Preliminary Stormwater Management Report
Portsmouth Bypass

SCI-823-10.13
PID # 79977

Prepared for:

The Ohio Department

Of Transportation

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May 10, 2013

Prepared by

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STORMWATER MANAGEMENT SUMMARY

Project Description

The project will construct a new four lane limited access highway (S.R. 823) from Lucasville-Minford Rd. (C.R. 28) to U.S. Route 23. The majority of the roadway constructed will require new R/W. This report only contains the stormwater management summary for Section 2 of the project.

DLZ's scope of services for this portion of the project included a preliminary drainage evaluation to establish the R/W required to construct the proposed roadway and associated drainage features. The drainage design presented herein is preliminary and will need to be refined once the roadway design process continues.

Based upon the comments received from ODOT, the CDSS calculations provided with the previous Stage 1 design have numerous errors. Many issues remain unresolved due to these errors, which are systematic. It appears that outfall from the roadway runoff was not taken into account in many of the Stage 1 ditch calculations. However, per ODOT's direction, we used the Stage 1 CDSS calculations to determine drainage area and other necessary watershed characteristics. DLZ performed a preliminary analysis of the project stream hydraulics, culverts, and BMP to define the necessary R/W for the project. Further details are as follows:

- Drainage sub-areas were taken from the previous Stage 1 calculations and were not verified.
- Water Quality BMP are required for the project since the earth disturbed area (EDA) will be above the 5-acre threshold.
- Water Quantity BMP are required since the EDA is above the 5 acre threshold and the site creates more than one acre of new impervious area, is not a redevelopment project in an ultra-urban setting, and does not discharge directly to a large river. A preliminary BMP analysis was performed for each drainage outfall on the project. Preliminary grading was performed to ensure that adequate R/W would be available for BMP that involve proposed detention basins. The approximate size of each detention basin is shown on the R/W plans.
- Each culvert calculation was reviewed and it was determined rock channel protection is required for energy control at the outlet of each culvert.
- The impact of wetland mitigation or conservation easements on the proposed R/W for the project was not determined at this time. Additional R/W for these items will need to be obtained once the final plans are developed.
- The calculations performed by DLZ should be considered preliminary and will need to be verified during the final design of the roadway.

Existing Conditions

The existing project area consists of mainly rural undeveloped land with hilly topography. The project site contains many hills and valley, which result in the formation of numerous streams, which cross through the project area. Since the location of the new road is near the high end of the hills, many of these streams are headwater streams.

Proposed Improvements

The new roadway and associated drainage systems will be constructed along the alignment shown on the plans. The new roadway is uncurbed with a concrete median. A closed storm sewer system will drain the median. Open ditches and open culverts will drain the outside areas. The roadway drainage will discharge to natural watercourses in multiple locations along the project alignment.

Drainage Design Criteria and Methods

In general, drainage calculations were prepared in accordance with the ODOT Location and Design Manual, Volume 2, Drainage Design (L&D Manual). DLZ used HydroCAD and the SCS TR-20 method to develop hydrographs for both the existing and proposed condition for each detention basin design. HydroCAD was also used to estimate the required detention volumes for each detention basin. The detention basins are sized to discharge the proposed 100-peak flow rate at a lower flow rate than the existing 100-year peak flow rate. We used precipitation data from NOAA Atlas 14.

Design and Calculation Summary

Most of the project is new development. Therefore, we designed the entire project, with the exception of some minor areas, to include post construction water quality BMP.

Vegetated biofilters and exfiltration trenches can be used to treat water quality for much of the proposed roadway alignment. The scope of this study did not include final storm sewer design. Exfiltration tranches may not be needed in some locations where the median storm sewer outlets into a ditch that functions as a vegetated biofilter. Exfiltration trenches will be required in any location where the median storm sewer outlets into a ditch not designed as a vegetated biofilter or where the final design is changed to outlet the median storm sewer into a location other than the roadside ditches. Exfiltration trenches are presented as another tool in the BMP toolbox for the designer to use in final design.

Detention basins can be provided to treat water quantity. Detention basins can also be oversized to provide water quality BMP in locations where vegetated biofilters cannot be used or to consolidate maintenance activities.

It was determined that ditches with slopes over 10% often required a non-vegetated mat and therefore cannot function as vegetated biofilters. In most of these areas, we placed a flatter ditch at the top of the slope to treat the roadside drainage. This roadside ditch treats the water quality and then flows down the slope to the steeper ditch. In other areas where the ditch

slopes were steep enough to prohibit the use of a vegetated ditch, detention basins were sized to treat the required water quality volume (WQv) in addition to treating water quantity. Detention basins were also sized to treat water quality in locations where they could be placed to consolidate maintenance activities, such as the ramps to U.S. Route 23. Outlet sizes are preliminary and will need to be finalized during final design, after the location and geometry of the detention ponds are finalized. Alternatives to these BMP may exist and further evaluation is warranted during final design.

The vegetated biofilter design included an evaluation of the Stage 1 ditch calculations, where available. The majority of the ditches were designed with 10' bottom widths, which equals the maximum enhanced bankfull width (EBW) specified in section 1117.3 of the L&D Manual. Therefore, a 10' wide was used in the development of the cross sections and associated construction limits. Ditch calculations from approximately station 770 to the US 23 interchange were missing from the Stage 1 submittal. Ditch calculations are excluded from our scope so we were directed by ODOT not to prepare the missing ditch calculations.

Exfiltration trenches were included in the Stage 1 design where applicable. Exfiltration trenches provide water quality treatment and can be placed in front of storm sewer inlets along the concrete median. A more thorough analysis of the location and length of the exfiltration trenches should be evaluated during the final design process.

SUBSECTION 2A

Subsection 2A is from station 540 to station 660. For the entire subsection 2A exfiltration trenches were placed in the median. The need for and location of exfiltration trenches should be evaluated during the final design process. Vegetated biofilters were placed on the outside ditches, except as noted below. Following is a summary of the proposed water quantity and water quantity BMP for each drainage area in subsection 2A:

Basin A1-Station 578

The proposed peak flow rate was higher than the existing peak flow rate. A detention basin was placed near the downstream outlet of this subarea.

Basin A2-Station 600

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin A3-Station 610

Due to the proposed road cutting off some valleys and redirecting some drainage area to other subareas, the proposed drainage area and subsequent peak flow rate was less than the existing drainage area and peak flow rate. Therefore, a detention basin is not proposed for this subarea.

Basin A4-Station 618

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin A5-Station 623

Due to the proposed road cutting off some valleys and redirecting some drainage area to other subareas, the proposed drainage area and subsequent peak flow rate was less than the existing drainage area and peak flow rate. Therefore, a detention basin is not proposed for this subarea.

Basin A6-Station 636

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin A7-Station 650

Due to the proposed road cutting off some valleys and redirecting some drainage area to other subareas, the proposed drainage area and subsequent peak flow rate was less than the existing drainage area and peak flow rate. Therefore, a detention basin is not proposed for this subarea.

Basin A8-Station 659

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow

rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Table 1-Water Quality and Water Quantity BMP Summary

Subsection 2A

Basin	Station	Water Quality BMP	Water Quantity BMP	Required Detention Volume	Provided Detention Volume
				AC*FT	AC*FT
A1	578	Vegetated Biofilter	Detention Basin	2.78	2.94
A2	600	Vegetated Biofilter	Detention Basin ^	0.87	1.12
A3	610	Vegetated Biofilter	None *	N/A	
A4	618	Vegetated Biofilter	Detention Basin ^	0.51	0.53
A5	623	Vegetated Biofilter	None *	N/A	
A6	636	Vegetated Biofilter	Detention Basin ^	0.95	1.05
A7	650	Vegetated Biofilter	None *	N/A	
A8	659	Vegetated Biofilter	Detention Basin ^	3.93	5.20

Notes:
^ Detention basin placed on the upstream end of the culvert
* Not required because proposed peak discharge is less than existing peak discharge

SUBSECTION 2B

Subsection 2B is from station 660 to station 851. For the entire subsection 2B exfiltration trenches were placed in the median. The need for and location of exfiltration trenches should be evaluated during the final design process. Vegetated biofilters were placed on the outside ditches, except as noted below. Following is a summary of the proposed water quantity and water quantity BMP for each drainage area in subsection 2B:

Basin B1-Station 673

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain

this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin B2-Station 682

Due to the proposed road cutting off some valleys and redirecting some drainage area to other subareas, the proposed drainage area and subsequent peak flow rate was less than the existing drainage area and peak flow rate. Therefore, a detention basin is not proposed for this subarea.

Basin B3-Station 700

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which includes the drainage area from the culvert crossing at 693+50, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin B4-Station 718

The proposed peak flow rate was higher than the existing peak flow rate. A detention basin was placed on the south side near the downstream outlet of this subarea. Some of the ditches in this area had slopes over 10%, which could require a non-vegetated lining and would not function as a vegetated biofilter. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin B5-Station 749

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin B6-Station 766

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which also includes the drainage area from the culvert crossing at 761+50 and 766, is lower than the existing peak flow rate at the subbasin outlet. Since there were 3 culvert crossings in this subbasin, we placed an additional, smaller detention basin at the inlet of the culvert at 761+50. Detention basins for the final design can be placed at either of the locations and can be placed in combination to provide the required detention volume. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin B7-Station 781

Due to the proposed road cutting off some valleys and redirecting some drainage area to other subareas, the proposed drainage area and subsequent peak flow rate was less than the existing drainage area and peak flow rate. Therefore, a detention basin is not proposed for this subarea.

Basin B8-Station 796

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin B9-Station 815

The proposed peak flow rate was higher than the existing peak flow rate. Due to topographic restrictions, a detention basin was placed near the upstream inlet of the culvert that will drain this subarea. The detention basin was oversized so the proposed peak flow rate at the outlet of the culvert, which is also the outlet for the subbasin, is lower than the existing peak flow rate at the subbasin outlet. This area has steep slopes running down to the culvert which may require non-vegetated matting, so we recommend placing a flatter roadside ditch at the top of the slope to capture and treat the roadside drainage before it goes down the slope.

