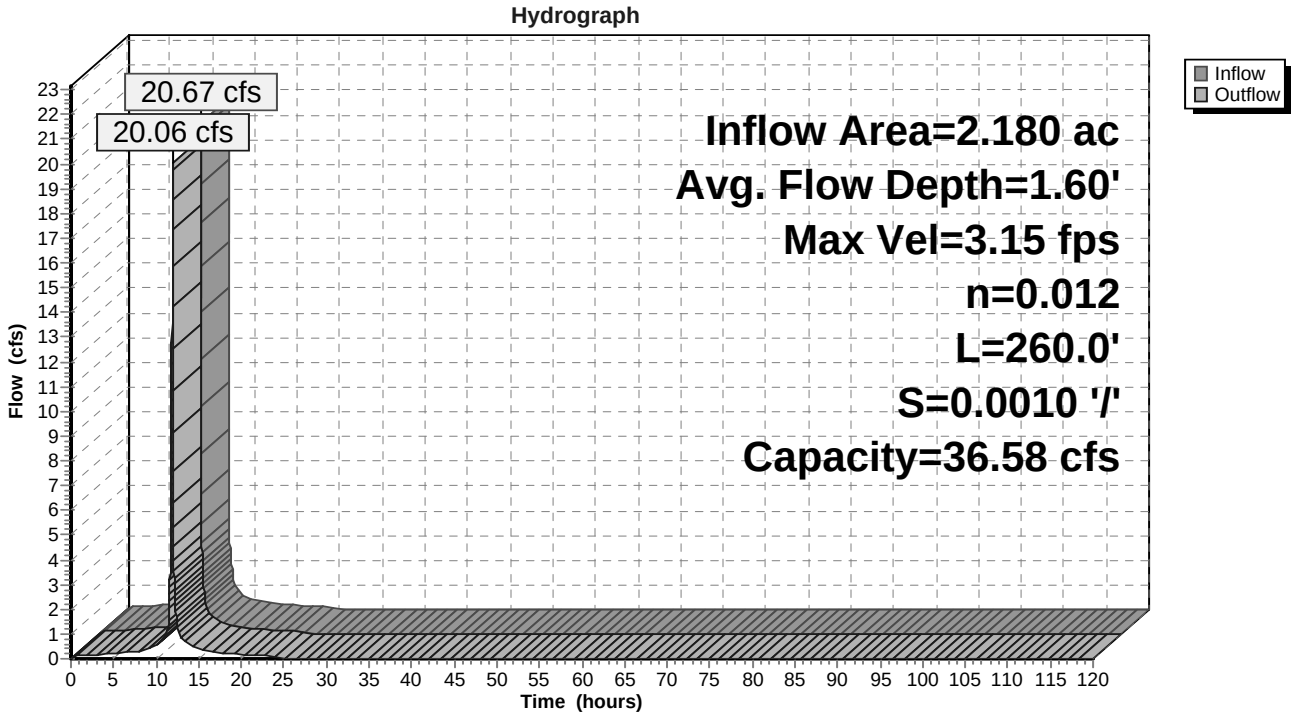
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.15 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.05 fps, Avg. Travel Time= 4.1 min

Peak Storage= 1,656 cf @ 11.94 hrs
Average Depth at Peak Storage= 1.60'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 36.58 cfs

0.00' x 2.00' deep channel, n= 0.012
Side Slope Z-value= 1.0 4.0 '/' Top Width= 10.00'
Length= 260.0' Slope= 0.0010 '/'
Inlet Invert= 0.00', Outlet Invert= -0.26'



Reach 2R: SW Toe Diversion Berm



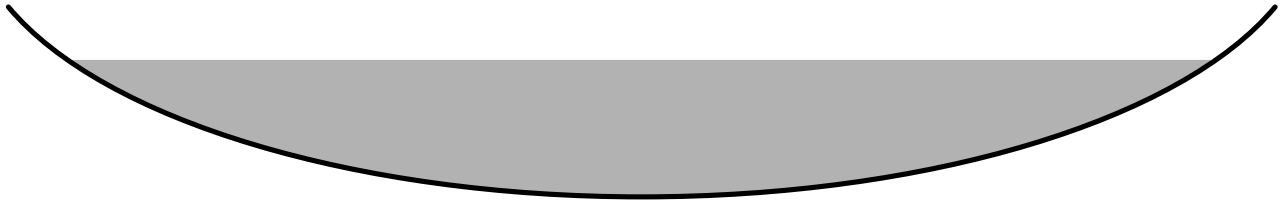
Summary for Reach 3R: Outlet Channel

Inflow Area = 63.550 ac, 45.21% Impervious, Inflow Depth > 5.00" for 25-year adjusted event
Inflow = 34.20 cfs @ 12.98 hrs, Volume= 26.463 af
Outflow = 34.20 cfs @ 12.98 hrs, Volume= 26.463 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.80 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 1.2 min

Peak Storage= 612 cf @ 12.98 hrs
Average Depth at Peak Storage= 1.08'
Bank-Full Depth= 1.50' Flow Area= 20.0 sf, Capacity= 69.37 cfs

20.00' x 1.50' deep Parabolic Channel, n= 0.030 Grassed
Length= 50.0' Slope= 0.0050 '/'
Inlet Invert= 439.80', Outlet Invert= 439.55'



