APPENDICES

Appendix A

Pre- and Post-Stormwater Management Calculations

I. PURPOSE

The purpose of this calculation is to describe the design considerations associated with stormwater management during (pre-construction) and following (post-construction) the proposed closure activities at the Duke Energy W.S. Lee Steam Station (site) located in Belton, Anderson County, South Carolina. These stormwater management calculations summarize the applicable design requirements established by the South Carolina Department of Health and Environmental Control (SC DHEC), demonstrate how the proposed conceptual design achieves the applicable criteria/requirements, evaluate the hydrologic conditions (i.e., pre- and post-developed conditions, peak flows, etc.), and provides the associated conceptual design analysis.

The presented information is preliminary in nature, and prepared to describe the proposed means for conveying stormwater from the closure areas. As such, these analyses focus primarily on quantity (flow) control. Further consideration to erosion and sedimentation controls, channel linings, outlet protection and similar considerations will be fully developed during detailed design.

The proposed closure activities at the W. S. Lee Steam Station include removal of ash materials in the primary ash basin, secondary ash basin and structural fill area and construction of a new lined landfill within the current limits of the secondary ash basin area. The new lined landfill will manage the existing ash materials removed from the primary and secondary ash basins and structural fill area. This conceptual stormwater management plan is specific to the management of stormwater associated with construction activities and post-closure stormwater (i.e., unit closure related). The stormwater management features specific to the construction of the new lined landfill will be addressed in a separate document as part of the landfill design activities/permit application submission.

II. REGULATORY CONSIDERATIONS

The site is currently operating under the SC DHEC National Pollutant Discharge Elimination System (NPDES) Permit No. SC0002291 for Discharge to Surface Waters. Surface water runoff (as well as some current process flows that will be diverted prior to closure) from the primary ash basin, secondary ash basin and structural fill area are discharged to permitted Outfall 004. The stormwater management schemes described in this calculation anticipates ultimate post-closure discharge to historically permitted Outfalls 006 and 007. These outfalls are not currently permitted (although requested by Duke Energy in the last renewal cycle) because they discharge only stormwater flows (not associated with industrial activity). It is possible that a permit modification will be required to utilize these outfalls (due to the landfill-related runoff).

The pre-construction stormwater management calculations (to be utilized throughout construction) are designed to be temporary collection, diversion, conveyance and management systems. The design considers the requirements of SC DHEC's NPDES Permit for Stormwater Discharges Associated with Construction Activities, Permit No, SCR100000 and Best Management Practices (BMPs) guidance associated with this permit. A Comprehensive Stormwater Pollution Prevention Plan (C-SWPPP) will ultimately be developed for use during construction. The temporary conveyance systems have been designed to accommodate the 25-year, 24-hour storm event.

The permanent, post-closure stormwater management calculations have been developed in consideration of SC DHEC's Bureau of Land and Waste Management Regulation R.61-107.19, Section 258.26 Run-on/run-off Control Systems and Section 258.27 Surface Water Requirements. While not directly applicable to closure areas, this regulation requires that stormwater control systems be developed to collect and control stormwater volumes resulting from the 25-year, 24-hour storm event. The permanent stormwater control systems have also been designed to accommodate a 25-year, 24-hour storm event.

III. RESOURCES AND GENERAL METHODOLOGY

Rainfall data for the design and analysis of drainage components was obtained from the National Oceanic and Atmospheric Administration (NOAA). The Anderson County Soil Conservancy Service was consulted to identify the hydrologic soil group (HSG) associated with soils present at the project site; in the absence of a unified HSG across the project site, AECOM assumed that site soils were categorized as HSG 'D' in order to be conservative for this preliminary analysis. HydroCAD version 9.10 was used to hydrologically model the pre-construction and post-closure site conditions, and it uses the SCS Method and the NRCS TR-20 methodology to generate and route specific run-off hydrographs, allowing comparison between the pre- and post-developed conditions. Additionally, AutoCAD Civil 3D version 2014 was utilized to prepare calculation data used in the HydroCAD model and to prepare drainage exhibits (i.e., drainage areas and maps, time of concentration flow paths, etc.).

IV. EROSION AND SEDIMENT CONTROL

Several erosion and sediment control (E&SC) features and BMPs will be implemented throughout the closure activities and the construction of the new landfill at the W. S. Lee Steam Station. The proposed E&SC features and BMPs will conform to the latest version of the SC DHEC BMP Handbook. The preliminary locations of the proposed E&SC features and BMPs, as well as details for their installation, maintenance, etc., are provided within the Conceptual Closure Plan drawings.

In general, pre-construction stormwater management features include temporary diversion ditches installed in the upland areas southwest of the primary and secondary ash basin areas. Sediment traps and rock check dams may be installed within the ditches to minimize erosion and sediment migration, as well as to control flow velocities within the ditches. Also, silt fencing may be installed at appropriate locations.

Post-construction stormwater run-off may be managed primarily via permanent lined ditches. Rock check dams may also be installed within the ditches primarily to control flow velocities, and rock outlet protection will be installed at drainage ditch and outlet pipe discharge locations to minimize erosion and sediment migration.

Stormwater management features, E&SC features, and BMPs specific to the construction of the new landfill will be addressed in a separate document. However, it is anticipated that stormwater management BMPs during construction of the new landfill will generally consist of establishing vegetation

on slopes, installation of down-chutes armored with rip-rap, diversion ditches, and storm sewer culverts. Temporary sedimentation ponds may also be utilized during landfill operation and closure.

V. TEMPORARY RUN-ON CONTROL

During closure activities at the W. S. Lee Steam Station, run-on control will be achieved through the installation of several temporary diversion ditches in the upland areas south of the primary and secondary ash basins. In order to be conservative, the drainage areas to each of the proposed temporary diversion ditches were calculated and the largest area (i.e., the greatest peak discharge value) was subsequently used to design a typical run-on diversion ditch. This will allow the temporary run-on diversion ditches to be constructed in a consistent manner, resulting in general ease of construction as well as maintenance during construction.

The largest drainage area, which will convey stormwater flow to the western run-on diversion ditch, was calculated to be 8.1 acres. This western diversion ditch was then utilized as the basis for the typical temporary run-on control section. A curve number (CN) of 94, corresponding to newly graded areas, was used. The time of concentration was estimated to be 4.0 minutes under pre-construction conditions; thus, a minimum time of concentration of 10.0 minutes was used in subsequent calculations. The corresponding peak run-off discharge rate was calculated to be 66.27 cubic feet-per-second (cfs) for the 25-year frequency design storm (24-hour duration).

The western run-on diversion ditch, which will divert run-on from the secondary ash basin area, is approximately 2,000 feet long with a minimum channel depth of 2 feet and an average slope along the length of the channel of 1.0%. It also has a 1.5-foot bottom width and 2H:1V channel side slopes. For the 25-year frequency design storm (24-hour duration), the average flow depth in the western run-on diversion ditch was calculated to be 1.86 feet and the maximum flow velocity in the channel is 5.89 feet-per-second (fps). The western run-on diversion ditch has a bank-full flow capacity of approximately 67.68 cfs and thus is adequate to convey the 25-year frequency design storm (24-hour duration). See Attachment 1 for Calculations.

VI. PRE-CONSTRUCTION NW PHASE 1

Prior to the removal of ash materials from the secondary ash basin, a drainage ditch (i.e., Reach 11R – SE to NW Channel; see Attachment 2) will be constructed northwest of the structural fill area and southwest of the secondary ash basin. The SE to NW Channel will convey run-off from the upland wooded areas, south of the existing transmission line, and from the southwest portion of the structural fill area to an existing swale located along the northwestern property line. The existing swale will convey the run-off to the northwest to an existing 60-inch diameter corrugated metal pipe (CMP), which will subsequently convey the flow beneath the existing railroad and ultimately discharge to the Saluda River (see Figure 1 in Attachment 2).

The SE to NW Channel drainage area (at the point of discharge) is comprised of four discrete areas (S3, S4, S8, and S10; see Attachment 1). The cumulative drainage area is estimated to be 46.5 acres, which is comprised of 40.0 acres of grass cover (>75%) and 6.5 acres of woods/grass combination, resulting in a weighted CN of 80. Note that the specified land uses represent post-construction conditions because

the SE to NW Channel will be a permanent stormwater management feature; however, one drainage area (S3) is outside of the limits of disturbance of the project and thus will remain in its wooded condition following construction. The peak run-off discharge rate from the cumulative drainage area was calculated to be 213.16 cfs for the 25-year frequency design storm (24-hour duration). Preliminarily, the SE to NW Channel is approximately 1,100 feet long with a minimum channel depth of 3 feet and an average slope along the length of the channel of 1.0%. It also has a 3-foot bottom width and 2H:1V channel side slopes.

For the 25-year frequency design storm (24-hour duration), the average flow depth in the SE to NW Channel was calculated to be 2.91 feet and the maximum flow velocity in the channel is 8.13 fps. The SE to NW Channel has a bank-full flow capacity of approximately 223.61 cfs and thus is adequate to convey the 25-year frequency design storm (24-hour duration). See Attachment 2 for Calculations and Drainage Map.

VII. PRE-CONSTRUCTION NW PHASE 2

Prior to clearing and grubbing of the areas immediately southwest of the secondary ash basin area and the subsequent commencement of excavation for the embankment of the new landfill, a drainage ditch (i.e., Reach 12R – SW to NE Channel; see Attachment 3) will be constructed along the northwest side of the new landfill footprint. The SE to NW Channel outlet location will be re-graded to convey run-off from the SW to NE Channel instead of to the existing swale as was the case in Phase 1 (see Section 2: Pre-Construction NW Phase 1). The SW to NE Channel will also pick up run-off from the areas immediately southwest of the secondary ash basin, which will be re-graded (following clearing and grubbing) to facilitate flow towards the channel.

The SW to NE Channel will convey run-off to a proposed concrete box culvert, from which point the flow will be conveyed to another drainage ditch (i.e., Reach 13R – NW to SE Channel; see Attachment 2) and subsequently to three storm sewer culverts, which will ultimately discharge the flow to the Saluda River at former NPDES-permitted Outfall 007 (see Figure 2 in Attachment 3).

The additional areas from which the SW to NE Channel will pick up run-off (S6 and S9, collectively 18.7 acres; see Attachment 3) were assigned CNs of 80 (>75% grass cover) corresponding to post-construction conditions, as the SW to NE Channel is a permanent stormwater management feature. (The design of the SE to NW Channel, which will also convey run-off to the SW to NW Channel in Phase 2, is discussed above). The peak run-off discharge rate to the SW to NE Channel was calculated to be 264.96 cfs for the 25-year frequency design storm (24-hour duration). Preliminarily, the SW to NE Channel is approximately 2,000 feet long with a minimum channel depth of 3 feet and an average slope along the length of the channel of 2.1%. It also has a 3-foot bottom width and 2H:1V channel side slopes.

For the 25-year frequency design storm (24-hour duration), the average flow depth in the SW to NE Channel was calculated to be 2.72 feet and the maximum flow velocity in the channel is 11.34 fps. The SW to NE Channel has a bank-full flow capacity of approximately 324.05 cfs and thus is more than

adequate to convey the 25-year frequency design storm (24-hour duration). See Attachment 3 for Calculations and Drainage Map.

As mentioned previously, the SW to NE Channel will convey run-off to a proposed concrete box culvert (i.e., Pond 11P – Square Box; see Attachment 2), located outside of the northern corner of the new landfill footprint. The peak run-off discharge rate to the Square Box culvert was calculated to be 259.80 cfs for the 25-year frequency design storm (24-hour duration). Preliminarily, the Square Box culvert is a concrete box, 8 feet wide by 5 feet high, and is approximately 100 feet long with a slope of 2.0% (start invert elevation 713.00 and end invert elevation 711.00). For the 25-year frequency design storm (24-hour duration), the peak flow depth in the Square Box culvert was calculated to be 717.68; thus, the flow is contained within the 5-foot high structure. See Attachment 3 for Calculations and Drainage Map.

As mentioned above, the Square Box culvert will convey run-off to the NW to SE Channel. The peak run-off discharge rate to the NW to SE Channel was calculated to be 259.80 cfs for the 25-year frequency design storm (24-hour duration). Preliminarily, the NW to SE Channel is approximately 400 feet long with a minimum channel depth of 3 feet and an average slope along the length of the channel of 9.5%. It also has a 3-foot bottom width and 2H:1V channel side slopes.

For the 25-year frequency design storm (24-hour duration), the average flow depth in the NW to SE Channel was calculated to be 1.91 feet and the maximum flow velocity in the channel is 19.85 fps. The NW to SE Channel has a bank-full flow capacity of 689.23 cfs and is thus more than adequate to convey the 25-year frequency design storm (24-hour duration). See Attachment 3 for Calculations and Drainage Map.

As mentioned previously, the NW to SE Channel will convey run-off to three storm sewer culverts (i.e., Pond 14P – Outlet Pipes; see Attachment 2), which will discharge the flow to the Saluda River at the Outfall 007. Currently, a 48-inch diameter CMP exists at this outfall; however, the length, slope, and condition of the pipe are unknown. For the purposes of this preliminary analysis, it was assumed that the existing pipe is 100 feet long, has a slope of 5.0%, and is in satisfactory condition; it was also assumed that the existing pipe will be supplemented with additional pipes to handle the increased flow anticipated at Outfall 007 as a result of the closure activities. Collectively, these pipes are referred to herein as the 007 Outlet Pipes.

The peak run-off discharge rate to the 007 Outlet Pipes was calculated to be 258.29 cfs for the 25-year frequency design storm (24-hour duration). Preliminarily, the 007 Outlet Pipes will consist of three 48-inch diameter CMPs (one existing pipe and two new pipes), each 100 feet long and installed at a slope of 5.0% (start invert elevation 664.00 and end invert elevation 659.00).

For the 25-year frequency design storm (24-hour duration), the peak flow depth in the 007 Outlet Pipes was calculated to be 668.02, which is 0.02 feet above the pipe crown elevation on the headwater side. However, the Outlet Pipes will be installed at the bottom of an existing depression; thus, ponding on the headwater side of the pipes was deemed acceptable for the purposes of this preliminary design. Furthermore, a 0.02-foot surcharge above the pipe crown elevation on the headwater side was considered negligible. See Attachment 3 for Calculations and Drainage Map.

VIII. POST-CLOSURE NW

Following completion of the new landfill construction, stormwater on the northwestern portion of the site will be managed as discussed above in Pre-Construction NW Phase 2, with one exception: run-off from the northwestern half of the new landfill will be conveyed to the SW to NE Channel, in addition to the other flows discussed above.

The northwestern half of the new landfill is approximately 17.5 acres in size and was assigned a CN of 80 (>75% grass cover), corresponding to post-construction conditions. The addition of the run-off from this area results in a calculated peak discharge run-off rate to the SW to NE Channel of 302.80 cfs for the 25-year frequency design storm (24-hour duration). As discussed above, preliminarily the SW to NE Channel is approximately 2,000 feet long with a minimum channel depth of 3 feet and an average slope along the length of the channel of 2.1%. It also has a 3-foot bottom width and 2H:1V channel side slopes.

For the 25-year frequency design storm (24-hour duration), the average flow depth in the SW to NE Channel was calculated to be 2.90 feet and the maximum flow velocity in the channel is 11.76 fps. The SW to NE Channel has a bank-full flow capacity of approximately 324.05 cfs and thus is adequate to convey the 25-year frequency design storm (24-hour duration). See Attachment 4 for Calculations and Drainage Map.

As mentioned previously, the SW to NE Channel will convey run-off to the Square Box culvert. With the addition of a portion of the run-off from the new landfill, the peak run-off discharge rate to the Square Box culvert was calculated to be 299.42 cfs for the 25-year frequency design storm (24-hour duration). The Square Box culvert is a concrete box, 8 feet wide by 5 feet high, and is approximately 100 feet long with a slope of 2.0% (start invert elevation 713.00 and end invert elevation 711.00).

For the 25-year frequency design storm (24-hour duration), the peak flow depth in the Square Box culvert was calculated to be 718.16; thus, there will be an approximate 1.16-foot surcharge above the crown on the headwater side, which was deemed acceptable for the purposes of this preliminary design. See Attachment 4 for Calculations and Drainage Map.

As mentioned above, the Square Box culvert will convey run-off to the NW to SE Channel. With the addition of a portion of the run-off from the new landfill, the peak run-off discharge rate to the NW to SE Channel was calculated to be 299.42 cfs for the 25-year frequency design storm (24-hour duration). The NW to SE Channel is approximately 400 feet long with a minimum channel depth of 3 feet and an average slope along the length of the channel of 9.5%. It also has a 3-foot bottom width and 2H:1V channel side slopes.

For the 25-year frequency design storm (24-hour duration), the average flow depth in the NW to SE Channel was calculated to be 2.05 feet and the maximum flow velocity in the channel is 20.61 fps. The NW to SE Channel has a bank-full flow capacity of 689.23 cfs and is thus more than adequate to convey

the 25-year frequency design storm (24-hour duration). See Attachment 4 for Calculations and Drainage Map.

As mentioned previously, the NW to SE Channel will convey run-off to the 007 Outlet Pipes. With the addition of a portion of the run-off from the new landfill, the peak run-off discharge rate to the Outlet Pipes was calculated to be 299.01 cfs for the 25-year frequency design storm (24-hour duration). The 007 Outlet Pipes will consist of three 48-inch diameter CMPs (one existing pipe and two new pipes), each 100 feet long and installed at a slope of 5.0% (start invert elevation 664.00 and end invert elevation 659.00).

For the 25-year frequency design storm (24-hour duration), the peak flow depth in the 007 Outlet Pipes was calculated to be 668.71, which is 0.71 feet above the pipe crown elevation on the headwater side. However, the 007 Outlet Pipes will be installed at the bottom of an existing depression; thus, minor ponding on the headwater side of the pipes was deemed acceptable for the purposes of this preliminary design. See Attachment 4 for Calculations and Drainage Map.

IX. POST-CLOSURE SE

Following closure by removal at the primary ash basin, the area within the former primary ash basin limits will be re-graded to promote run-off north towards the Saluda River. To estimate the runoff flow from the primary basin area and the contributing sub-watersheds located east, west and south, two hypothetical channels were modeled to convey the flow. The hypothetical N Channel (N) i.e. Reach 16R-N, and the hypothetical S Channel (S) i.e. Reach 17R-S (See Attachment 5) will convey the flow and converge into a set of proposed storm sewer culverts beneath a new access road, and ultimately to the Saluda River at existing Outfall 006 (see Attachment 5). While modelled as a channel for the purposes of these conceptual calculations, the S Channel may be designed to be a natural swale during subsequent design activities. These hypothetical channels were solely modeled to estimate the runoff flow volumes in order to size the discharge storm sewer culverts. During excavation of the ash materials from the primary basin, distinct drainage channels will be considered and designed.

The N Channel will collect run-off from the upland area southwest of the former primary ash basin (S5), the former structural fill area, the southeastern half of the new landfill, and a portion of the former primary ash basin area. The cumulative N Channel drainage area (at the point of discharge) was calculated to be 54.5 acres. A CN of 80 (>75% grass cover) was used, corresponding to post-construction conditions. The peak run-off discharge rate was calculated to be 208.36 cfs for the 25-year frequency design storm (24-hour duration). Preliminarily, the N Channel is approximately 1,500 feet long with a minimum channel depth of 3 feet and an average slope along the length of the channel of 2.93%. It also has a 4-foot bottom width and 2H:1V channel side slopes.

For the 25-year frequency design storm (24-hour duration), the average flow depth in the N Channel was calculated to be 2.08 feet and the maximum flow velocity in the channel is 11.98 fps. The N Channel has a bank-full flow capacity of 438.86 cfs and is thus more than adequate to convey the 25-year frequency design storm (24-hour duration). See Attachment 5 for Calculations and Drainage Map.

The S Channel will collect runoff from the upland south and east adjacent areas to the former primary ash basin (S1, S2, E4, E5, and E6), and from a portion of the former primary ash basin area. The cumulative S Channel drainage area (at the point of discharge) was calculated to be 78.1 acres. A CN of 80 (>75% grass cover) was used, corresponding to post-construction conditions. The peak run-off discharge rate was calculated to be 338.94 cfs for the 25-year frequency design storm (24-hour duration). Preliminarily, the S Channel is approximately 2,500 feet long with a minimum channel depth of 3 feet and an average slope along the length of the channel of 1.76%. It also has a 4-foot bottom width and 2H:1V channel side slopes.

For the 25-year frequency design storm (24-hour duration), the average flow depth in the S Channel was calculated to be 2.94 feet and the maximum flow velocity in the channel is 11.18 fps. The S Channel has a bank-full flow capacity of 339.94 cfs and is thus adequate to convey the 25-year frequency design storm (24-hour duration). See Attachment 5 for Calculations and Drainage Map.

As mentioned previously, the N Channel and S Channel flow will convey run-off to a set of proposed storm sewer discharge culverts beneath the new access road (i.e., Pond 15P – Outlet Pipes; see Attachment 5), which will discharge the flow to the Saluda River at the existing Outfall 006. Currently, a 54-inch diameter CMP exists at Outfall 006; however, the length, slope, and condition of the pipe are unknown. For the purposes of this preliminary analysis, it was assumed that the existing pipe is 175 feet long, has a slope of 5.0%, and is in satisfactory condition; it was also assumed that the existing pipe will be supplemented with additional pipes to handle the increased flow anticipated at Outfall 006 as a result of the closure activities. Collectively, these pipes are referred to herein as the 006 Outlet Pipes.

The peak run-off discharge rate to the 006 Outlet Pipes was calculated to be 515.32 cfs for the 25-year frequency design storm (24-hour duration). Preliminary, the 006 Outlet Pipes will consist of four 54-inch diameter CMPs (one existing pipe and three new pipes), each 175 feet long and installed at a slope of 5.0% (start invert elevation 671.50 and end invert elevation 662.75).

For the 25-year frequency design storm (24-hour duration), the peak flow depth in the 006 Outlet Pipes was calculated to be 676.58, which is 0.58 feet above the pipe crown elevation on the headwater side. However, the 006 Outlet Pipes will be installed at the bottom of an existing depression; thus, minor ponding on the headwater side of the pipes was deemed acceptable for the purposes of this preliminary design. See Attachment 5 for Calculations and Drainage Map.

X. CONCLUSIONS

Based on the analyses described herein, the proposed stormwater management controls are believed adequate and appropriate for management of both pre-construction and post-construction flows. Because of the preliminary nature of this evaluation, the assumptions are fairly conservative. It should also be noted that ground survey information will be collected to address a number of the data gaps and assumptions for the existing systems. Following collection of this data and evolution of the landfill

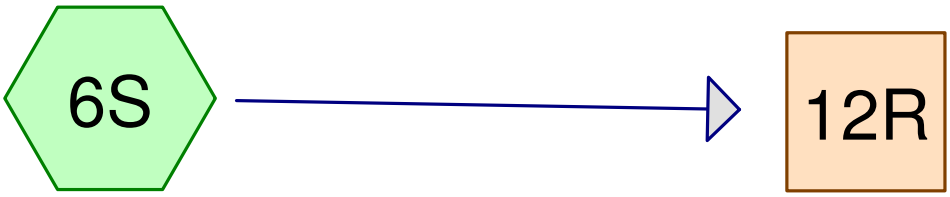
design activities, the stormwater management system calculations will be updated and presented as part of the landfill application submission and other future construction documents.

XI. REFERENCES

Not Used

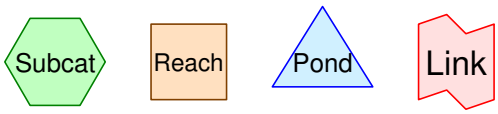
Attachment 1

Temporary Run-on Control – Calculations



S9

Pre-Construction
Western Run-on Ditch



Drainage Diagram for Typical Run-on Ditch - 2015-10-27
Prepared by URS Corporation, Printed 10/27/2015
HydroCAD® 9.10 s/n 06598 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
8.100	94	Newly graded area, HSG D (6S)
8.100	94	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
8.100	HSG D	6S
0.000	Other	
8.100		**TOTAL AREA**

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 6S: S9 Runoff Area=8.100 ac 0.00% Impervious Runoff Depth>5.71"
Flow Length=550' Slope=0.0500 '/' Tc=10.0 min CN=94 Runoff=66.27 cfs 3.852 af

Reach 12R: Pre-Construction Western Avg. Flow Depth=1.86' Max Vel=5.89 fps Inflow=66.27 cfs 3.852 af
n=0.025 L=2,000.0' S=0.0100 '/' Capacity=67.68 cfs Outflow=56.75 cfs 3.827 af

Total Runoff Area = 8.100 ac Runoff Volume = 3.852 af Average Runoff Depth = 5.71"
100.00% Pervious = 8.100 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 6S: S9

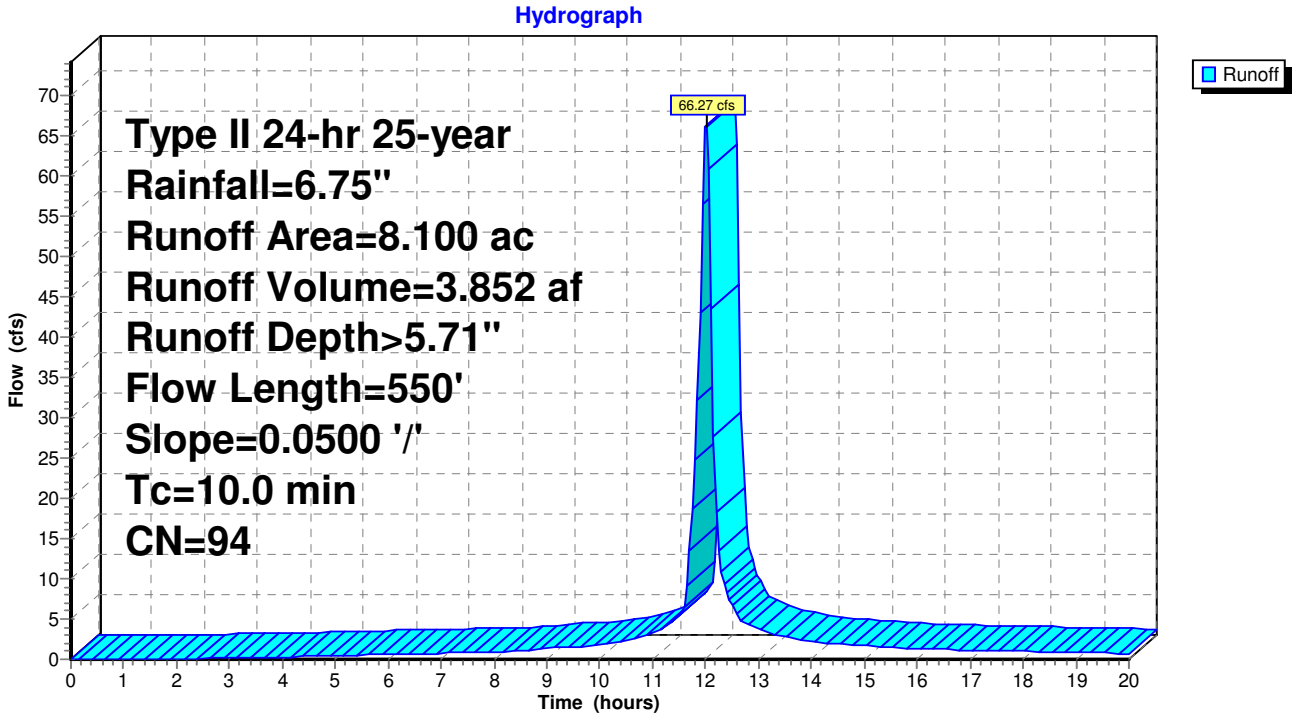
Runoff = 66.27 cfs @ 12.01 hrs, Volume= 3.852 af, Depth> 5.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.100	94	Newly graded area, HSG D
8.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	150	0.0500	2.41		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 4.00"
3.0	400	0.0500	2.24		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
4.0	550	Total, Increased to minimum Tc = 10.0 min			

Subcatchment 6S: S9



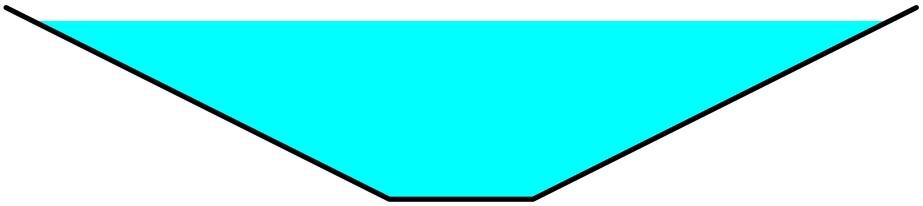
Summary for Reach 12R: Pre-Construction Western Run-on Ditch

Inflow Area = 8.100 ac, 0.00% Impervious, Inflow Depth > 5.71" for 25-year event
Inflow = 66.27 cfs @ 12.01 hrs, Volume= 3.852 af
Outflow = 56.75 cfs @ 12.16 hrs, Volume= 3.827 af, Atten= 14%, Lag= 9.0 min

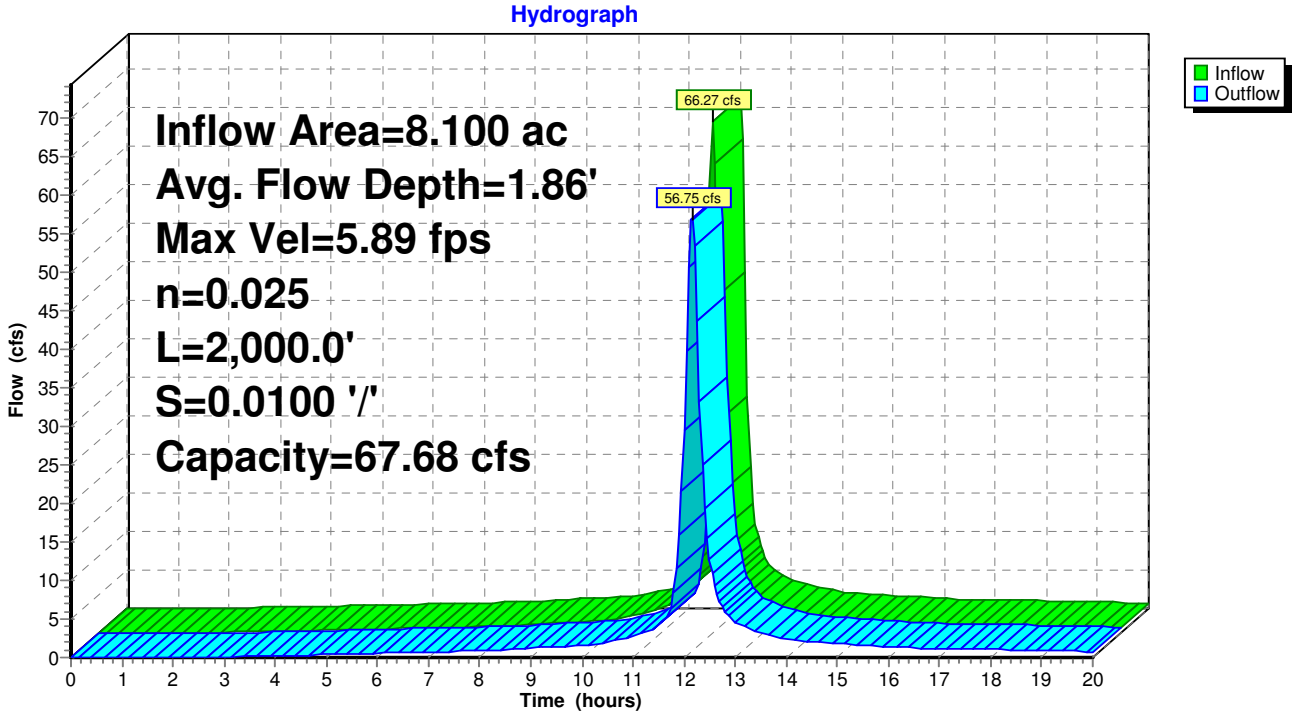
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.89 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 2.10 fps, Avg. Travel Time= 15.9 min

Peak Storage= 19,402 cf @ 12.06 hrs
Average Depth at Peak Storage= 1.86'
Bank-Full Depth= 2.00', Capacity at Bank-Full= 67.68 cfs

1.50' x 2.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 9.50'
Length= 2,000.0' Slope= 0.0100 '/'
Inlet Invert= 766.00', Outlet Invert= 746.00'

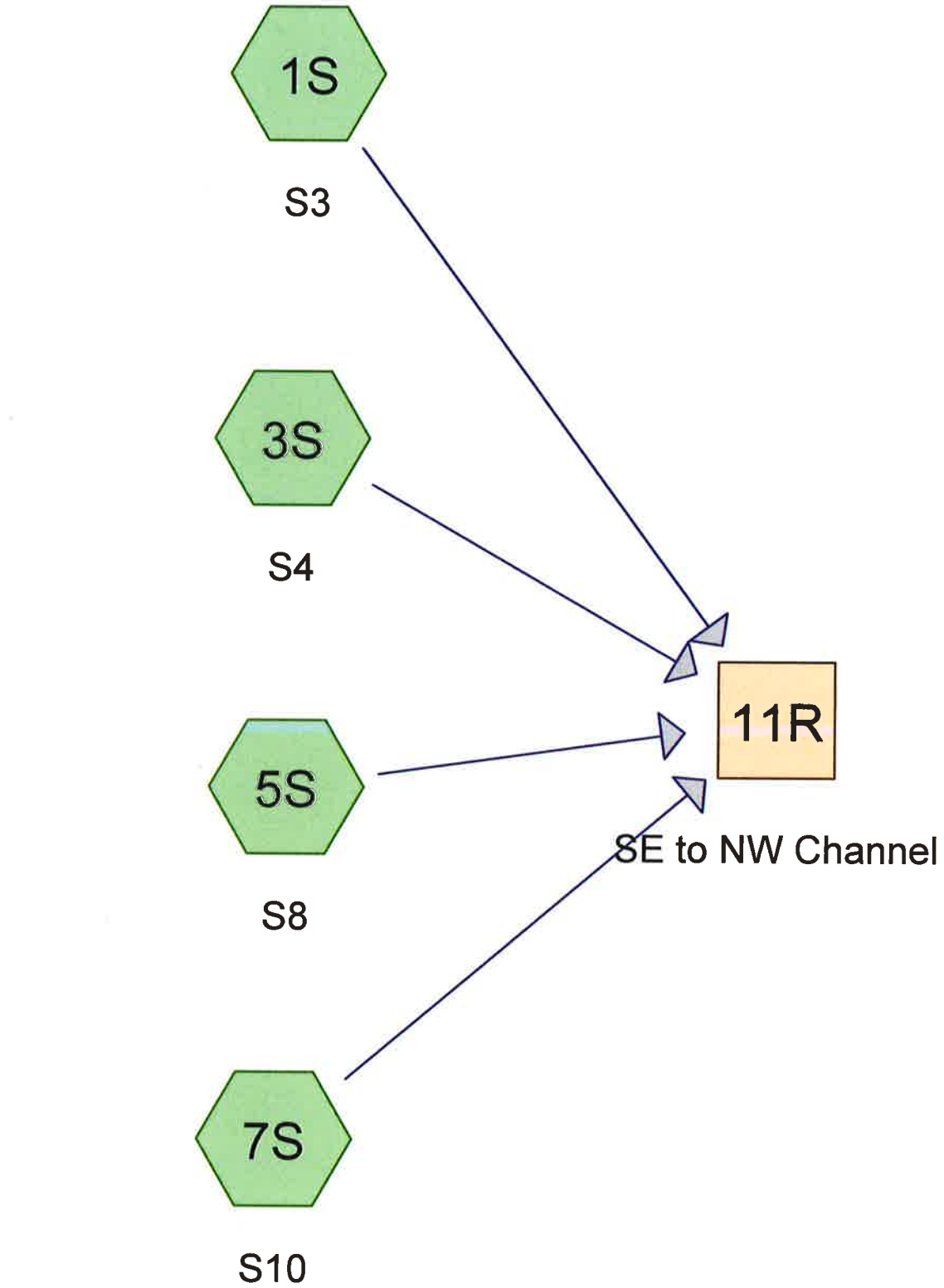


Reach 12R: Pre-Construction Western Run-on Ditch



Attachment 2

Pre-Construction NW Phase 1 – Calculations and Drainage Map



Subcat Reach Pond Link

Drainage Diagram for Pre-Construction NW Phase 1 - 2015-10-05
Prepared by URS Corporation, Printed 10/5/2015
HydroCAD® 9.10 s/n 06598 © 2011 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
40.000	80	>75% Grass cover, Good, HSG D (3S, 5S, 7S)
6.500	82	Woods/grass comb., Fair, HSG D (1S)
46.500	80	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
46.500	HSG D	1S, 3S, 5S, 7S
0.000	Other	
46.500		**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: S3 Runoff Area=6.500 ac 0.00% Impervious Runoff Depth>4.35"
Flow Length=640' Slope=0.0344 '/' Tc=21.4 min CN=82 Runoff=32.06 cfs 2.359 af

Subcatchment 3S: S4 Runoff Area=19.200 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,590' Slope=0.0377 '/' Tc=24.0 min CN=80 Runoff=84.97 cfs 6.622 af

Subcatchment 5S: S8 Runoff Area=8.500 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,230' Slope=0.0455 '/' Tc=23.9 min CN=80 Runoff=37.70 cfs 2.932 af

Subcatchment 7S: S10 Runoff Area=12.300 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,055' Slope=0.0550 '/' Tc=20.2 min CN=80 Runoff=59.95 cfs 4.248 af