Basin B10-Station 823

Due to the proposed road cutting off some valleys and redirecting some drainage area to other subareas, the proposed drainage area and subsequent peak flow rate was less than the existing drainage area and peak flow rate. Therefore, a detention basin is not proposed for this subarea.

Table 2-Water Quality and Water Quantity BMP Summary

Subsection 2B

Basin	Station	Water Quality BMP	Water Quantity BMP	Required Detention Volume	Provided Detention Volume
				AC*FT	AC*FT
B1	673	Vegetated Biofilter	Detention Basin #	1.47	1.78
B2	682	Vegetated Biofilter	None*	N/A	
B3	700	Vegetated Biofilter	Detention Basin #	1.38	1.69
B4	718	Vegetated Biofilter	Detention Basin	8.60	8.70
B5	749	Vegetated Biofilter	Detention Basin #	1.58	2.00
B6	766	Vegetated Biofilter	Detention Basin #	1.95	1.49 & 2.02
B7	781	Vegetated Biofilter	Vegetated Biofilter	N/A	
B8	796	Vegetated Biofilter	Detention Basin #	0.84	1.58
B9	815	Vegetated Biofilter	Detention Basin #	1.65	2.88
B10	823	Vegetated Biofilter	None*	N/A	

Notes:
Detention basin placed on the upstream end of the culvert
* Not required because proposed peak discharge is less than existing peak discharge

SUBSECTION 2C

Subsection 2C is from station 851 to the west end of the project, at station 904. For the entire subsection 2C exfiltration trenches were placed in the median. The need for and location of exfiltration trenches should be evaluated during the final design process. Vegetated biofilters were placed on the outside ditches, except as noted below. Following is a summary of the proposed water quantity and water quantity BMP for each drainage area in subsection 2C:

Basin C1-Station 850

The proposed peak flow rate is higher than the existing peak flow rate, since the proposed road from station 825 to 851 causes a change in the drainage area. A detention basin was placed on the south side near the downstream outlet of this subarea. Some of the ditches in this area had slopes over 10%, which could require a non-vegetated lining and would not function as a vegetated biofilter. Therefore, we sized the detention basin to include the WQv to treat water quality as well as water quantity.

Basin C2-Station 854 and 857

The discharge points of the two culverts, which cross SR 823 just past station 854 and just before station 857, converges at approximately station 857 on the south side of the proposed roadway alignment. The proposed discharge rate is less than the existing flow rate due to a reduction in the drainage area, caused by the diverting of some of the original drainage area into basin C1. Therefore, no water quantity BMP are necessary for the drainage area to these culverts.

Basin C3-Station 869

The discharge point of this culvert is located at approximately STA 870 on the south side of the proposed roadway alignment. The proposed discharge rate does not exceed the existing flow rate due to a reduction in the drainage area. Therefore, no water quantity BMP are necessary for the drainage area to these culverts.

Basin C4-Station 895

The stormwater on the proposed roadway alignment from approximately station 870 to 896 drains west toward the existing railroad tracks. On the north side, the stormwater drains under the railroad tracks in a proposed culvert located just north of where Ramp C crosses the railroad tracks. On the south side the ditches flow west through a culvert that crosses the railroad tracks just south of Ramp B.

The proposed discharge rate exceeds the existing flow rate due to an increase in both the size of the drainage area and an increase in impervious area due to the roadway construction. Therefore, water quantity BMP are necessary for Basin C4. The detention basins were placed north of Ramp C and in the infield along Ramp B. We sized these basins to provide both water quality and water quantity BMP, which consolidates the location of both the water quality and quantity controls for this area and could reduce long-term maintenance costs. The drainage from both the north and south sides of the proposed roadway needs to be treated, so two possible pond locations are shown on the plans.

Basin C5-Station 900

The proposed roadway alignment from the railroad tracks to the northern ends of Ramps D and C at the US 23 interchange drain through a proposed culvert crossing under Ramps D and A on the west side of the interchange. The proposed discharge rate exceeds the existing

flow rate due to an increase in both the size of the drainage area and an increase in impervious area due to the roadway construction. Therefore, water quantity BMP are necessary for the Basin C5. The preliminary calculations assumed that an extended detention pond would be utilized, but a constructed wetland may also be feasible to provide both stormwater quantity and quality controls.

Since water quantity control for this area is necessary, an extended detention pond was sized to provide treatment of the WQv. While vegetated biofilters or exfiltration trenches may be utilized to provide water quality for portions of this area, it would also be possible to construct an extended detention pond or constructed wetland in the infield area of Ramp D. This would consolidate all maintenance into one area and provide a single BMP for both stormwater quality and quantity

See the attached drainage area maps and calculations for further detail for each of these basins.

Table 3-Water Quality and Water Quantity BMP Summary

Subsection 2C

Basin	Station	Water Quality BMP	Water Quantity BMP	Required Detention Volume (WQv)	Provided Detention Volume
				AC*FT	AC*FT
C1	850	Vegetated Biofilter	Detention Basin	1.40 (0.14)	2.30
C2	854 and 857	Vegetated Biofilter	None *	N/A (1.26)	
C3	869	Vegetated Biofilter	None *	N/A (0.15)	
C4	895	Detention Basin	Detention Basin ^	1.79 (0.34)	3.33
C5	900	Detention Basin	Detention Basin	3.02 (0.69)	4.07

Notes:
^ Detention basin placed on the upstream end of the culvert
* Not required because proposed peak discharge is less than existing peak discharge (WQv) is included in total required detention volume

Energy Control Structures at Culverts

Using the culvert velocity in the CDSS culvert analysis calculations provided with the Stage 1 plans, we determined the required energy control structures for each culvert. In locations where CDSS calculations were not provided with the Stage 1 plans or the revised profile

changed the culvert geometry, we ran new CDSS calculations. The rock channel protection was sized using the 100-year flood discharge. The rock channel protection is shown in the R/W plans and the proposed R/W was set to allow adequate placement on the rock channel protection.

For most of the culverts, the slope is steep and the flow is supercritical. The calculations assume tailwater has no impact on slowing the velocity of the flow. As a result, the calculation for the velocity is conservative. A thorough investigation of tailwater and its effect on the culvert velocity and associated rock channel protection should be performed during final design. See Tables 4, 5, and 6 for a summary the required rock channel protection.

Table 4-Erosion Control Summary Subsection 2A

Basin	Station	Culvert Size	Number of Barrels	Culvert Velocity	Length of Rock Channel Protection
		IN	#	FPS	FT
A1	578	N/A			
A2	600	60	1	16	20
A3	610	36	1	14	15
A4	618	48	1	16	20
A5	623	54	1	14	20
A6	636	66	1	16	20
A7	650	N/A			
A8	659	60	2	14	20

Table 5-Erosion Control Summary Subsection 2B

Basin	Station	Culvert Size	Number of Barrels	Culvert Velocity	Length of Rock Channel Protection
		IN	#	FPS	FT
B1	673	60	1	19	20
B2	682	N/A			
B3	700	60	1	17	20
B4	718	84	1	17	20
B5	749	60	1	16	20
B6	761	48	1	11	15
B6	766	48	1	17	20
B6	771	60	1	16	20
B7	781	N/A			
B8	796	66	1	18	25
B9	815	60	2	12	20
B10	823	60	1	17	20

Table 6-Erosion Control Summary Subsection 2C

Basin	Station	Culvert Size	Number of Barrels	Culvert Velocity	Length of Rock Channel Protection
		IN	#	FPS	FT
C1	850	N/A			
C2a	854	72	3	11	20
C2b	857	66	1	13	20
C3	869	42	1	14	15
C4	895	+	+	+	+
C5	900	+	+	+	+

+ The culverts in basin C4 and C5 are internal culverts and rock channel protection for these culverts will not affect construction limits.

Treatment Percentage

This project covers a small amount of existing right-of-way. We calculated the treatment percentage as described in section 1115.6.2 of the L&D Manual-Volume 2. The existing impervious area, consisting of existing right of way, is 42 ac and the proposed new impervious area, consisting of proposed right of way, is 558 ac, which results in a required treatment percentage of 94.4%. The treatment percentage for the overall project will be close to 100%. Therefore, the preliminary layout included 10' ditches for vegetated biofilters, berm ditches where ditch slopes were too steep to function as vegetated biofilters, and detention basins for nearly the entire project alignment to ensure that BMPs are feasible within the R/W.