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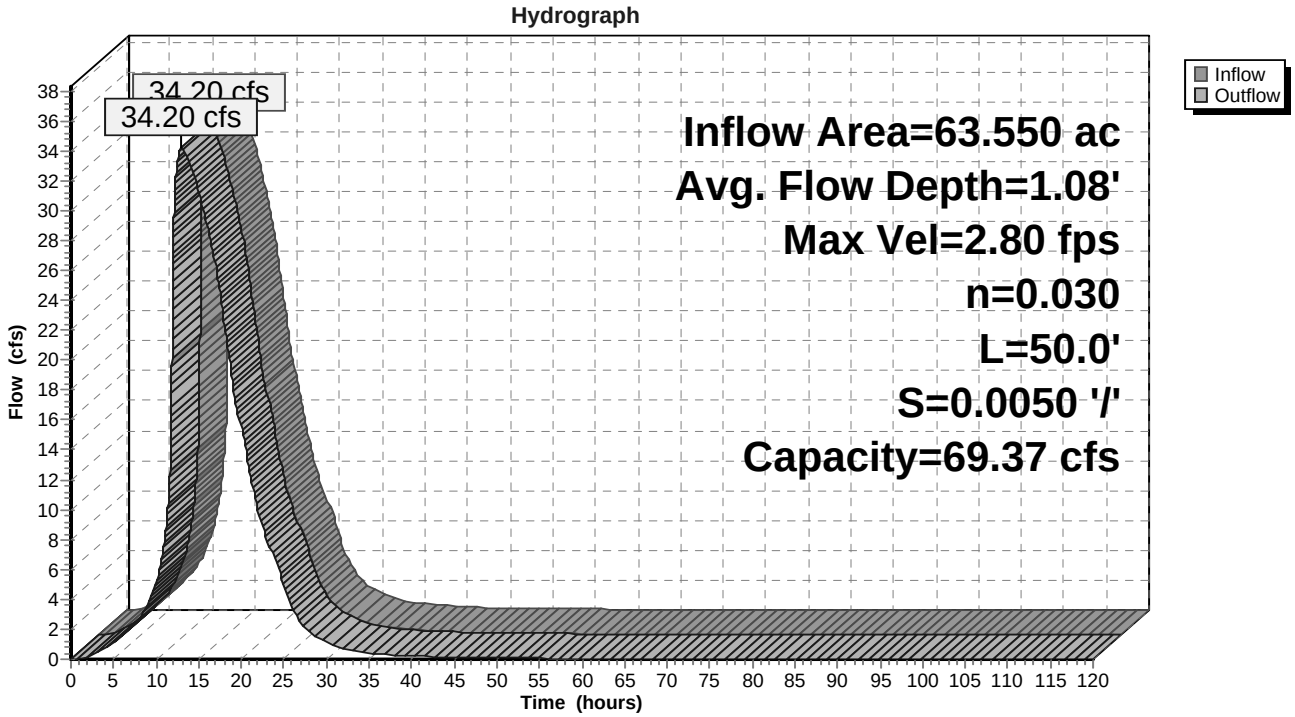
Reach 3R: Outlet Channel