Reach 11R: SE to NW Channel Avg. Flow Depth=2.91' Max Vel=8.13 fps Inflow=213.16 cfs 16.161 af
n=0.025 L=1,100.0' S=0.0100 '/' Capacity=223.61 cfs Outflow=208.29 cfs 16.111 af

Total Runoff Area = 46.500 ac Runoff Volume = 16.161 af Average Runoff Depth = 4.17"
100.00% Pervious = 46.500 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: S3

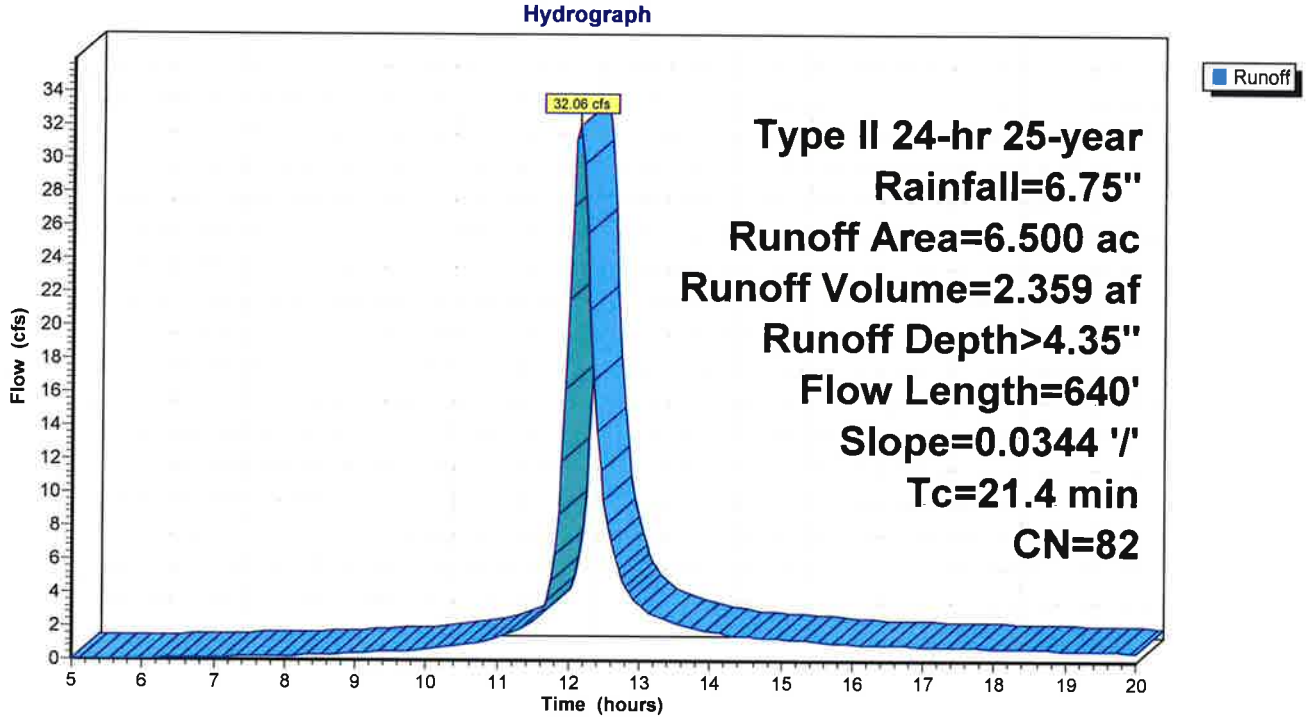
Runoff = 32.06 cfs @ 12.14 hrs, Volume= 2.359 af, Depth> 4.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
6.500	82	Woods/grass comb., Fair, HSG D
6.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	300	0.0344	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
4.4	340	0.0344	1.30		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
21.4	640	Total			

Subcatchment 1S: S3



Summary for Subcatchment 3S: S4

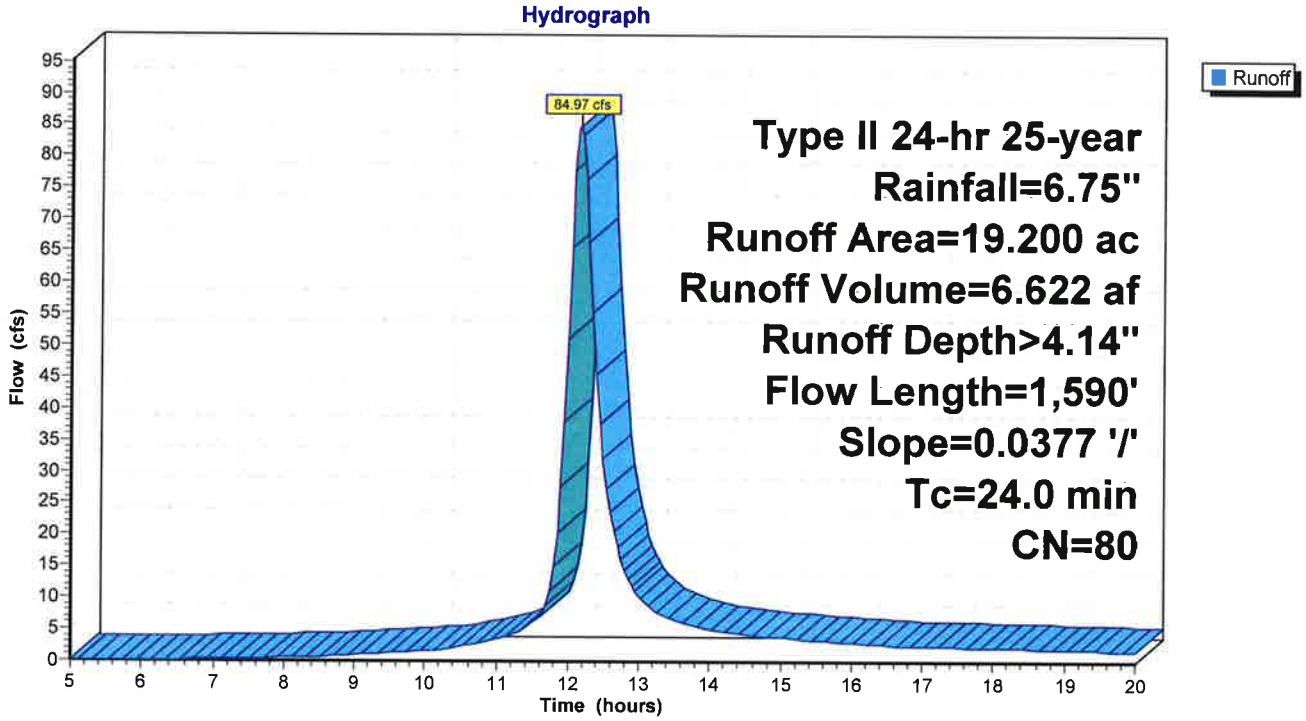
Runoff = 84.97 cfs @ 12.17 hrs, Volume= 6.622 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
19.200	80	>75% Grass cover, Good, HSG D
19.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	300	0.0377	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
6.0	490	0.0377	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	800	0.0377	8.42	46.32	**Trap/Vee/Rect Channel Flow,** Bot.W=2.50' D=1.00' Z= 3.0 '/' Top.W=8.50' n= 0.025 Earth, clean & straight
24.0	1,590	Total			

Subcatchment 3S: S4



Summary for Subcatchment 5S: S8

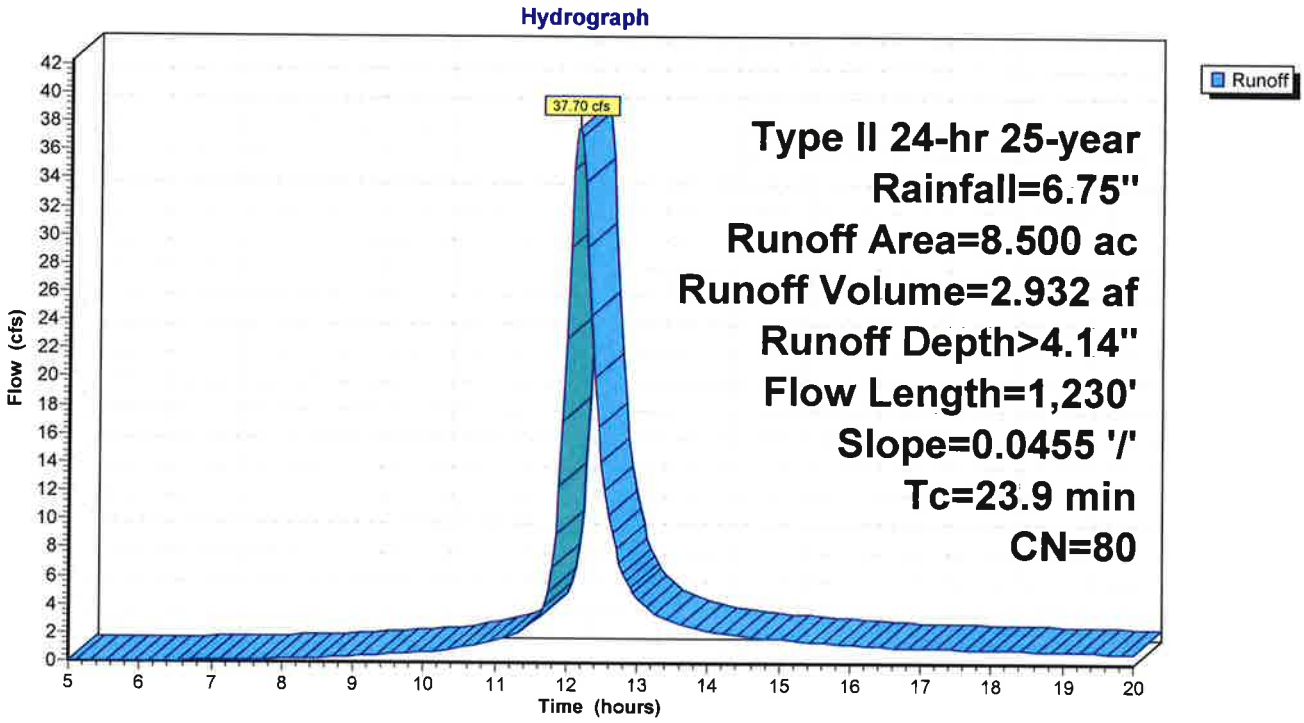
Runoff = 37.70 cfs @ 12.17 hrs, Volume= 2.932 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.500	80	>75% Grass cover, Good, HSG D
8.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	300	0.0455	0.33		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
8.4	750	0.0455	1.49		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	180	0.0455	8.77	39.46	**Trap/Vee/Rect Channel Flow,** Bot.W=1.50' D=1.00' Z= 3.0 '/' Top.W=7.50' n= 0.025 Earth, clean & straight
23.9	1,230	Total			

Subcatchment 5S: S8



Summary for Subcatchment 7S: S10

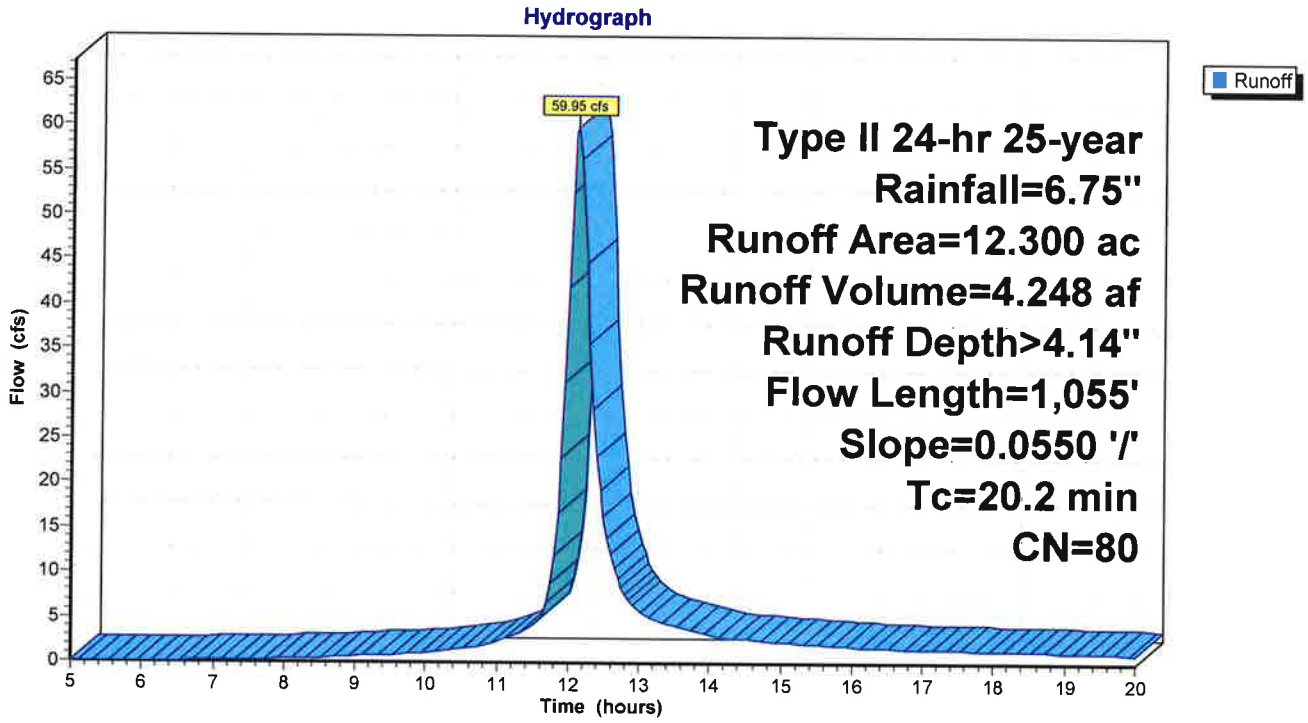
Runoff = 59.95 cfs @ 12.13 hrs, Volume= 4.248 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
12.300	80	>75% Grass cover, Good, HSG D
12.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	300	0.0550	0.36		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
5.7	560	0.0550	1.64		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	195	0.0550	8.69	30.94	**Trap/Vee/Rect Channel Flow,** Bot.W=2.50' D=0.75' Z= 3.0 '/' Top.W=7.00' n= 0.025 Earth, clean & straight
20.2	1,055	Total			

Subcatchment 7S: S10



Summary for Reach 11R: SE to NW Channel

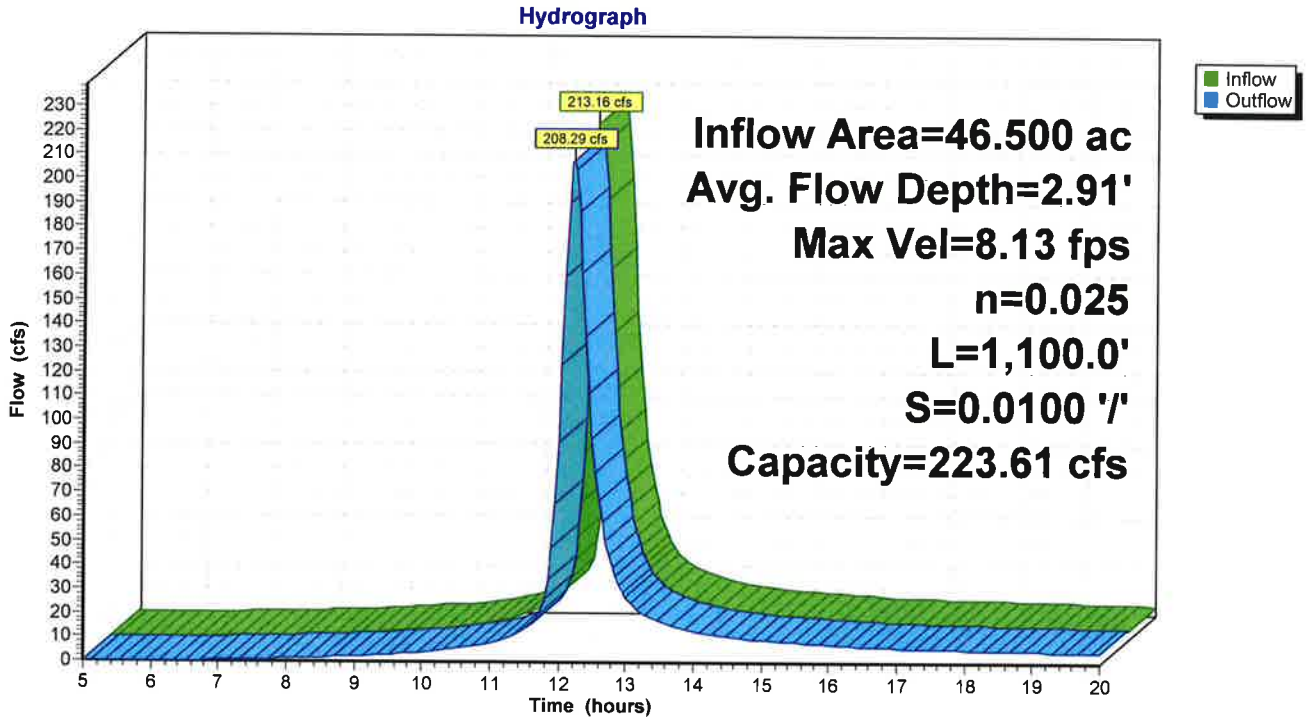
Inflow Area = 46.500 ac, 0.00% Impervious, Inflow Depth > 4.17" for 25-year event
Inflow = 213.16 cfs @ 12.15 hrs, Volume= 16.161 af
Outflow = 208.29 cfs @ 12.22 hrs, Volume= 16.111 af, Atten= 2%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.13 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 3.03 fps, Avg. Travel Time= 6.0 min

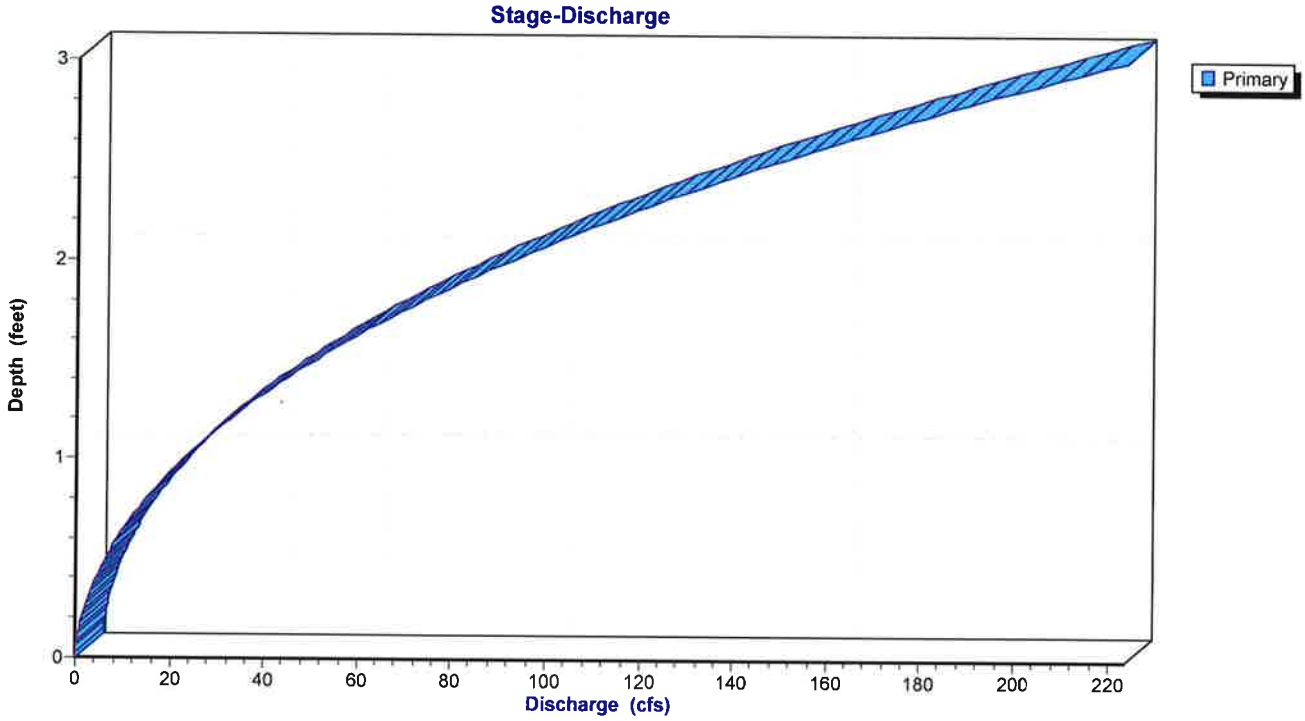
Peak Storage= 28,306 cf @ 12.18 hrs
Average Depth at Peak Storage= 2.91'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 223.61 cfs

3.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,100.0' Slope= 0.0100 '/'
Inlet Invert= 766.00', Outlet Invert= 755.00'

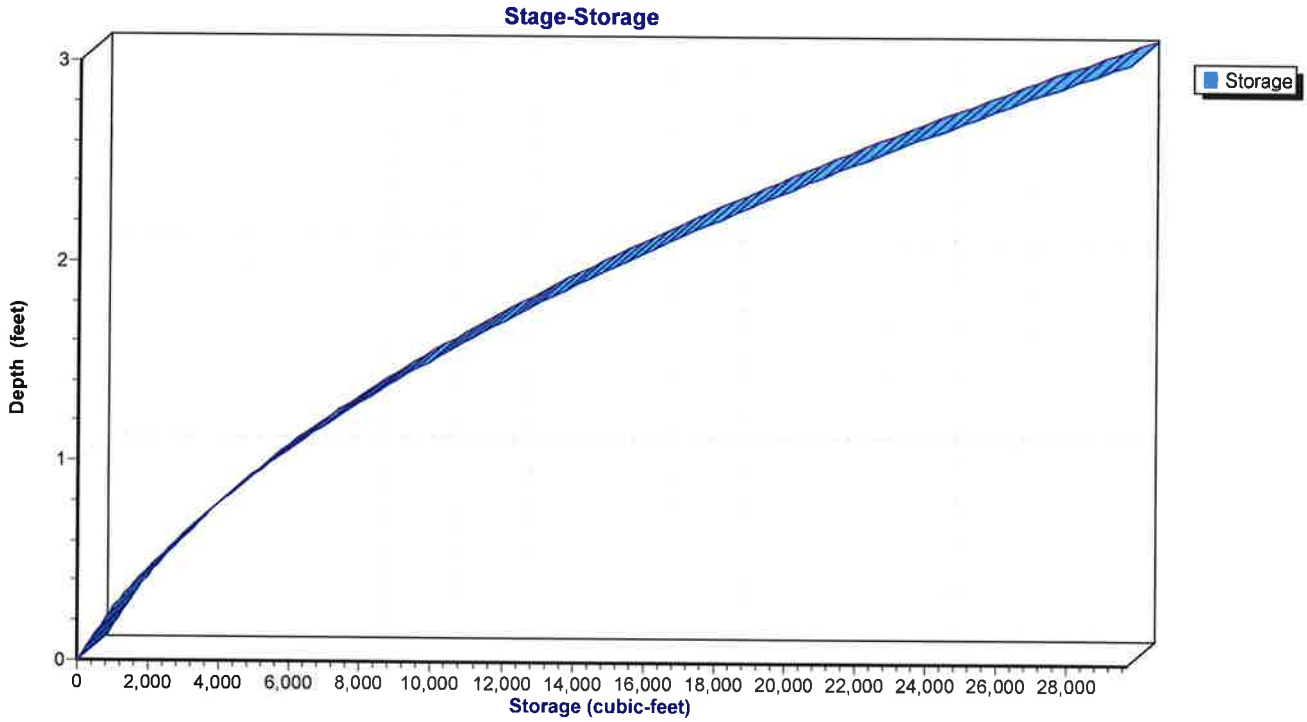
Reach 11R: SE to NW Channel

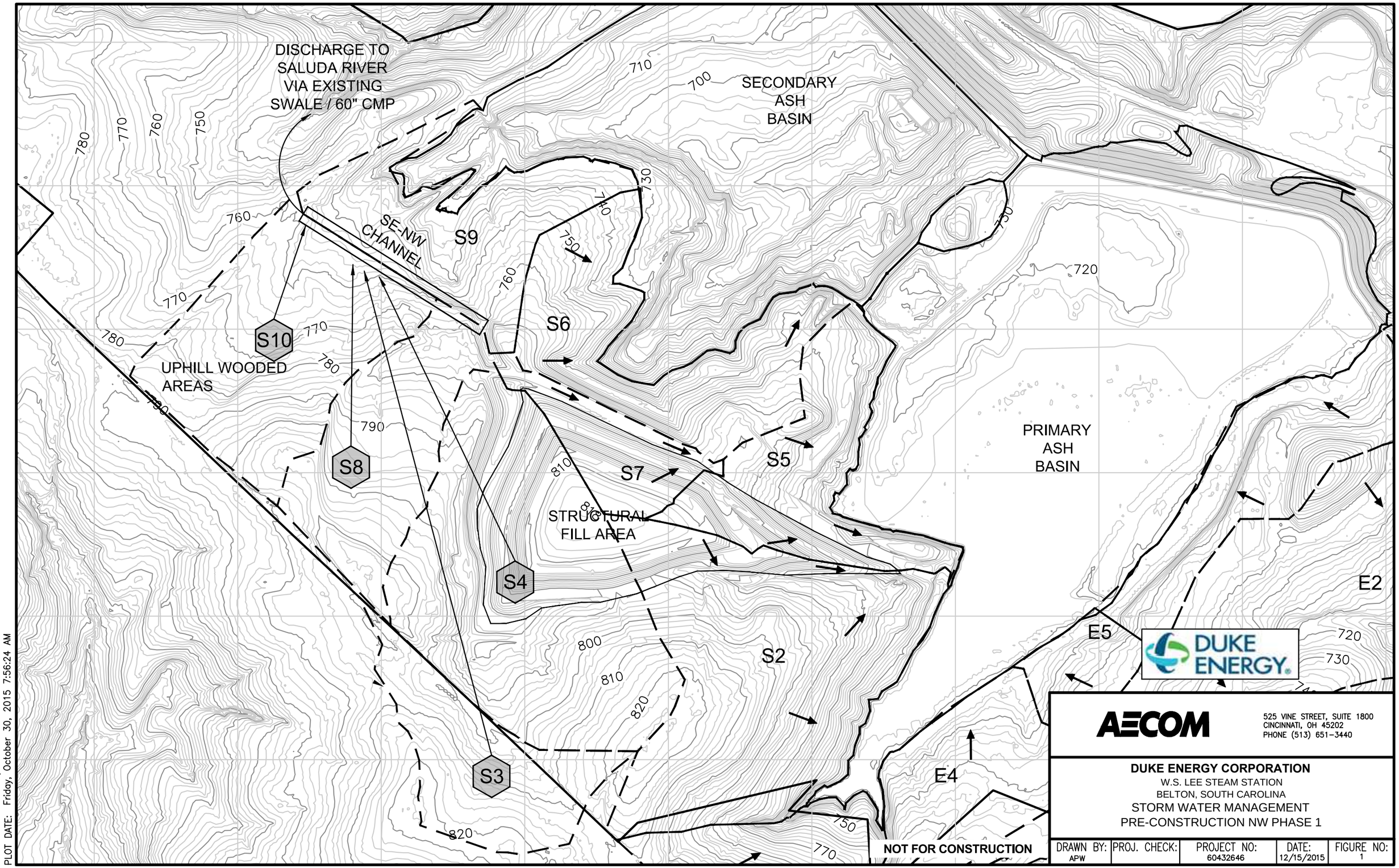


Reach 11R: SE to NW Channel



Reach 11R: SE to NW Channel





AECOM

525 VINE STREET, SUITE 1800
CINCINNATI, OH 45202
PHONE (513) 651-3440

DUKE ENERGY CORPORATION
W.S. LEE STEAM STATION
BELTON, SOUTH CAROLINA
STORM WATER MANAGEMENT
PRE-CONSTRUCTION NW PHASE 1

DRAWN BY:	PROJ. CHECK:	PROJECT NO:	DATE:	FIGURE NO:
APW		60432646	12/15/2015	1

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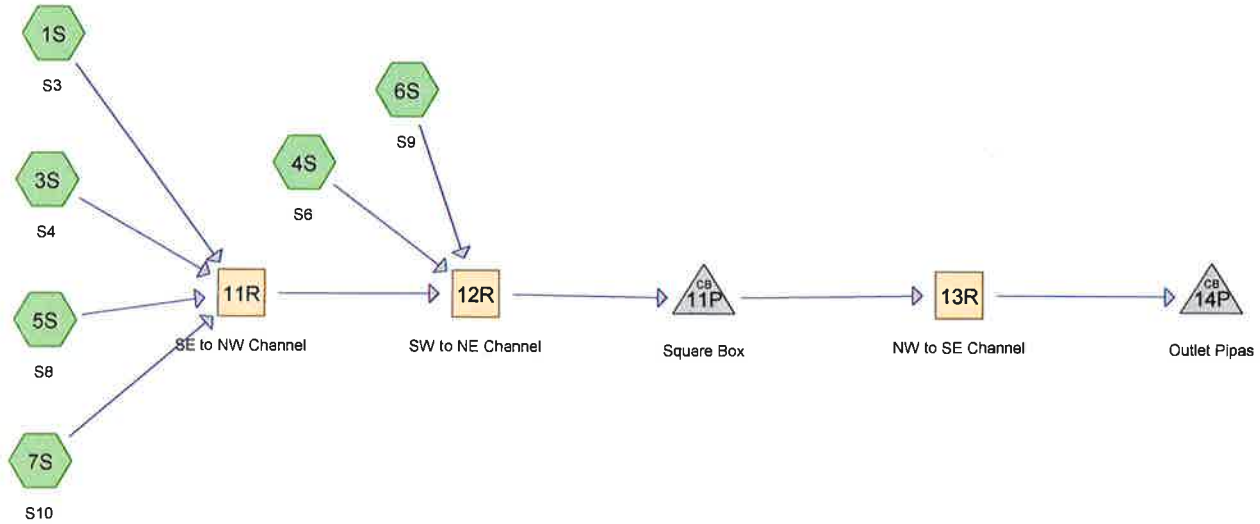
LAST UPDATE: Friday, October 30, 2015 7:48:34 AM
PLOT DATE: Friday, October 30, 2015 7:56:24 AM

Attachment 3

Pre-Construction NW Phase 2 – Calculations and Drainage Map



Subcat Reach Pond Link

Drainage Diagram for Pre-Construction NW Phase 2 - 2015-10-05
Prepared by URS Corporation, Printed 10/5/2015
HydroCAD® 9.10 s/n 06598 © 2011 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
58.700	80	>75% Grass cover, Good, HSG D (3S, 4S, 5S, 6S, 7S)
6.500	82	Woods/grass comb., Fair, HSG D (1S)
65.200	80	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
65.200	HSG D	1S, 3S, 4S, 5S, 6S, 7S
0.000	Other	
65.200		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Fill (inches)
1	11P	713.00	711.00	100.0	0.0200	0.013	96.0	60.0	0.0
2	14P	664.00	659.00	100.0	0.0500	0.025	48.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: S3 Runoff Area=6.500 ac 0.00% Impervious Runoff Depth>4.35"
Flow Length=640' Slope=0.0344 '/' Tc=21.4 min CN=82 Runoff=32.06 cfs 2.359 af

Subcatchment 3S: S4 Runoff Area=19.200 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,590' Slope=0.0377 '/' Tc=24.0 min CN=80 Runoff=84.97 cfs 6.622 af

Subcatchment 4S: S6 Runoff Area=10.000 ac 0.00% Impervious Runoff Depth>4.11"
Flow Length=2,085' Slope=0.0077 '/' Tc=43.7 min CN=80 Runoff=29.94 cfs 3.426 af

Subcatchment 5S: S8 Runoff Area=8.500 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,230' Slope=0.0455 '/' Tc=23.9 min CN=80 Runoff=37.70 cfs 2.932 af

Subcatchment 6S: S9 Runoff Area=8.700 ac 0.00% Impervious Runoff Depth>4.13"
Flow Length=2,785' Slope=0.0244 '/' Tc=30.1 min CN=80 Runoff=33.45 cfs 2.995 af

Subcatchment 7S: S10 Runoff Area=12.300 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,055' Slope=0.0550 '/' Tc=20.2 min CN=80 Runoff=59.95 cfs 4.248 af

Reach 11R: SE to NW Channel Avg. Flow Depth=2.91' Max Vel=8.13 fps Inflow=213.16 cfs 16.161 af
n=0.025 L=1,100.0' S=0.0100 '/' Capacity=223.61 cfs Outflow=208.29 cfs 16.111 af

Reach 12R: SW to NE Channel Avg. Flow Depth=2.72' Max Vel=11.34 fps Inflow=264.96 cfs 22.532 af
n=0.025 L=2,000.0' S=0.0210 '/' Capacity=324.05 cfs Outflow=259.80 cfs 22.440 af

Reach 13R: NW to SE Channel Avg. Flow Depth=1.91' Max Vel=19.85 fps Inflow=259.80 cfs 22.440 af
n=0.025 L=400.0' S=0.0950 '/' Capacity=689.23 cfs Outflow=258.29 cfs 22.429 af

Pond 11P: Square Box Peak Elev=717.68' Inflow=259.80 cfs 22.440 af
96.0" x 60.0" Box Culvert n=0.013 L=100.0' S=0.0200 '/' Outflow=259.80 cfs 22.440 af

Pond 14P: Outlet Pipes Peak Elev=668.02' Inflow=258.29 cfs 22.429 af
48.0" Round Culvert x 3.00 n=0.025 L=100.0' S=0.0500 '/' Outflow=258.29 cfs 22.429 af

Total Runoff Area = 65.200 ac Runoff Volume = 22.582 af Average Runoff Depth = 4.16"
100.00% Pervious = 65.200 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: S3

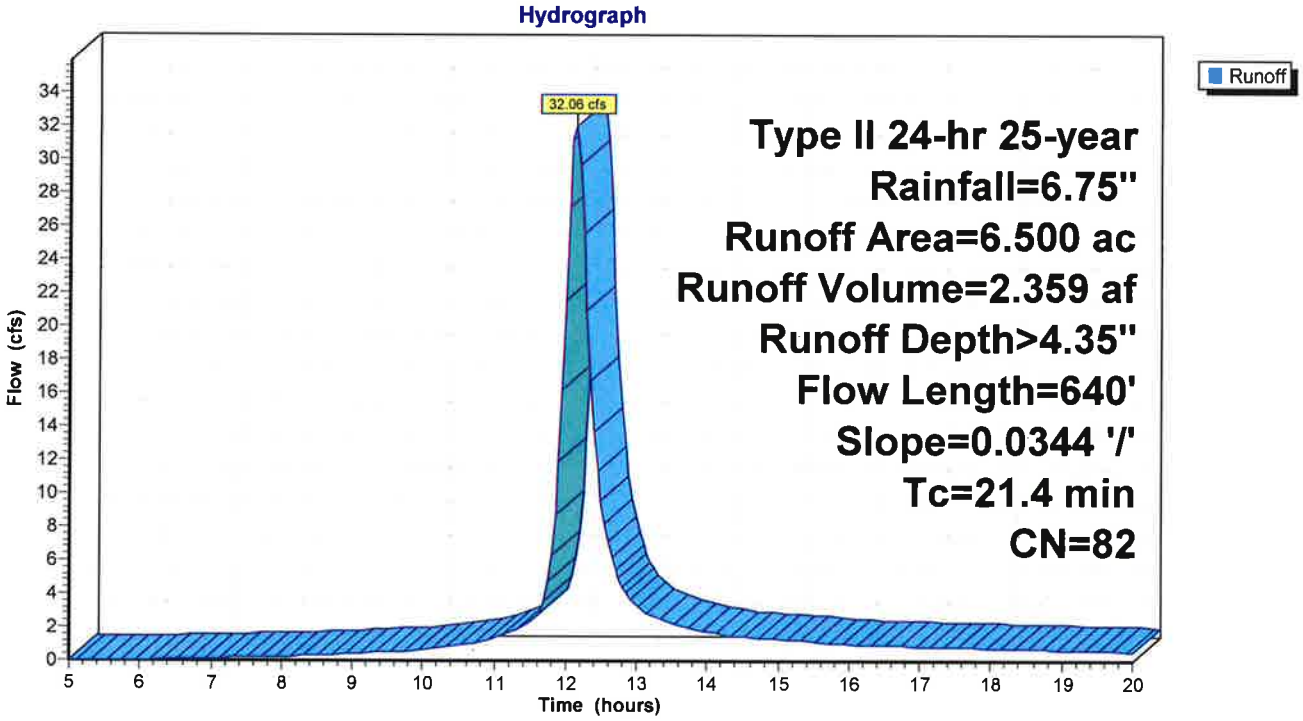
Runoff = 32.06 cfs @ 12.14 hrs, Volume= 2.359 af, Depth> 4.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
6.500	82	Woods/grass comb., Fair, HSG D
6.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	300	0.0344	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
4.4	340	0.0344	1.30		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
21.4	640	Total			