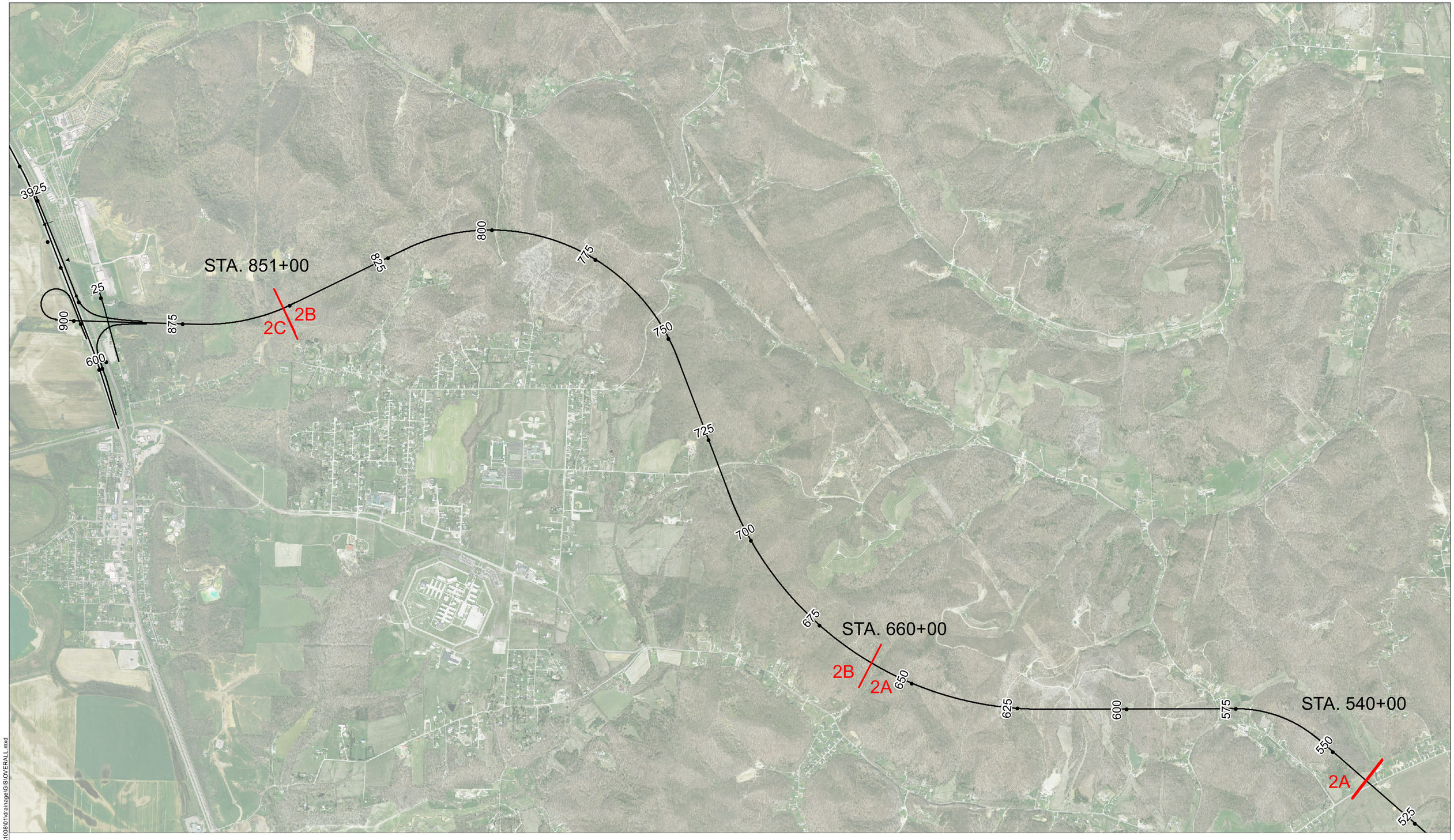
Maintenance Considerations

Most detention basins will be placed at the end of culverts and many of these culverts will be at the bottom of steep valleys. In these steep valleys, the foreslopes will be 2:1 and protected by guardrail. Access to these sites can be accomplished by removing a section of guardrail and the equipment required to excavation the sediment. This equipment will likely require tracks to traverse these steep slopes. In some areas, maintenance equipment can access detention basins by traveling along flatter areas that can be graded along the proposed right-of-way line. The contractor may also opt to leave in access roads that may be constructed during construction for future maintenance. This report does not provide final design for access roads. Any required access roads should be completely designed during the final design process.

Floodplain Considerations

As shown on the attached floodplain map exhibit in Section 3, the western portion of the S.R. 823 interchange with U.S. 23 is located in the 100-year flood plain. Approval from the

floodplain administrator for Scioto County will be needed for the improvements proposed in the flood plain.



Legend

Proposed Center Line

Overall Map

N

0 500 1,000 Feet

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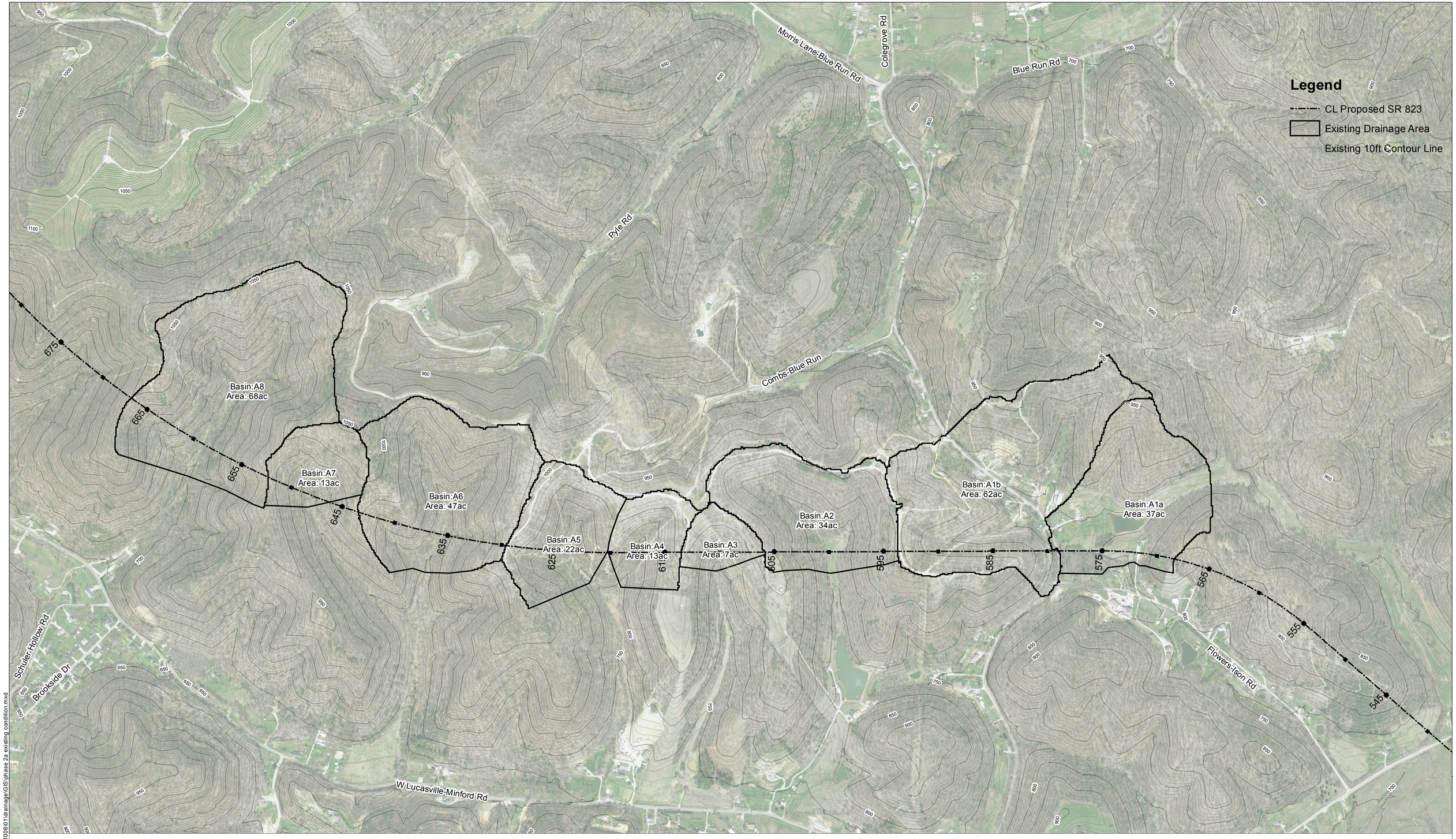

Subsection 2A Existing Drainage Area Map

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Morris Lane-Blue Run Rd

Colegrove Rd

Blue Run Rd

Pyle Rd

Combs-Blue Run

Basin:A8 & A7
Area: 88ac

Basin:A6
Area: 49ac

Basin:A7
Area: 3ac

Basin:A5
Area: 19ac

Basin:A4
Area: 14ac

Basin:A3
Area: 4ac

Basin:A2
Area: 35ac

Basin:A1b
Area: 64ac

Basin:A1a
Area: 42ac

675
665
655
645
635
625
615
605
595
585
575
565
555
545

Schuler Hollow Rd

Brookside Dr

W Lucasville-Minford Rd

W Lucasville-Minford Rd

Flowers-Ison Rd

Legend

- CL Proposed SR 823
- Construction Limit
- Proposed Pond
- Proposed Drainage Area

Subsection 2A Proposed Drainage Area Map

N

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Feet

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Subsection 2B Existing Drainage Area Map

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Subsection 2B Proposed Drainage Area Map