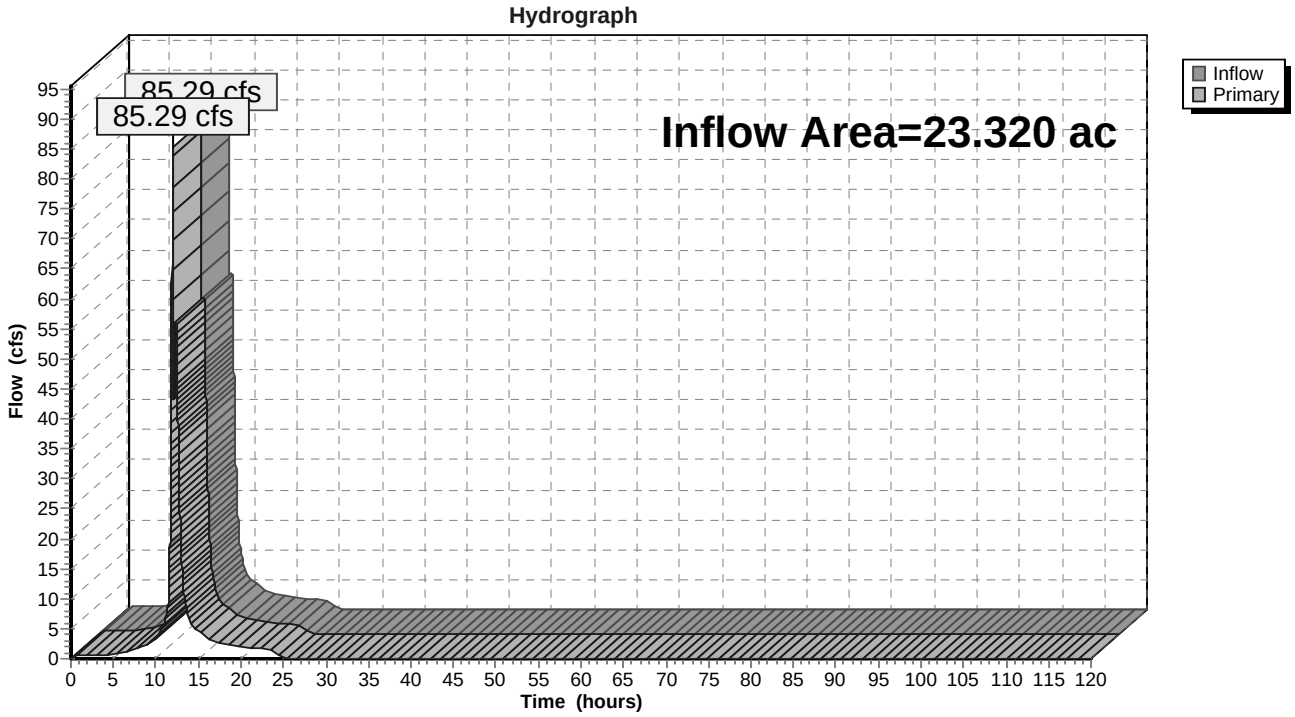


Summary for Pond 1: Existing 10" HDPE

Inflow Area = 23.320 ac, 33.92% Impervious, Inflow Depth = 4.95" for 25-year adjusted event
Inflow = 85.29 cfs @ 11.96 hrs, Volume= 9.617 af
Primary = 85.29 cfs @ 11.96 hrs, Volume= 9.617 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs

Pond 1: Existing 10" HDPE



Summary for Pond 2: Existing 30" CMP

Inflow Area = 9.510 ac, 0.00% Impervious, Inflow Depth = 4.41" for 25-year adjusted event
Inflow = 43.61 cfs @ 12.14 hrs, Volume= 3.494 af
Outflow = 43.61 cfs @ 12.14 hrs, Volume= 3.494 af, Atten= 0%, Lag= 0.0 min
Primary = 27.49 cfs @ 12.31 hrs, Volume= 2.766 af
Secondary = 29.45 cfs @ 12.07 hrs, Volume= 0.728 af

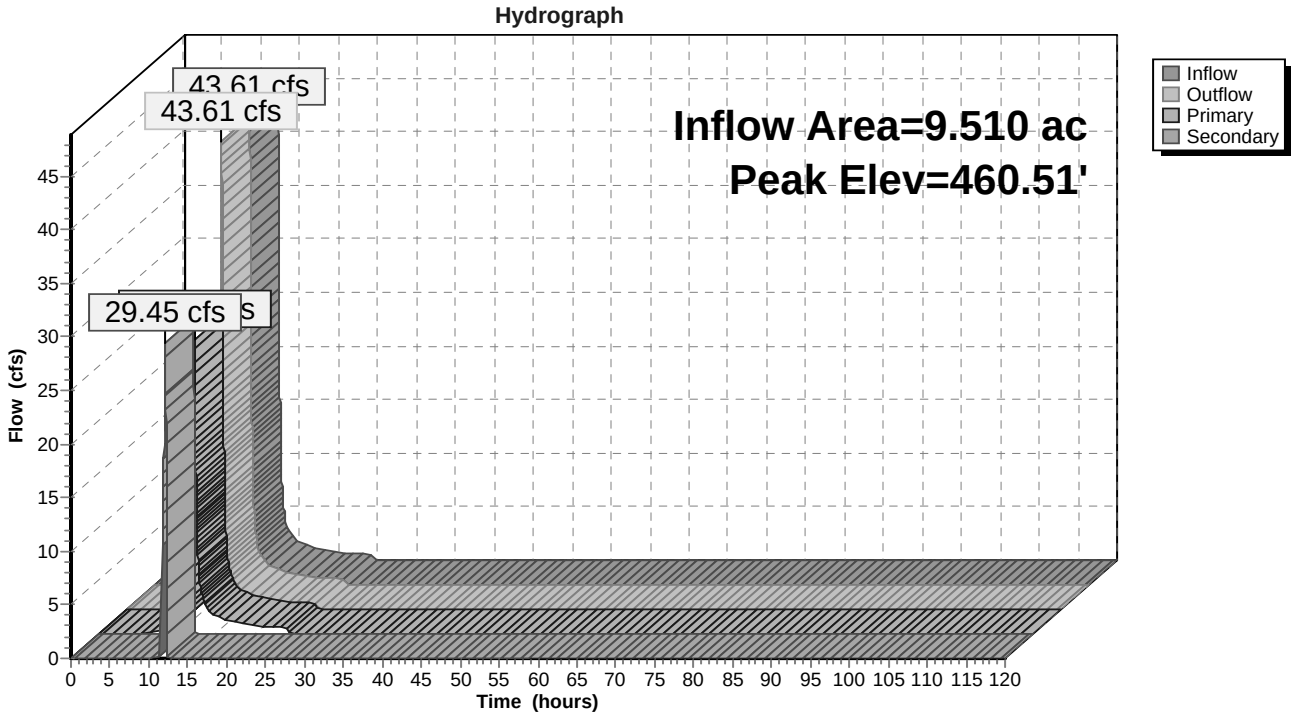
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 460.51' @ 11.97 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	454.52'	**30.0" Round Culvert** L= 27.0' Ke= 0.500 Inlet / Outlet Invert= 454.52' / 454.44' S= 0.0030 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 4.91 sf
#2	Secondary	460.00'	**100.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=28.31 cfs @ 12.31 hrs HW=460.01' TW=458.58' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 28.31 cfs @ 5.77 fps)