Subcatchment 1S: S3



Summary for Subcatchment 3S: S4

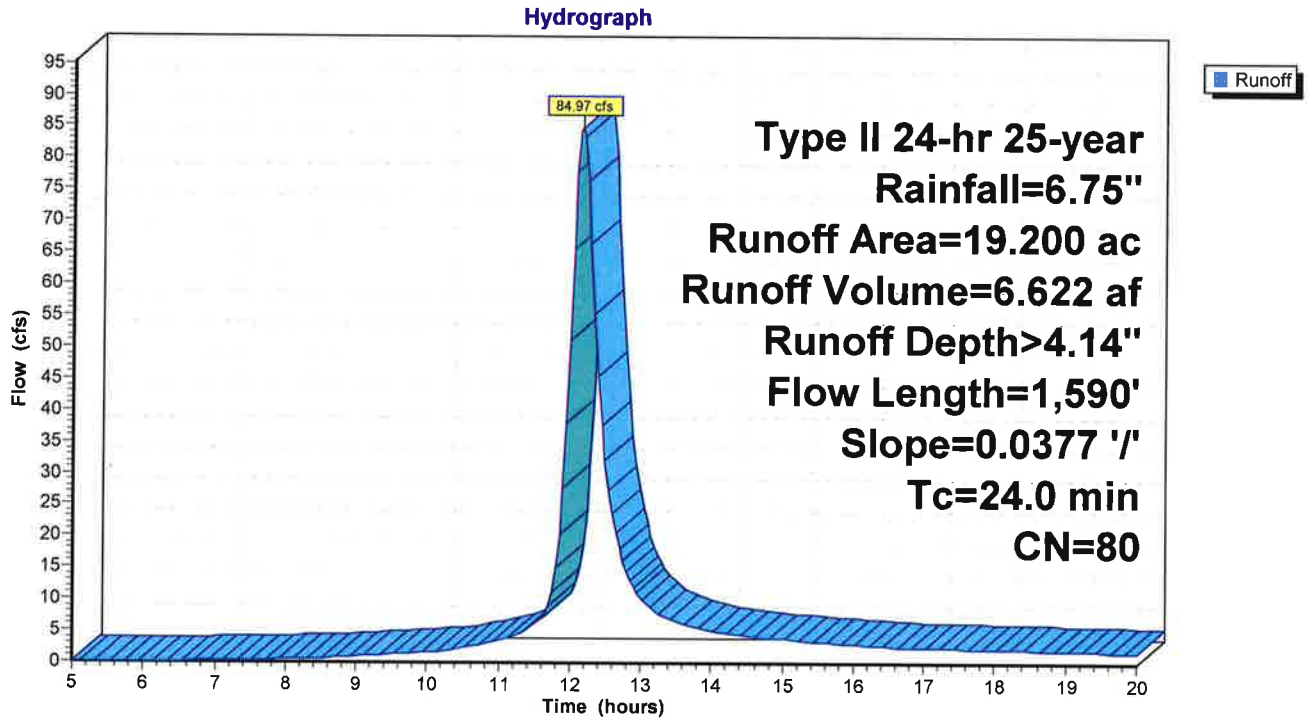
Runoff = 84.97 cfs @ 12.17 hrs, Volume= 6.622 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
19.200	80	>75% Grass cover, Good, HSG D
19.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	300	0.0377	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
6.0	490	0.0377	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	800	0.0377	8.42	46.32	**Trap/Vee/Rect Channel Flow,** Bot.W=2.50' D=1.00' Z= 3.0 '/' Top.W=8.50' n= 0.025 Earth, clean & straight
24.0	1,590	Total			

Subcatchment 3S: S4



Summary for Subcatchment 4S: S6

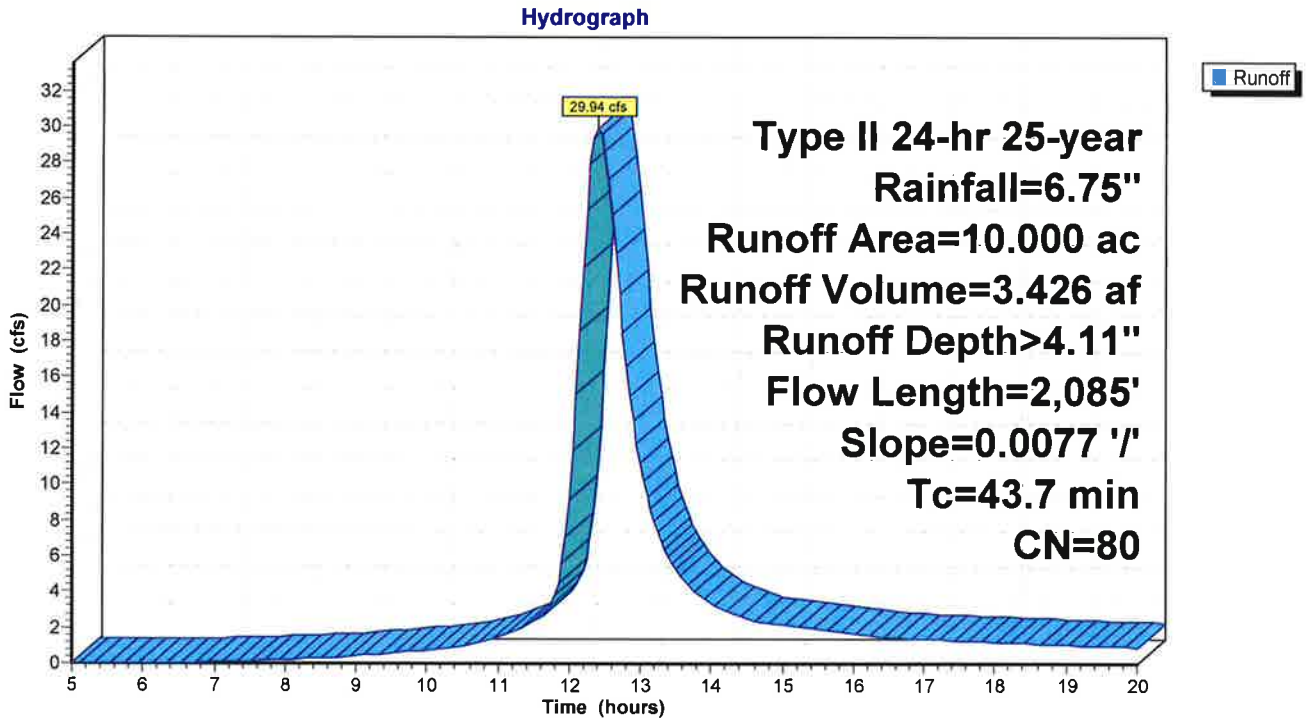
Runoff = 29.94 cfs @ 12.41 hrs, Volume= 3.426 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
10.000	80	>75% Grass cover, Good, HSG D
10.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.9	300	0.0077	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
5.8	215	0.0077	0.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.0	1,570	0.0077	3.71	18.57	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=1.00' Z= 3.0 '/' Top.W=8.00' n= 0.025 Earth, clean & straight
43.7	2,085	Total			

Subcatchment 4S: S6



Summary for Subcatchment 5S: S8

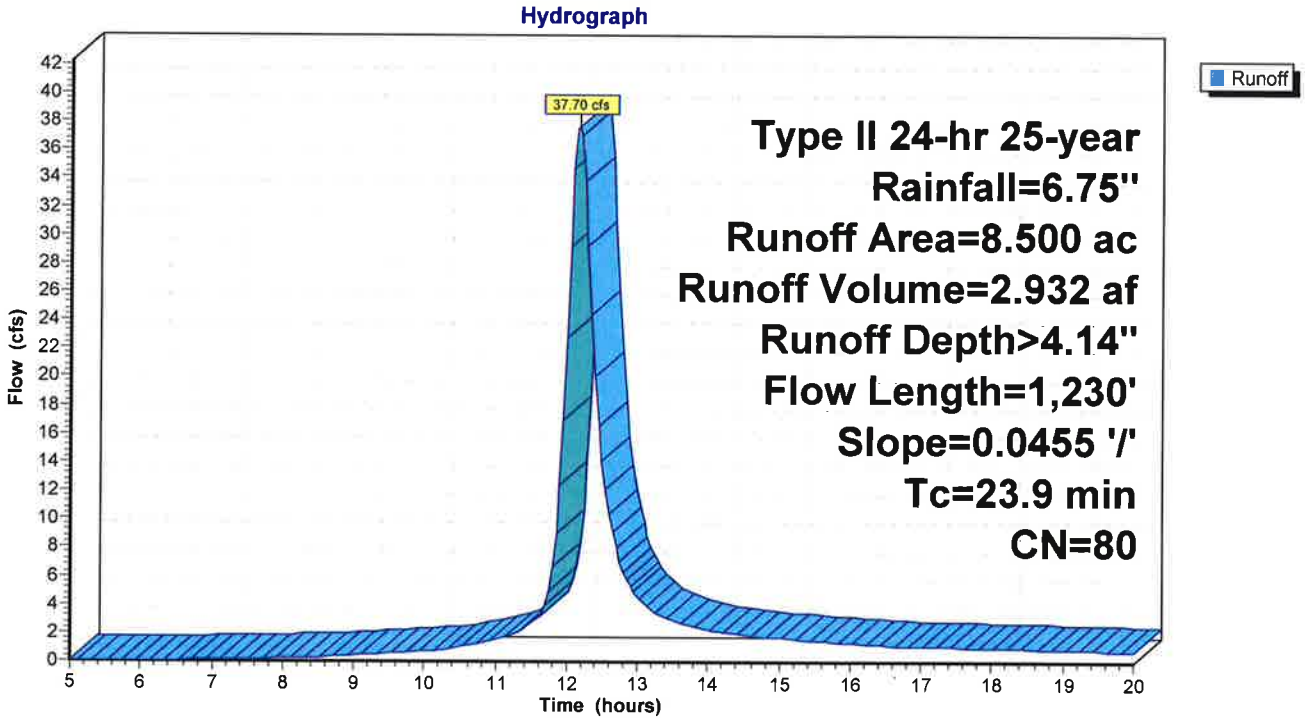
Runoff = 37.70 cfs @ 12.17 hrs, Volume= 2.932 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.500	80	>75% Grass cover, Good, HSG D
8.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	300	0.0455	0.33		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
8.4	750	0.0455	1.49		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	180	0.0455	8.77	39.46	**Trap/Vee/Rect Channel Flow,** Bot.W=1.50' D=1.00' Z= 3.0 '/' Top.W=7.50' n= 0.025 Earth, clean & straight
23.9	1,230	Total			

Subcatchment 5S: S8



Summary for Subcatchment 6S: S9

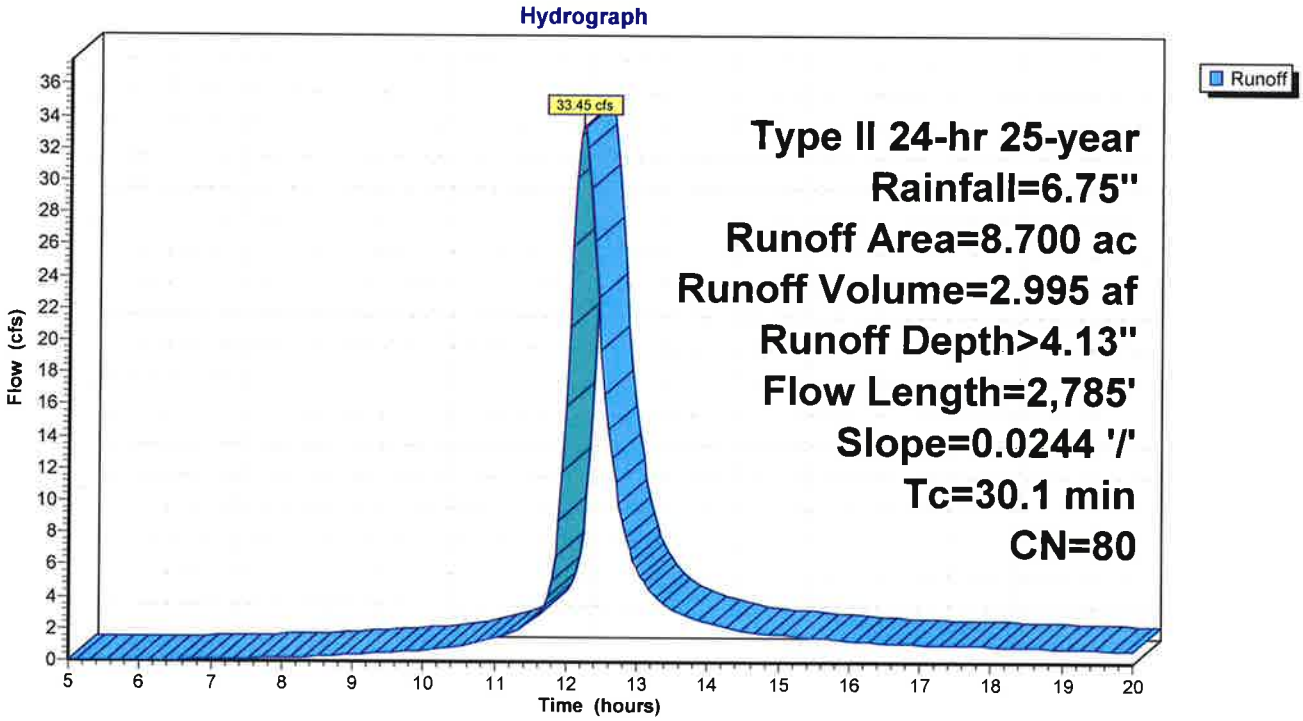
Runoff = 33.45 cfs @ 12.24 hrs, Volume= 2.995 af, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.700	80	>75% Grass cover, Good, HSG D
8.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	300	0.0244	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
4.0	260	0.0244	1.09		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.6	2,225	0.0244	5.63	17.96	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=0.75' Z= 3.0 '/' Top.W=6.50' n= 0.025 Earth, clean & straight
30.1	2,785	Total			

Subcatchment 6S: S9



Summary for Subcatchment 7S: S10

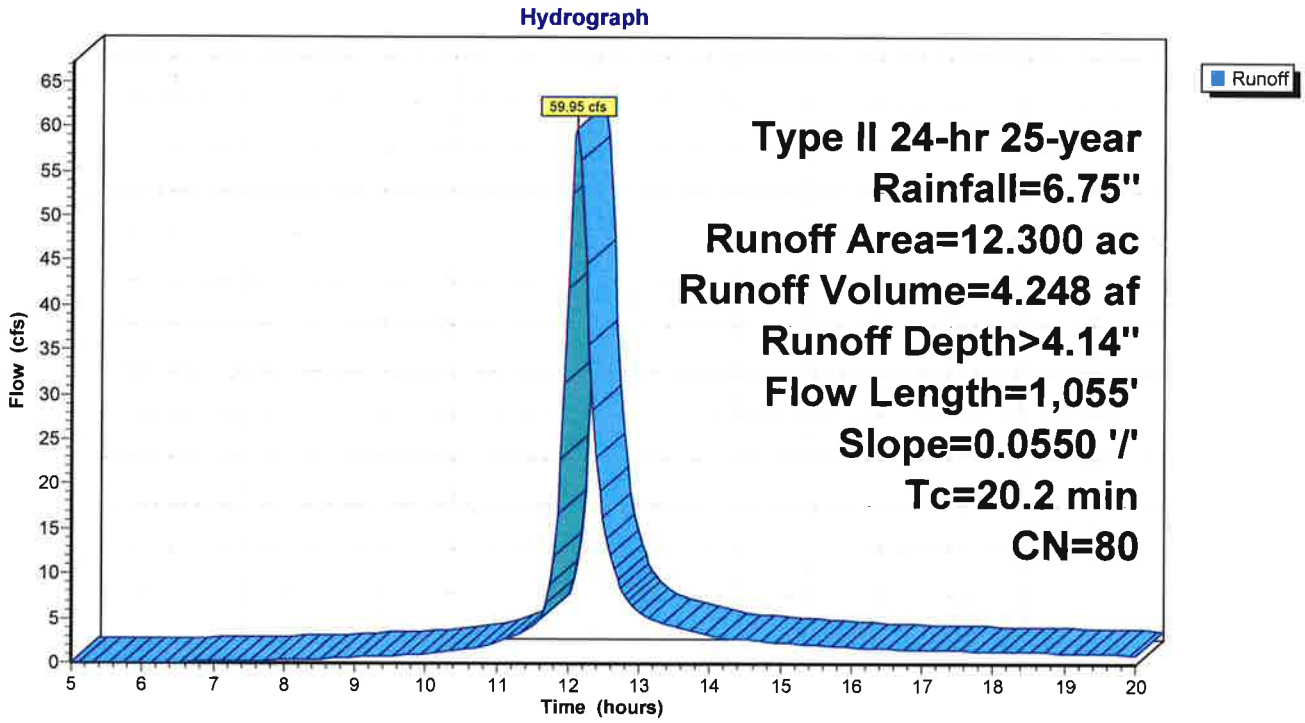
Runoff = 59.95 cfs @ 12.13 hrs, Volume= 4.248 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
12.300	80	>75% Grass cover, Good, HSG D
12.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	300	0.0550	0.36		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
5.7	560	0.0550	1.64		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	195	0.0550	8.69	30.94	**Trap/Vee/Rect Channel Flow,** Bot.W=2.50' D=0.75' Z= 3.0 '/' Top.W=7.00' n= 0.025 Earth, clean & straight
20.2	1,055	Total			

Subcatchment 7S: S10



Summary for Reach 11R: SE to NW Channel

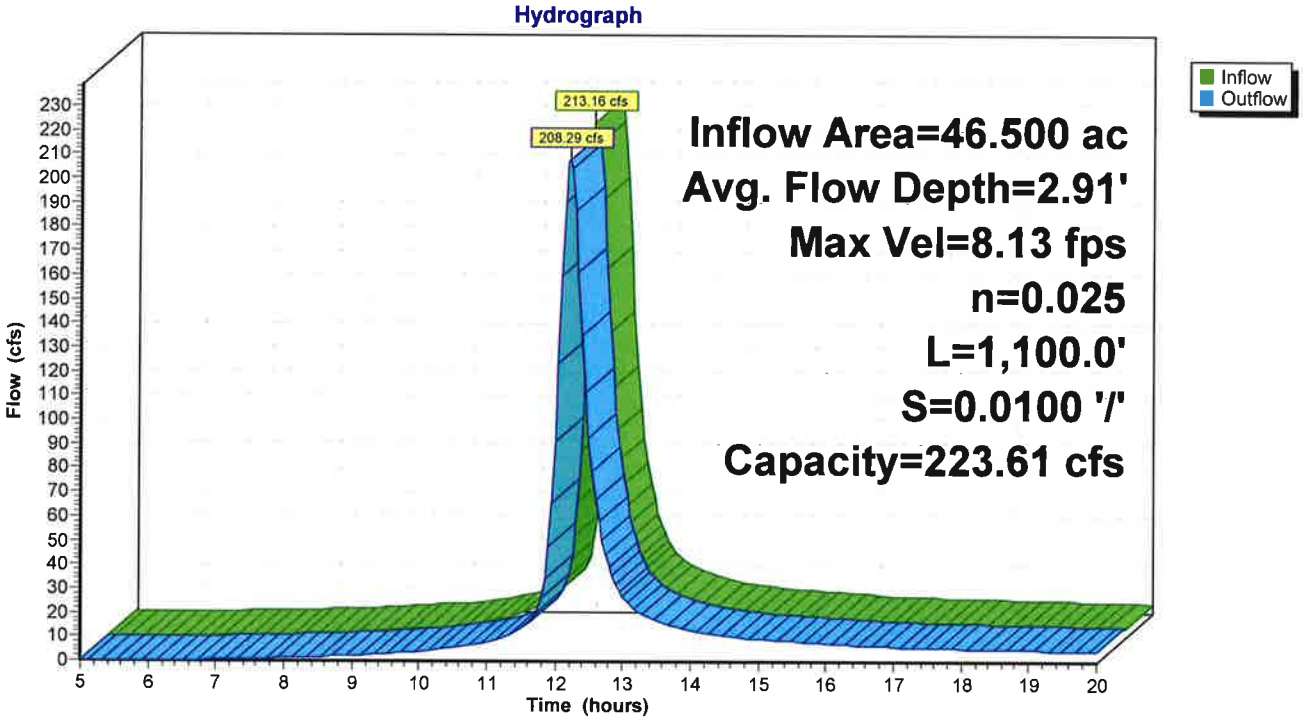
Inflow Area = 46.500 ac, 0.00% Impervious, Inflow Depth > 4.17" for 25-year event
Inflow = 213.16 cfs @ 12.15 hrs, Volume= 16.161 af
Outflow = 208.29 cfs @ 12.22 hrs, Volume= 16.111 af, Atten= 2%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.13 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 3.03 fps, Avg. Travel Time= 6.0 min

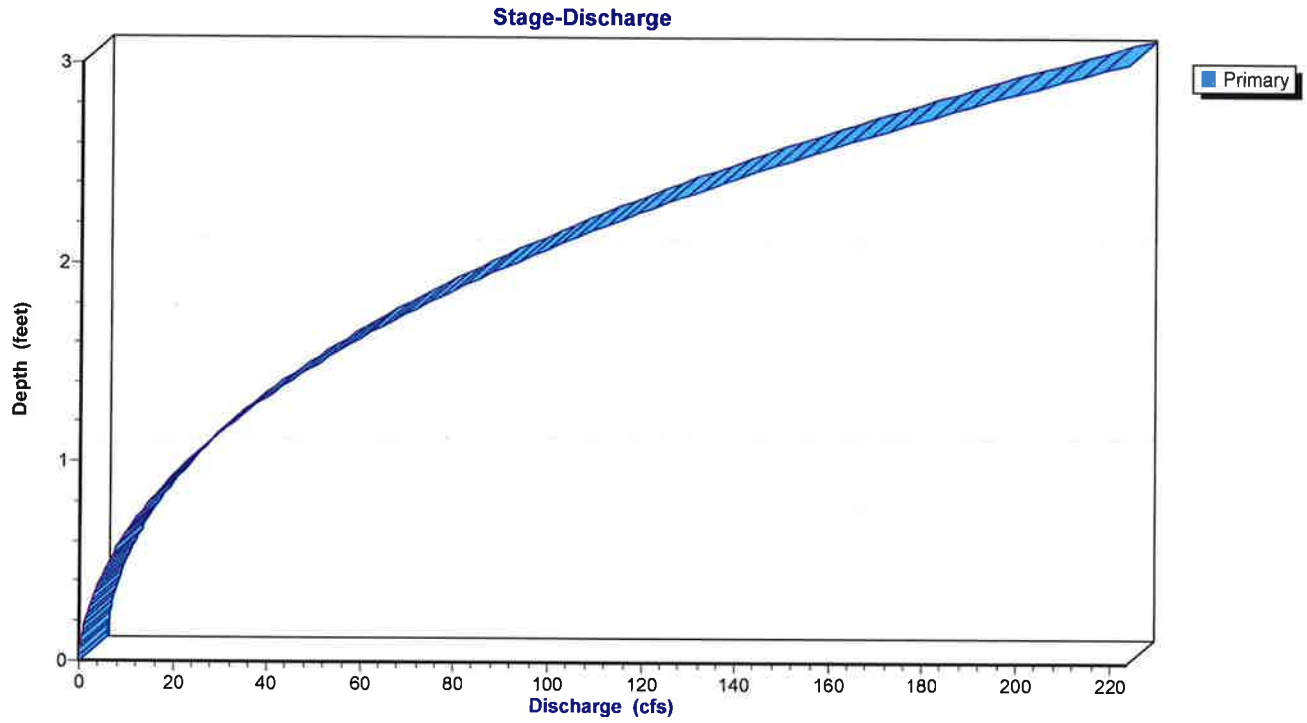
Peak Storage= 28,306 cf @ 12.18 hrs
Average Depth at Peak Storage= 2.91'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 223.61 cfs

3.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,100.0' Slope= 0.0100 '/'
Inlet Invert= 766.00', Outlet Invert= 755.00'

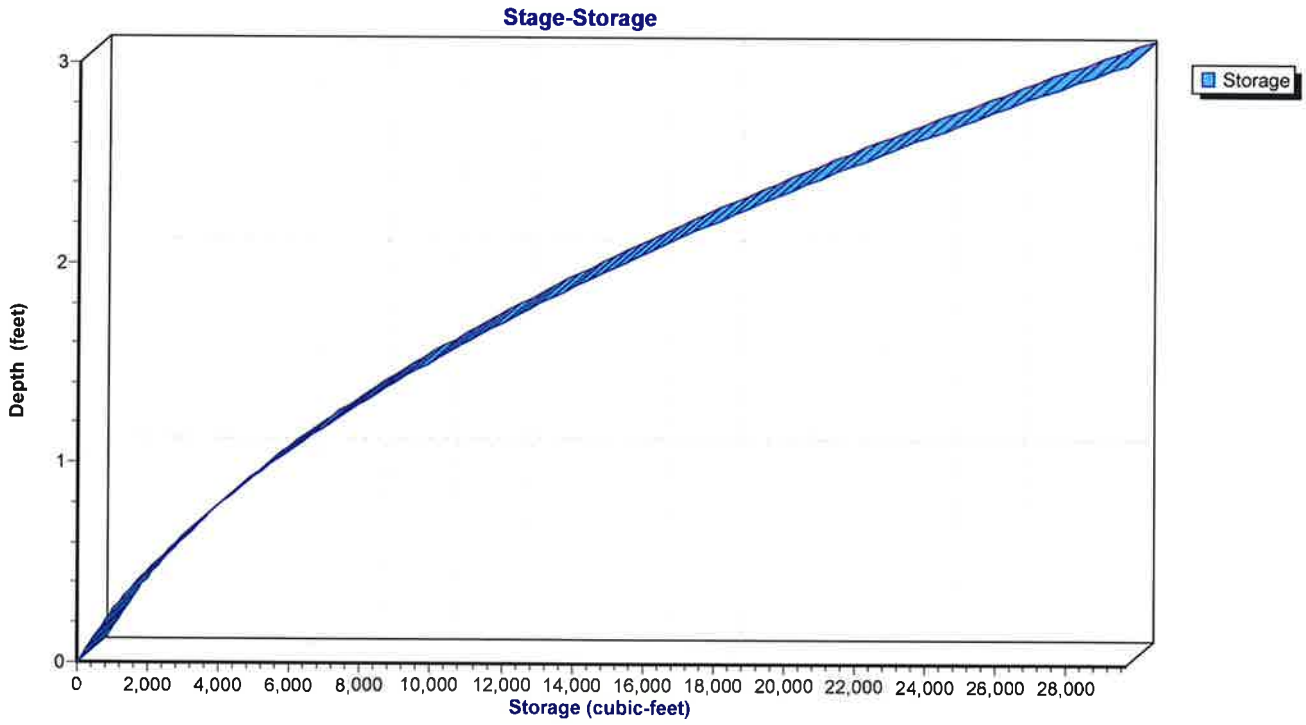
Reach 11R: SE to NW Channel



Reach 11R: SE to NW Channel



Reach 11R: SE to NW Channel



Summary for Reach 12R: SW to NE Channel

[62] Hint: Exceeded Reach 11R OUTLET depth by 0.29' @ 12.50 hrs

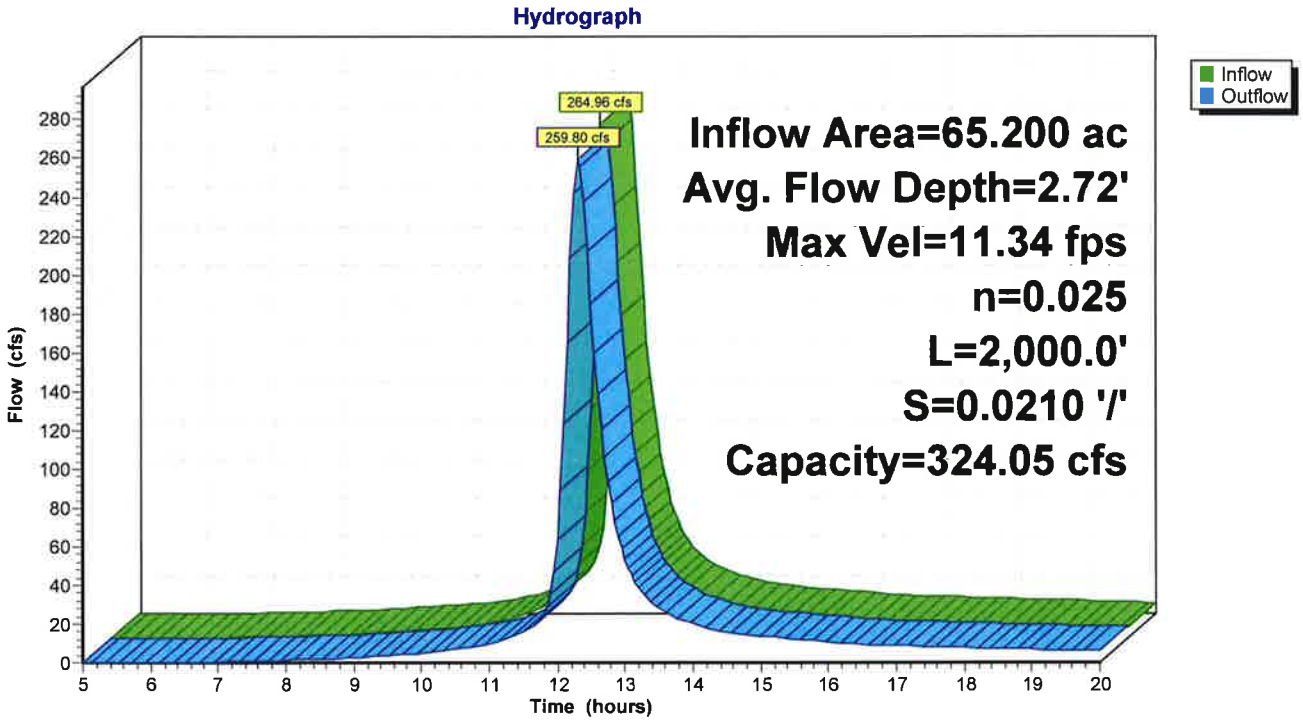
Inflow Area = 65.200 ac, 0.00% Impervious, Inflow Depth > 4.15" for 25-year event
Inflow = 264.96 cfs @ 12.23 hrs, Volume= 22.532 af
Outflow = 259.80 cfs @ 12.32 hrs, Volume= 22.440 af, Atten= 2%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.34 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 4.37 fps, Avg. Travel Time= 7.6 min

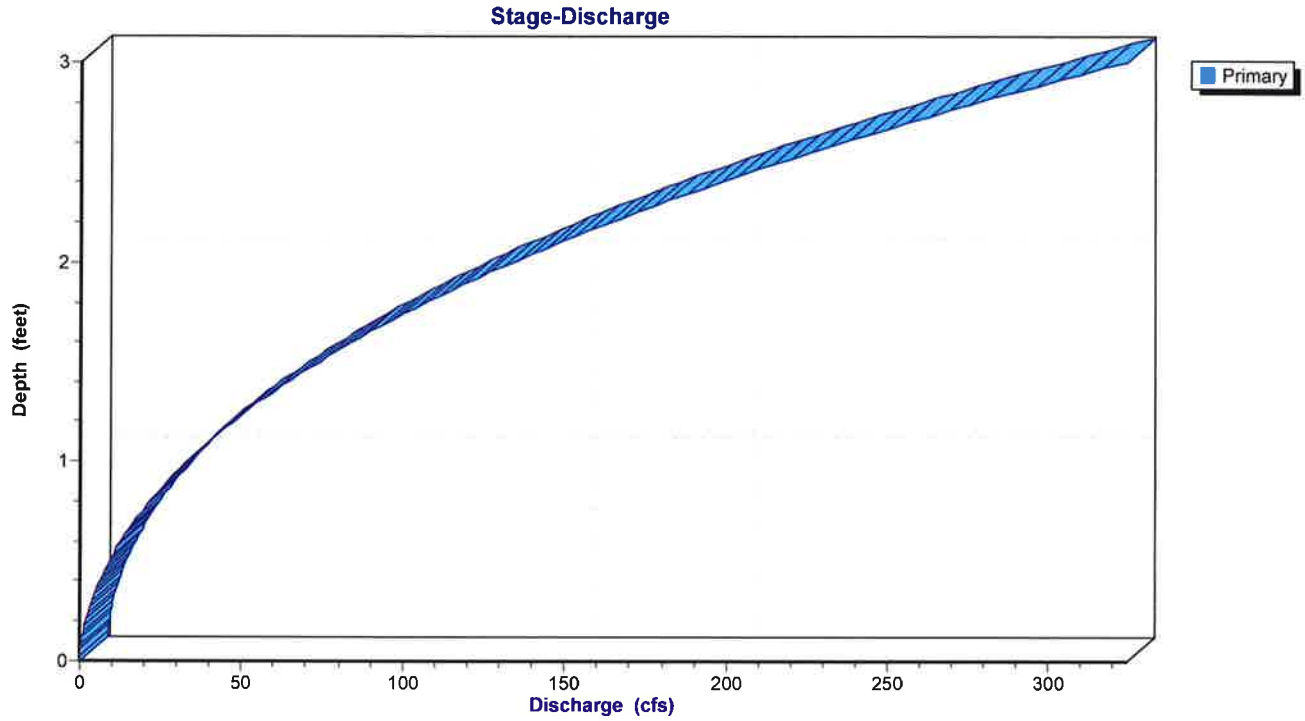
Peak Storage= 45,818 cf @ 12.27 hrs
Average Depth at Peak Storage= 2.72'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 324.05 cfs

3.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 2,000.0' Slope= 0.0210 '/'
Inlet Invert= 755.00', Outlet Invert= 713.00'

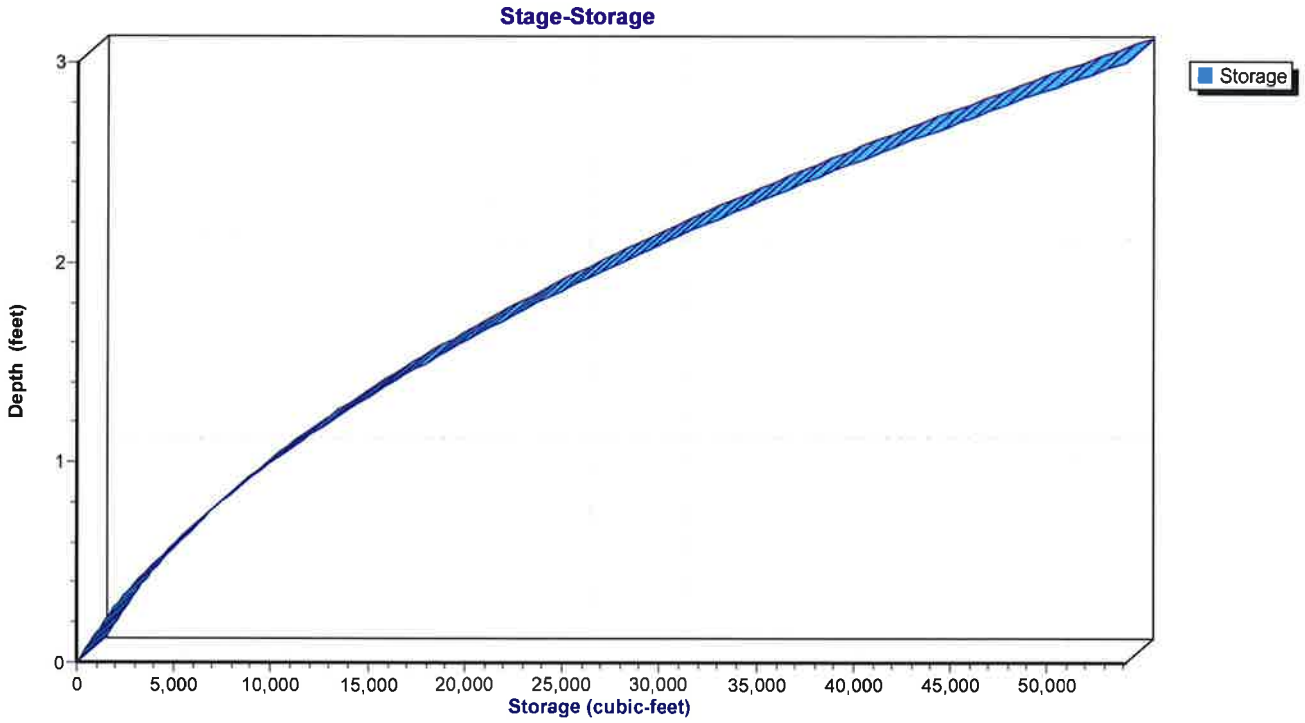
Reach 12R: SW to NE Channel



Reach 12R: SW to NE Channel



Reach 12R: SW to NE Channel



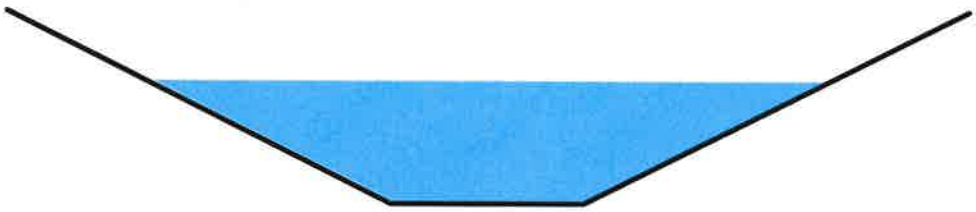
Summary for Reach 13R: NW to SE Channel

Inflow Area = 65.200 ac, 0.00% Impervious, Inflow Depth > 4.13" for 25-year event
Inflow = 259.80 cfs @ 12.32 hrs, Volume= 22.440 af
Outflow = 258.29 cfs @ 12.33 hrs, Volume= 22.429 af, Atten= 1%, Lag= 0.6 min