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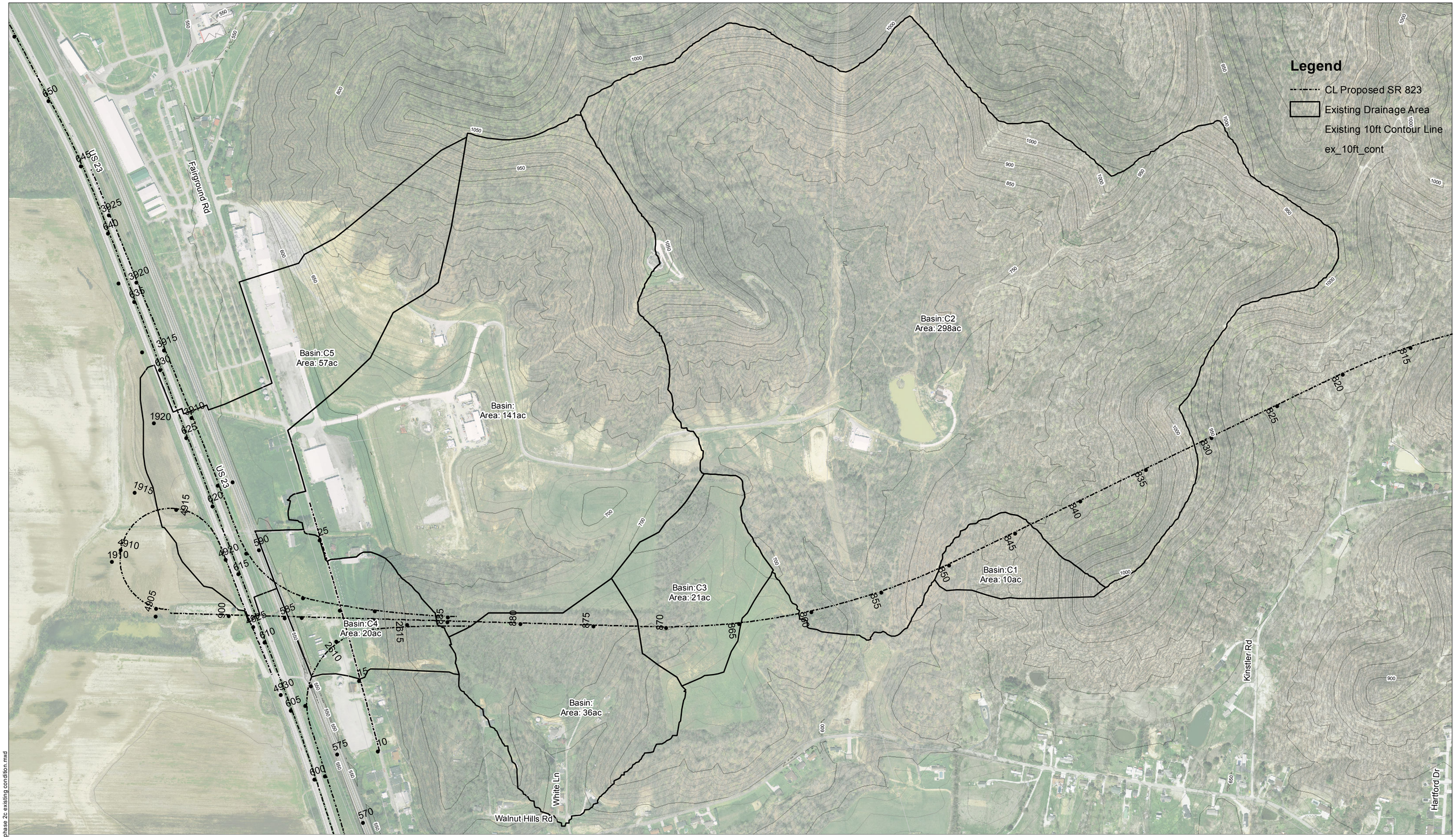

Subsection 2C Existing Drainage Area Map

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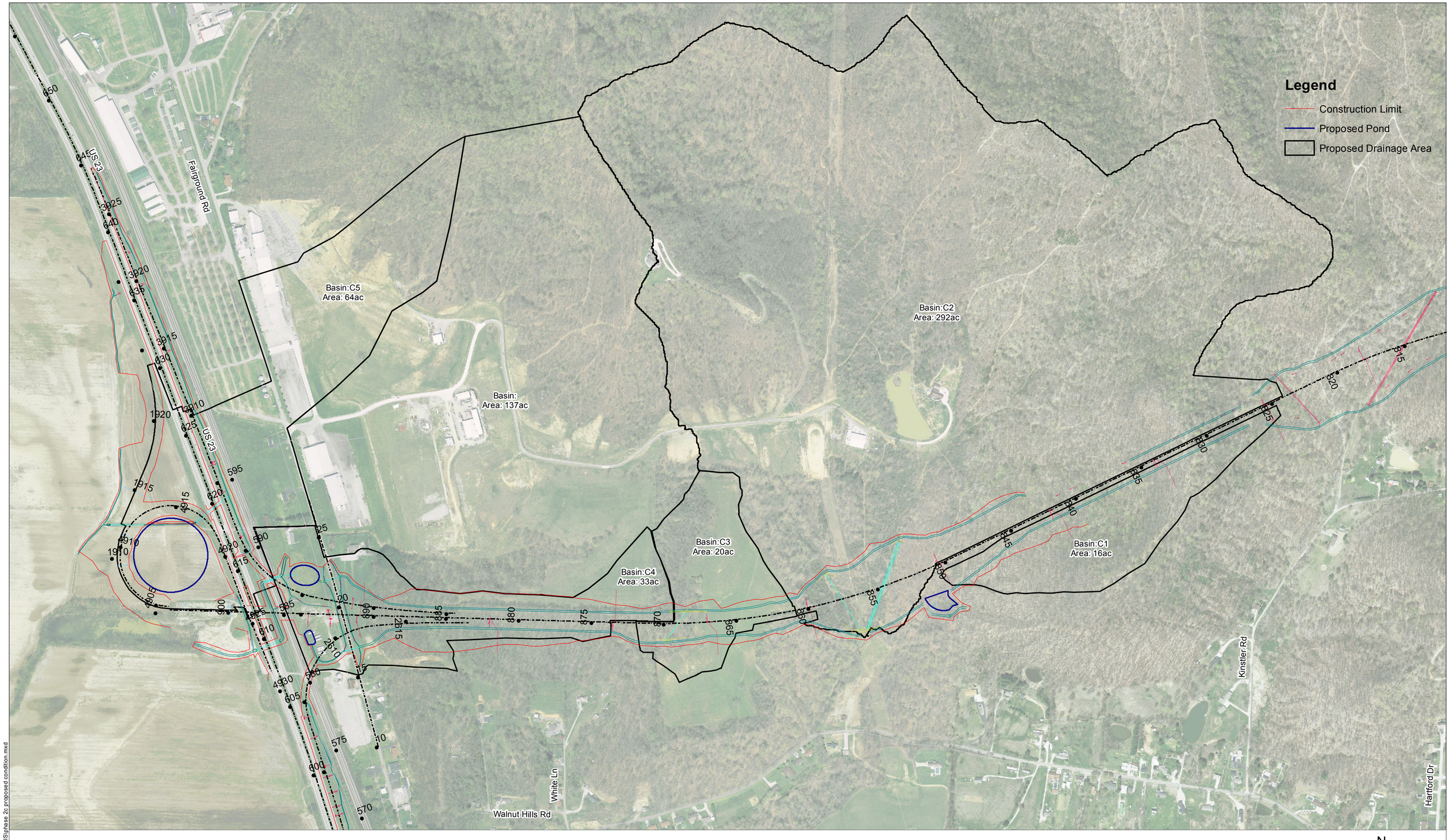

Subsection 2C Proposed Drainage Area Map

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Date: 10/31/2012 Author: YM

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Q
WS: 543'

SCIOTO RIVER

P
WS: 542.7'

U.S. 23

O
WS: 542.5'

N
WS: 542.3'

S.R. 823

C.R. 55

M
WS: 542.2'

L
WS: 542'

S.R. 348

Legend

- FEMA XS
- Proposed Road Center Line
- 100 Year Flood Plain
- Floodway

N

0 200 400
Feet

FEMA MAP

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2A **Location :** CULVERT STA 600+51

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 831.50 **Outlet Invert Elevation (ft.) :** 797.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 458.00 **Culvert Slope (ft./ft.) :** 0.0753

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
111.20	35.14	836.14	N/A	1 - C	15.59	1.96	3.01	0.0271	INLET	0.00	797.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2A **Location :** CULVERT STA 610+41

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 884.50 **Outlet Invert Elevation (ft.) :** 824.50

Pipe Quantity : 1

Culvert Type : Circular Corrugated

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations) **Pipe Length (ft.) :** 296.00 **Culvert Slope (ft./ft.) :** 0.2027

Pipe Size : 36 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
20.60	59.92	886.65	N/A	1 - C	14.11	0.78	1.46	0.0281	INLET	0.00	824.50

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2A **Location :** CULVERT STA 617+56

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 866.50 **Outlet Invert Elevation (ft.) :** 784.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 48 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 511.00 **Culvert Slope (ft./ft.) :** 0.1614

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
46.70	82.51	869.54	N/A	1 - C	16.21	1.12	2.05	0.0275	INLET	0.00	784.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2A **Location :** CULVERT STA 622+56

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 826.00 **Outlet Invert Elevation (ft.) :** 782.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 54 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 598.00 **Culvert Slope (ft./ft.) :** 0.0736

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
72.40	44.24	829.73	N/A	1 - C	13.77	1.64	2.48	0.0273	INLET	0.00	782.00

CULVERT ANALYSIS

PID : 19415 **Date :** 05/07/2013 **Project :** PORTSMOUTH BYPASS - 2A **Location :** CULVERT STA 635+99

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 776.00 **Outlet Invert Elevation (ft.) :** 740.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 66 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 598.00 **Culvert Slope (ft./ft.) :** 0.0602

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
148.40	36.85	781.30	N/A	1 - C	15.54	2.33	3.40	0.0269	INLET	0.00	740.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2A **Location :** CULVERT STA 658+78

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 724.50 **Outlet Invert Elevation (ft.) :** 688.00

Pipe Quantity : 2

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 595.00 **Culvert Slope (ft./ft.) :** 0.0613

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
110.90	37.13	729.13	N/A	1 - C	14.46	2.07	3.00	0.0271	INLET	0.00	688.00

CULVERT ANALYSIS

PID : 19415 **Date :** 05/07/2013 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 672+93

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 831.00 **Outlet Invert Elevation (ft.) :** 694.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 620.00 **Culvert Slope (ft./ft.) :** 0.2210

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
93.10	137.24	835.11	N/A	1 - C	18.91	1.49	2.74	0.0332	INLET	0.00	694.00

CULVERT ANALYSIS

PID : 19415 **Date :** 03/04/2013 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 699+51

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 786.00 **Outlet Invert Elevation (ft.) :** 708.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 759.00 **Culvert Slope (ft./ft.) :** 0.1028

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
99.60	78.38	790.30	N/A	1 - C	16.94	1.70	2.84	0.0271	INLET	0.00	708.00

CULVERT ANALYSIS

PID : 19415 **Date :** 05/09/2013 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA CR54 CROSS

Description : STA 718+21 **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 714.40 **Outlet Invert Elevation (ft.) :** 693.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 84 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 475.00 **Culvert Slope (ft./ft.) :** 0.0451