Secondary OutFlow Max=31.80 cfs @ 12.07 hrs HW=460.25' TW=459.89' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 31.80 cfs @ 1.26 fps)

Pond 2: Existing 30" CMP



Summary for Pond 3: Existing 48" CMP

Inflow Area = 43.660 ac, 32.80% Impervious, Inflow Depth = 4.81" for 25-year adjusted event
Inflow = 170.04 cfs @ 11.95 hrs, Volume= 17.490 af
Outflow = 170.04 cfs @ 11.95 hrs, Volume= 17.490 af, Atten= 0%, Lag= 0.0 min
Primary = 82.34 cfs @ 12.42 hrs, Volume= 13.088 af
Secondary = 153.93 cfs @ 11.95 hrs, Volume= 4.402 af

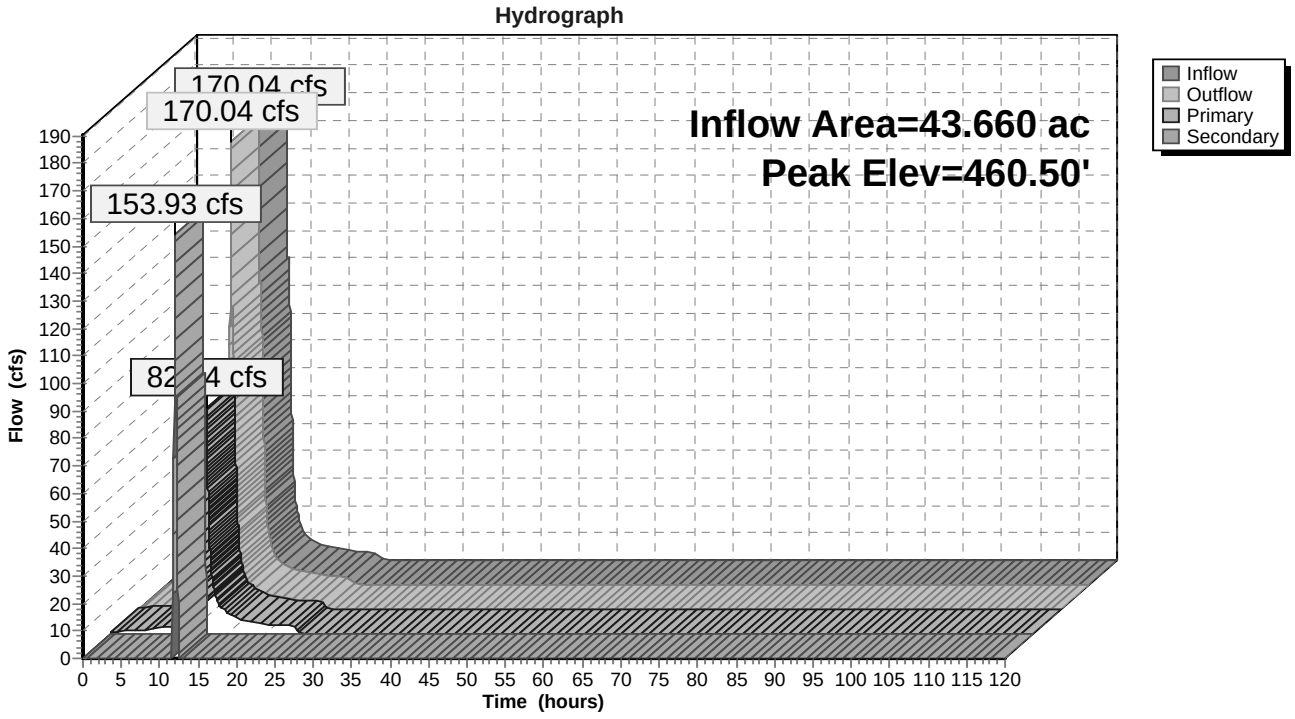
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 460.50' @ 11.96 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	451.68'	**48.0" Round CMP_Round 48"** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 451.68' / 451.48' S= 0.0040 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 12.57 sf
#2	Secondary	458.00'	**50.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=85.63 cfs @ 12.42 hrs HW=457.97' TW=455.97' (Dynamic Tailwater)
└**1=CMP_Round 48"** (Inlet Controls 85.63 cfs @ 6.81 fps)

Secondary OutFlow Max=148.39 cfs @ 11.95 hrs HW=460.49' TW=460.43' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 148.39 cfs @ 1.19 fps)

Pond 3: Existing 48" CMP



Summary for Pond 4: Existing 36" Box Culvert

Inflow Area = 47.770 ac, 34.54% Impervious, Inflow Depth = 4.80" for 25-year adjusted event
Inflow = 195.68 cfs @ 11.95 hrs, Volume= 19.092 af
Outflow = 195.68 cfs @ 11.95 hrs, Volume= 19.092 af, Atten= 0%, Lag= 0.0 min
Primary = 121.38 cfs @ 12.04 hrs, Volume= 18.370 af
Secondary = 75.99 cfs @ 11.95 hrs, Volume= 0.722 af