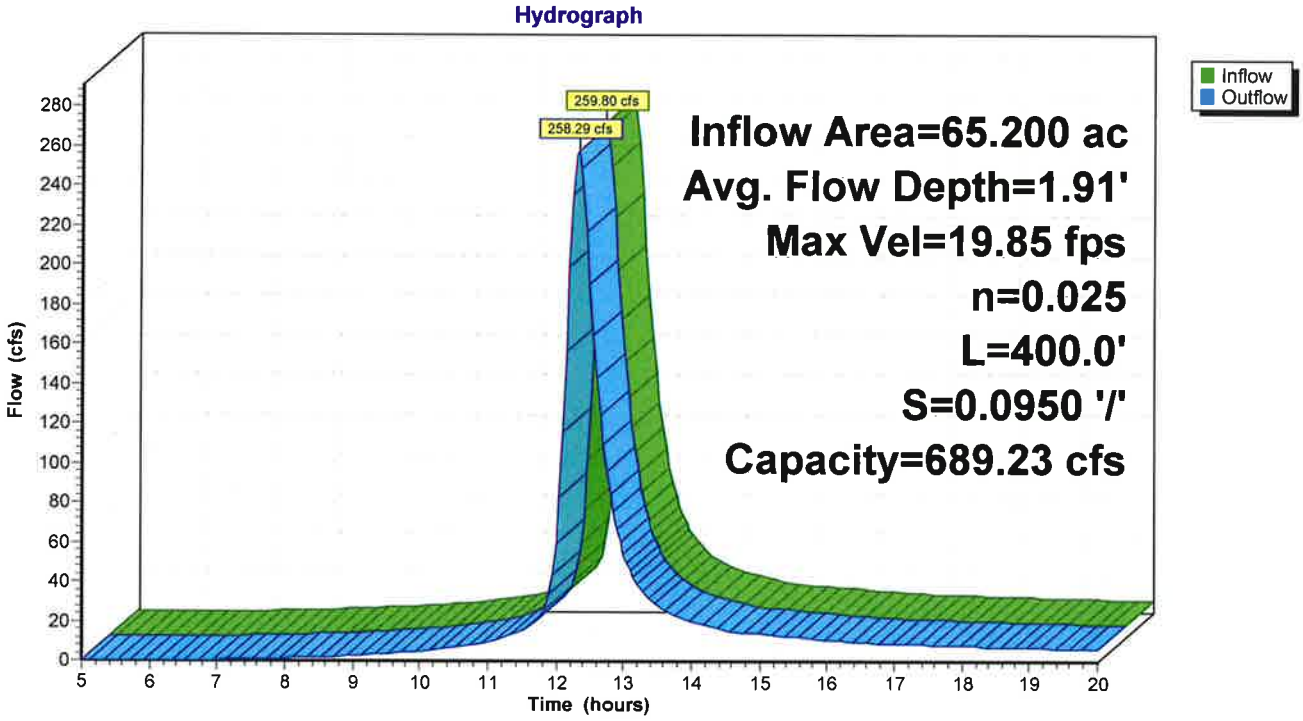
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 19.85 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 7.43 fps, Avg. Travel Time= 0.9 min

Peak Storage= 5,227 cf @ 12.32 hrs
Average Depth at Peak Storage= 1.91'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 689.23 cfs

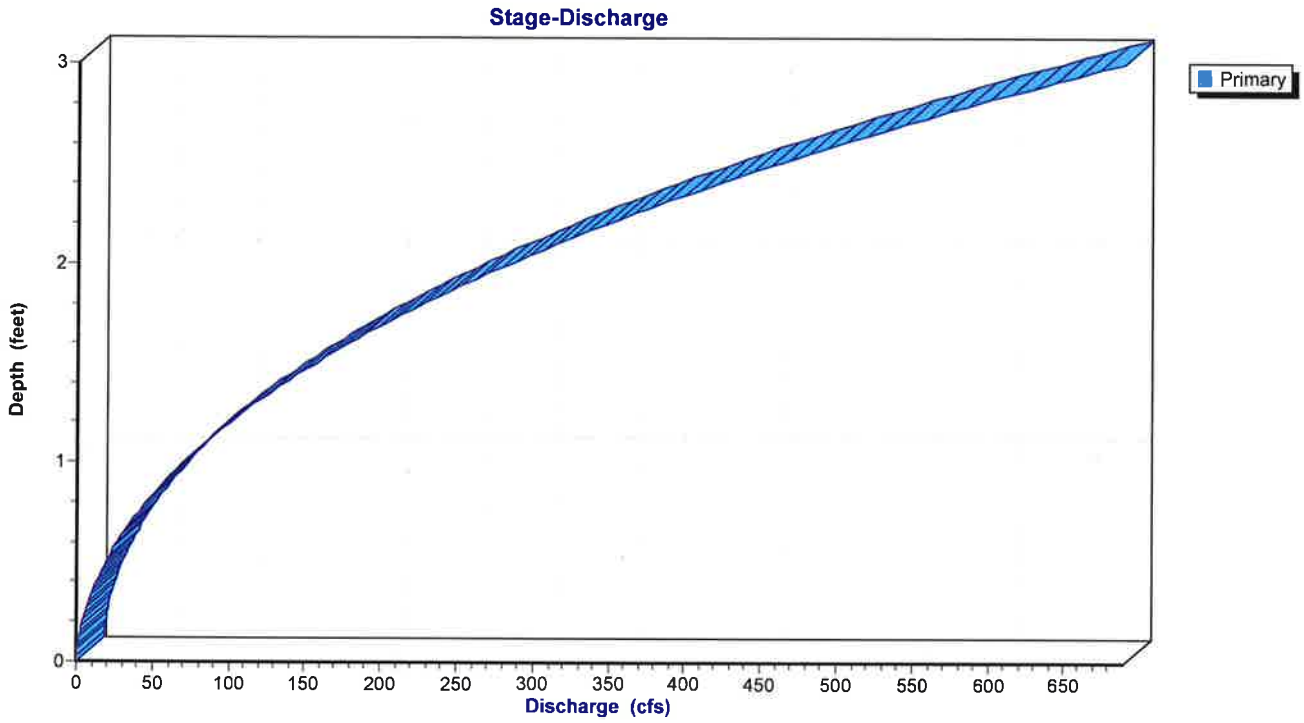
3.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 400.0' Slope= 0.0950 '/'
Inlet Invert= 709.00', Outlet Invert= 671.00'



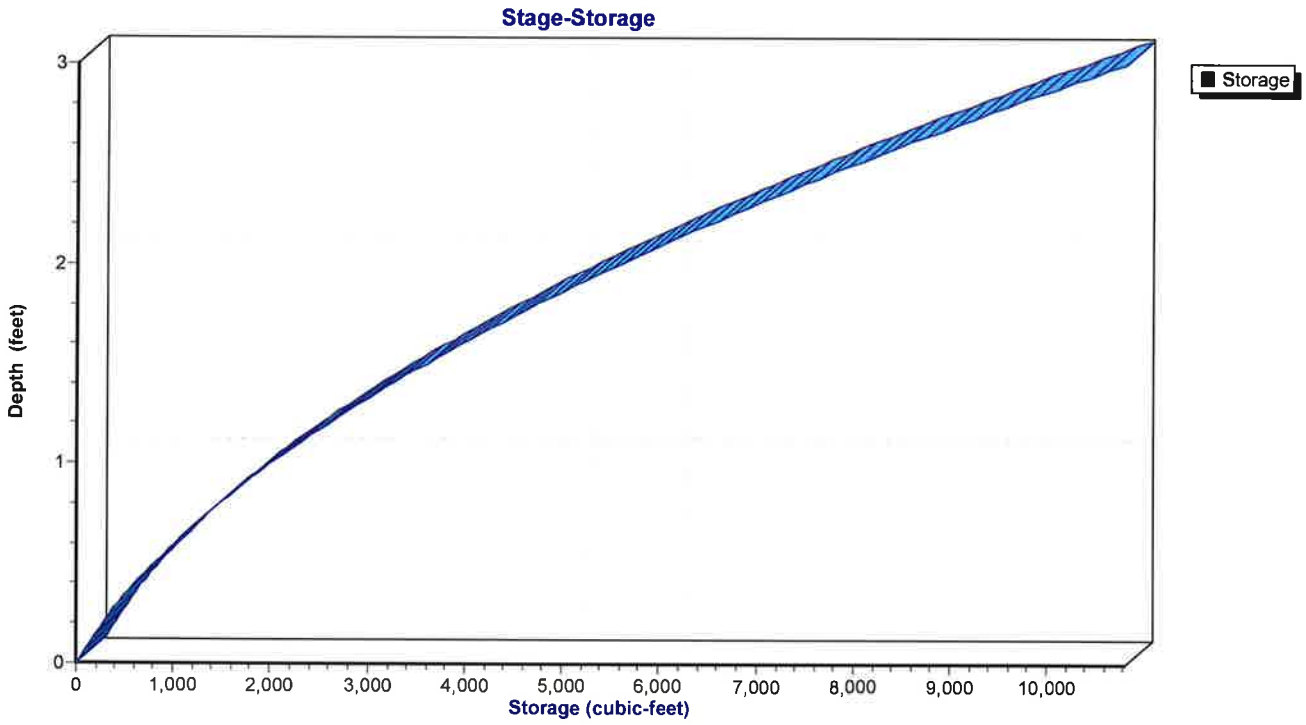
Reach 13R: NW to SE Channel



Reach 13R: NW to SE Channel



Reach 13R: NW to SE Channel



Summary for Pond 11P: Square Box

[57] Hint: Peaked at 717.68' (Flood elevation advised)
[62] Hint: Exceeded Reach 12R OUTLET depth by 2.02' @ 12.35 hrs

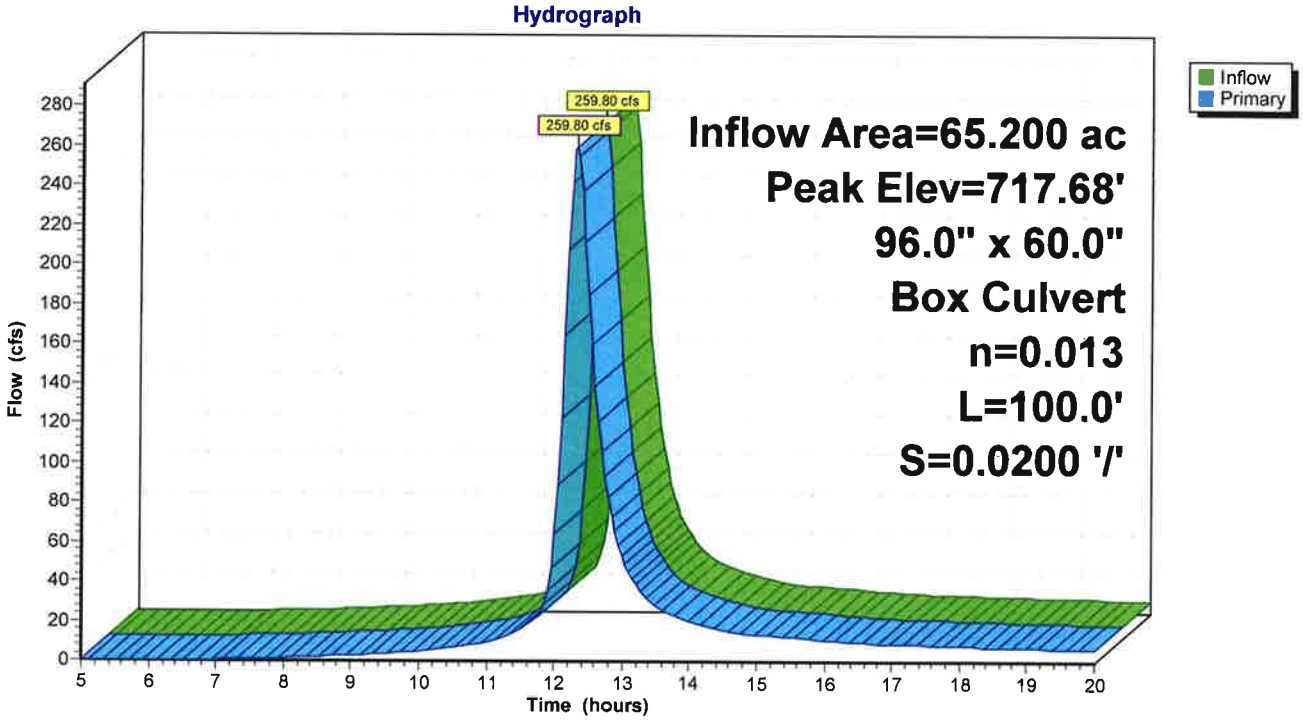
Inflow Area =	65.200 ac,	0.00% Impervious,	Inflow Depth >	4.13"	for 25-year event
Inflow =	259.80 cfs @	12.32 hrs,	Volume=	22.440 af	
Outflow =	259.80 cfs @	12.32 hrs,	Volume=	22.440 af,	Atten= 0%, Lag= 0.0 min
Primary =	259.80 cfs @	12.32 hrs,	Volume=	22.440 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 717.68' @ 12.32 hrs

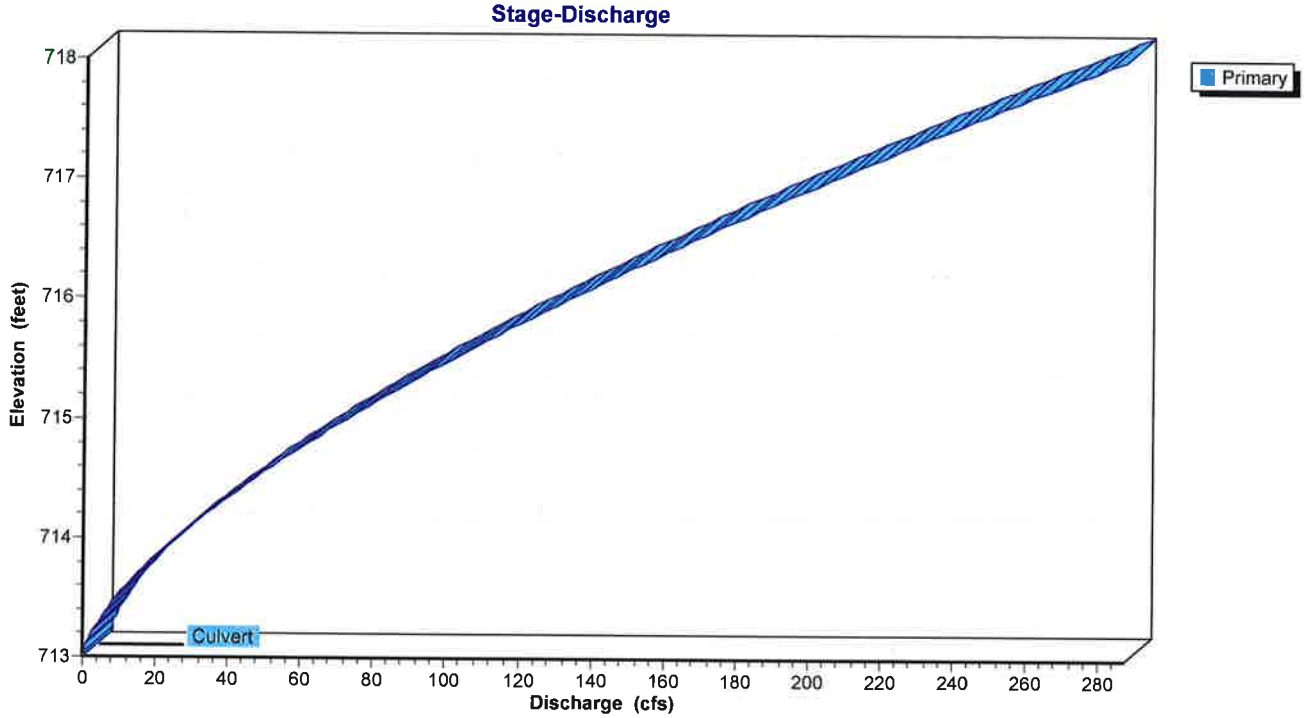
Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	**96.0" W x 60.0" H Box Culvert** L= 100.0' Box, 10-30° wingwalls, square crown, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 711.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete, trowel finish

Primary OutFlow Max=257.62 cfs @ 12.32 hrs HW=717.65' (Free Discharge)
└**1=Culvert** (Inlet Controls 257.62 cfs @ 6.92 fps)

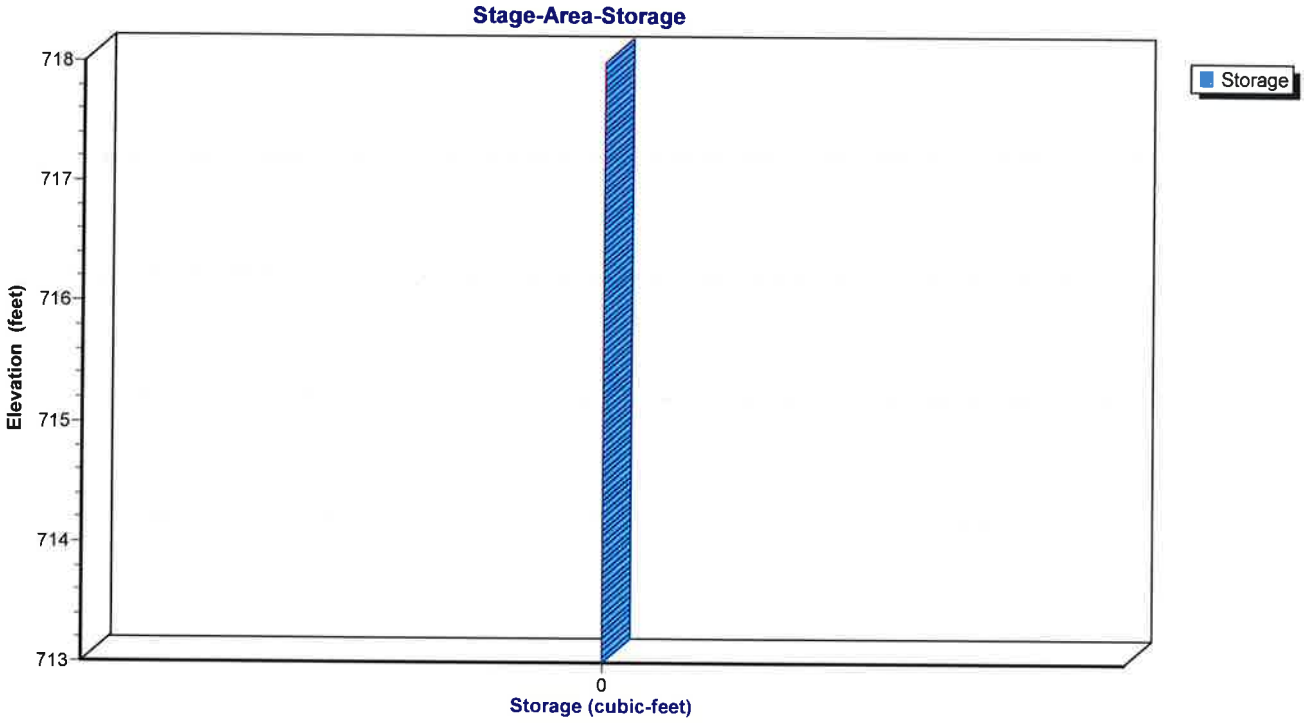
Pond 11P: Square Box



Pond 11P: Square Box



Pond 11P: Square Box



Summary for Pond 14P: Outlet Pipes

[57] Hint: Peaked at 668.02' (Flood elevation advised)

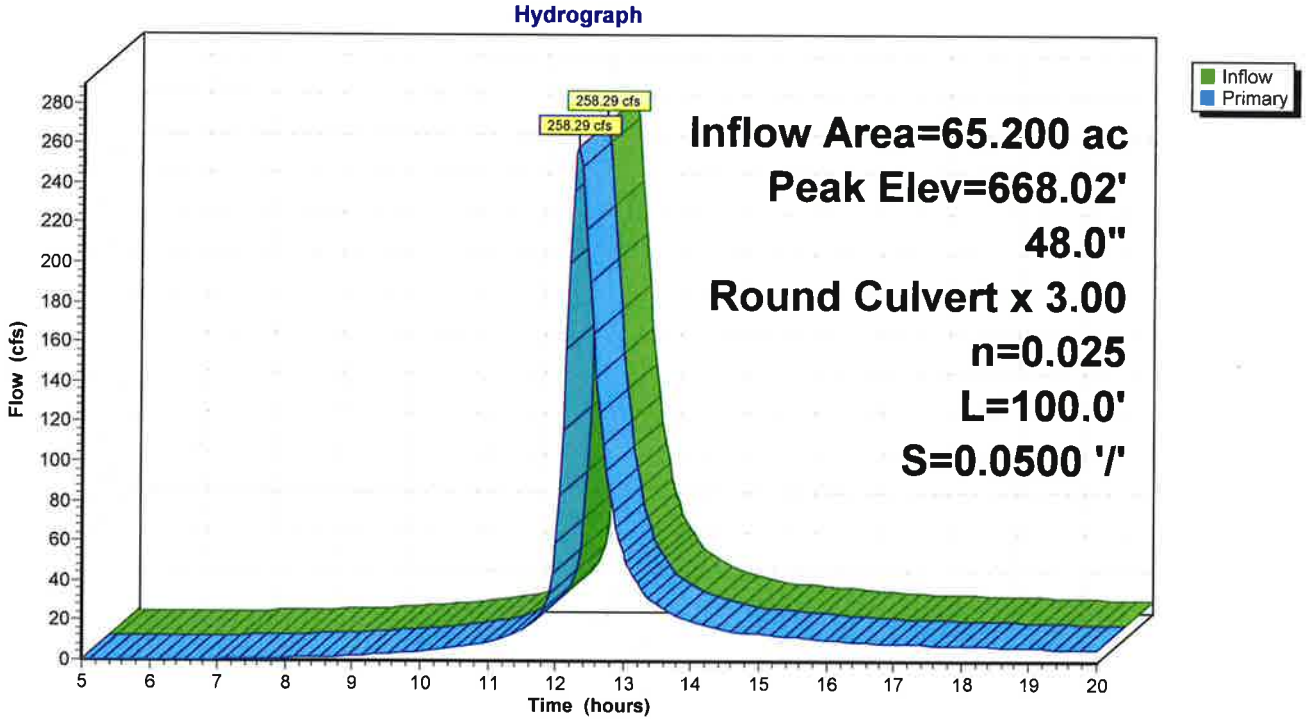
Inflow Area =	65.200 ac,	0.00% Impervious,	Inflow Depth >	4.13"	for 25-year event
Inflow =	258.29 cfs @	12.33 hrs,	Volume=	22.429 af	
Outflow =	258.29 cfs @	12.33 hrs,	Volume=	22.429 af,	Atten= 0%, Lag= 0.0 min
Primary =	258.29 cfs @	12.33 hrs,	Volume=	22.429 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 668.02' @ 12.33 hrs

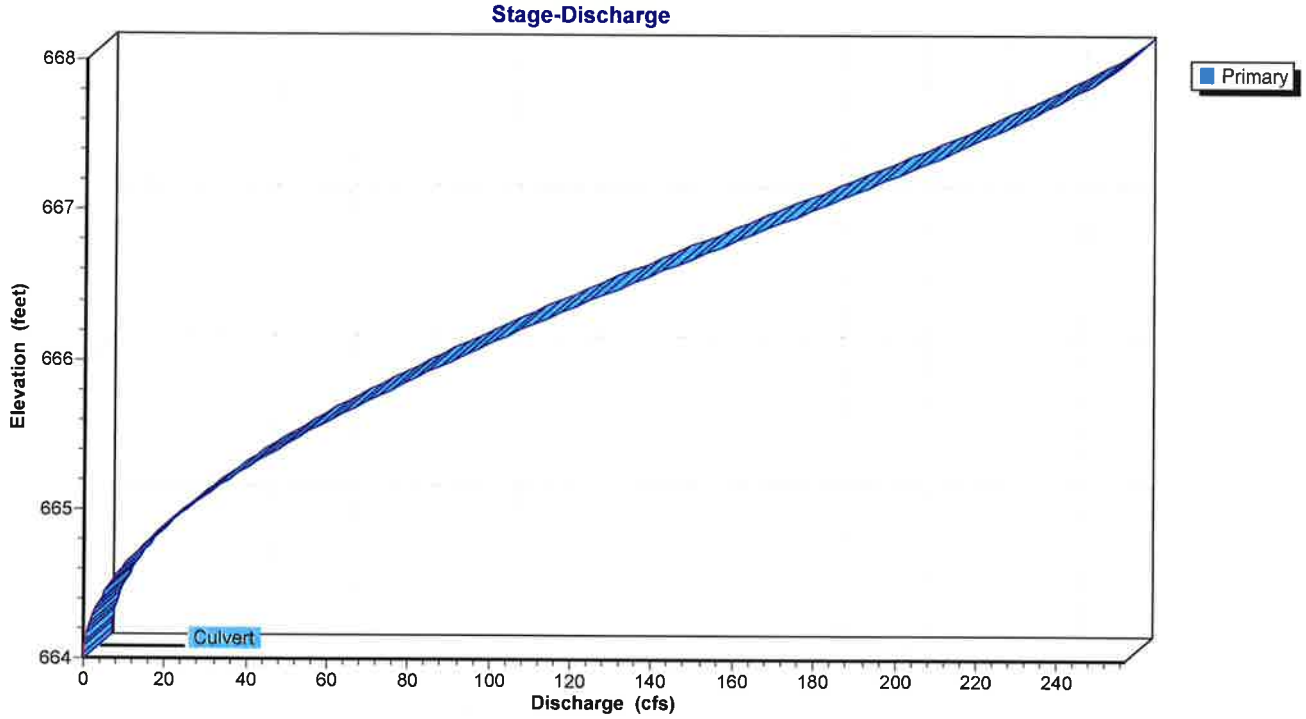
Device	Routing	Invert	Outlet Devices
#1	Primary	664.00'	**48.0" Round Culvert X 3.00** L= 100.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 664.00' / 659.00' S= 0.0500 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=256.39 cfs @ 12.33 hrs HW=667.99' (Free Discharge)
└**1=Culvert** (Inlet Controls 256.39 cfs @ 6.80 fps)

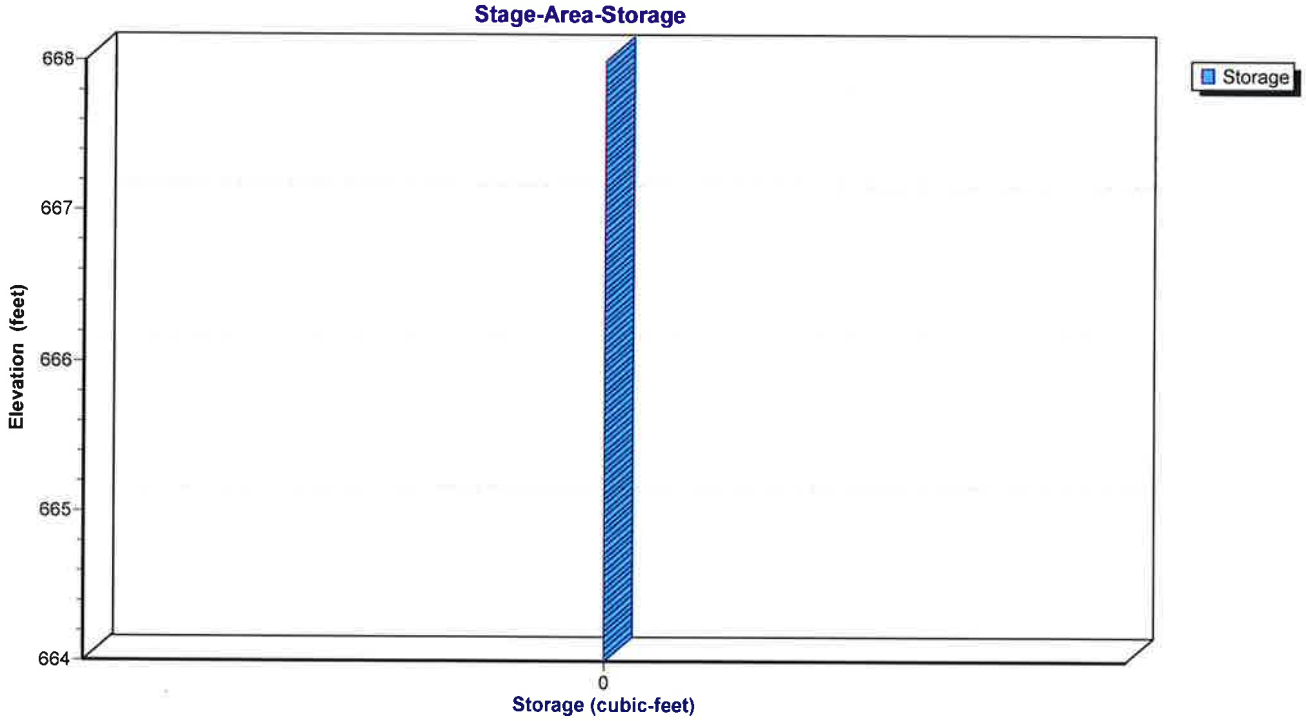
Pond 14P: Outlet Pipes

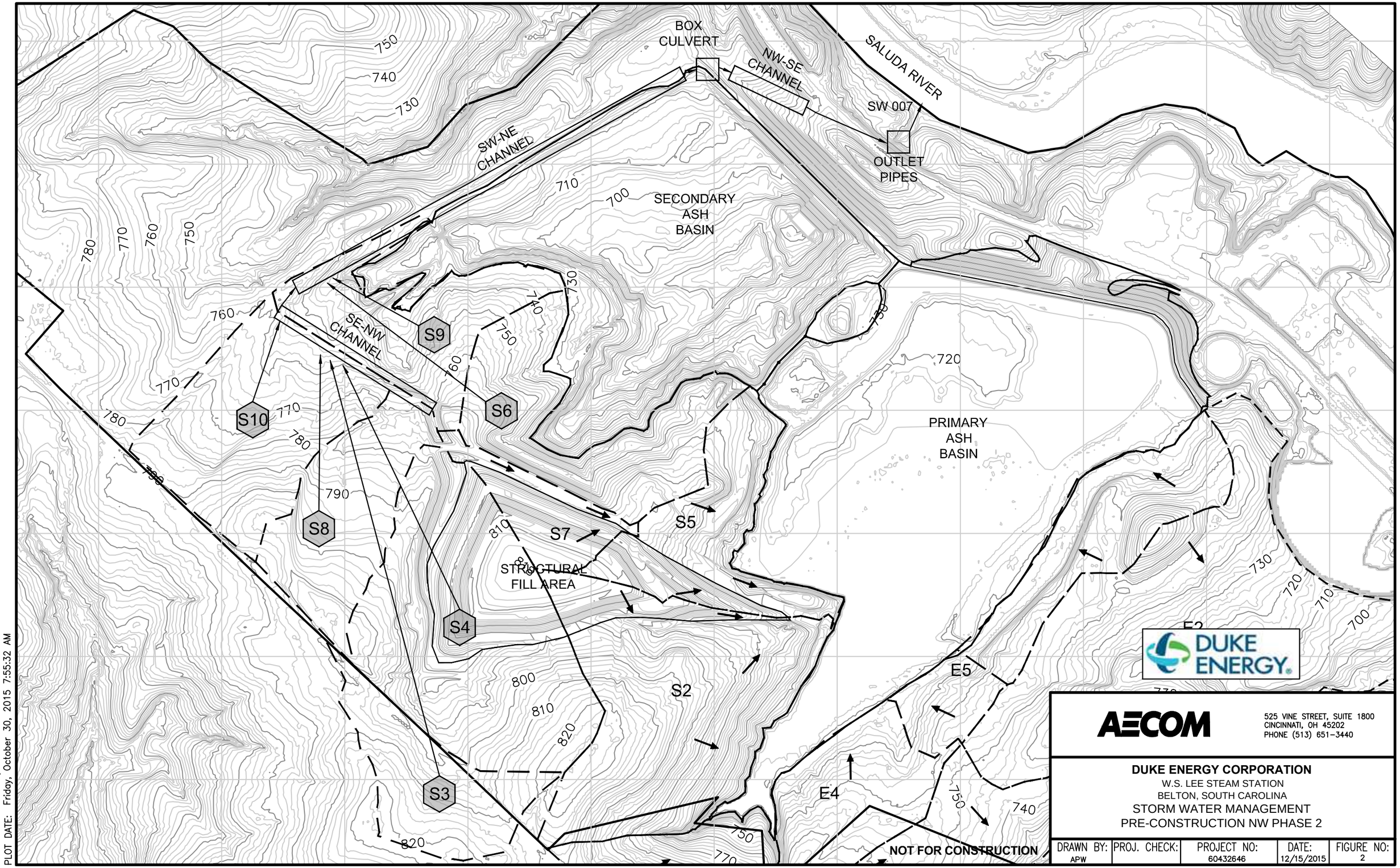


Pond 14P: Outlet Pipes



Pond 14P: Outlet Pipes





AECOM

525 VINE STREET, SUITE 1800
CINCINNATI, OH 45202
PHONE (513) 651-3440

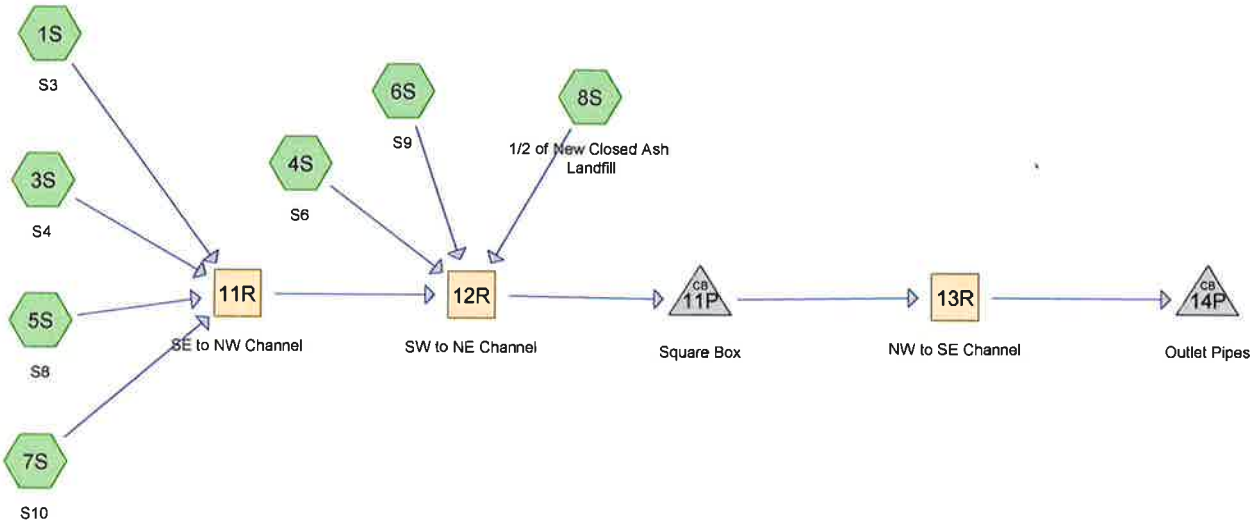
DUKE ENERGY CORPORATION
W.S. LEE STEAM STATION
BELTON, SOUTH CAROLINA
STORM WATER MANAGEMENT
PRE-CONSTRUCTION NW PHASE 2

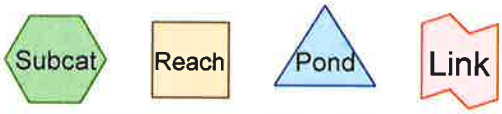
DRAWN BY:	PROJ. CHECK:	PROJECT NO:	DATE:	FIGURE NO:
APW		60432646	12/15/2015	2

PATH/FILENAME: J:\PROJECT\D\DUKE ENERGY\60432646 WS LEE STATION CLOSURE\DATA-TECH\DWG\CLOSURE PLAN SET - DUKE\AW FM 10.29.15 STORMWATER PRE_POST_DRAFT.DWG
LAST UPDATE: Friday, October 30, 2015 7:48:34 AM
PLOT DATE: Friday, October 30, 2015 7:55:32 AM

Attachment 4

Post-Construction NW – Calculations and Drainage Map





Drainage Diagram for Post-Construction NW - 2015-10-05
Prepared by URS Corporation, Printed 10/5/2015
HydroCAD® 9.10 s/n 06598 © 2011 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
76.200	80	>75% Grass cover, Good, HSG D (3S, 4S, 5S, 6S, 7S, 8S)
6.500	82	Woods/grass comb., Fair, HSG D (1S)
82.700	80	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
82.700	HSG D	1S, 3S, 4S, 5S, 6S, 7S, 8S
0.000	Other	
82.700		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Fill (inches)
1	11P	713.00	711.00	100.0	0.0200	0.013	96.0	60.0	0.0
2	14P	664.00	659.00	100.0	0.0500	0.025	48.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: S3 Runoff Area=6.500 ac 0.00% Impervious Runoff Depth>4.35"
Flow Length=640' Slope=0.0344 '/' Tc=21.4 min CN=82 Runoff=32.06 cfs 2.359 af

Subcatchment 3S: S4 Runoff Area=19.200 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,590' Slope=0.0377 '/' Tc=24.0 min CN=80 Runoff=84.97 cfs 6.622 af

Subcatchment 4S: S6 Runoff Area=10.000 ac 0.00% Impervious Runoff Depth>4.11"
Flow Length=2,085' Slope=0.0077 '/' Tc=43.7 min CN=80 Runoff=29.94 cfs 3.426 af