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
304.60	23.01	721.81	N/A	1 - C	16.91	3.32	4.59	0.0265	INLET	0.00	693.00

CULVERT ANALYSIS

PID : 19415 **Date :** 03/04/2013 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 749+33

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 823.00 **Outlet Invert Elevation (ft.) :** 768.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 775.00 **Culvert Slope (ft./ft.) :** 0.0710

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
121.00	55.87	827.95	N/A	1 - C	15.60	2.09	3.14	0.0271	INLET	0.00	768.00

CULVERT ANALYSIS

PID : 19415 **Date :** 05/07/2013 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 761+45

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 882.00 **Outlet Invert Elevation (ft.) :** 849.20

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 48 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 524.00 **Culvert Slope (ft./ft.) :** 0.0626

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
40.80	32.65	884.81	N/A	1 - C	11.11	1.33	1.91	0.0275	INLET	0.00	849.20

CULVERT ANALYSIS

PID : 19415 **Date :** 05/10/2013 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 766+00

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 866.73 **Outlet Invert Elevation (ft.) :** 788.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 48 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 605.00 **Culvert Slope (ft./ft.) :** 0.1301

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
59.70	79.11	870.28	N/A	1 - C	16.09	1.34	2.33	0.0275	INLET	0.00	788.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 771+00

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 859.00 **Outlet Invert Elevation (ft.) :** 790.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 773.00 **Culvert Slope (ft./ft.) :** 0.0893

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
97.90	69.34	863.25	N/A	1 - C	16.02	1.75	2.81	0.0271	INLET	0.00	790.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 796+06

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 857.00 **Outlet Invert Elevation (ft.) :** 766.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 66 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 632.00 **Culvert Slope (ft./ft.) :** 0.1440

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
80.00	90.62	860.60	N/A	1 - C	17.87	1.34	2.46	0.0269	INLET	0.00	766.00

CULVERT ANALYSIS

PID : 19415 **Date :** 05/07/2013 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 815+00

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 761.00 **Outlet Invert Elevation (ft.) :** 720.00

Pipe Quantity : 2

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 935.00 **Culvert Slope (ft./ft.) :** 0.0439

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
83.50	41.05	764.85	N/A	1 - C	11.85	1.94	2.59	0.0271	INLET	0.00	720.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2B **Location :** CULVERT STA 823+45

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 783.00 **Outlet Invert Elevation (ft.) :** 723.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 60 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 476.00 **Culvert Slope (ft./ft.) :** 0.1261

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
72.00	59.83	786.53	N/A	1 - C	16.61	1.36	2.40	0.0271	INLET	0.00	723.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2C **Location :** CULVERT STA 854+59

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 622.40 **Outlet Invert Elevation (ft.) :** 608.00

Pipe Quantity : 3

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 72 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 641.60 **Culvert Slope (ft./ft.) :** 0.0224

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
142.00	14.62	627.23	N/A	1 - C	10.70	2.86	3.23	0.0267	INLET	0.00	608.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2C **Location :** CULVERT STA 857+56

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 630.70 **Outlet Invert Elevation (ft.) :** 609.70

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 66 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 445.50 **Culvert Slope (ft./ft.) :** 0.0471

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
136.00	21.60	635.67	N/A	1 - C	13.88	2.37	3.25	0.0269	INLET	0.00	609.70

CULVERT ANALYSIS

PID : 19415 **Date :** 12/17/2012 **Project :** PORTSMOUTH BYPASS - 2C **Location :** CULVERT STA 869+02

Description : UPDATED CULVERT CALS **Designer :** YM

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 651.00 **Outlet Invert Elevation (ft.) :** 631.30

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 42 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 232.20 **Culvert Slope (ft./ft.) :** 0.0848

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
59.00	20.77	655.02	N/A	1 - C	13.70	1.61	2.41	0.0278	INLET	0.00	631.30

Summary for Subcatchment 6S: A1 (STA 578) EXISTING CONDITION

Runoff = 105.18 cfs @ 12.40 hrs, Volume= 13.546 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-35.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

	Area (ac)	CN	Description
*	62.260	61	
*	36.860	59	
	99.120	60	Weighted Average
	99.120		100.00% Pervious Area

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

Summary for Subcatchment 8S: A1 (STA 578) PROPOSED CONDITION

Runoff = 141.10 cfs @ 12.39 hrs, Volume= 17.383 af, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-35.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

	Area (ac)	CN	Description
*	42.410	64	
*	64.280	64	
	106.690	64	Weighted Average
	106.690		100.00% Pervious Area

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

Summary for Pond 7P: A1 (STA 578) POND

Inflow Area = 106.690 ac, 0.00% Impervious, Inflow Depth = 1.96" for 100-YEAR event
Inflow = 141.10 cfs @ 12.39 hrs, Volume= 17.383 af
Outflow = 103.41 cfs @ 12.63 hrs, Volume= 17.356 af, Atten= 27%, Lag= 14.9 min
Primary = 103.41 cfs @ 12.63 hrs, Volume= 17.356 af

Routing by Stor-Ind method, Time Span= 5.00-35.00 hrs, dt= 0.05 hrs
Peak Elev= 6.06' @ 12.63 hrs Surf.Area= 0.459 ac Storage= 2.784 af

Plug-Flow detention time= 31.3 min calculated for 17.327 af (100% of inflow)
Center-of-Mass det. time= 31.0 min (915.8 - 884.8)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	4.591 af	**200.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**50.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 13.64 sf

Primary OutFlow Max=103.28 cfs @ 12.63 hrs HW=6.05' (Free Discharge)
1=Culvert (Inlet Controls 103.28 cfs @ 7.57 fps)

Summary for Subcatchment 1S: A2 (STA 600) EXISTING DRAINAGE

Runoff = 38.21 cfs @ 12.36 hrs, Volume= 4.140 af, Depth> 1.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.570	61	>75% Grass cover, Good, HSG B
1.000	98	Paved parking, HSG A
22.780	55	Woods, Good, HSG B
8.910	70	Woods, Good, HSG C
34.260	60	Weighted Average
33.260		97.08% Pervious Area
1.000		2.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.3	217	0.1660	0.11		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.2600	8.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.9	1,167		5.00		**Direct Entry, CHANNEL**
36.8	1,684	Total			

Summary for Subcatchment 5S: A2 (STA 600) PROPOSED DRAINAGE

Runoff = 48.20 cfs @ 12.35 hrs, Volume= 5.049 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
5.440	61	>75% Grass cover, Good, HSG B
2.200	74	>75% Grass cover, Good, HSG C
3.600	98	Paved parking, HSG A
16.840	55	Woods, Good, HSG B
6.620	70	Woods, Good, HSG C
34.700	64	Weighted Average
31.100		89.63% Pervious Area
3.600		10.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.3	217	0.1660	0.11		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.2600	8.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.9	1,167		5.00		**Direct Entry, CHANNEL**
36.8	1,684	Total			

Summary for Pond 4P: A2 (STA 600) POND

Inflow Area = 34.700 ac, 10.37% Impervious, Inflow Depth > 1.75" for 100-YEAR event
Inflow = 48.20 cfs @ 12.35 hrs, Volume= 5.049 af
Outflow = 37.81 cfs @ 12.55 hrs, Volume= 4.890 af, Atten= 22%, Lag= 12.1 min
Primary = 37.81 cfs @ 12.55 hrs, Volume= 4.890 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 3.17' @ 12.55 hrs Surf.Area= 0.275 ac Storage= 0.874 af

Plug-Flow detention time= 27.6 min calculated for 4.890 af (97% of inflow)
Center-of-Mass det. time= 16.5 min (844.7 - 828.1)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.755 af	**120.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**38.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.88 sf

Primary OutFlow Max=37.75 cfs @ 12.55 hrs HW=3.17' (Free Discharge)
1=Culvert (Inlet Controls 37.75 cfs @ 4.79 fps)

Summary for Subcatchment 1S: A3 (STA 610) EXISTING DRAINAGE

Runoff = 9.83 cfs @ 12.34 hrs, Volume= 1.014 af, Depth> 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.460	61	>75% Grass cover, Good, HSG B
0.530	74	>75% Grass cover, Good, HSG C
2.590	55	Woods, Good, HSG B
2.700	70	Woods, Good, HSG C
7.280	63	Weighted Average
7.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.6	214	0.1360	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.3100	8.96		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	112		5.00		**Direct Entry, CHANNEL**
35.6	626	Total			

Summary for Subcatchment 5S: A3 (STA 610) PROPOSED DRAINAGE

Runoff = 7.99 cfs @ 12.32 hrs, Volume= 0.796 af, Depth> 2.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.630	61	>75% Grass cover, Good, HSG B
0.620	74	>75% Grass cover, Good, HSG C
0.230	55	Woods, Good, HSG B
1.310	70	Woods, Good, HSG C
0.500	98	Paved parking, HSG A
4.290	70	Weighted Average
3.790		88.34% Pervious Area
0.500		11.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.6	214	0.1360	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.3100	8.96		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	112		5.00		**Direct Entry, CHANNEL**
35.6	626	Total			

Summary for Subcatchment 6S: A4 (STA 618) EXISTING DRAINAGE

Runoff = 33.86 cfs @ 12.17 hrs, Volume= 2.551 af, Depth> 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
0.430	74	>75% Grass cover, Good, HSG C
0.820	98	Paved parking, HSG B
0.130	55	Woods, Good, HSG B
11.340	70	Woods, Good, HSG C
12.720	72	Weighted Average
11.900		93.55% Pervious Area
0.820		6.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	113	0.1410	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.3130	9.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.1	618		5.00		**Direct Entry, CHANNEL**
23.2	1,031	Total			