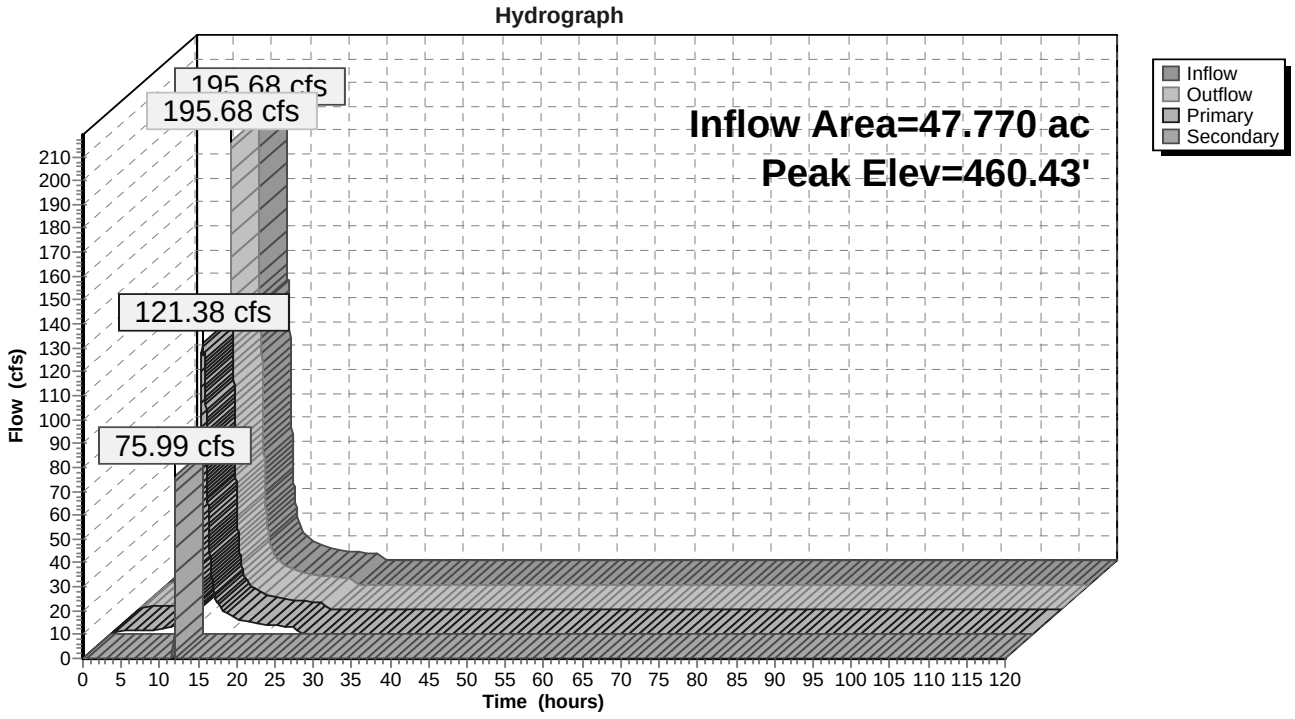
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 460.43' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	450.42'	**36.0" W x 36.0" H Box Culvert** L= 12.0' Ke= 0.500 Inlet / Outlet Invert= 450.42' / 450.17' S= 0.0208 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 9.00 sf
#2	Secondary	460.00'	**100.0' long x 100.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=121.74 cfs @ 12.04 hrs HW=460.11' TW=451.74' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 121.74 cfs @ 13.53 fps)

Secondary OutFlow Max=75.96 cfs @ 11.95 hrs HW=460.43' TW=452.70' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 75.96 cfs @ 1.77 fps)

Pond 4: Existing 36" Box Culvert



Summary for Pond 7P: Existing 27" Culvert

Inflow Area = 1.850 ac, 0.00% Impervious, Inflow Depth = 4.52" for 25-year adjusted event
Inflow = 9.37 cfs @ 12.10 hrs, Volume= 0.696 af
Outflow = 9.37 cfs @ 12.10 hrs, Volume= 0.696 af, Atten= 0%, Lag= 0.0 min
Primary = 9.37 cfs @ 12.10 hrs, Volume= 0.696 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