Subcatchment 5S: S8 Runoff Area=8.500 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,230' Slope=0.0455 '/' Tc=23.9 min CN=80 Runoff=37.70 cfs 2.932 af

Subcatchment 6S: S9 Runoff Area=8.700 ac 0.00% Impervious Runoff Depth>4.13"
Flow Length=2,785' Slope=0.0244 '/' Tc=30.1 min CN=80 Runoff=33.45 cfs 2.995 af

Subcatchment 7S: S10 Runoff Area=12.300 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,055' Slope=0.0550 '/' Tc=20.2 min CN=80 Runoff=59.95 cfs 4.248 af

Subcatchment 8S: 1/2 of New Closed Ash Runoff Area=17.500 ac 0.00% Impervious Runoff Depth>4.16"
Flow Length=1,500' Slope=0.2500 '/' Tc=11.3 min CN=80 Runoff=111.32 cfs 6.060 af

Reach 11R: SE to NW Channel Avg. Flow Depth=2.91' Max Vel=8.13 fps Inflow=213.16 cfs 16.161 af
n=0.025 L=1,100.0' S=0.0100 '/' Capacity=223.61 cfs Outflow=208.29 cfs 16.111 af

Reach 12R: SW to NE Channel Avg. Flow Depth=2.90' Max Vel=11.76 fps Inflow=302.80 cfs 28.592 af
n=0.025 L=2,000.0' S=0.0210 '/' Capacity=324.05 cfs Outflow=299.42 cfs 28.484 af

Reach 13R: NW to SE Channel Avg. Flow Depth=2.05' Max Vel=20.61 fps Inflow=299.42 cfs 28.484 af
n=0.025 L=400.0' S=0.0950 '/' Capacity=689.23 cfs Outflow=299.01 cfs 28.471 af

Pond 11P: Square Box Peak Elev=718.16' Inflow=299.42 cfs 28.484 af
96.0" x 60.0" Box Culvert n=0.013 L=100.0' S=0.0200 '/' Outflow=299.42 cfs 28.484 af

Pond 14P: Outlet Pipes Peak Elev=668.71' Inflow=299.01 cfs 28.471 af
48.0" Round Culvert x 3.00 n=0.025 L=100.0' S=0.0500 '/' Outflow=299.01 cfs 28.471 af

Total Runoff Area = 82.700 ac Runoff Volume = 28.642 af Average Runoff Depth = 4.16"
100.00% Pervious = 82.700 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: S3

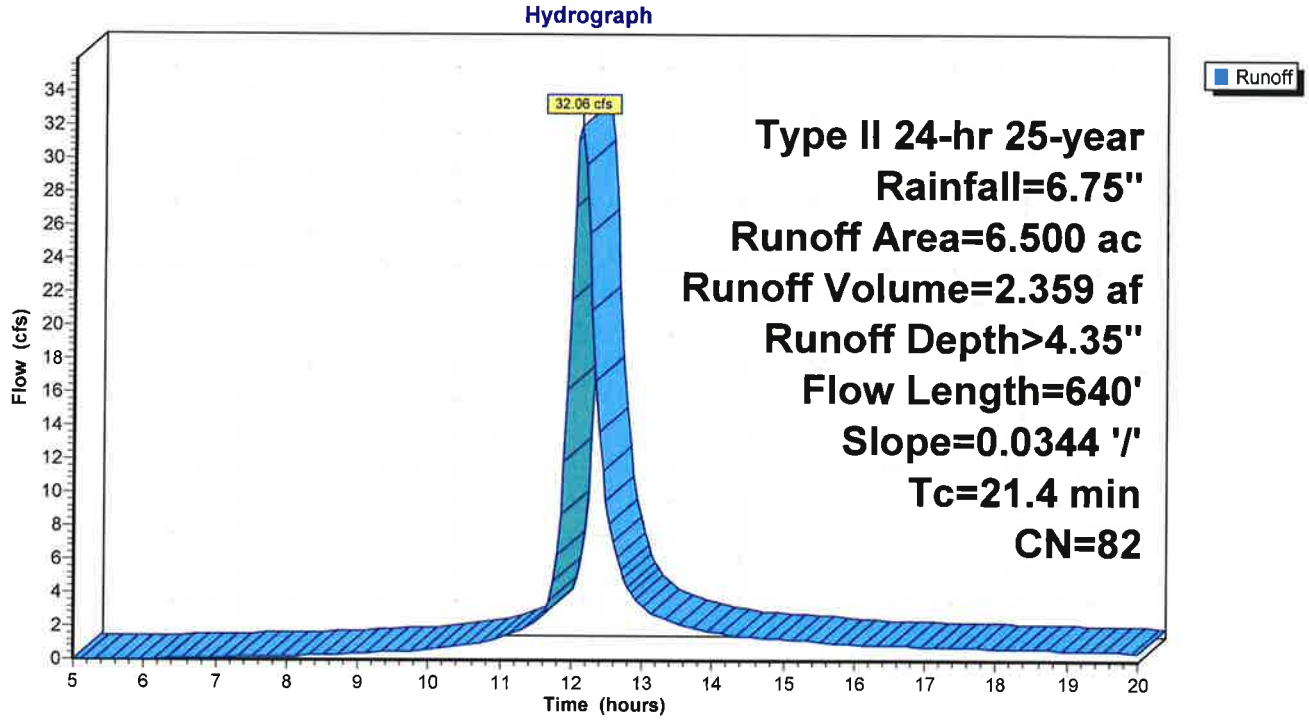
Runoff = 32.06 cfs @ 12.14 hrs, Volume= 2.359 af, Depth> 4.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
6.500	82	Woods/grass comb., Fair, HSG D
6.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	300	0.0344	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
4.4	340	0.0344	1.30		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
21.4	640	Total			

Subcatchment 1S: S3



Summary for Subcatchment 3S: S4

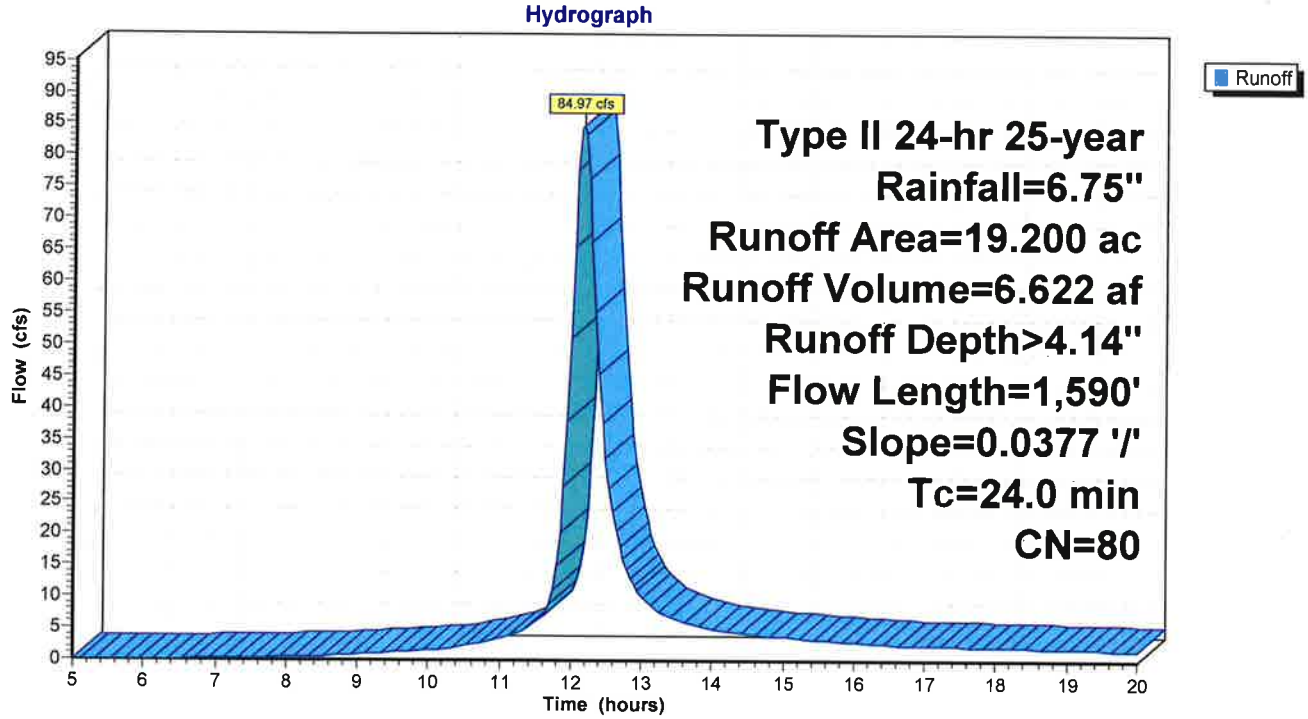
Runoff = 84.97 cfs @ 12.17 hrs, Volume= 6.622 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
19.200	80	>75% Grass cover, Good, HSG D
19.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	300	0.0377	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
6.0	490	0.0377	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	800	0.0377	8.42	46.32	**Trap/Vee/Rect Channel Flow,** Bot.W=2.50' D=1.00' Z= 3.0 '/' Top.W=8.50' n= 0.025 Earth, clean & straight
24.0	1,590	Total			

Subcatchment 3S: S4



Summary for Subcatchment 4S: S6

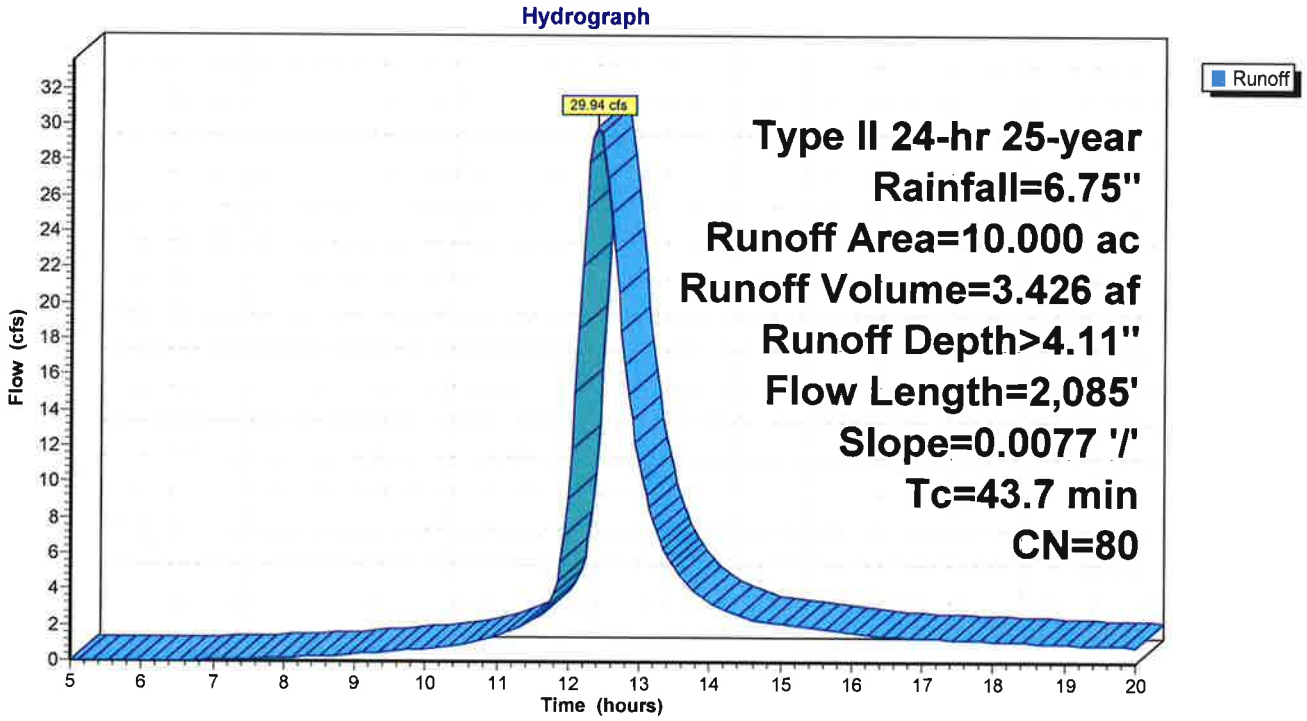
Runoff = 29.94 cfs @ 12.41 hrs, Volume= 3.426 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
10.000	80	>75% Grass cover, Good, HSG D
10.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.9	300	0.0077	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
5.8	215	0.0077	0.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.0	1,570	0.0077	3.71	18.57	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=1.00' Z= 3.0 '/' Top.W=8.00' n= 0.025 Earth, clean & straight
43.7	2,085	Total			

Subcatchment 4S: S6



Summary for Subcatchment 5S: S8

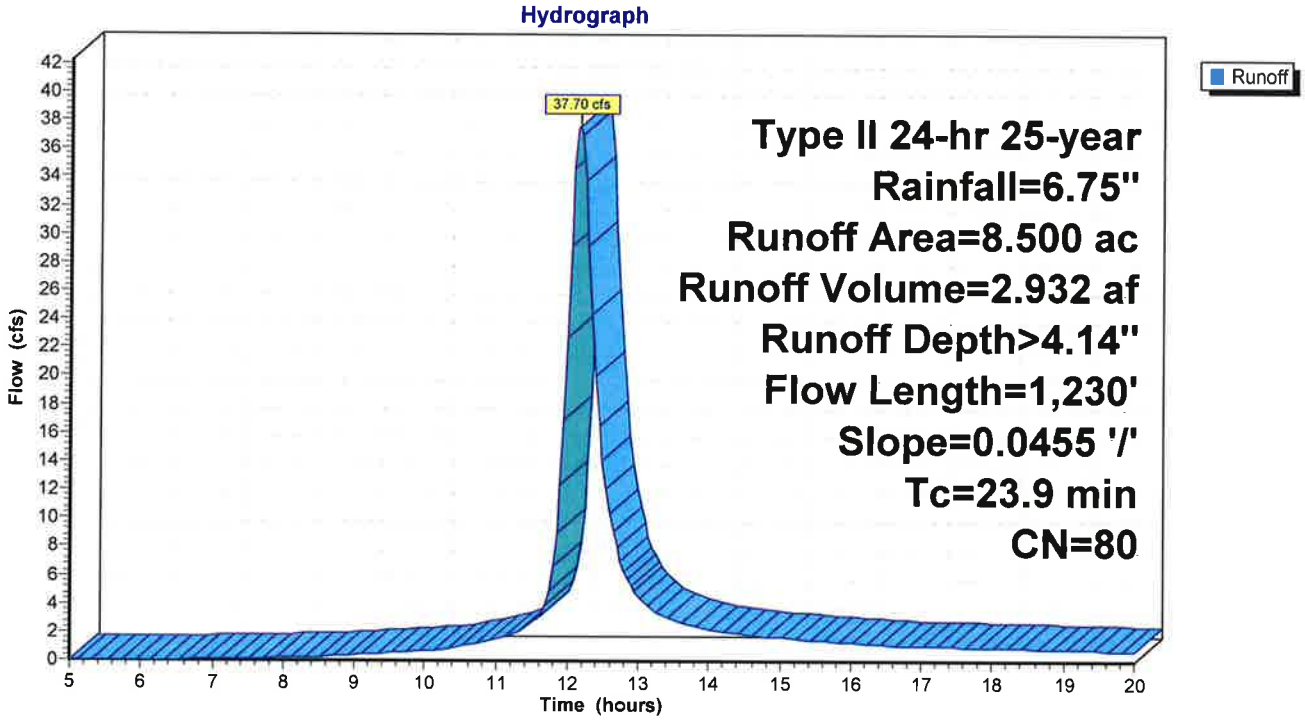
Runoff = 37.70 cfs @ 12.17 hrs, Volume= 2.932 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.500	80	>75% Grass cover, Good, HSG D
8.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	300	0.0455	0.33		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
8.4	750	0.0455	1.49		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	180	0.0455	8.77	39.46	**Trap/Vee/Rect Channel Flow,** Bot.W=1.50' D=1.00' Z= 3.0 '/' Top.W=7.50' n= 0.025 Earth, clean & straight
23.9	1,230	Total			

Subcatchment 5S: S8



Summary for Subcatchment 6S: S9

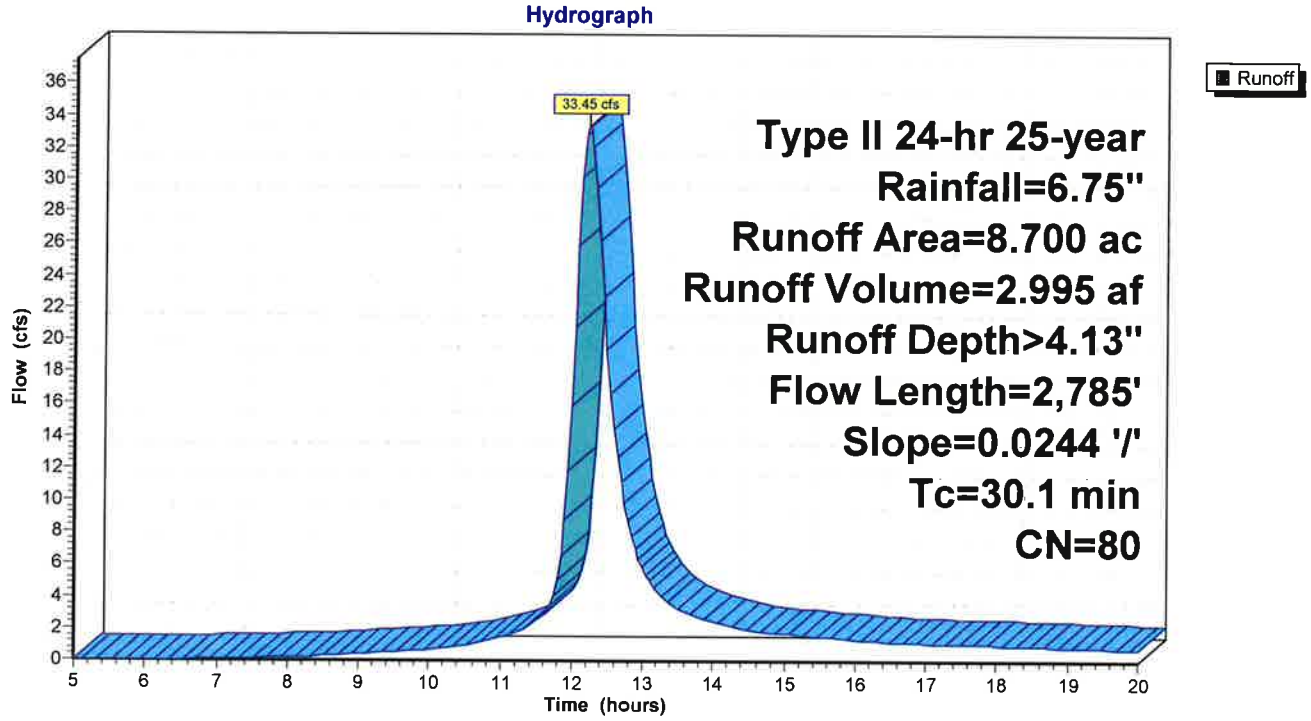
Runoff = 33.45 cfs @ 12.24 hrs, Volume= 2.995 af, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.700	80	>75% Grass cover, Good, HSG D
8.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	300	0.0244	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
4.0	260	0.0244	1.09		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.6	2,225	0.0244	5.63	17.96	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=0.75' Z= 3.0 '/' Top.W=6.50' n= 0.025 Earth, clean & straight
30.1	2,785	Total			

Subcatchment 6S: S9



Summary for Subcatchment 7S: S10

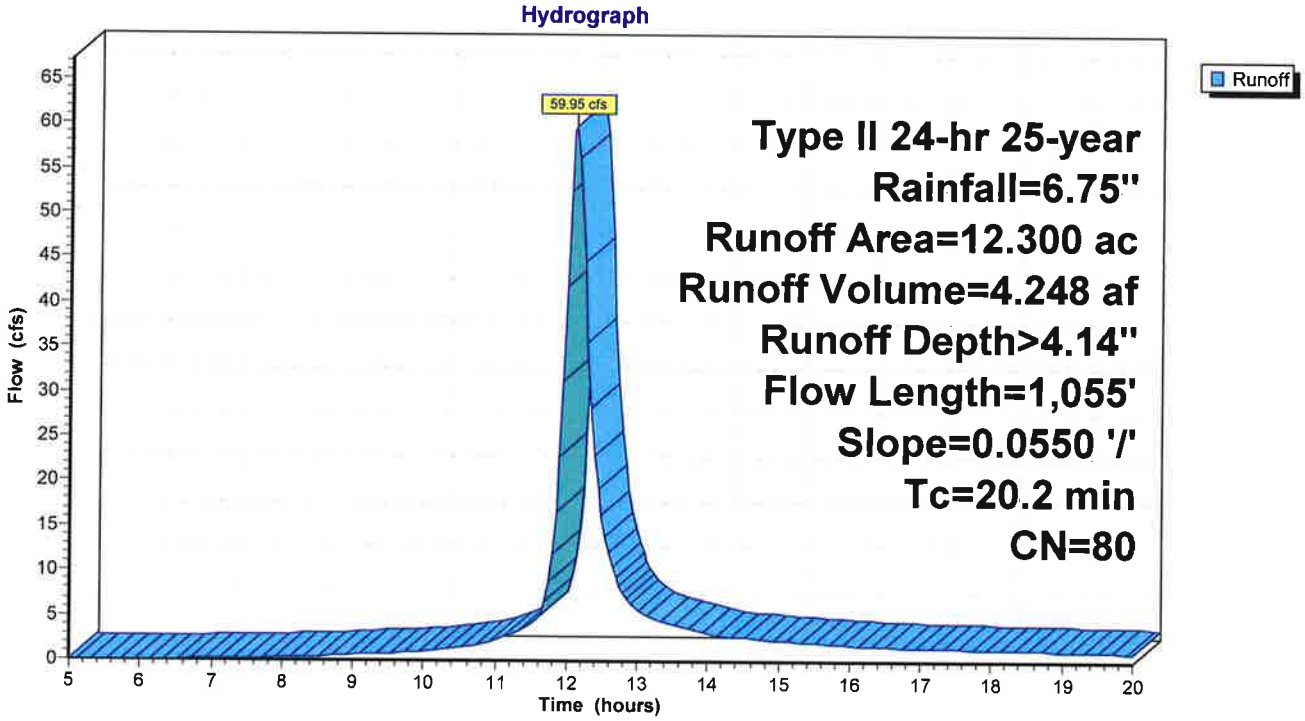
Runoff = 59.95 cfs @ 12.13 hrs, Volume= 4.248 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
12.300	80	>75% Grass cover, Good, HSG D
12.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.1	300	0.0550	0.36		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
5.7	560	0.0550	1.64		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	195	0.0550	8.69	30.94	**Trap/Vee/Rect Channel Flow,** Bot.W=2.50' D=0.75' Z= 3.0 '/' Top.W=7.00' n= 0.025 Earth, clean & straight
20.2	1,055	Total			

Subcatchment 7S: S10



Summary for Subcatchment 8S: 1/2 of New Closed Ash Landfill

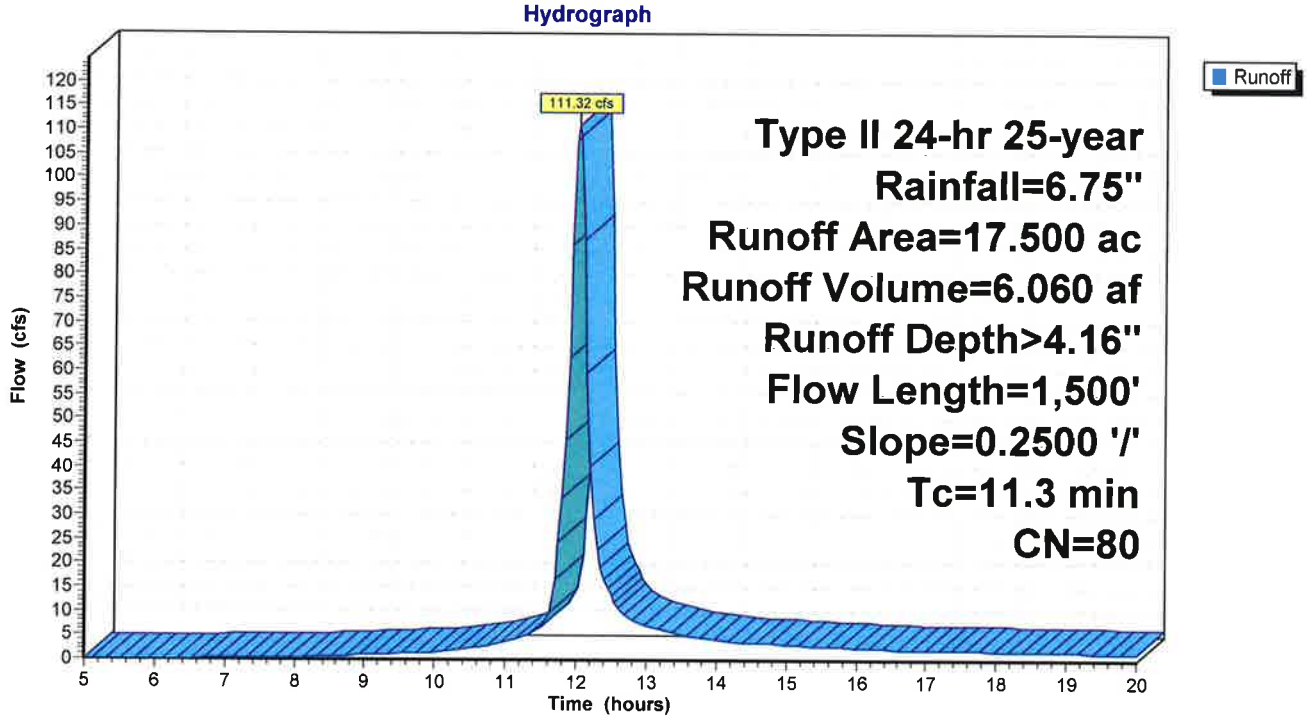
Runoff = 111.32 cfs @ 12.03 hrs, Volume= 6.060 af, Depth> 4.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
17.500	80	>75% Grass cover, Good, HSG D
17.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	300	0.2500	0.65		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
3.3	700	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	500	0.2500	27.72	311.89	**Trap/Vee/Rect Channel Flow,** Bot.W=3.00' D=1.50' Z= 3.0 '/' Top.W=12.00' n= 0.025 Earth, clean & straight
11.3	1,500	Total			

Subcatchment 8S: 1/2 of New Closed Ash Landfill



Summary for Reach 11R: SE to NW Channel

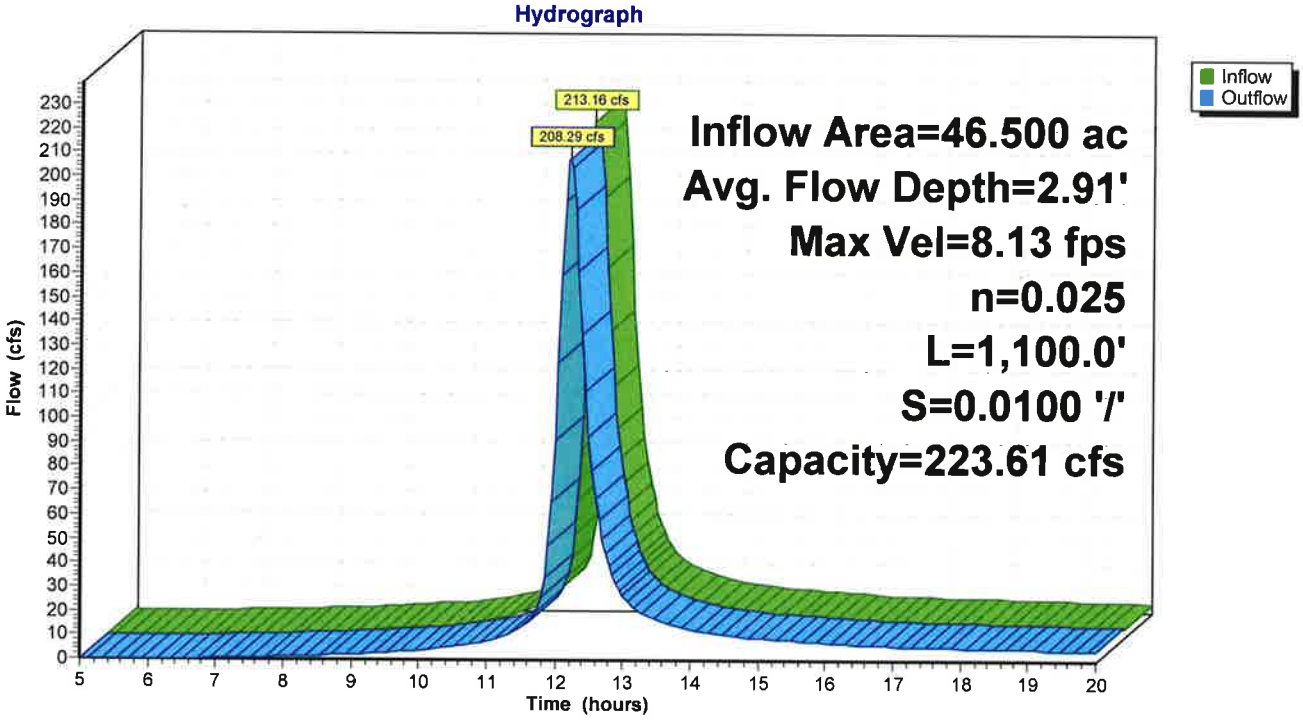
Inflow Area = 46.500 ac, 0.00% Impervious, Inflow Depth > 4.17" for 25-year event
Inflow = 213.16 cfs @ 12.15 hrs, Volume= 16.161 af
Outflow = 208.29 cfs @ 12.22 hrs, Volume= 16.111 af, Atten= 2%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.13 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 3.03 fps, Avg. Travel Time= 6.0 min

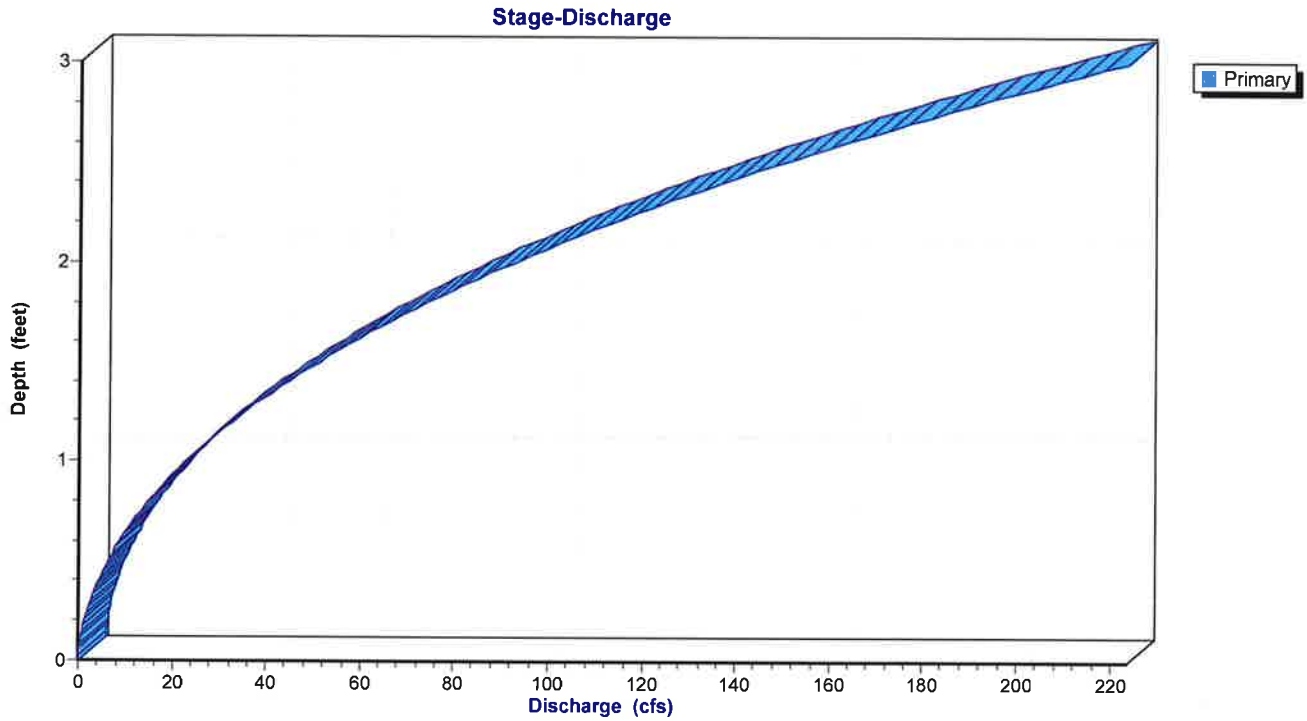
Peak Storage= 28,306 cf @ 12.18 hrs
Average Depth at Peak Storage= 2.91'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 223.61 cfs

3.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 1,100.0' Slope= 0.0100 '/'
Inlet Invert= 766.00', Outlet Invert= 755.00'

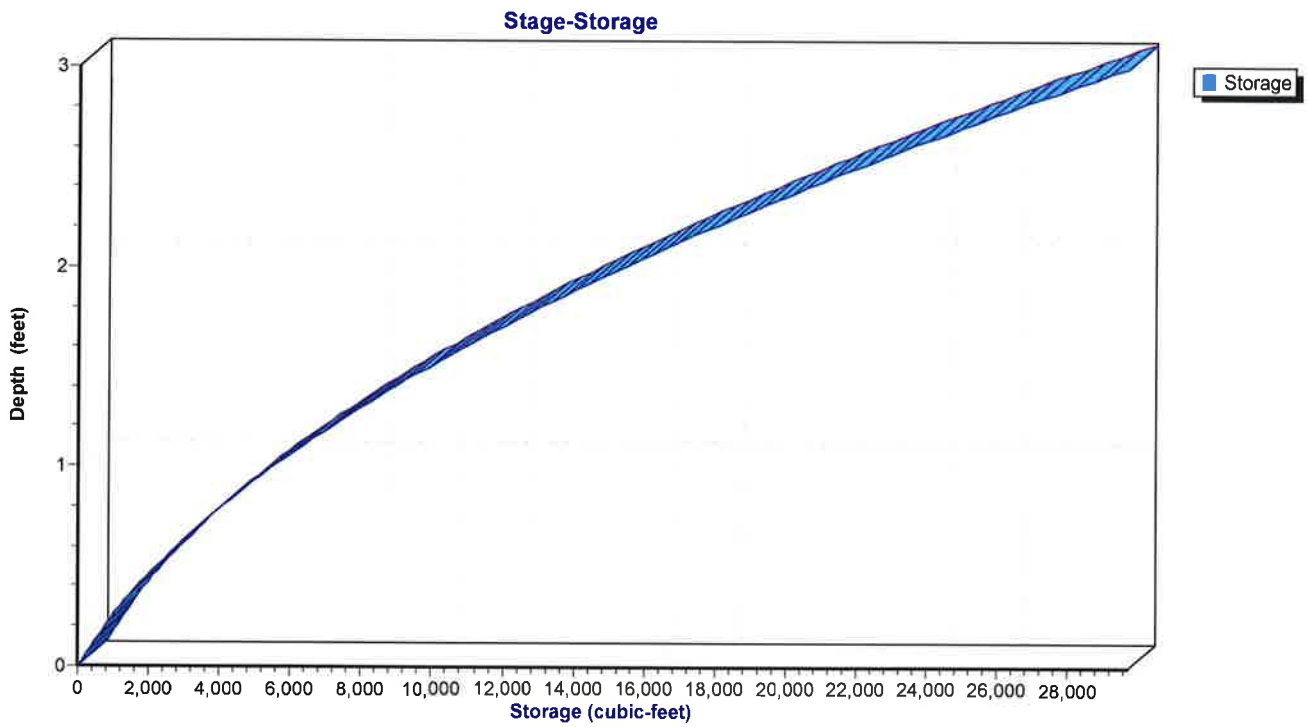
Reach 11R: SE to NW Channel



Reach 11R: SE to NW Channel



Reach 11R: SE to NW Channel



Summary for Reach 12R: SW to NE Channel

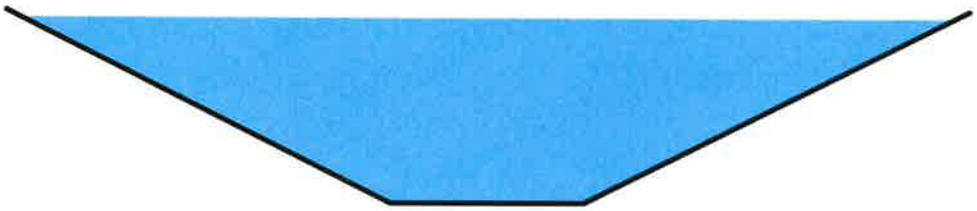
[62] Hint: Exceeded Reach 11R OUTLET depth by 0.38' @ 12.50 hrs

Inflow Area = 82.700 ac, 0.00% Impervious, Inflow Depth > 4.15" for 25-year event
Inflow = 302.80 cfs @ 12.19 hrs, Volume= 28.592 af
Outflow = 299.42 cfs @ 12.27 hrs, Volume= 28.484 af, Atten= 1%, Lag= 4.8 min