Summary for Subcatchment 1S: A4 (STA 618) PROPOSED DRAINAGE

Runoff = 41.90 cfs @ 12.16 hrs, Volume= 3.156 af, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
0.470	61	>75% Grass cover, Good, HSG B
4.530	74	>75% Grass cover, Good, HSG C
2.410	98	Paved parking, HSG B
0.100	55	Woods, Good, HSG B
6.220	70	Woods, Good, HSG C
13.730	76	Weighted Average
11.320		82.45% Pervious Area
2.410		17.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	113	0.1410	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.3130	9.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.1	618		5.00		**Direct Entry, CHANNEL**
23.2	1,031	Total			

Summary for Pond 4P: A4 (STA 618) POND

Inflow Area = 13.730 ac, 17.55% Impervious, Inflow Depth > 2.76" for 100-YEAR event
Inflow = 41.90 cfs @ 12.16 hrs, Volume= 3.156 af
Outflow = 33.73 cfs @ 12.28 hrs, Volume= 3.090 af, Atten= 19%, Lag= 7.2 min
Primary = 33.73 cfs @ 12.28 hrs, Volume= 3.090 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 3.08' @ 12.28 hrs Surf.Area= 0.165 ac Storage= 0.509 af

Plug-Flow detention time= 21.9 min calculated for 3.090 af (98% of inflow)
Center-of-Mass det. time= 13.8 min (810.6 - 796.8)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	1.653 af	**120.00'W x 60.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**36.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf

Primary OutFlow Max=33.60 cfs @ 12.28 hrs HW=3.06' (Free Discharge)
1=Culvert (Inlet Controls 33.60 cfs @ 4.75 fps)

Summary for Subcatchment 6S: A5 (STA 623) EXISTING DRAINAGE

Runoff = 51.24 cfs @ 12.22 hrs, Volume= 4.327 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.400	98	Paved parking, HSG B
20.220	70	Woods, Good, HSG C
21.620	72	Weighted Average
20.220		93.52% Pervious Area
1.400		6.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	151	0.1530	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.3600	9.66		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.4	713		5.00		**Direct Entry, CHANNEL**
27.9	1,164	Total			

Summary for Subcatchment 7S: A5 (STA 623) PROPOSED DRAINAGE

Runoff = 46.57 cfs @ 12.22 hrs, Volume= 3.929 af, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
4.810	74	>75% Grass cover, Good, HSG C
1.550	98	Paved parking, HSG B
12.590	70	Woods, Good, HSG C
18.950	73	Weighted Average
17.400		91.82% Pervious Area
1.550		8.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	151	0.1530	0.10		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.3600	9.66		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.4	713		5.00		**Direct Entry, CHANNEL**
27.9	1,164	Total			

Summary for Subcatchment 6S: A6 (STA 636) EXISTING DRAINAGE

Runoff = 115.21 cfs @ 12.17 hrs, Volume= 8.771 af, Depth> 2.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
0.010	55	Woods, Good, HSG B
47.040	70	Woods, Good, HSG C
47.050	70	Weighted Average
47.050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	135	0.2520	0.12		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.3200	9.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.3	1,298		5.00		**Direct Entry, CHANNEL**
23.5	1,733	Total			

Summary for Subcatchment 8S: A6 (STA 636) PROPOSED DRAINAGE

Runoff = 133.46 cfs @ 12.17 hrs, Volume= 10.127 af, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
13.020	74	>75% Grass cover, Good, HSG C
3.470	98	Paved parking, HSG A
0.010	55	Woods, Good, HSG B
32.260	70	Woods, Good, HSG C
48.760	73	Weighted Average
45.290		92.88% Pervious Area
3.470		7.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	135	0.2520	0.12		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.3200	9.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.3	1,298		5.00		**Direct Entry, CHANNEL**
23.5	1,733	Total			

Summary for Pond 4P: A6 (STA 636) POND

Inflow Area = 48.760 ac, 7.12% Impervious, Inflow Depth > 2.49" for 100-YEAR event
Inflow = 133.46 cfs @ 12.17 hrs, Volume= 10.127 af
Outflow = 113.42 cfs @ 12.27 hrs, Volume= 10.056 af, Atten= 15%, Lag= 6.2 min
Primary = 113.42 cfs @ 12.27 hrs, Volume= 10.056 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 9.17' @ 12.27 hrs Surf.Area= 0.103 ac Storage= 0.947 af

Plug-Flow detention time= 8.2 min calculated for 10.022 af (99% of inflow)
Center-of-Mass det. time= 5.5 min (807.9 - 802.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	1.033 af	**100.00'W x 45.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**45.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 11.04 sf

Primary OutFlow Max=112.79 cfs @ 12.27 hrs HW=9.09' (Free Discharge)
1=Culvert (Inlet Controls 112.79 cfs @ 10.21 fps)

Summary for Subcatchment 6S: A8 (STA 660) EXISTING DRAINAGE

Runoff = 139.14 cfs @ 12.26 hrs, Volume= 13.841 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
67.500	70	Woods, Good, HSG C
67.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	175	0.2230	0.12		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.4200	10.43		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.0	1,798		5.00		**Direct Entry, CHANNEL**
30.7	2,273	Total			

Summary for Subcatchment 8S: A8 (STA 660) PROPOSED DRAINAGE

Runoff = 203.78 cfs @ 12.26 hrs, Volume= 20.067 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
61.240	70	Woods, Good, HSG C
5.450	98	Paved parking, HSG A
21.600	74	>75% Grass cover, Good, HSG C
88.290	73	Weighted Average
82.840		93.83% Pervious Area
5.450		6.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	175	0.2230	0.12		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.4200	10.43		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.0	1,798		5.00		**Direct Entry, CHANNEL**
30.7	2,273	Total			

Summary for Pond 4P: A8 (STA 660) POND

Inflow Area = 88.290 ac, 6.17% Impervious, Inflow Depth = 2.73" for 100-YEAR event
Inflow = 203.78 cfs @ 12.26 hrs, Volume= 20.067 af
Outflow = 138.31 cfs @ 12.48 hrs, Volume= 19.986 af, Atten= 32%, Lag= 13.1 min
Primary = 138.31 cfs @ 12.48 hrs, Volume= 19.986 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 6.59' @ 12.48 hrs Surf.Area= 0.597 ac Storage= 3.934 af

Plug-Flow detention time= 36.3 min calculated for 19.986 af (100% of inflow)
Center-of-Mass det. time= 33.8 min (888.3 - 854.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5.969 af	**200.00'W x 130.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**57.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 17.72 sf

Primary OutFlow Max=138.05 cfs @ 12.48 hrs HW=6.58' (Free Discharge)
1=Culvert (Inlet Controls 138.05 cfs @ 7.79 fps)

Summary for Subcatchment 1S: B1 (STA 675) EXISTING DRAINAGE

Runoff = 45.11 cfs @ 12.32 hrs, Volume= 4.439 af, Depth> 2.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
23.930	70	Woods, Good, HSG C
23.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.0	300	0.3267	0.16		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.4683	11.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	738		5.00		**Direct Entry, CHANNEL**
35.0	1,338	Total			

Summary for Subcatchment 5S: B1(STA 675) PROPOSED DRAINAGE

Runoff = 69.11 cfs @ 12.31 hrs, Volume= 6.756 af, Depth> 2.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
10.260	74	>75% Grass cover, Good, HSG C
2.990	98	Paved parking, HSG A
18.319	70	Woods, Good, HSG C
31.569	74	Weighted Average
28.579		90.53% Pervious Area
2.990		9.47% Impervious Area

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

Summary for Pond 4P: B1(STA 600) POND

Inflow Area = 31.569 ac, 9.47% Impervious, Inflow Depth > 2.57" for 100-YEAR event
Inflow = 69.11 cfs @ 12.31 hrs, Volume= 6.756 af
Outflow = 44.98 cfs @ 12.57 hrs, Volume= 6.582 af, Atten= 35%, Lag= 15.9 min
Primary = 44.98 cfs @ 12.57 hrs, Volume= 6.582 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.34' @ 12.57 hrs Surf.Area= 0.275 ac Storage= 1.472 af

Plug-Flow detention time= 29.4 min calculated for 6.582 af (97% of inflow)
Center-of-Mass det. time= 19.9 min (829.4 - 809.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.755 af	**120.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**33.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 5.94 sf

Primary OutFlow Max=44.91 cfs @ 12.57 hrs HW=5.33' (Free Discharge)
1=Culvert (Inlet Controls 44.91 cfs @ 7.56 fps)

Summary for Subcatchment 1S: B3 (STA 700) EXISTING DRAINAGE

Runoff = 94.74 cfs @ 12.40 hrs, Volume= 10.462 af, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
56.550	70	Woods, Good, HSG C
56.550		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.6	300	0.2333	0.14		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.4	1,328		5.00		**Direct Entry, CHANNEL**
41.5	1,928	Total			

Summary for Subcatchment 5S: B3 (STA 700) PROPOSED DRAINAGE

Runoff = 106.67 cfs @ 12.39 hrs, Volume= 11.707 af, Depth> 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
18.992	74	>75% Grass cover, Good, HSG C
3.935	98	Paved parking, HSG A
33.848	70	Woods, Good, HSG C
56.775	73	Weighted Average
52.840		93.07% Pervious Area
3.935		6.93% Impervious Area

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

Summary for Pond 4P: B3 (STA 700) POND

Inflow Area = 56.775 ac, 6.93% Impervious, Inflow Depth > 2.47" for 100-YEAR event
Inflow = 106.67 cfs @ 12.39 hrs, Volume= 11.707 af
Outflow = 94.30 cfs @ 12.55 hrs, Volume= 11.503 af, Atten= 12%, Lag= 9.2 min
Primary = 94.30 cfs @ 12.55 hrs, Volume= 11.503 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.00' @ 12.55 hrs Surf.Area= 0.275 ac Storage= 1.376 af

Plug-Flow detention time= 17.6 min calculated for 11.465 af (98% of inflow)
Center-of-Mass det. time= 11.3 min (827.6 - 816.3)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.755 af	**120.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**52.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 14.75 sf

Primary OutFlow Max=94.24 cfs @ 12.55 hrs HW=4.99' (Free Discharge)
1=Culvert (Inlet Controls 94.24 cfs @ 6.39 fps)