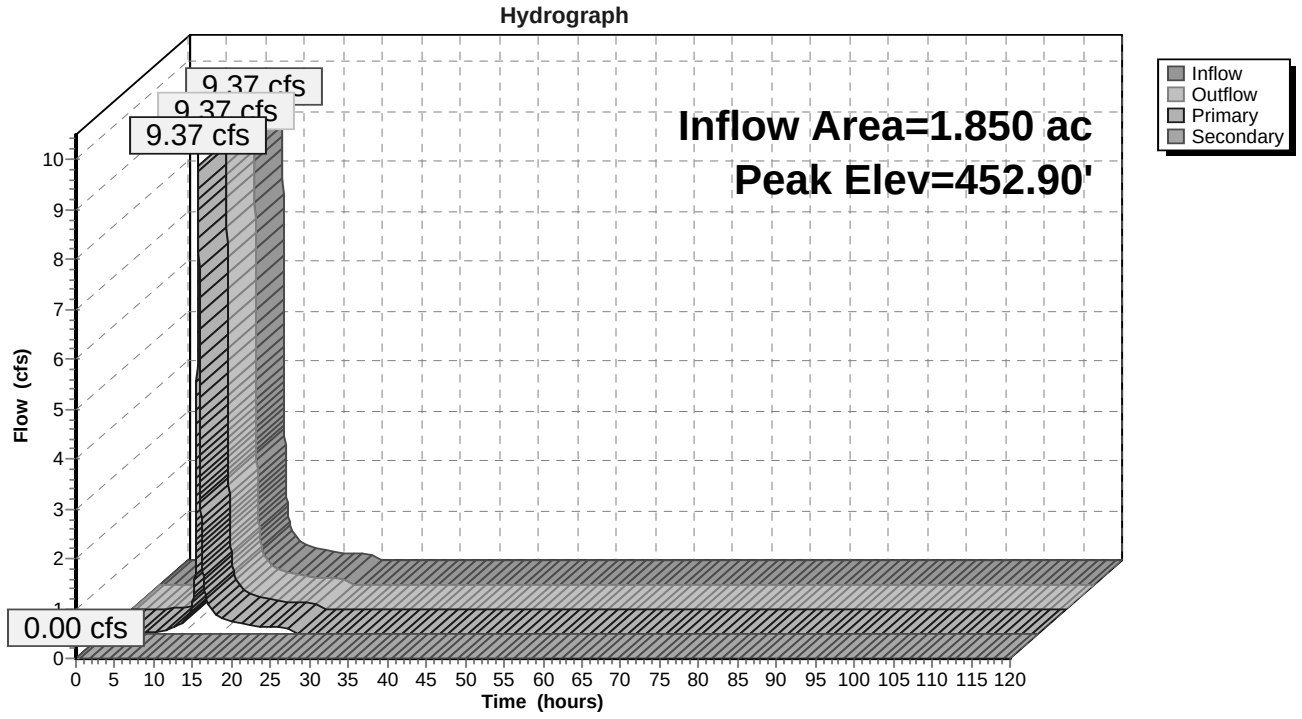
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 452.90' @ 11.96 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	450.50'	**27.0" Round Culvert** L= 127.0' Ke= 0.500 Inlet / Outlet Invert= 450.19' / 450.50' S= -0.0024 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 3.98 sf
#2	Secondary	454.50'	**100.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=9.37 cfs @ 12.10 hrs HW=452.63' TW=451.52' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 9.37 cfs @ 2.71 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=450.50' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: Existing 27" Culvert



Summary for Pond CV-6: Proposed 36" South Culvert, CV-6

Inflow Area = 6.660 ac, 81.68% Impervious, Inflow Depth = 5.67" for 25-year adjusted event
Inflow = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af
Outflow = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af, Atten= 0%, Lag= 0.0 min
Primary = 58.55 cfs @ 11.92 hrs, Volume= 3.147 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

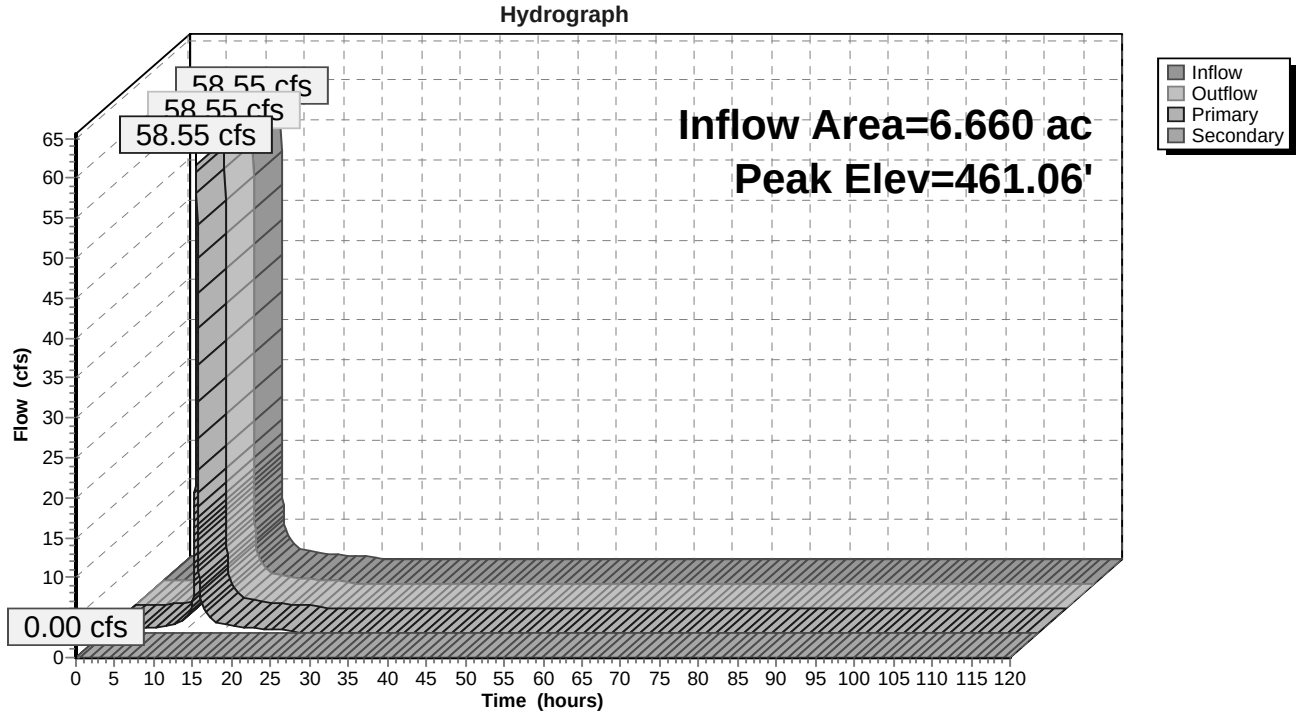
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 461.06' @ 11.92 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	456.60'	**36.0" Round Culvert** L= 400.0' Ke= 0.500 Inlet / Outlet Invert= 456.60' / 449.20' S= 0.0185 '/' Cc= 0.900 n= 0.012, Flow Area= 7.07 sf
#2	Secondary	464.00'	**20.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=58.43 cfs @ 11.92 hrs HW=461.05' TW=452.64' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 58.43 cfs @ 8.27 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=456.60' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond CV-6: Proposed 36" South Culvert, CV-6