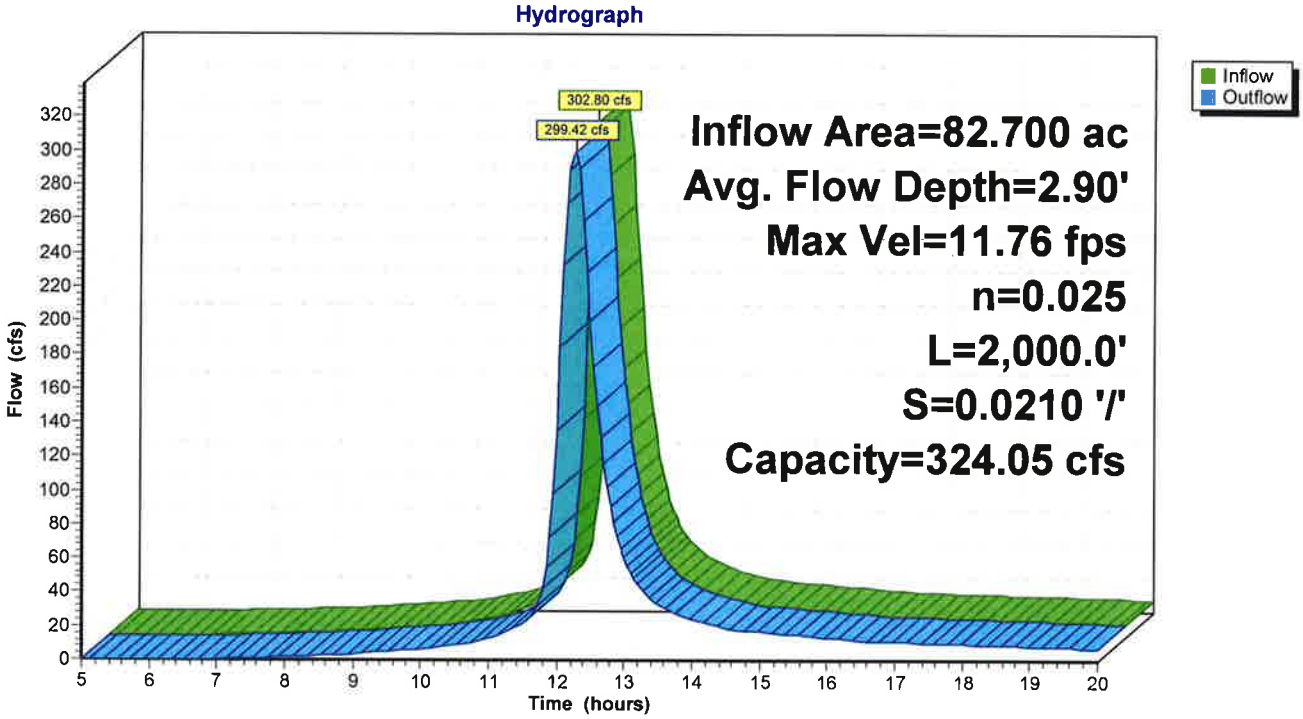
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.76 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 4.70 fps, Avg. Travel Time= 7.1 min

Peak Storage= 50,945 cf @ 12.22 hrs
Average Depth at Peak Storage= 2.90'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 324.05 cfs

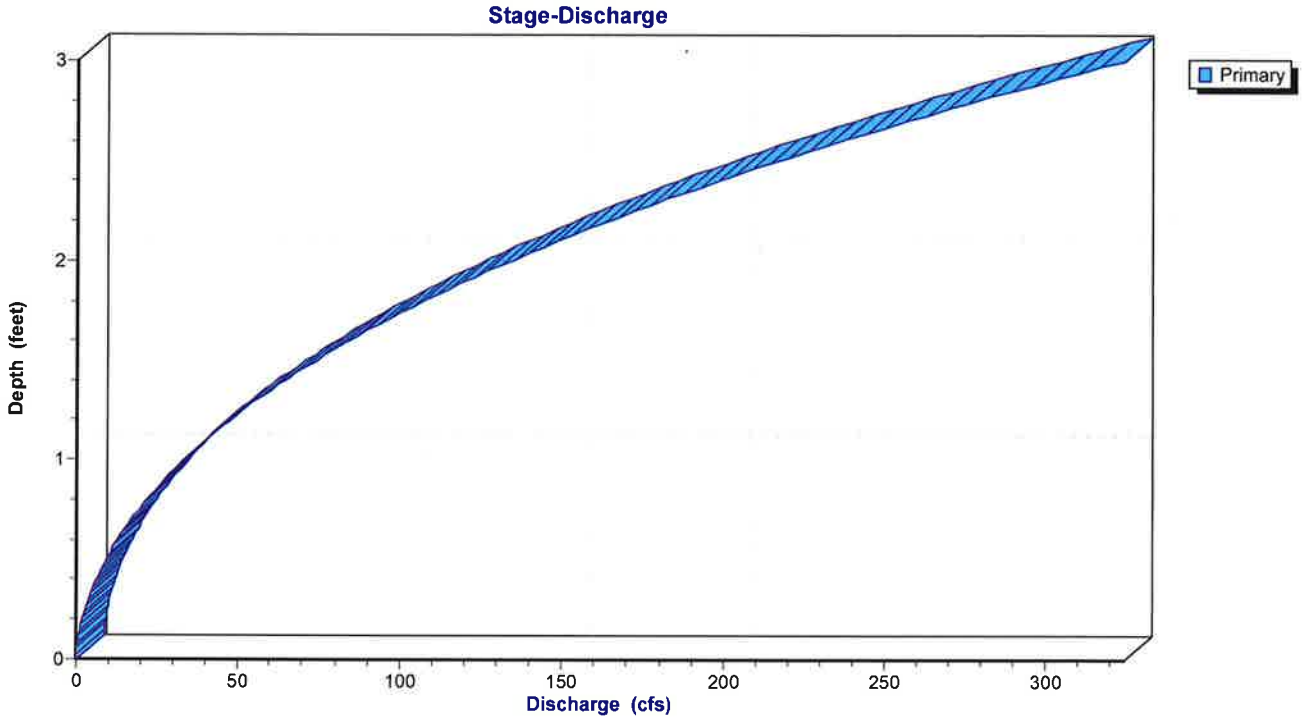
3.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 2,000.0' Slope= 0.0210 '/'
Inlet Invert= 755.00', Outlet Invert= 713.00'



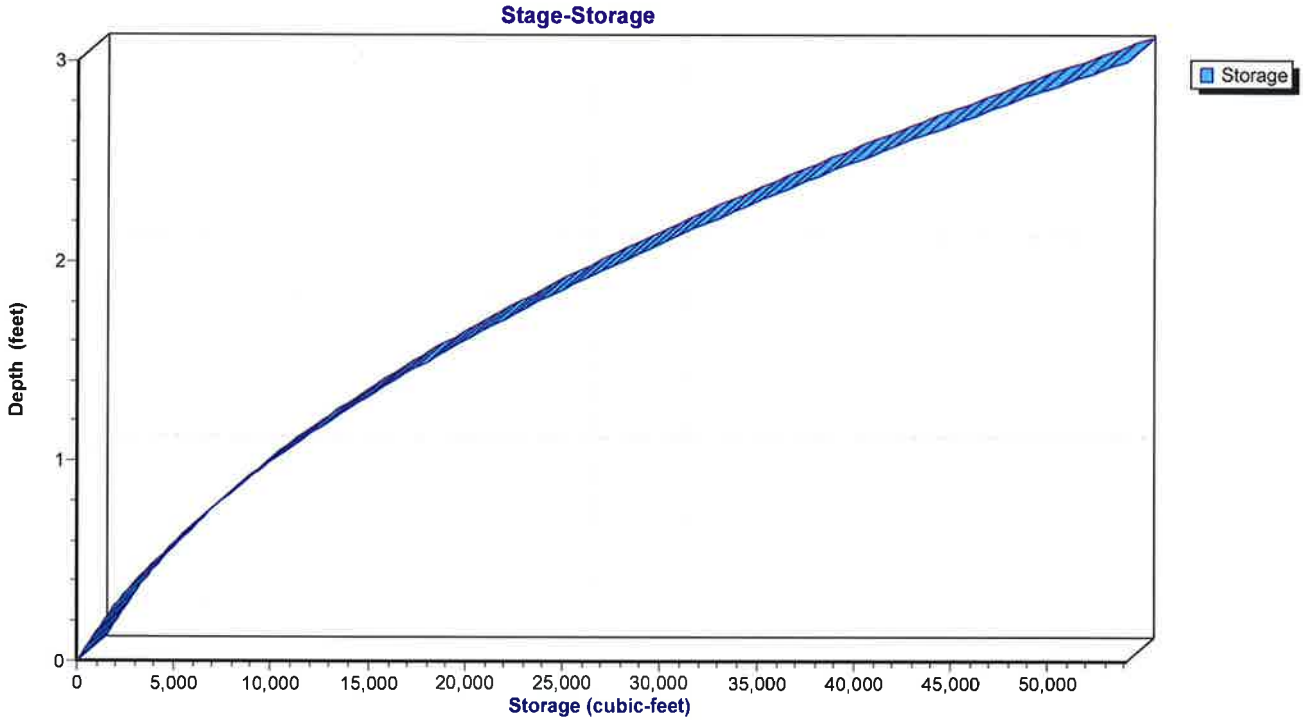
Reach 12R: SW to NE Channel



Reach 12R: SW to NE Channel



Reach 12R: SW to NE Channel



Summary for Reach 13R: NW to SE Channel

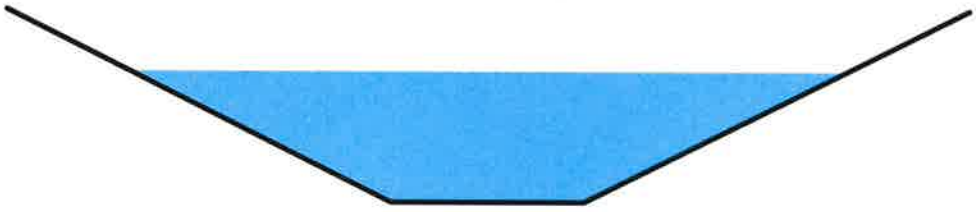
[79] Warning: Submerged Pond 11P Primary device # 1 OUTLET by 0.04'

Inflow Area = 82.700 ac, 0.00% Impervious, Inflow Depth > 4.13" for 25-year event
Inflow = 299.42 cfs @ 12.27 hrs, Volume= 28.484 af
Outflow = 299.01 cfs @ 12.28 hrs, Volume= 28.471 af, Atten= 0%, Lag= 0.6 min

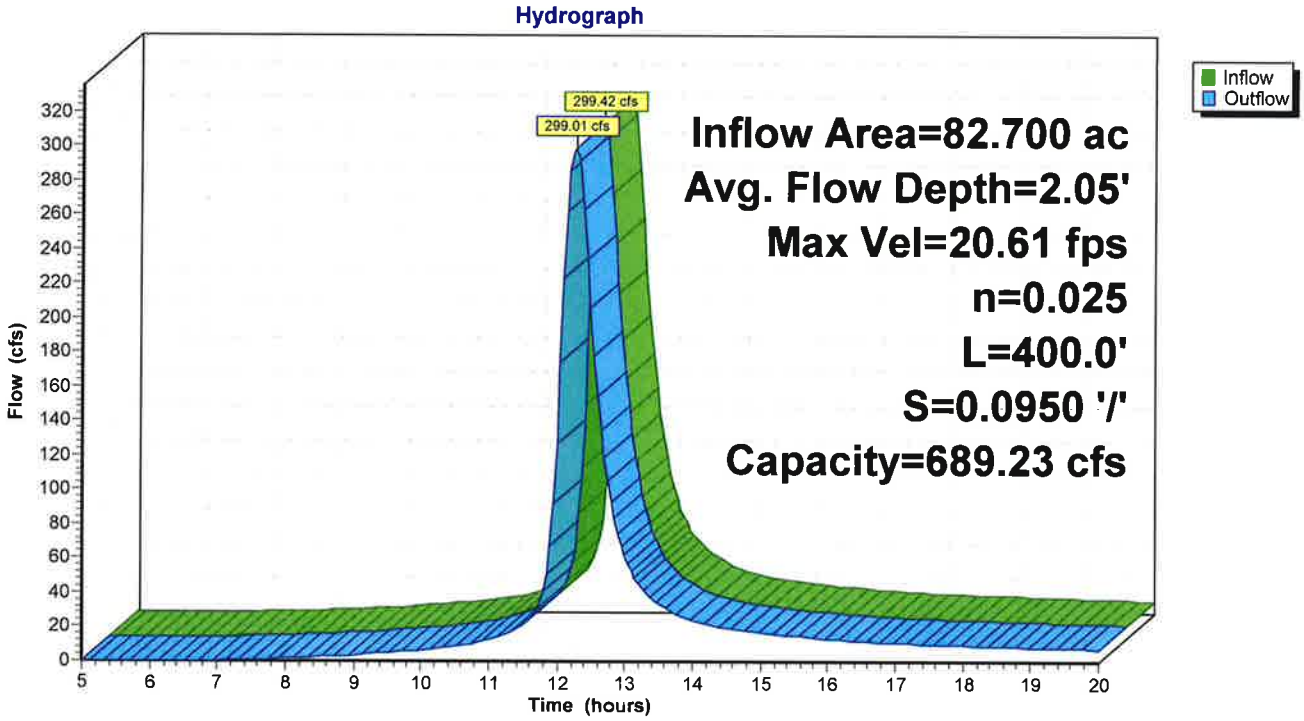
Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 20.61 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 8.03 fps, Avg. Travel Time= 0.8 min

Peak Storage= 5,806 cf @ 12.27 hrs
Average Depth at Peak Storage= 2.05'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 689.23 cfs

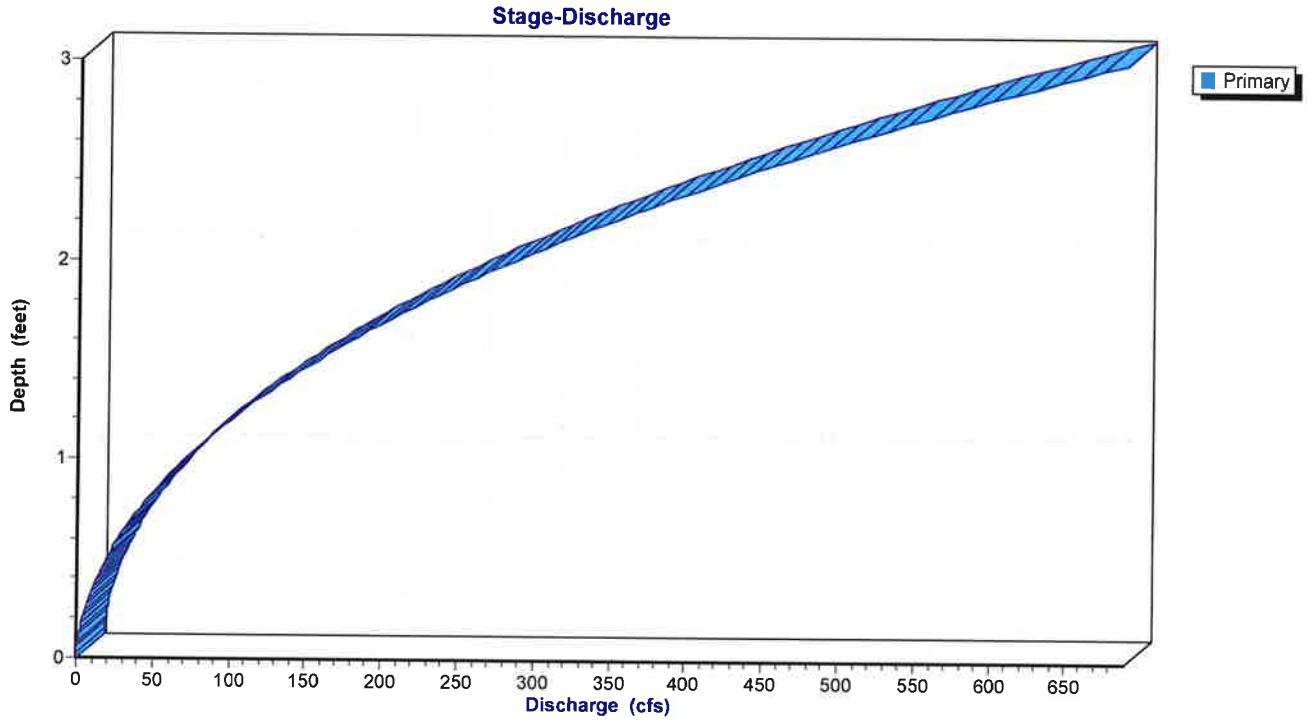
3.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 15.00'
Length= 400.0' Slope= 0.0950 '/'
Inlet Invert= 709.00', Outlet Invert= 671.00'



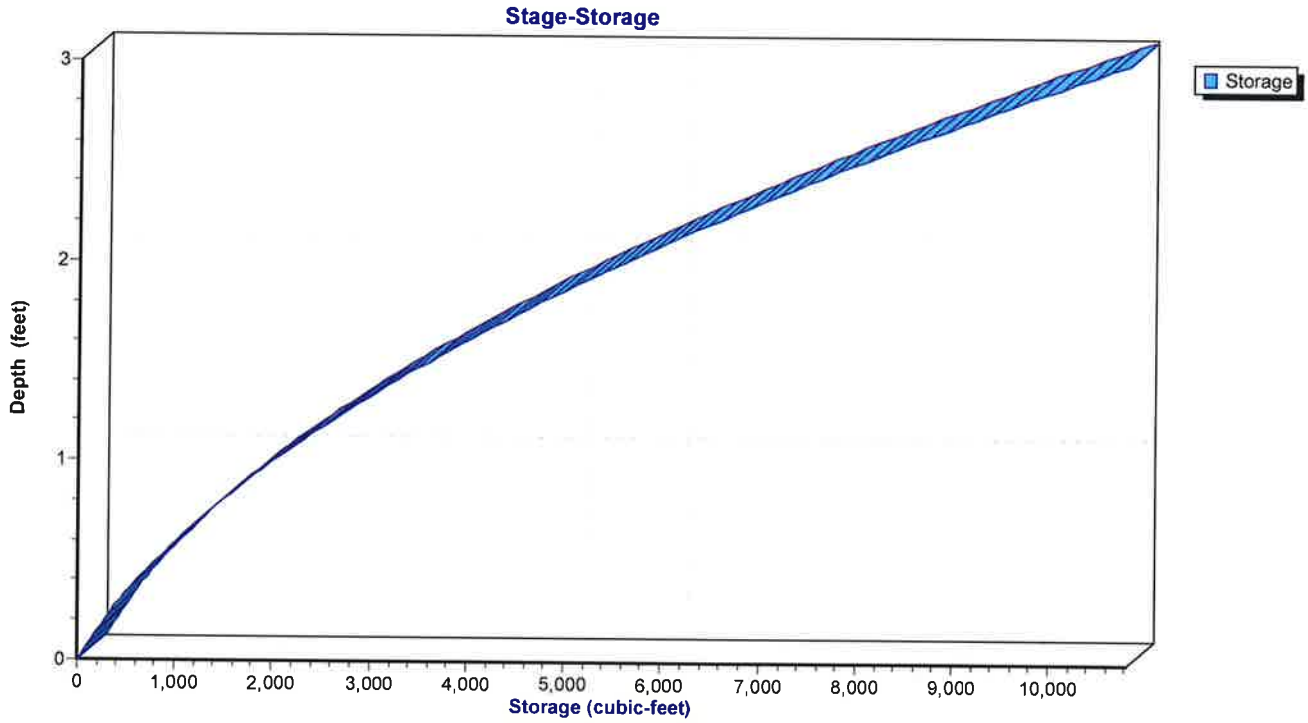
Reach 13R: NW to SE Channel



Reach 13R: NW to SE Channel



Reach 13R: NW to SE Channel



Summary for Pond 11P: Square Box

[57] Hint: Peaked at 718.16' (Flood elevation advised)
[62] Hint: Exceeded Reach 12R OUTLET depth by 2.30' @ 12.30 hrs

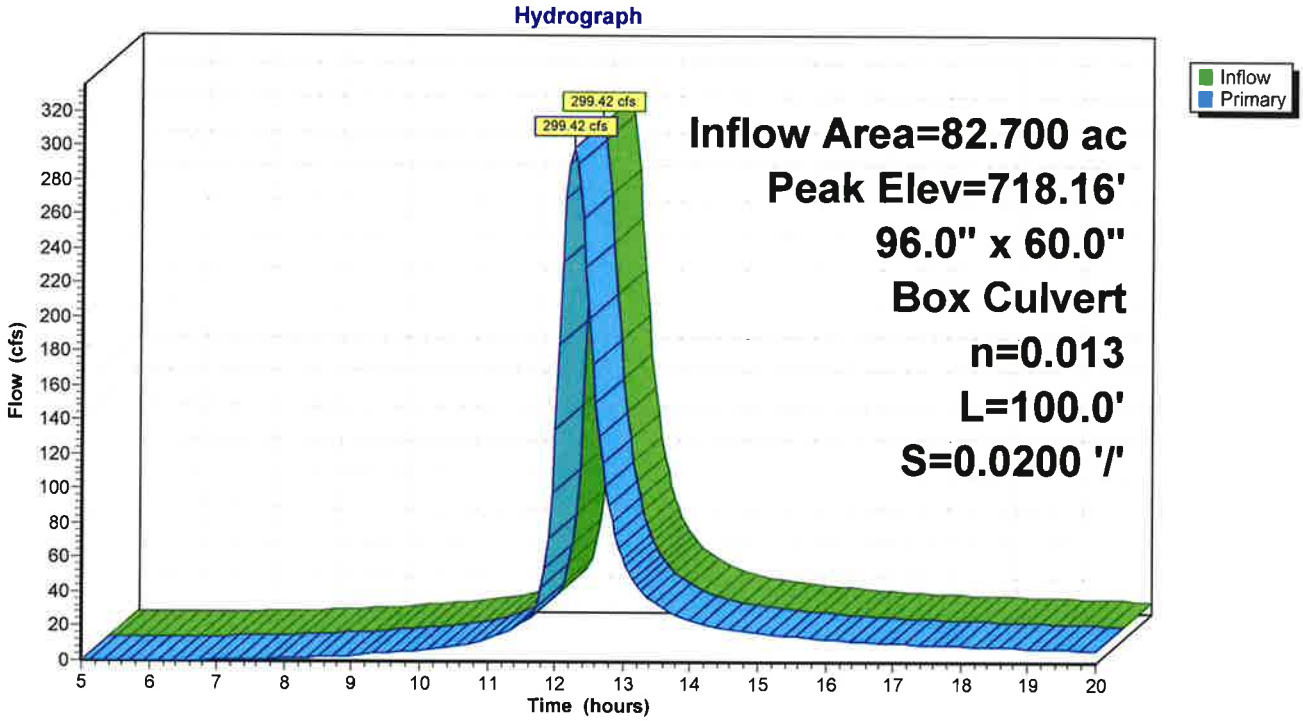
Inflow Area =	82.700 ac,	0.00% Impervious,	Inflow Depth >	4.13"	for 25-year event
Inflow =	299.42 cfs @	12.27 hrs,	Volume=	28.484 af	
Outflow =	299.42 cfs @	12.27 hrs,	Volume=	28.484 af,	Atten= 0%, Lag= 0.0 min
Primary =	299.42 cfs @	12.27 hrs,	Volume=	28.484 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 718.16' @ 12.27 hrs

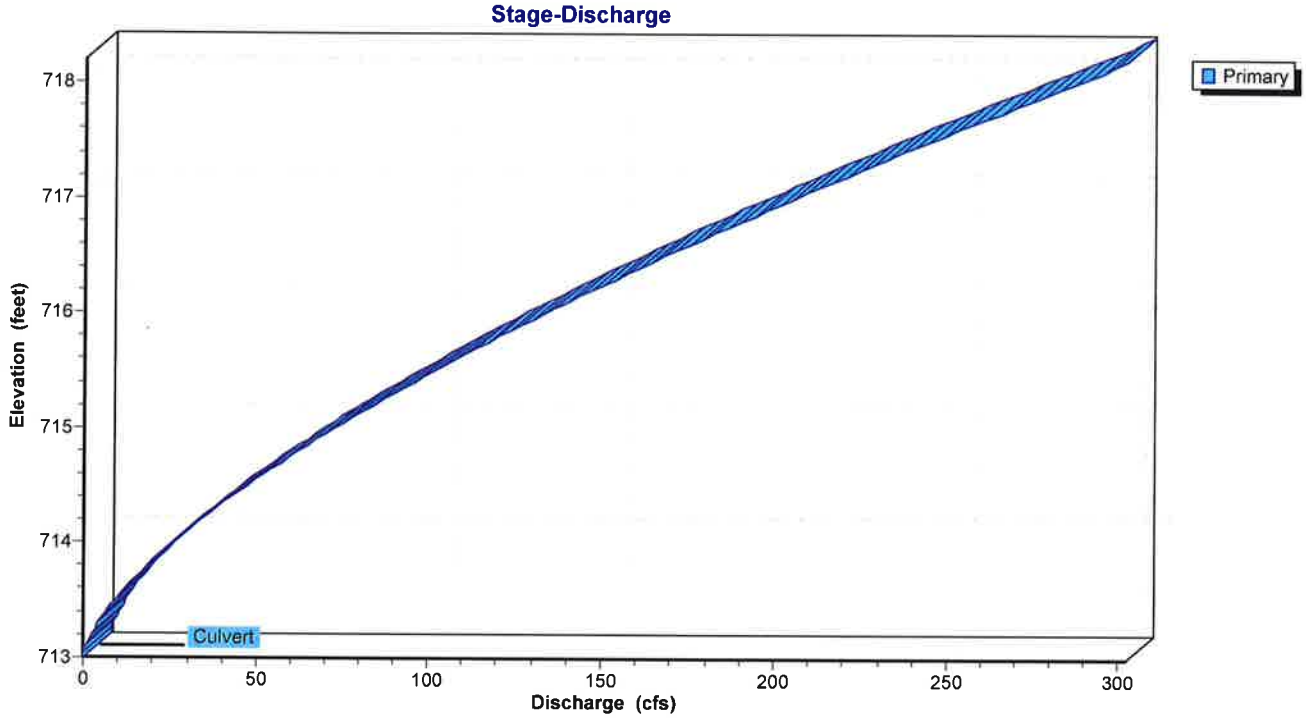
Device	Routing	Invert	Outlet Devices
#1	Primary	713.00'	**96.0" W x 60.0" H Box Culvert** L= 100.0' Box, 10-30° wingwalls, square crown, Ke= 0.500 Inlet / Outlet Invert= 713.00' / 711.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete, trowel finish

Primary OutFlow Max=298.22 cfs @ 12.27 hrs HW=718.14' (Free Discharge)
└**1=Culvert** (Inlet Controls 298.22 cfs @ 7.46 fps)

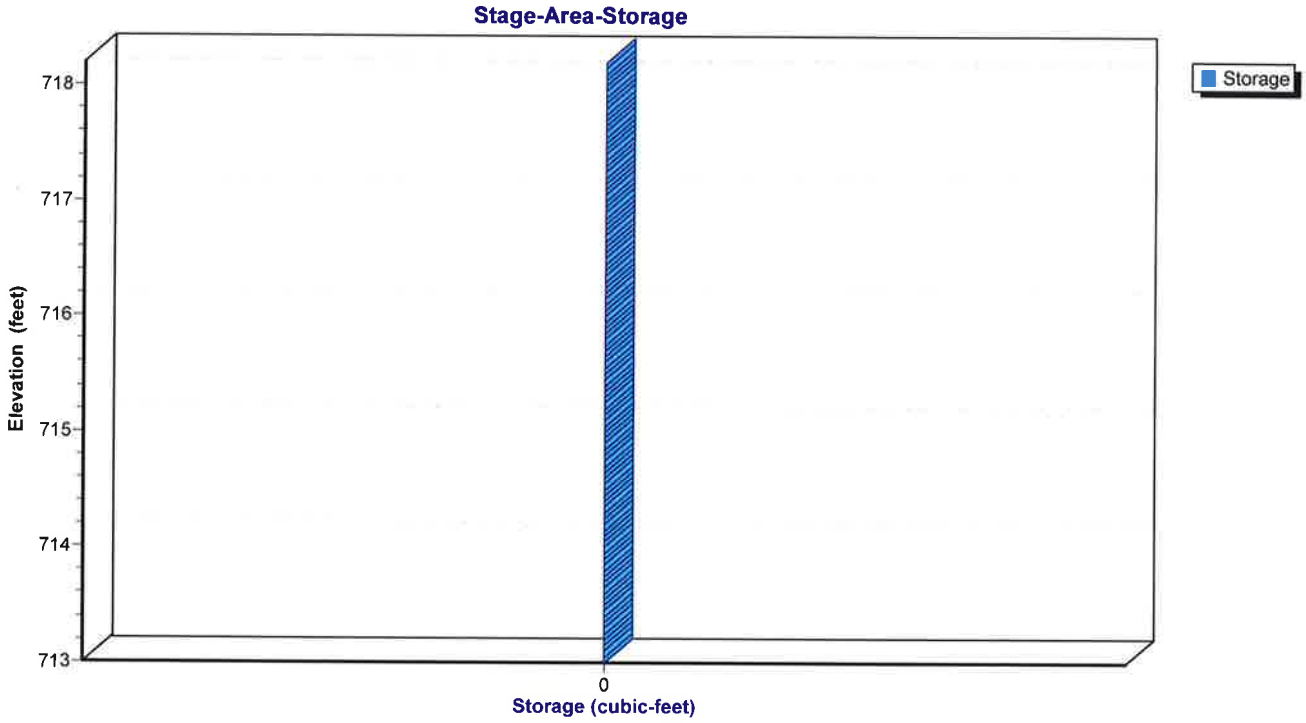
Pond 11P: Square Box



Pond 11P: Square Box



Pond 11P: Square Box



Summary for Pond 14P: Outlet Pipes

[57] Hint: Peaked at 668.71' (Flood elevation advised)

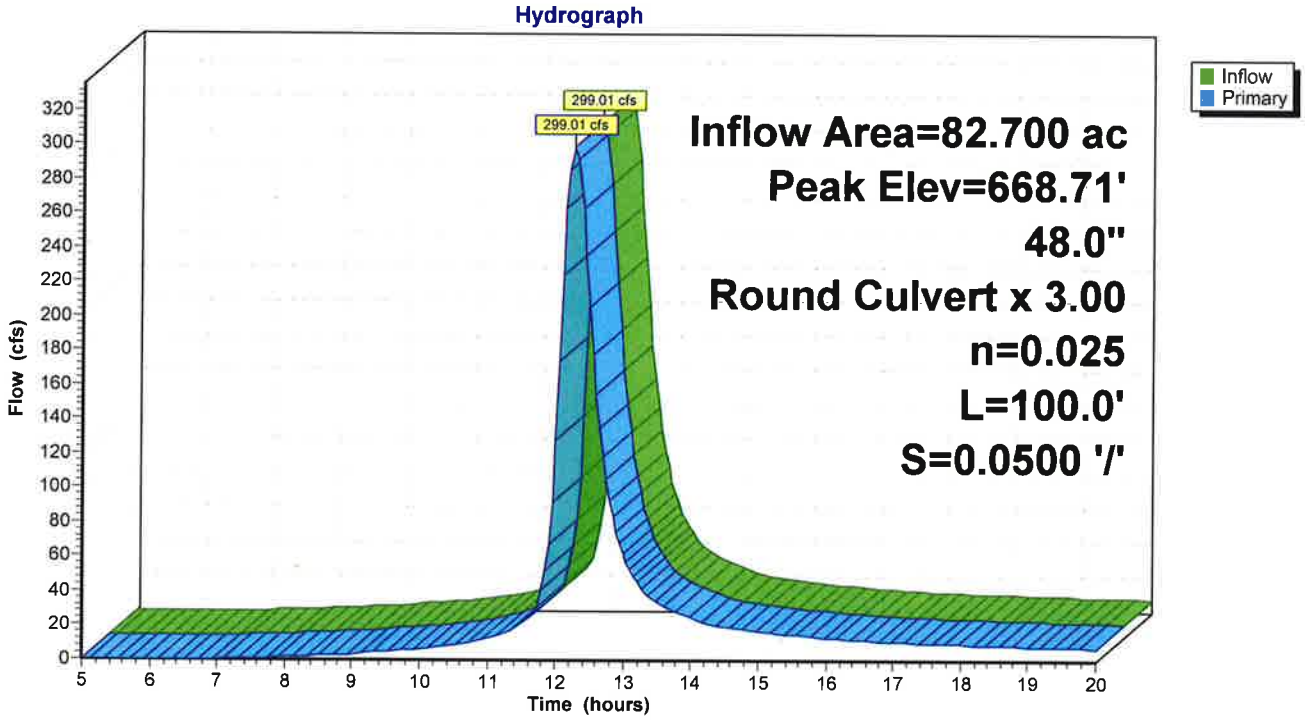
Inflow Area =	82.700 ac,	0.00% Impervious,	Inflow Depth >	4.13"	for 25-year event
Inflow =	299.01 cfs @	12.28 hrs,	Volume=	28.471 af	
Outflow =	299.01 cfs @	12.28 hrs,	Volume=	28.471 af,	Atten= 0%, Lag= 0.0 min
Primary =	299.01 cfs @	12.28 hrs,	Volume=	28.471 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 668.71' @ 12.28 hrs

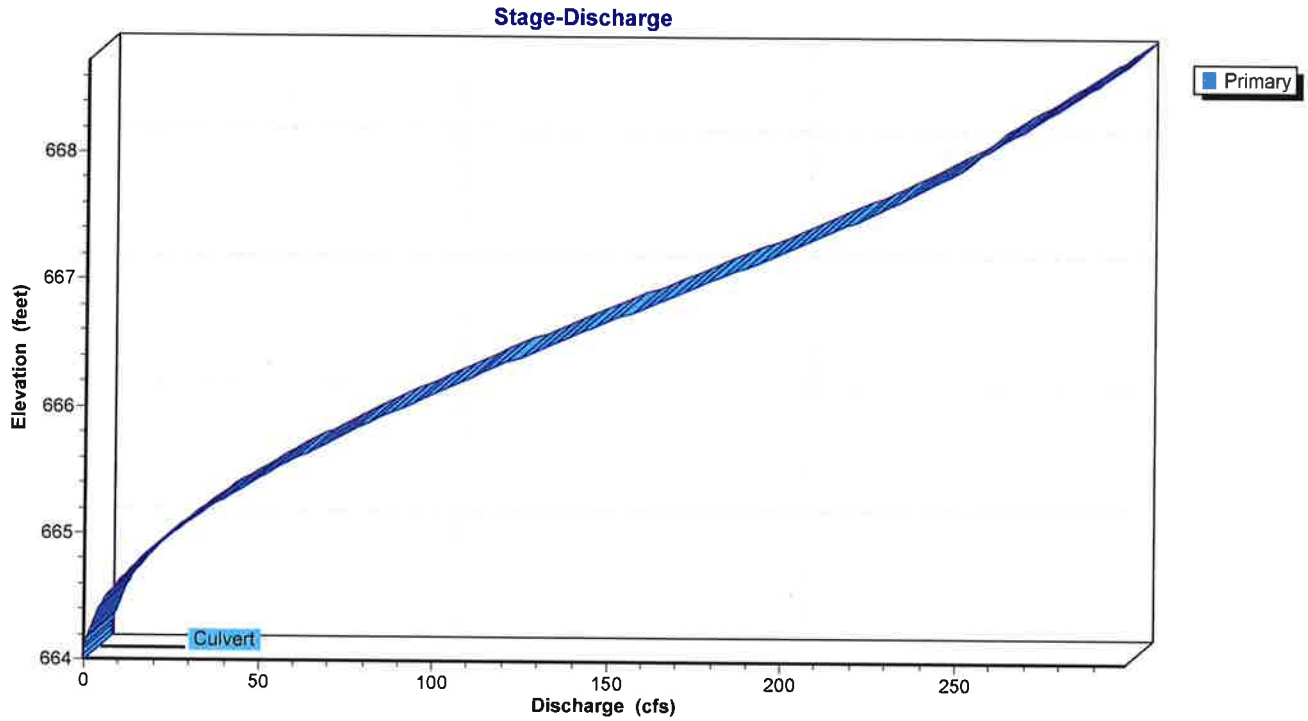
Device	Routing	Invert	Outlet Devices
#1	Primary	664.00'	**48.0" Round Culvert X 3.00** L= 100.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 664.00' / 659.00' S= 0.0500 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=297.51 cfs @ 12.28 hrs HW=668.69' (Free Discharge)
└**1=Culvert** (Inlet Controls 297.51 cfs @ 7.89 fps)