Summary for Subcatchment 13S: B4 (STA 715) EXISTING CONDITION

Runoff = 275.69 cfs @ 12.51 hrs, Volume= 34.605 af, Depth> 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

	Area (ac)	CN	Description
*	33.310	71	B4
*	45.930	73	B4A
*	28.090	75	B5
*	61.120	73	B5A
	168.450	73	Weighted Average
	168.450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.4	300	0.1933	0.13		**Sheet Flow, B5A** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.4067	10.27		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.6	1,683		5.00		**Direct Entry,**
4.9	1,482		5.00		**Direct Entry,**
50.4	3,765	Total			

Summary for Subcatchment 9S: B4 (STA 715) PROPOSED CONDITION

Runoff = 335.86 cfs @ 12.50 hrs, Volume= 42.099 af, Depth> 2.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

	Area (ac)	CN	Description
*	36.404	74	B4
*	45.920	73	B4A
*	54.229	77	B5
*	61.400	73	B5A
	197.953	74	Weighted Average
	197.953		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.4					**Direct Entry, B5A**

Summary for Pond 15P: B4 COMBINED POND

Inflow Area = 197.953 ac, 0.00% Impervious, Inflow Depth > 2.55" for 100-YEAR event
Inflow = 335.86 cfs @ 12.50 hrs, Volume= 42.099 af
Outflow = 276.84 cfs @ 12.74 hrs, Volume= 40.253 af, Atten= 18%, Lag= 14.3 min
Primary = 276.84 cfs @ 12.74 hrs, Volume= 40.253 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 4.68' @ 12.74 hrs Surf.Area= 1.837 ac Storage= 8.600 af

Plug-Flow detention time= 40.0 min calculated for 40.253 af (96% of inflow)
Center-of-Mass det. time= 24.9 min (846.2 - 821.4)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	18.365 af	**200.00'W x 400.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**210.0" Round Culvert** L= 200.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 240.53 sf

Primary OutFlow Max=276.52 cfs @ 12.74 hrs HW=4.68' (Free Discharge)
↑**1=Culvert** (Barrel Controls 276.52 cfs @ 8.04 fps)

Summary for Subcatchment 1S: B5 (STA 750) EXISTING DRAINAGE

Runoff = 85.92 cfs @ 12.40 hrs, Volume= 9.530 af, Depth> 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.770	74	>75% Grass cover, Good, HSG C
5.190	80	>75% Grass cover, Good, HSG D
0.930	98	Paved parking, HSG A
31.310	70	Woods, Good, HSG C
7.030	77	Woods, Good, HSG D
46.230	73	Weighted Average
45.300		97.99% Pervious Area
0.930		2.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.7	300	0.0567	0.13		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 2.72"
0.5	300	0.3200	9.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	1,146		5.00		**Direct Entry, CHANNEL**
42.0	1,746	Total			

Summary for Subcatchment 5S: B5 (STA 750) PROPOSED DRAINAGE

Runoff = 103.33 cfs @ 12.40 hrs, Volume= 11.439 af, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
15.923	74	>75% Grass cover, Good, HSG C
5.622	80	>75% Grass cover, Good, HSG D
3.777	98	Paved parking, HSG A
19.877	70	Woods, Good, HSG C
6.620	77	Woods, Good, HSG D
51.819	75	Weighted Average
48.042		92.71% Pervious Area
3.777		7.29% Impervious Area

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

Summary for Pond 4P: B7 (STA 750) POND

Inflow Area = 51.819 ac, 7.29% Impervious, Inflow Depth > 2.65" for 100-YEAR event
Inflow = 103.33 cfs @ 12.40 hrs, Volume= 11.439 af
Outflow = 85.79 cfs @ 12.59 hrs, Volume= 11.234 af, Atten= 17%, Lag= 11.7 min
Primary = 85.79 cfs @ 12.59 hrs, Volume= 11.234 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.74' @ 12.59 hrs Surf.Area= 0.275 ac Storage= 1.581 af

Plug-Flow detention time= 19.5 min calculated for 11.234 af (98% of inflow)
Center-of-Mass det. time= 12.9 min (826.1 - 813.2)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.755 af	**120.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**46.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 11.54 sf

Primary OutFlow Max=85.70 cfs @ 12.59 hrs HW=5.73' (Free Discharge)
1=Culvert (Inlet Controls 85.70 cfs @ 7.43 fps)

Summary for Subcatchment 1S: B6 (STA 770) EXISTING DRAINAGE

Runoff = 107.45 cfs @ 12.36 hrs, Volume= 11.323 af, Depth> 2.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.860	80	>75% Grass cover, Good, HSG D
1.500	98	Paved parking, HSG A
45.840	70	Woods, Good, HSG C
7.630	77	Woods, Good, HSG D
56.830	72	Weighted Average
55.330		97.36% Pervious Area
1.500		2.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.5	300	0.2518	0.14		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.5	300	0.3848	9.99		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.9	856		5.00		**Direct Entry, CHANNEL**
38.9	1,456	Total			

Summary for Subcatchment 5S: B6 (STA 770) PROPOSED DRAINAGE

Runoff = 133.02 cfs @ 12.36 hrs, Volume= 13.967 af, Depth> 2.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
20.763	74	>75% Grass cover, Good, HSG C
4.948	80	>75% Grass cover, Good, HSG D
7.157	98	Paved parking, HSG A
21.671	70	Woods, Good, HSG C
6.591	77	Woods, Good, HSG D
61.130	76	Weighted Average
53.973		88.29% Pervious Area
7.157		11.71% Impervious Area

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

Summary for Pond 4P: B8 (STA 770) POND

Inflow Area = 61.130 ac, 11.71% Impervious, Inflow Depth > 2.74" for 100-YEAR event
Inflow = 133.02 cfs @ 12.36 hrs, Volume= 13.967 af
Outflow = 107.68 cfs @ 12.55 hrs, Volume= 13.745 af, Atten= 19%, Lag= 11.6 min
Primary = 107.68 cfs @ 12.55 hrs, Volume= 13.745 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 7.08' @ 12.55 hrs Surf.Area= 0.275 ac Storage= 1.951 af

Plug-Flow detention time= 18.1 min calculated for 13.700 af (98% of inflow)
Center-of-Mass det. time= 12.2 min (821.2 - 809.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.755 af	**120.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 12.57 sf

Primary OutFlow Max=107.68 cfs @ 12.55 hrs HW=7.08' (Free Discharge)
1=Culvert (Inlet Controls 107.68 cfs @ 8.57 fps)

Summary for Subcatchment 1S: B8 (STA 795) EXISTING DRAINAGE

Runoff = 36.75 cfs @ 12.50 hrs, Volume= 4.636 af, Depth> 1.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.290	98	Paved parking, HSG A
20.218	55	Woods, Good, HSG B
0.350	70	Woods, Good, HSG C
10.180	77	Woods, Good, HSG D
32.038	64	Weighted Average
30.748		95.97% Pervious Area
1.290		4.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.2	300	0.1373	0.11		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.3173	9.07		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.3	702		5.00		**Direct Entry, CHANNEL**
48.1	1,302	Total			

Summary for Subcatchment 5S: B8 (STA 795) PROPOSED DRAINAGE

Runoff = 42.74 cfs @ 12.48 hrs, Volume= 5.256 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
10.662	61	>75% Grass cover, Good, HSG B
0.407	74	>75% Grass cover, Good, HSG C
1.605	80	>75% Grass cover, Good, HSG D
3.993	98	Paved parking, HSG A
6.408	55	Woods, Good, HSG B
0.469	70	Woods, Good, HSG C
6.054	77	Woods, Good, HSG D
29.598	69	Weighted Average
25.605		86.51% Pervious Area
3.993		13.49% Impervious Area

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

Summary for Pond 4P: B9 (STA 795) POND

Inflow Area = 29.598 ac, 13.49% Impervious, Inflow Depth > 2.13" for 100-YEAR event
Inflow = 42.74 cfs @ 12.48 hrs, Volume= 5.256 af
Outflow = 36.34 cfs @ 12.69 hrs, Volume= 5.100 af, Atten= 15%, Lag= 12.7 min
Primary = 36.34 cfs @ 12.69 hrs, Volume= 5.100 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 3.04' @ 12.69 hrs Surf.Area= 0.275 ac Storage= 0.836 af

Plug-Flow detention time= 27.3 min calculated for 5.083 af (97% of inflow)
Center-of-Mass det. time= 16.9 min (845.0 - 828.1)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.755 af	**120.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**38.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.88 sf

Primary OutFlow Max=36.34 cfs @ 12.69 hrs HW=3.03' (Free Discharge)
1=Culvert (Inlet Controls 36.34 cfs @ 4.68 fps)

Summary for Subcatchment 1S: B9 (STA 810) EXISTING DRAINAGE

Runoff = 95.15 cfs @ 12.43 hrs, Volume= 10.916 af, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
0.880	98	Paved parking, HSG A
5.290	55	Woods, Good, HSG B
48.710	70	Woods, Good, HSG C
4.180	77	Woods, Good, HSG D
59.060	70	Weighted Average
58.180		98.51% Pervious Area
0.880		1.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
37.7	300	0.2167	0.13		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.2567	8.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.4	1,621		5.00		**Direct Entry, CHANNEL**
43.7	2,221	Total			

Summary for Subcatchment 5S: B9 (STA 810) PROPOSED DRAINAGE

Runoff = 112.49 cfs @ 12.42 hrs, Volume= 12.808 af, Depth> 2.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
0.714	61	>75% Grass cover, Good, HSG B
13.706	74	>75% Grass cover, Good, HSG C
4.827	80	>75% Grass cover, Good, HSG D
5.189	98	Paved parking, HSG A
5.290	55	Woods, Good, HSG B
31.221	70	Woods, Good, HSG C
1.227	77	Woods, Good, HSG D
62.174	73	Weighted Average
56.985		91.65% Pervious Area
5.189		8.35% Impervious Area