Summary for Pond CV-7: Proposed 5' x 12' Box Culvert SW Culvert, CV-7

Inflow Area = 56.280 ac, 38.98% Impervious, Inflow Depth = 4.89" for 25-year adjusted event
Inflow = 254.19 cfs @ 11.94 hrs, Volume= 22.935 af
Outflow = 254.19 cfs @ 11.94 hrs, Volume= 22.935 af, Atten= 0%, Lag= 0.0 min
Primary = 254.19 cfs @ 11.94 hrs, Volume= 22.935 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

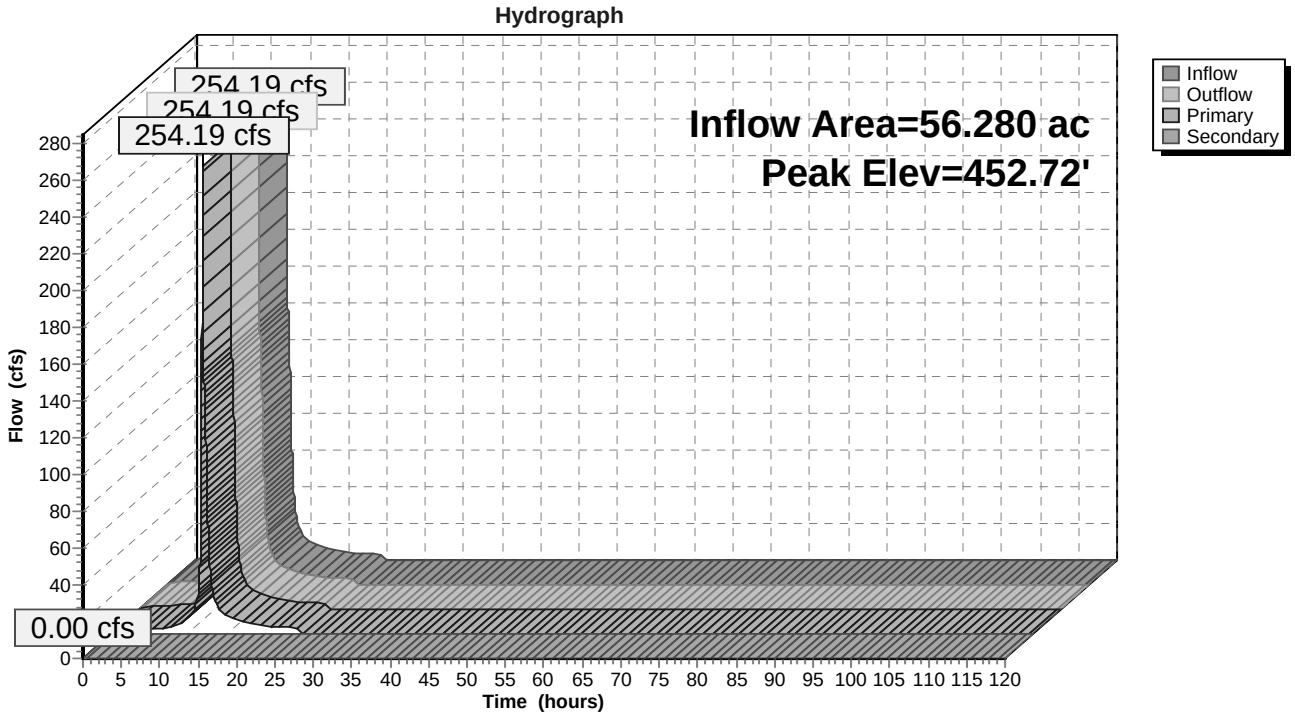
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 452.72' @ 11.94 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	449.20'	**144.0" W x 60.0" H Box Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 449.20' / 448.10' S= 0.0220 '/' Cc= 0.900 n= 0.011, Flow Area= 60.00 sf
#2	Secondary	454.00'	**100.0' long x 50.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=254.12 cfs @ 11.94 hrs HW=452.72' TW=443.90' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 254.12 cfs @ 6.02 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=449.20' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond CV-7: Proposed 5' x 12' Box Culvert SW Culvert, CV-7