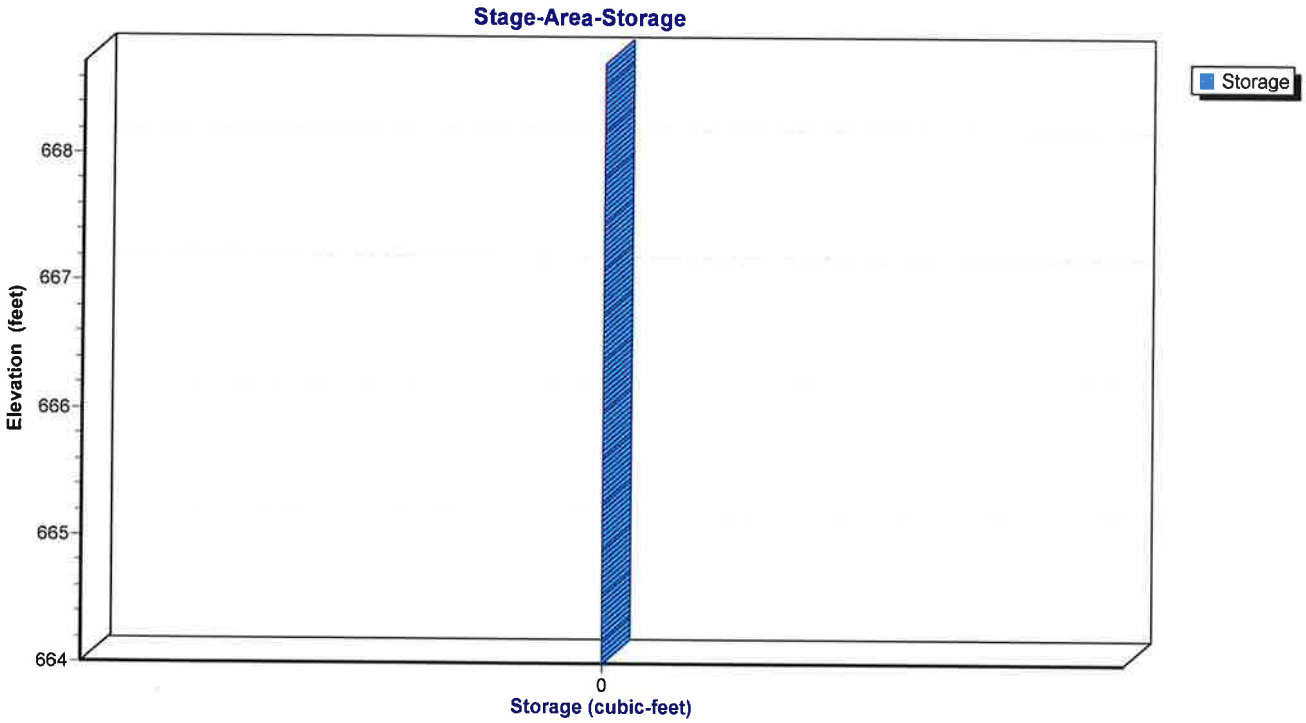
Pond 14P: Outlet Pipes

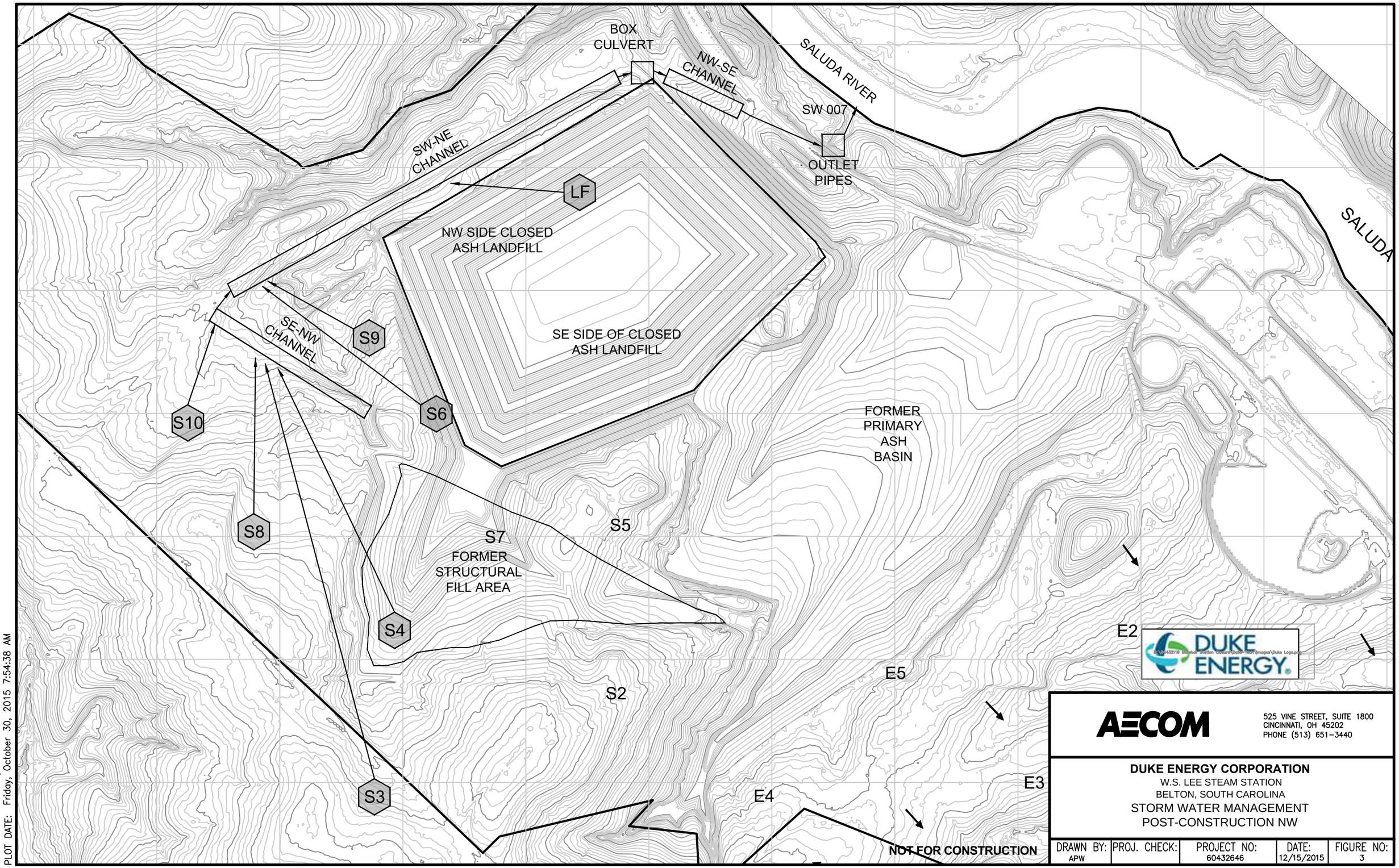


Pond 14P: Outlet Pipes



Pond 14P: Outlet Pipes





AECOM

525 VINE STREET, SUITE 1800
CINCINNATI, OH 45202
PHONE (513) 651-3440

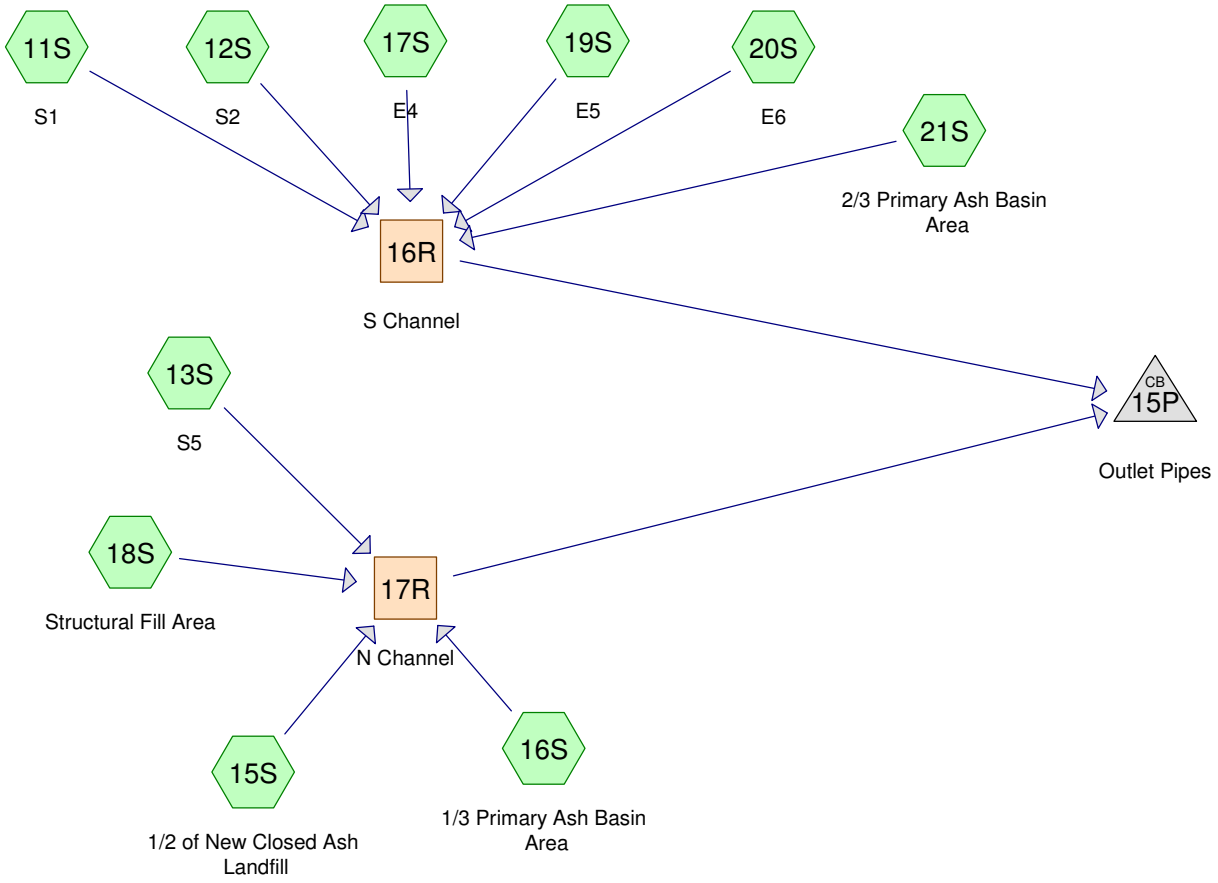
DUKE ENERGY CORPORATION
W.S. LEE STEAM STATION
BELTON, SOUTH CAROLINA
STORM WATER MANAGEMENT
POST-CONSTRUCTION NW

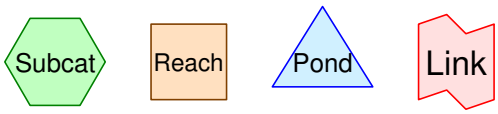
DRAWN BY:	PROJ. CHECK:	PROJECT NO:	DATE:	FIGURE NO:
APW		60432646	12/15/2015	3

PATH/FILENAME: J:\PROJECT\D\DUKE ENERGY\60432646 WS LEE STATION CLOSURE\DATA-TECH\DWG\CLOSURE PLAN SET - DUKE\AW FM 10.29.15 STORMWATER PRE_POST_DRAFT.DWG
LAST UPDATE: Friday, October 30, 2015 7:48:34 AM
PLOT DATE: Friday, October 30, 2015 7:54:38 AM

Attachment 5

Post-Construction SE –
Calculations and Drainage Map





Drainage Diagram for Post-Construction SE - 2015-10-27
Prepared by URS Corporation, Printed 10/28/2015
HydroCAD® 9.10 s/n 06598 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
132.600	80	>75% Grass cover, Good, HSG D (11S, 12S, 13S, 15S, 16S, 17S, 18S, 19S, 20S, 21S)
132.600	80	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
132.600	HSG D	11S, 12S, 13S, 15S, 16S, 17S, 18S, 19S, 20S, 21S
0.000	Other	
132.600		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Fill (inches)
1	15P	671.50	662.75	175.0	0.0500	0.025	54.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: S1 Runoff Area=8.500 ac 0.00% Impervious Runoff Depth>4.15"
Flow Length=665' Tc=12.5 min CN=80 Runoff=52.18 cfs 2.942 af

Subcatchment 12S: S2 Runoff Area=18.600 ac 0.00% Impervious Runoff Depth>4.15"
Flow Length=1,140' Tc=16.3 min CN=80 Runoff=101.38 cfs 6.431 af

Subcatchment 13S: S5 Runoff Area=8.500 ac 0.00% Impervious Runoff Depth>4.15"
Flow Length=1,215' Tc=16.6 min CN=80 Runoff=45.94 cfs 2.939 af

Subcatchment 15S: 1/2 of New Closed Ash Runoff Area=17.500 ac 0.00% Impervious Runoff Depth>4.16"
Flow Length=1,500' Slope=0.2500 '/' Tc=11.3 min CN=80 Runoff=111.32 cfs 6.060 af

Subcatchment 16S: 1/3 Primary Ash Basin Runoff Area=15.000 ac 0.00% Impervious Runoff Depth>4.13"
Flow Length=1,540' Tc=28.3 min CN=80 Runoff=59.97 cfs 5.166 af

Subcatchment 17S: E4 Runoff Area=8.000 ac 0.00% Impervious Runoff Depth>4.14"
Flow Length=1,370' Slope=0.0500 '/' Tc=21.4 min CN=80 Runoff=37.81 cfs 2.762 af

Subcatchment 18S: Structural Fill Area Runoff Area=13.500 ac 0.00% Impervious Runoff Depth>4.11"
Flow Length=2,500' Slope=0.0328 '/' Tc=46.2 min CN=80 Runoff=38.84 cfs 4.622 af

Subcatchment 19S: E5 Runoff Area=3.000 ac 0.00% Impervious Runoff Depth>4.16"
Flow Length=535' Tc=10.0 min CN=80 Runoff=19.91 cfs 1.039 af

Subcatchment 20S: E6 Runoff Area=8.000 ac 0.00% Impervious Runoff Depth>4.16"
Flow Length=890' Tc=10.0 min CN=80 Runoff=53.10 cfs 2.771 af

Subcatchment 21S: 2/3 Primary Ash Basin Runoff Area=32.000 ac 0.00% Impervious Runoff Depth>4.13"
Flow Length=1,540' Tc=28.3 min CN=80 Runoff=127.93 cfs 11.022 af

Reach 16R: S Channel Avg. Flow Depth=2.94' Max Vel=11.18 fps Inflow=338.94 cfs 26.968 af
n=0.025 L=2,500.0' S=0.0176 '/' Capacity=339.94 cfs Outflow=322.30 cfs 26.827 af

Reach 17R: N Channel Avg. Flow Depth=2.08' Max Vel=11.98 fps Inflow=208.36 cfs 18.787 af
n=0.025 L=1,500.0' S=0.0293 '/' Capacity=438.86 cfs Outflow=201.11 cfs 18.731 af

Pond 15P: Outlet Pipes Peak Elev=676.58' Inflow=515.32 cfs 45.558 af
54.0" Round Culvert x 4.00 n=0.025 L=175.0' S=0.0500 '/' Outflow=515.32 cfs 45.558 af

Total Runoff Area = 132.600 ac Runoff Volume = 45.754 af Average Runoff Depth = 4.14"
100.00% Pervious = 132.600 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 11S: S1

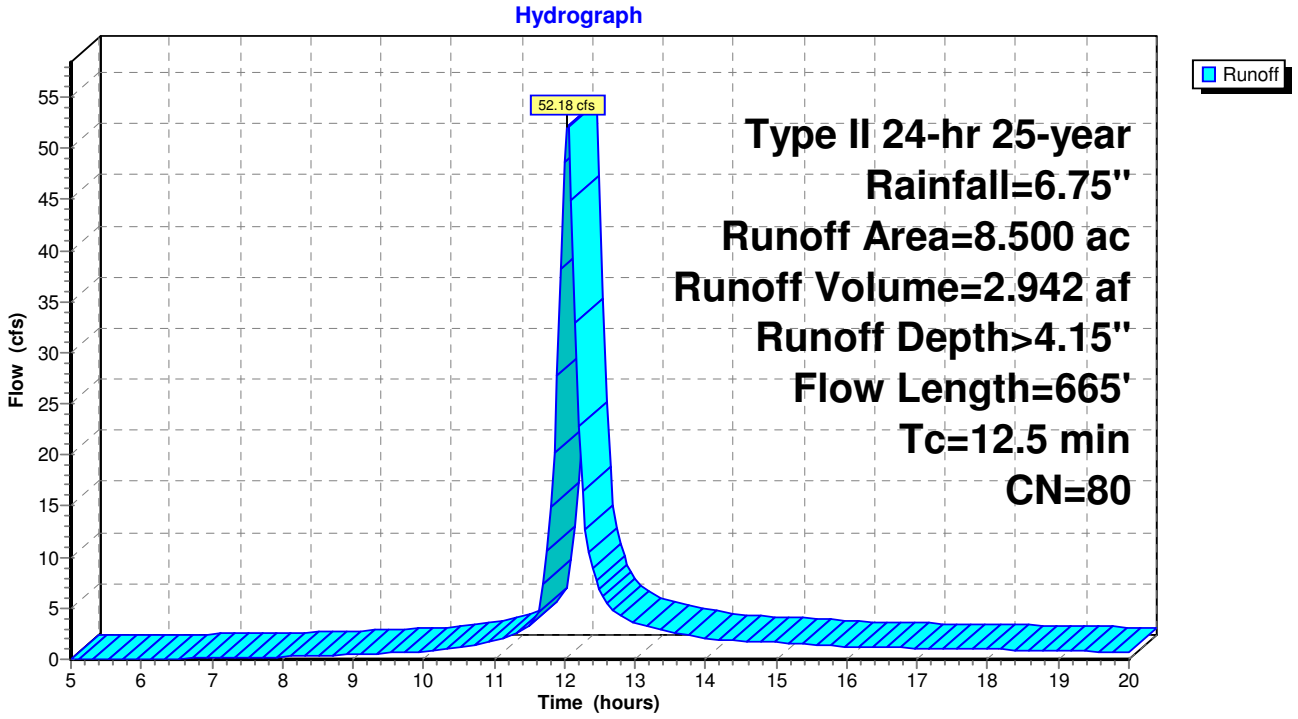
Runoff = 52.18 cfs @ 12.04 hrs, Volume= 2.942 af, Depth> 4.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.500	80	>75% Grass cover, Good, HSG D
8.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	150	0.0400	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
3.3	515	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
12.5	665	Total			

Subcatchment 11S: S1



Summary for Subcatchment 12S: S2

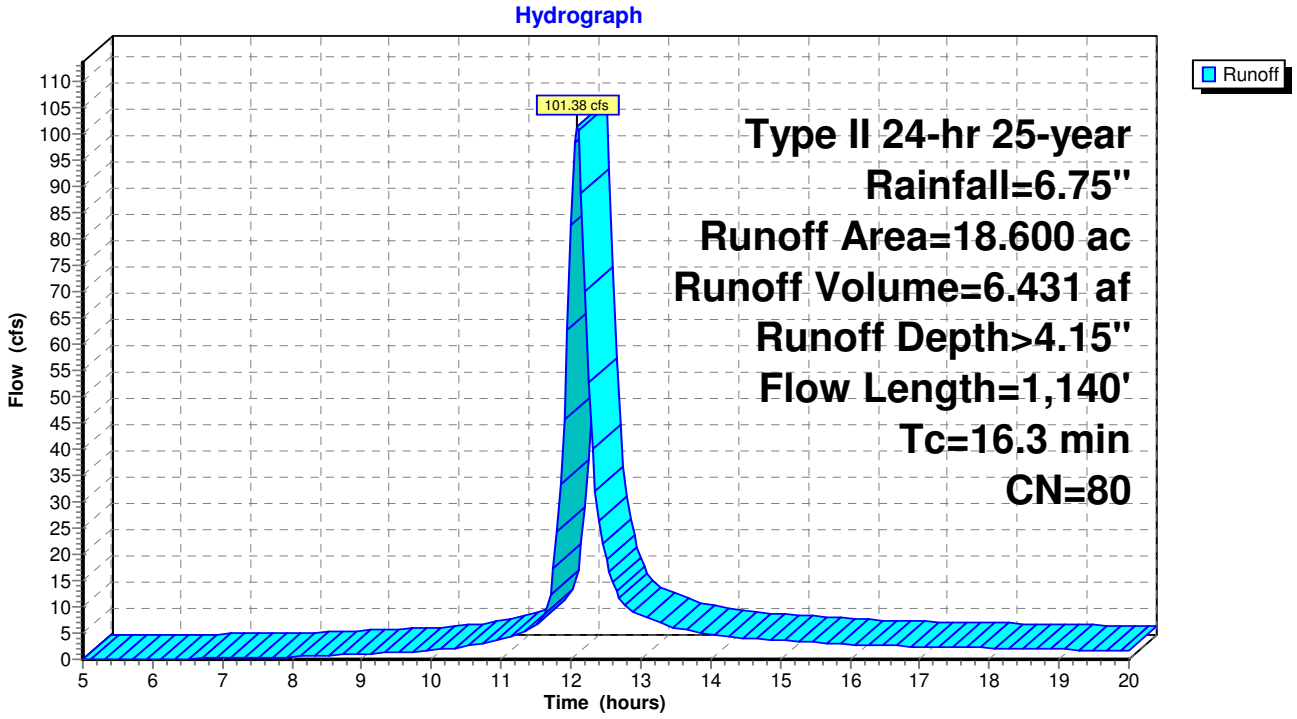
Runoff = 101.38 cfs @ 12.08 hrs, Volume= 6.431 af, Depth> 4.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
18.600	80	>75% Grass cover, Good, HSG D
18.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	150	0.0400	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
7.1	990	0.1100	2.32		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
16.3	1,140	Total			

Subcatchment 12S: S2



Summary for Subcatchment 13S: S5

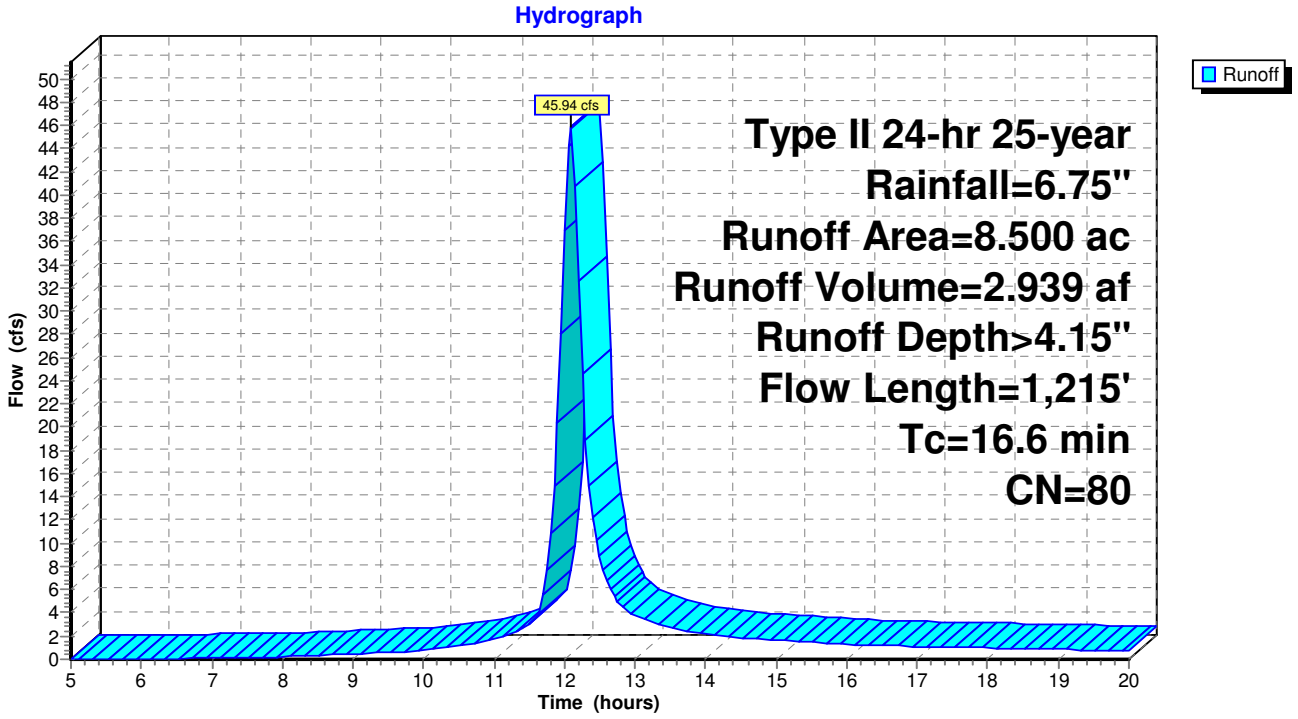
Runoff = 45.94 cfs @ 12.09 hrs, Volume= 2.939 af, Depth> 4.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.500	80	>75% Grass cover, Good, HSG D
8.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	150	0.0800	0.36		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
9.6	1,065	0.0700	1.85		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
16.6	1,215	Total			

Subcatchment 13S: S5



Summary for Subcatchment 15S: 1/2 of New Closed Ash Landfill

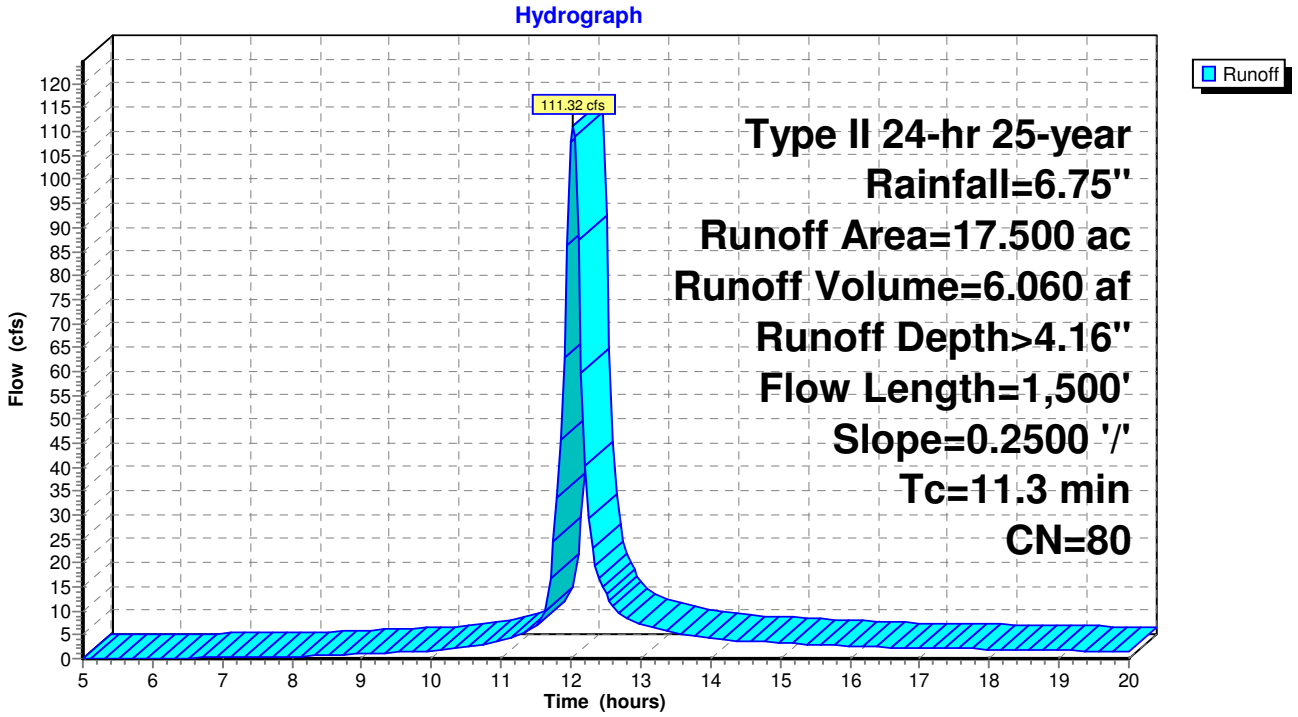
Runoff = 111.32 cfs @ 12.03 hrs, Volume= 6.060 af, Depth> 4.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
17.500	80	>75% Grass cover, Good, HSG D
17.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	300	0.2500	0.65		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
3.3	700	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	500	0.2500	27.72	311.89	**Trap/Vee/Rect Channel Flow,** Bot.W=3.00' D=1.50' Z= 3.0 '/' Top.W=12.00' n= 0.025 Earth, clean & straight
11.3	1,500	Total			

Subcatchment 15S: 1/2 of New Closed Ash Landfill



Summary for Subcatchment 16S: 1/3 Primary Ash Basin Area

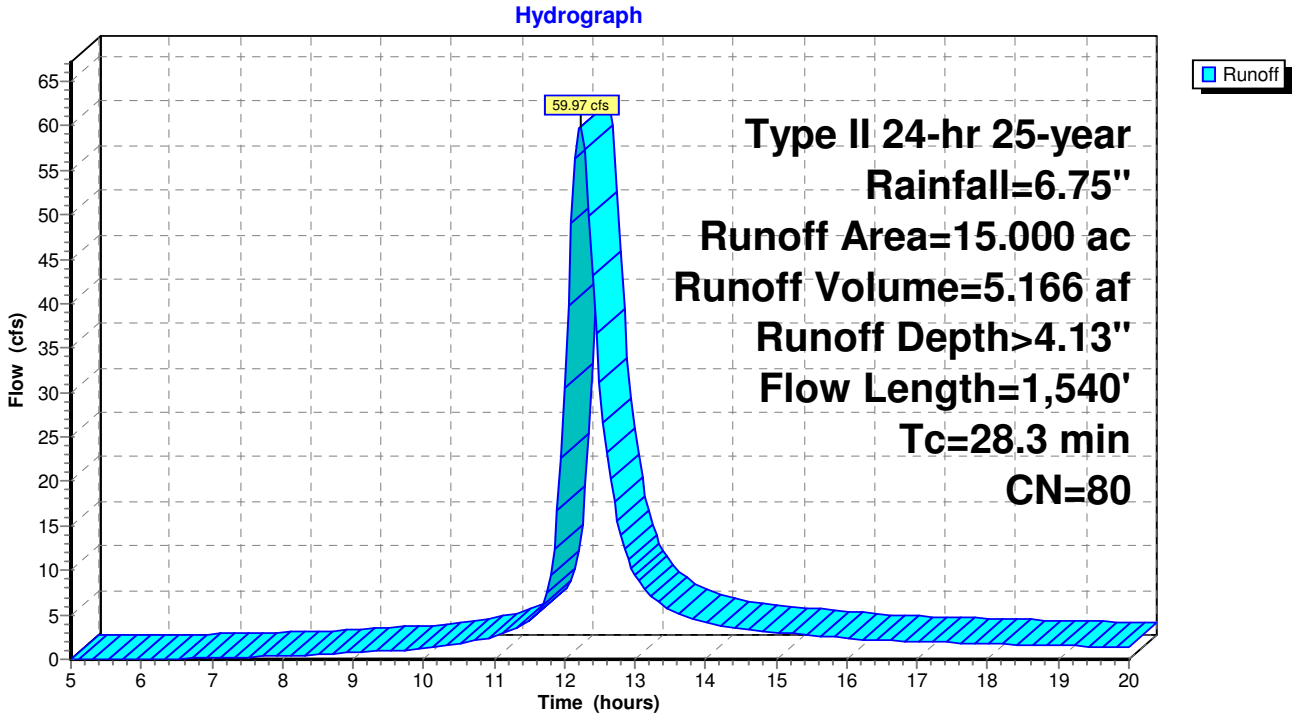
Runoff = 59.97 cfs @ 12.22 hrs, Volume= 5.166 af, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
15.000	80	>75% Grass cover, Good, HSG D
15.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	150	0.0400	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
19.1	1,390	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
28.3	1,540	Total			

Subcatchment 16S: 1/3 Primary Ash Basin Area



Summary for Subcatchment 17S: E4

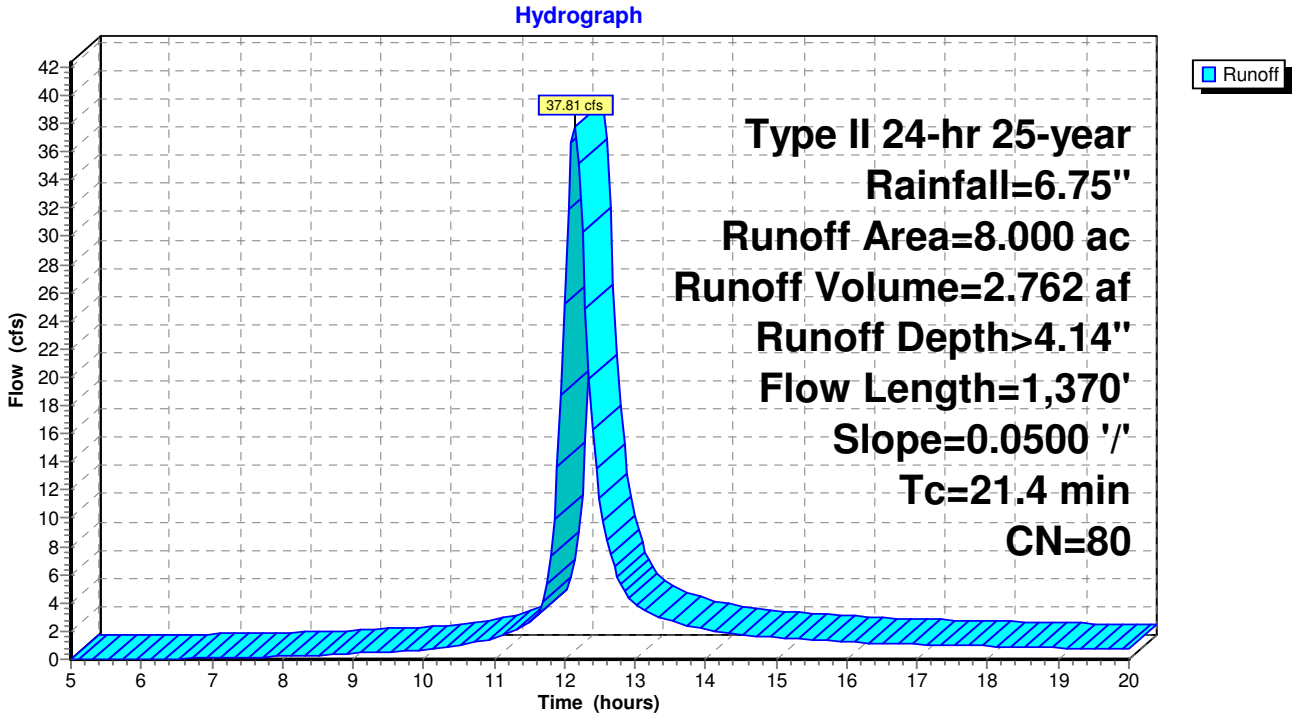
Runoff = 37.81 cfs @ 12.14 hrs, Volume= 2.762 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.000	80	>75% Grass cover, Good, HSG D
8.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	150	0.0500	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
13.0	1,220	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
21.4	1,370	Total			

Subcatchment 17S: E4



Summary for Subcatchment 18S: Structural Fill Area

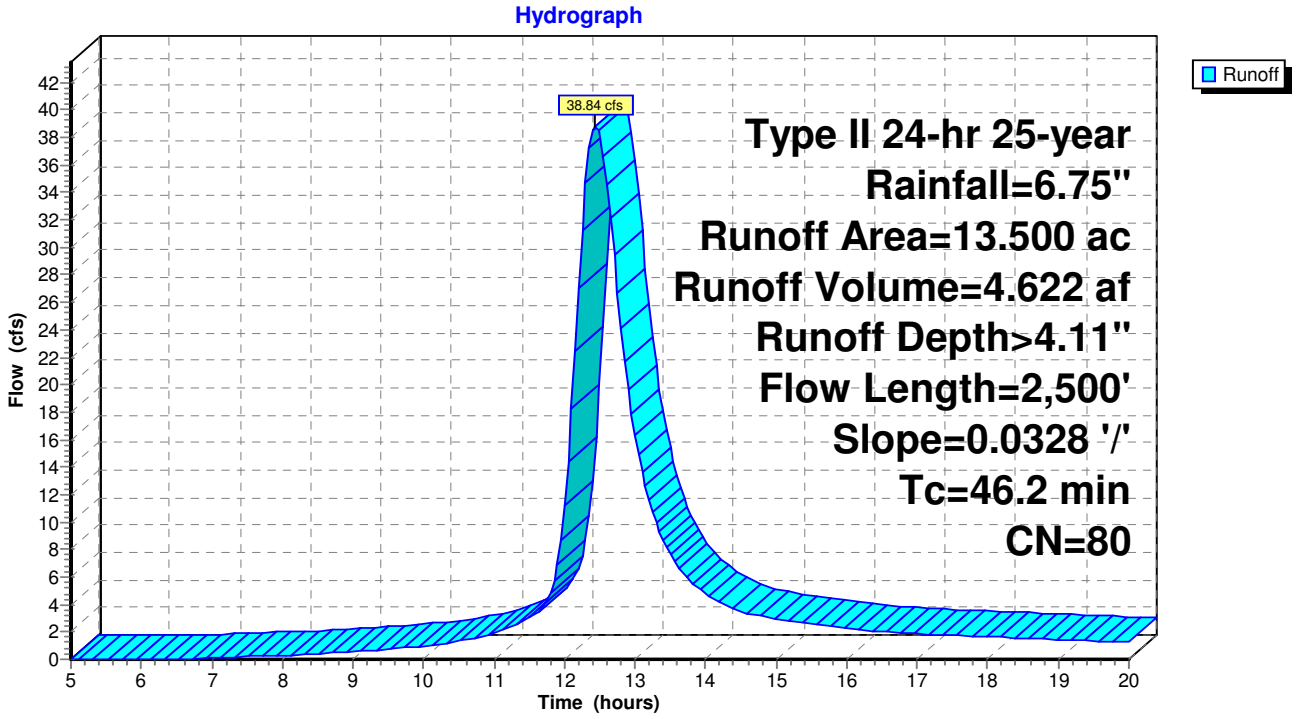
Runoff = 38.84 cfs @ 12.44 hrs, Volume= 4.622 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
13.500	80	>75% Grass cover, Good, HSG D
13.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.3	300	0.0328	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
28.9	2,200	0.0328	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
46.2	2,500	Total			