Summary for Pond CV-8: 30" HDPE, CV-8

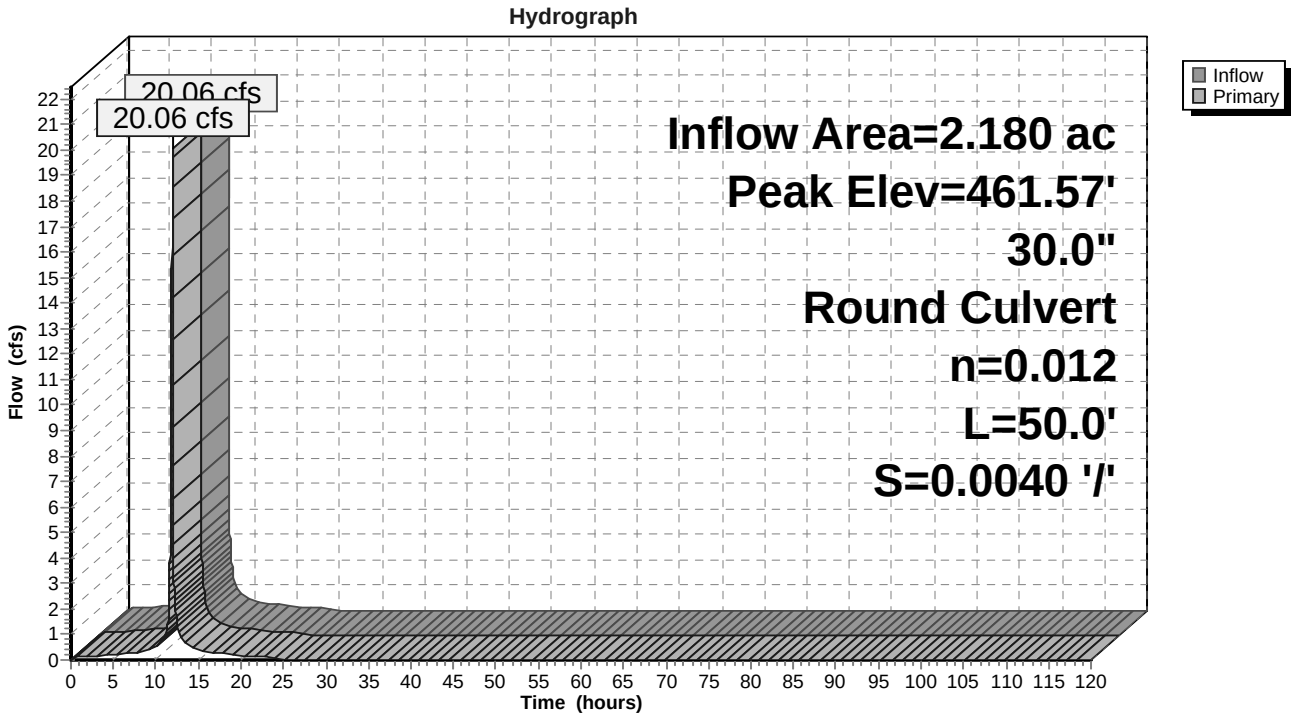
Inflow Area = 2.180 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 20.06 cfs @ 11.94 hrs, Volume= 1.090 af
Outflow = 20.06 cfs @ 11.94 hrs, Volume= 1.090 af, Atten= 0%, Lag= 0.0 min
Primary = 20.06 cfs @ 11.94 hrs, Volume= 1.090 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 461.57' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	453.70'	**30.0" Round Culvert** L= 50.0' Ke= 0.900 Inlet / Outlet Invert= 453.70' / 453.50' S= 0.0040 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf

Primary OutFlow Max=19.89 cfs @ 11.94 hrs HW=461.56' TW=460.43' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 19.89 cfs @ 4.05 fps)

Pond CV-8: 30" HDPE, CV-8



Summary for Pond CV-9: Proposed Detention Pond (at former leachate pond), CV-9

Inflow Area = 63.550 ac, 45.21% Impervious, Inflow Depth = 5.01" for 25-year adjusted event
Inflow = 321.73 cfs @ 11.93 hrs, Volume= 26.524 af
Outflow = 34.20 cfs @ 12.98 hrs, Volume= 26.463 af, Atten= 89%, Lag= 62.8 min
Primary = 34.20 cfs @ 12.98 hrs, Volume= 26.463 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 446.11' @ 12.98 hrs Surf.Area= 3.096 ac Storage= 13.324 af

Plug-Flow detention time= 254.5 min calculated for 26.461 af (100% of inflow)
Center-of-Mass det. time= 253.4 min (1,018.3 - 765.0)

Volume	Invert	Avail.Storage	Storage Description
#1	440.00'	28.090 af	**245.00'W x 245.00'L x 10.00'H Prismatoid Z=10.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	440.00'	**24.0" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 440.00' / 439.80' S= 0.0040 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Secondary	449.00'	**20.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=34.20 cfs @ 12.98 hrs HW=446.11' TW=440.88' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 34.20 cfs @ 10.89 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=440.00' TW=439.80' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond CV-9: Proposed Detention Pond (at former leachate pond), CV-9