Subcatchment 18S: Structural Fill Area



Summary for Subcatchment 19S: E5

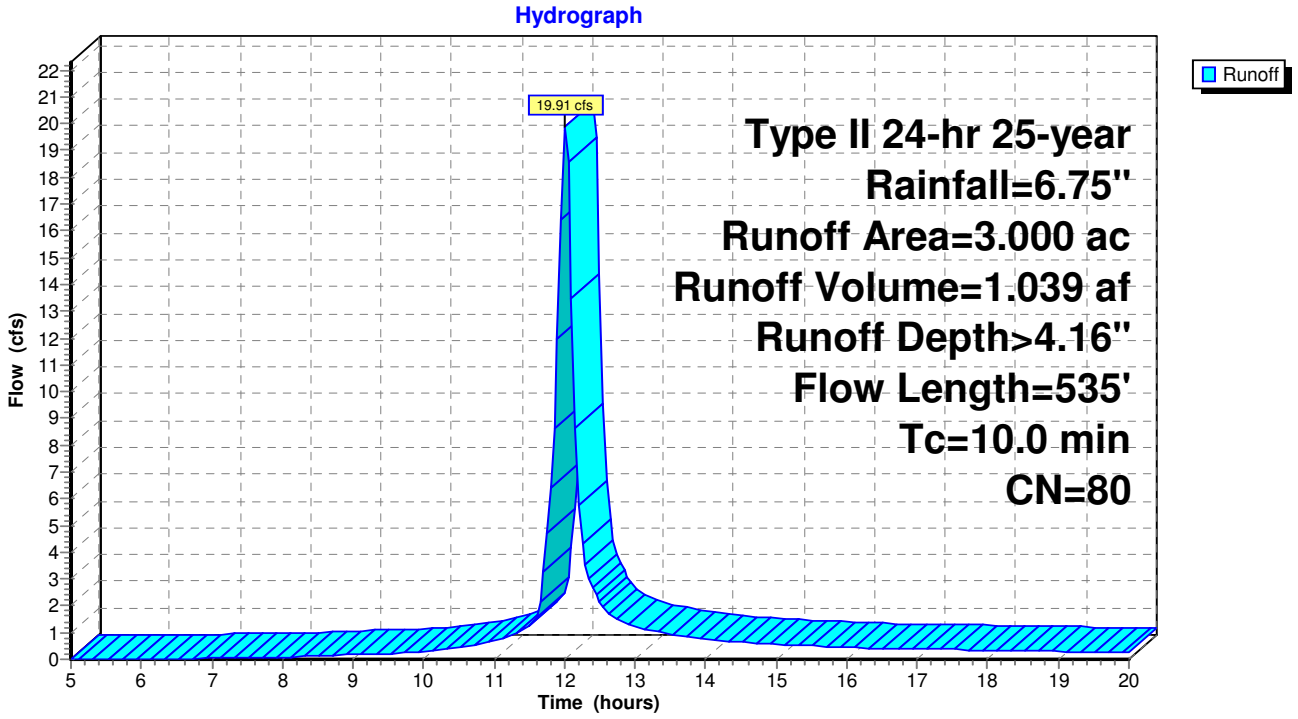
Runoff = 19.91 cfs @ 12.01 hrs, Volume= 1.039 af, Depth> 4.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
3.000	80	>75% Grass cover, Good, HSG D
3.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.1	150	0.1100	0.41		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
2.9	385	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.0	535	Total, Increased to minimum Tc = 10.0 min			

Subcatchment 19S: E5



Summary for Subcatchment 20S: E6

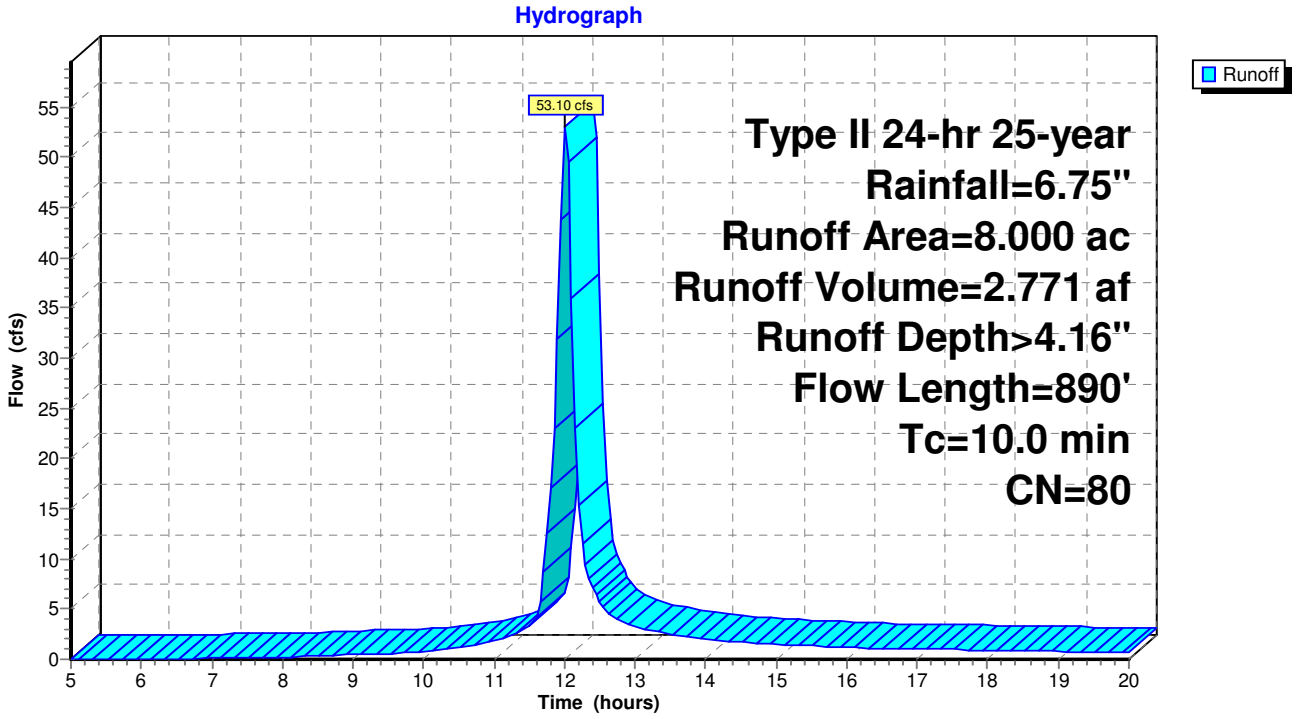
Runoff = 53.10 cfs @ 12.01 hrs, Volume= 2.771 af, Depth> 4.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
8.000	80	>75% Grass cover, Good, HSG D
8.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	150	0.1300	0.44		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
2.0	740	0.8000	6.26		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.7	890	Total, Increased to minimum Tc = 10.0 min			

Subcatchment 20S: E6



Summary for Subcatchment 21S: 2/3 Primary Ash Basin Area

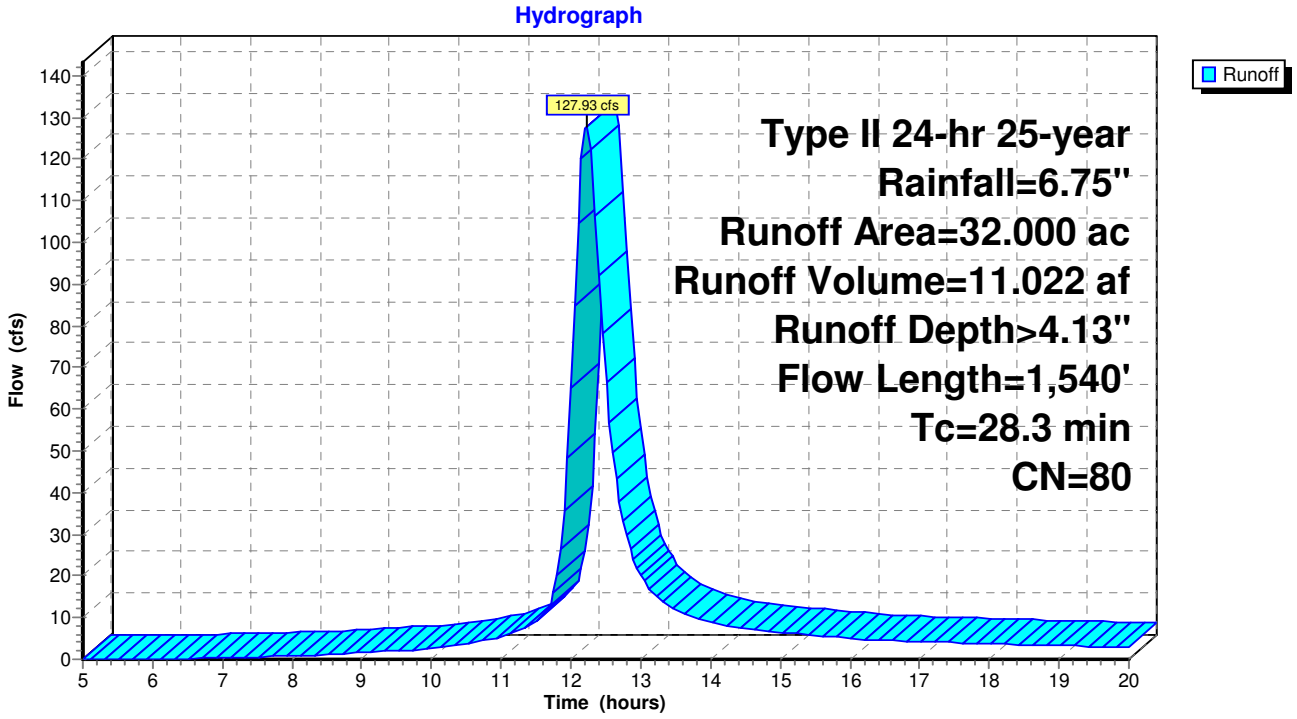
Runoff = 127.93 cfs @ 12.22 hrs, Volume= 11.022 af, Depth> 4.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year Rainfall=6.75"

Area (ac)	CN	Description
32.000	80	>75% Grass cover, Good, HSG D
32.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	150	0.0400	0.27		**Sheet Flow,** Grass: Short n= 0.150 P2= 4.00"
19.1	1,390	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
28.3	1,540	Total			

Subcatchment 21S: 2/3 Primary Ash Basin Area



Summary for Reach 16R: S Channel

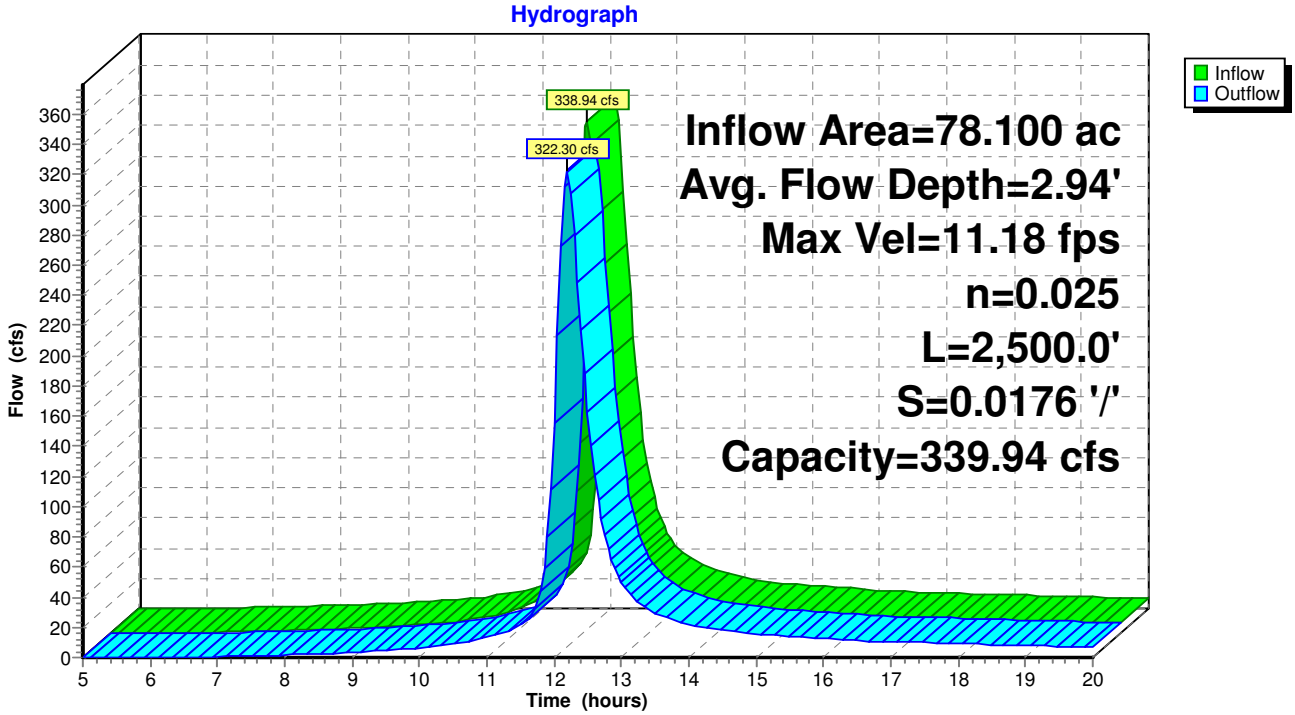
Inflow Area = 78.100 ac, 0.00% Impervious, Inflow Depth > 4.14" for 25-year event
Inflow = 338.94 cfs @ 12.08 hrs, Volume= 26.968 af
Outflow = 322.30 cfs @ 12.19 hrs, Volume= 26.827 af, Atten= 5%, Lag= 7.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.18 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 4.23 fps, Avg. Travel Time= 9.8 min

Peak Storage= 72,462 cf @ 12.13 hrs
Average Depth at Peak Storage= 2.94'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 339.94 cfs

4.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 2,500.0' Slope= 0.0176 '/'
Inlet Invert= 730.00', Outlet Invert= 686.00'

Reach 16R: S Channel



Summary for Reach 17R: N Channel

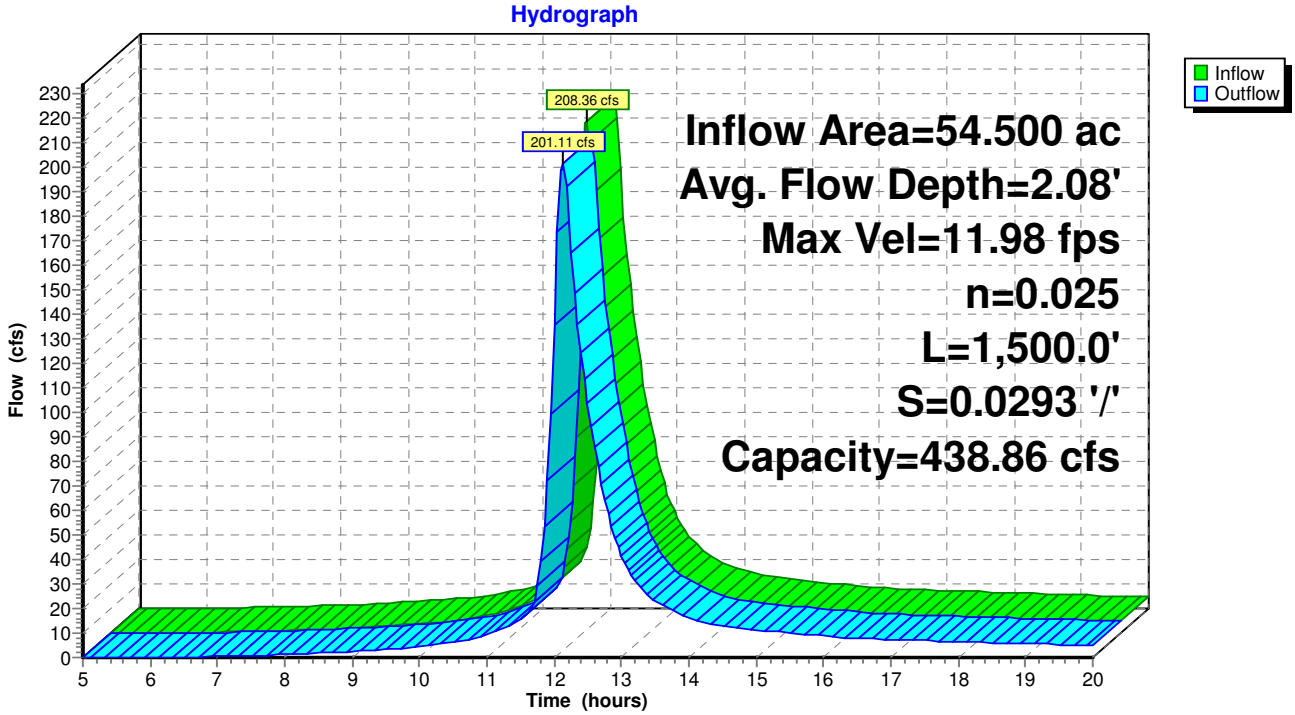
Inflow Area = 54.500 ac, 0.00% Impervious, Inflow Depth > 4.14" for 25-year event
Inflow = 208.36 cfs @ 12.06 hrs, Volume= 18.787 af
Outflow = 201.11 cfs @ 12.13 hrs, Volume= 18.731 af, Atten= 3%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.98 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 4.54 fps, Avg. Travel Time= 5.5 min

Peak Storage= 25,524 cf @ 12.09 hrs
Average Depth at Peak Storage= 2.08'
Bank-Full Depth= 3.00', Capacity at Bank-Full= 438.86 cfs

4.00' x 3.00' deep channel, n= 0.025 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 1,500.0' Slope= 0.0293 '/'
Inlet Invert= 730.00', Outlet Invert= 686.00'

Reach 17R: N Channel



Summary for Pond 15P: Outlet Pipes

[57] Hint: Peaked at 676.58' (Flood elevation advised)

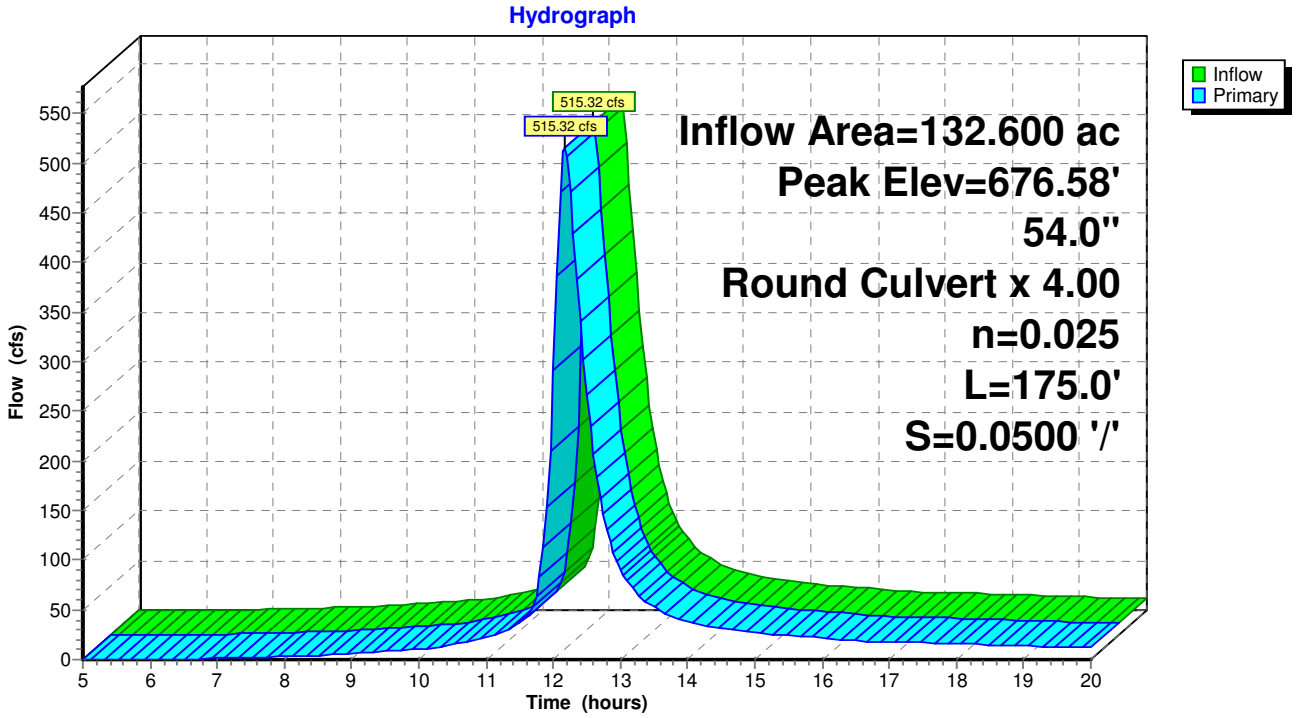
Inflow Area =	132.600 ac,	0.00% Impervious,	Inflow Depth >	4.12"	for	25-year event
Inflow =	515.32 cfs @	12.17 hrs,	Volume=	45.558 af		
Outflow =	515.32 cfs @	12.17 hrs,	Volume=	45.558 af,	Atten= 0%,	Lag= 0.0 min
Primary =	515.32 cfs @	12.17 hrs,	Volume=	45.558 af		

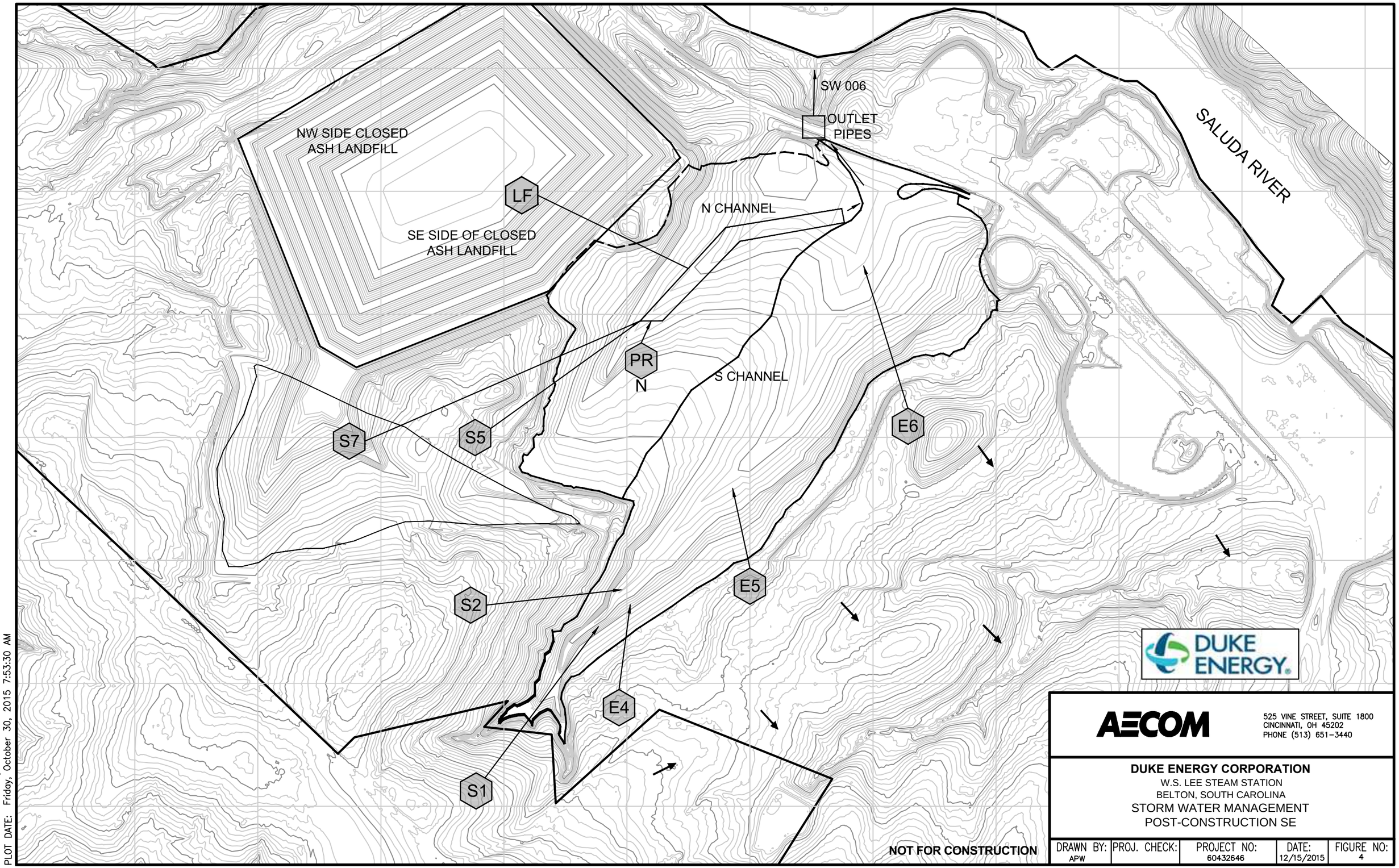
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 676.58' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	671.50'	**54.0" Round Culvert X 4.00** L= 175.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 671.50' / 662.75' S= 0.0500 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=509.83 cfs @ 12.17 hrs HW=676.52' (Free Discharge)
└─**1=Culvert** (Inlet Controls 509.83 cfs @ 8.01 fps)

Pond 15P: Outlet Pipes





AECOM

525 VINE STREET, SUITE 1800
CINCINNATI, OH 45202
PHONE (513) 651-3440

DUKE ENERGY CORPORATION
W.S. LEE STEAM STATION
BELTON, SOUTH CAROLINA
STORM WATER MANAGEMENT
POST-CONSTRUCTION SE

DRAWN BY:	PROJ. CHECK:	PROJECT NO:	DATE:	FIGURE NO:
APW		60432646	12/15/2015	4

PATH/FILENAME: J:\PROJECT\D\DUKE ENERGY\60432646 WS LEE STATION CLOSURE\DATA-TECH\DWG\CLOSURE PLAN SET - DUKE\AW FM 10.29.15 STORMWATER PRE_POST_DRAFT.DWG
LAST UPDATE: Friday, October 30, 2015 7:48:34 AM
PLOT DATE: Friday, October 30, 2015 7:53:30 AM

Appendix B

Proposed Dewatering Activities

I. PURPOSE

The purpose of this document is to present the proposed activities to be conducted to remove interstitial waters (to be referred to as dewatering) from the primary ash basin and secondary ash basin in order to condition the ash materials for ultimate placement as fill at a new lined landfill. These activities will be conducted at the Duke Energy Carolinas, LLC (Duke Energy) W.S. Lee Steam Station (site) located in Belton, Anderson County, South Carolina. It should be noted that this evaluation has been prepared as part of the Conceptual Closure Plan and that details will be refined as additional field investigations are conducted and data is collected. The objective of the dewatering activities is condition sluiced ash materials such that they are able to be placed in the landfill to achieve the desired moisture content. The mechanisms and methodologies for dewatering will be further detailed during the design phase and identified in future documents prepared as part of those activities.

II. SAFETY CONSIDERATIONS

The dewatering activities (and associated pumping rates) will be limited to a maximum drawdown rate of 6-inches per day in consideration of the South Carolina Department of Health and Environmental Control (SC DHEC) Dams and Reservoirs Safety Act Regulations, 1997. The primary and secondary ash basin impoundments are permitted under the Dams and Reservoirs Safety Act Regulations, SC Regulations R.72-1 through R.72-9, and will be decommissioned according to these safety requirements. The Primary Ash Basin Dam is classified by SC DHEC as an Intermediate Size, High Hazard dam (D4887). The Secondary Ash Basin Dam is classified by SC DHEC as Intermediate Size, Significant Hazard dam (D4888).

III. DEWATERING METHODOLOGY

As stated above, the objective of the dewatering activities is to condition ash to a desired moisture content in order to allow for the placement of the ash materials as fill within the new lined landfill. The key to effective dewatering of ash material is flexibility and development of a general program that can change with and adapt to the associated variables (i.e., ash composition, weather, insitu moisture contents, etc.). The general sequence of dewatering activities is as follows:

- Step 1: Reduce free surface water volume utilizing existing outlet structures and infrastructure.
- Step 2: Develop dewatering sump area, install trenches to facilitate drainage, and begin dewatering activities in upgradient portions of secondary ash basin.
- Step 2A: Begin removal of secondary ash basin materials for placement within primary ash basin or structural fill area.
- Step 2B: Complete closure by removal in secondary ash basin and eliminate sump.
- Step 3: Develop dewatering sump area and begin dewatering activities in upgradient portions of primary ash basin.
- Step 3A: Progressively and incrementally excavate and complete closure by removal of primary ash basin until dewatering activities are complete.

The methodologies proposed for each of these steps is further described below:

Step 1: Reduce Free Water Volume (i.e., Decanting)

The wastewaters generated as part of the dewatering activities (i.e., removal of interstitial waters) will require treatment because these activities will eliminate the current treatment functions of the ash basins (i.e., sediment settling). It is anticipated that the free water volume surface will be lowered prior to commencement of the construction activities in order to reduce the volume of waters that must be treated and improve efficiency.

Effluent from the primary ash basin currently flows through a 36-inch reinforced concrete decant pipe, protected by a skimmer extending downward several feet and discharging to a rip-rap lined channel. Flow from the primary ash basin to the secondary ash basin is controlled via a reinforced concrete box structure surrounding the inlet with removable 9- to 12-inch stop logs. A similar structure is in place at the embankment of the secondary ash basin to allow discharge to the site's National Pollutant Discharge Elimination System (NPDES) permitted Outfall 004.

The reduction of the free water volume is anticipated to be accomplished via the lowering of stop logs from the primary ash basin to the secondary ash basin, and then the lowering of stop logs (or pumping) from the secondary ash basin to the outfall. Again, the water surface lowering will be conducted at a maximum rate of 6 inches per day in consideration of dam safety requirements. The free water volume is defined as the water above the ash materials and stop log removal will be suspended as the top of ash is approached. Changes in wastewater characteristics are not anticipated during this free water volume reduction. This activity will be performed under the facility's NPDES permit.

Steps 2 and 3: Ash Basin Dewatering

Steps 2 and 3 identified above provide construction sequence that is relevant to the proposed dewatering activities. However, the basic mechanism for conducting dewatering and achieving the desired moisture content will be generally consistent for both basins. The dewatering activities are intended to provide a logical and systematic approach to promote drainage from dewatering work pad areas to a sump area in each ash basin, and eliminate stormwater run-on to the dewatering work pads. These activities will be implemented incrementally, moving from upgradient areas to downgradient areas (near sump and embankment). Waters collected in the sump area will be conveyed to an on-site wastewater treatment facility. The proposed activities are generally as follows:

- Excavate and maintain perimeter rim ditches within the limits of the ash basins and promote drainage towards the sump areas. Rim ditch excavation depths are not anticipated to exceed 10 feet.
- At the commencement of activities at each new dewatering pad area, install temporary stormwater diversion controls to prevent run-on to the dewatering pad areas and promote drainage to the rim ditches and sump areas.
- Dewatering pad areas to be incrementally developed, beginning from upgradient areas and working towards embankment. The overall size and location of the dewatering pads will be determined based on the behavior of the ash materials.

- Trenching activities will begin within the established dewatering pad areas, with materials being flipped/stacked between trenches to create windrows to allow for the material to dry. The total trench depth is not anticipated to exceed 10 feet to maintain the safety and stability of the ash.
- In order to provide a means of access for construction equipment during dewatering activities, material may be stacked to construct reinforced access roads.
- If the proposed trenching and windrow dewatering systems are ineffective in efficiently achieving desired dry density conditions, the ash materials may be relocated to a staging area within the limits of the structural fill area and/or primary ash basin for further draining and drying. Contact water from these areas will be directed to the sumps for treatment and discharge.
- In the event these methodologies are ineffective in ash dewatering, additional strategies such as well points, educator pumping wells, etc. may be implemented.

More details related to the dewatering plan for the secondary and primary ash basins are provided in the Conceptual Closure Plan Drawings.

IV. CONCLUSIONS

The objective of the dewatering activities is to achieve the desired moisture content and allow for placement as fill in a new lined landfill system. The mechanisms for achieving this standard consist of a system of dewatering pads, developed with trench and windrow systems to promote drying and drainage to sump locations. The dewatering methodologies will be further detailed during the design phase and identified in future documents prepared as part of those activities.

V. REFERENCES

Not Used

Appendix C

Wastewater Treatment and NPDES Permit Modification

I. PURPOSE

The purpose of this evaluation is to consider the treatment abilities and permit modification activities that may be required to manage wastewater generated during the primary ash basin, secondary ash basin and structural fill area closure activities to be conducted at the Duke Energy Carolinas, LLC (Duke Energy) W.S. Lee Steam Station (site) located in Belton, Anderson County, South Carolina. A summary of the anticipated regulatory requirements related to wastewater management are also provided. It should be noted that this evaluation has been prepared as part of the Conceptual Closure Plan and that details will be refined as the design phases of this project are implemented.

II. REGULATORY CONSIDERATIONS

The site is currently operating under the South Carolina Department of Health and Environmental Control (SC DHEC) National Pollutant Discharge Elimination System (NPDES) Permit No. SC0002291 for Discharge to Surface Waters. The primary ash basin, secondary ash basin and structural fill area are discharged to permitted Outfall 004 with the following requirements for monitoring and associated effluent limitations:

Table 1: Outfall 004 Permit Monitoring Requirements

Effluent Characteristics	Current Discharge Limitations				Monitoring Requirements	
	Mass		Concentration			
	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Sampling Frequency	Sample Type
Flow effluent	MR, MGD	MR, MGD	--	--	1/month	Instantaneous
pH	Minimum 6.0 su, Maximum 9.0 su				1/month	grab
TSS	--	--	30 mg/L	100 mg/L	1/month	grab
Oil and Grease	--	--	15mg/L	20 mg/L	1/quarter	grab
Ceriodaphnia dubia Chronic Whole Effluent Toxicity @ CTC-=25%	MR	MR			1/quarter	Grab

Table Legend:

MR = Monitor and Report (no numeric limitation)
MGD = Million Gallons per Day
su = Standard Units
mg/L = Milligrams per Liter

The primary ash basin and secondary ash basin currently serve as wastewater treatment facilities, or surface impoundments, regulated under South Carolina Code of Regulations. The primary treatment mechanism provided by the existing impoundments is settling, resulting in the generation of solids of sludges that will ultimately be managed as part of the Conceptual Closure Plan. As a result of the closure activities, treatment will no longer be achieved within the impoundments and an alternate

mechanism for wastewater treatment and associated permit modification for the new wastewater discharge is required.

It is anticipated that the permit modification will consider SC DHEC water quality standards provided in SC Regulation R.61-68, as well as other appropriate standards such as the Steam Electric Power Generating Effluent Guidelines (ELGs). This will be evaluated prior to and during the NPDES permit modification process.

III. TREATMENT METHODOLOGY

The proposed methodology for managing wastewaters generated during construction activities are presented below. The wastewaters requiring management are anticipated to include the following:

- Stormwater commingled with ash materials (directed to the existing ash basins or otherwise in contact prior to closure),
- Interstitial waters generated during the dewatering process,
- Equipment washdown waters for activities conducted within the limits of the ash basins,
- Decontamination waters associated with sampling/monitoring and equipment washdown, and
- Waters generated through the achievement of dust control.

The results of recent analytical testing of the surface waters within the ash basins and interstitial waters are provided in the Conceptual Closure Plan. These analytical results would be representative of pre-treatment conditions.

In order to manage the wastewaters generated during the construction/closure activities, it is proposed to install an on-site treatment system. The use of an on-site treatment system will allow for the most efficient and timely management of water and reduce the potential for environmental impacts associated with off-site hauling.

More detailed design activities will be conducted during the detailed design phase to establish the required treatment mechanisms. Pilot studies may also be implemented. However, it is anticipated that the primary constituents of concern for the system are pH, total suspended solids (TSS), oil and grease (O&G) and potentially specific heavy metals. In order to manage these parameters, the following treatment train with associated treated parameter in [ ] is anticipated:

- Skimming [O&G] may occur within sumps and floating booms (or other device) may be provided. However, the wastewaters listed are not anticipated to be a significant source of O&G.
- pH Adjustment [pH],
- Settling and filtering [TSS and/or heavy metals], and
- Recirculation/holding capabilities (prior to discharge) in the event of effluent parameter exceedances.

The treatment system is anticipated to be equipped with a sampling station prior to effluent discharge, as well as intermittent meters for water quality monitoring. It is further anticipated that portable TSS monitoring systems, pH monitors and other monitoring devices may be used during operation to assess treatment effectiveness.

It is anticipated that treated effluent will continue to be discharged through Outfall 004 (to manhole upstream of discharge point).

IV. CONCLUSIONS

As part of the proposed closure activities, the existing wastewater treatment facilities (ash basins) will be eliminated from service and wastewaters generated during construction will require treatment. It is proposed to conduct these treatment activities on-site and anticipated that the primary COCs will be pH, TSS, O&G and specific heavy metals. These activities will require an NPDES Permit Modification.

V. REFERENCES

SC DHEC, National Pollutant Discharge Elimination System (NPDES) Permit No. SC0002291 for Discharge to Surface Waters.

SC DHEC, Regulation R.61-68.

US EPA, Steam Electric Power Generating Effluent Guidelines (ELGs).