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

Summary for Pond 4P: B10 (STA 810) POND

Inflow Area = 62.174 ac, 8.35% Impervious, Inflow Depth > 2.47" for 100-YEAR event
Inflow = 112.49 cfs @ 12.42 hrs, Volume= 12.808 af
Outflow = 95.24 cfs @ 12.61 hrs, Volume= 12.589 af, Atten= 15%, Lag= 11.5 min
Primary = 95.24 cfs @ 12.61 hrs, Volume= 12.589 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.98' @ 12.61 hrs Surf.Area= 0.275 ac Storage= 1.646 af

Plug-Flow detention time= 18.1 min calculated for 12.589 af (98% of inflow)
Center-of-Mass det. time= 11.8 min (829.8 - 818.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.755 af	**120.00'W x 100.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 100.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 0.00' / -1.00' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 12.57 sf

Primary OutFlow Max=95.12 cfs @ 12.61 hrs HW=5.96' (Free Discharge)
1=Culvert (Inlet Controls 95.12 cfs @ 7.57 fps)

Summary for Subcatchment 1S: B10 (STA 825) EXISTING DRAINAGE

Runoff = 38.19 cfs @ 12.26 hrs, Volume= 3.417 af, Depth> 2.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.870	55	Woods, Good, HSG B
17.220	70	Woods, Good, HSG C
19.090	69	Weighted Average
19.090		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.0	300	0.4534	0.18		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.72"
0.6	300	0.2933	8.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.6	480		5.00		**Direct Entry, CHANNEL**
30.2	1,080	Total			

Summary for Subcatchment 5S: B10 (STA 825) PROPOSED DRAINAGE

Runoff = 36.07 cfs @ 12.25 hrs, Volume= 3.208 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
0.000	61	>75% Grass cover, Good, HSG B
4.929	74	>75% Grass cover, Good, HSG C
1.280	98	Paved parking, HSG A
1.719	55	Woods, Good, HSG B
8.115	70	Woods, Good, HSG C
16.043	72	Weighted Average
14.763		92.02% Pervious Area
1.280		7.98% Impervious Area

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

Summary for Subcatchment 20S: C1 (STA 851) EX Drainage Area

Runoff = 23.14 cfs @ 12.23 hrs, Volume= 2.156 af, Depth> 2.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
9.890	72	Woods/grass comb., Good, HSG C
9.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.0	300	0.5500	0.19		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.70"
0.5	300	0.4000	10.18		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.0	589		5.00		**Direct Entry,**
28.5	1,189	Total			

Summary for Subcatchment 21S: C1 (STA 851) Proposed Drainage Area

Runoff = 48.89 cfs @ 12.26 hrs, Volume= 4.793 af, Depth> 2.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
1.900	98	Paved parking, HSG A
16.200	72	Woods/grass comb., Good, HSG C
3.900	58	Woods/grass comb., Good, HSG B
22.000	72	Weighted Average
20.100		91.36% Pervious Area
1.900		8.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	300	0.5300	0.19		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.70"
0.5	230	0.2600	8.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.0	1,207		5.00		**Direct Entry,**
30.9	1,737	Total			

Summary for Pond 22P: C1 (STA 851) Pond - South Side

Inflow Area = 22.000 ac, 8.64% Impervious, Inflow Depth > 2.61" for 100-YEAR event
Inflow = 48.89 cfs @ 12.26 hrs, Volume= 4.793 af
Outflow = 22.49 cfs @ 12.62 hrs, Volume= 4.698 af, Atten= 54%, Lag= 21.6 min
Primary = 22.49 cfs @ 12.62 hrs, Volume= 4.698 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 5.42' @ 12.62 hrs Surf.Area= 0.312 ac Storage= 1.258 af

Plug-Flow detention time= 38.5 min calculated for 4.694 af (98% of inflow)
Center-of-Mass det. time= 27.2 min (879.0 - 851.8)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	2.176 af	**70.00'W x 100.00'L x 8.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**20.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 0.00' / -0.10' S= 0.0050 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 2.18 sf

Primary OutFlow Max=22.49 cfs @ 12.62 hrs HW=5.42' (Free Discharge)
↑**1=Culvert** (Inlet Controls 22.49 cfs @ 10.31 fps)

Summary for Subcatchment 20S: C2 (STA 855) Existing Drainage Area

Runoff = 478.37 cfs @ 12.40 hrs, Volume= 58.225 af, Depth> 2.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
5.690	98	Paved parking, HSG A
2.580	98	Water Surface, HSG A
86.760	58	Woods/grass comb., Good, HSG B
203.090	72	Woods/grass comb., Good, HSG C
298.120	69	Weighted Average
289.850		97.23% Pervious Area
8.270		2.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.0	300	0.5000	0.18		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.70"
0.6	300	0.2800	8.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
14.2	4,258		5.00		**Direct Entry, channel**
41.8	4,858	Total			

Summary for Subcatchment 21S: C2 (STA 855) Proposed Drainage Area

Runoff = 468.25 cfs @ 12.40 hrs, Volume= 56.992 af, Depth> 2.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
11.460	98	Paved parking, HSG A
2.580	98	Water Surface, HSG A
83.680	58	Woods/grass comb., Good, HSG B
194.090	72	Woods/grass comb., Good, HSG C
291.810	69	Weighted Average
277.770		95.19% Pervious Area
14.040		4.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.0	300	0.5000	0.18		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.70"
0.6	300	0.2800	8.52		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
14.2	4,258		5.00		**Direct Entry,**
41.8	4,858	Total			

Summary for Subcatchment 20S: C3 (STA 869) Existing Drainage Area

Runoff = 39.34 cfs @ 12.29 hrs, Volume= 4.077 af, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
12.390	69	Pasture/grassland/range, Fair, HSG B
0.530	79	Pasture/grassland/range, Fair, HSG C
8.680	65	Woods/grass comb., Fair, HSG B
21.600	68	Weighted Average
21.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.5	300	0.1100	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.70"
1.4	300	0.0480	3.53		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.8	839		5.00		**Direct Entry,**
32.7	1,439	Total			

Summary for Subcatchment 21S: C3 (STA 869) Proposed Drainage Area

Runoff = 38.38 cfs @ 12.32 hrs, Volume= 4.180 af, Depth> 2.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
2.240	98	Paved parking, HSG A
10.840	69	Pasture/grassland/range, Fair, HSG B
0.540	79	Pasture/grassland/range, Fair, HSG C
6.270	65	Woods/grass comb., Fair, HSG B
19.890	71	Weighted Average
17.650		88.74% Pervious Area
2.240		11.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.6	300	0.0850	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.70"
1.4	300	0.0480	3.53		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.8	838		5.00		**Direct Entry,**
35.8	1,438	Total			

Summary for Subcatchment 20S: C4 (STA 895) Existing Drainage Area

Runoff = 26.93 cfs @ 12.32 hrs, Volume= 3.003 af, Depth> 1.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
12.190	61	Pasture/grassland/range, Good, HSG B
1.470	98	Paved parking, HSG A
5.790	58	Woods/grass comb., Good, HSG B
19.450	63	Weighted Average
17.980		92.44% Pervious Area
1.470		7.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.5	118	0.0170	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.70"
0.4	162	0.1600	6.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.6	1,683		5.00		**Direct Entry,**
34.5	1,963	Total			

Summary for Subcatchment 21S: C4 (STA 895) Proposed Drainage Area

Runoff = 47.36 cfs @ 12.39 hrs, Volume= 5.780 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
7.410	61	Pasture/grassland/range, Good, HSG B
6.140	98	Paved parking, HSG A
19.610	58	Woods/grass comb., Good, HSG B
33.160	66	Weighted Average
27.020		81.48% Pervious Area
6.140		18.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	300	0.0870	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.70"
0.9	284	0.1000	5.09		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.6	2,591		5.00		**Direct Entry,**
40.8	3,175	Total			

Summary for Pond 22P: C4 (STA 895) Pond

Inflow Area = 33.160 ac, 18.52% Impervious, Inflow Depth > 2.09" for 100-YEAR event
Inflow = 47.36 cfs @ 12.39 hrs, Volume= 5.780 af
Outflow = 22.43 cfs @ 12.87 hrs, Volume= 5.665 af, Atten= 53%, Lag= 28.8 min
Primary = 22.43 cfs @ 12.87 hrs, Volume= 5.665 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 5.39' @ 12.87 hrs Surf.Area= 0.392 ac Storage= 1.450 af

Plug-Flow detention time= 40.0 min calculated for 5.665 af (98% of inflow)
Center-of-Mass det. time= 29.1 min (902.3 - 873.2)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	1.698 af	**50.00'W x 140.00'L x 6.00'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**20.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 0.00' / -0.10' S= 0.0050 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 2.18 sf

Primary OutFlow Max=22.43 cfs @ 12.87 hrs HW=5.39' (Free Discharge)
1=Culvert (Inlet Controls 22.43 cfs @ 10.28 fps)

Summary for Subcatchment 20S: C5 (STA 900) EX Drainage Area

Runoff = 93.94 cfs @ 12.46 hrs, Volume= 12.414 af, Depth> 2.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
9.410	98	Paved parking, HSG A
22.580	61	>75% Grass cover, Good, HSG B
14.760	74	>75% Grass cover, Good, HSG C
10.210	70	Woods, Good, HSG C
0.310	55	Woods, Good, HSG B
57.270	72	Weighted Average
47.860		83.57% Pervious Area
9.410		16.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.6	300	0.2700	0.14		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.70"
0.7	300	0.2100	7.38		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.2	3,653		5.00		**Direct Entry,**
47.5	4,253	Total			

Summary for Subcatchment 21S: C5 (STA 900) PROPOSED Drainage Area

Runoff = 108.80 cfs @ 12.46 hrs, Volume= 14.325 af, Depth> 2.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-YEAR Rainfall=5.56"

Area (ac)	CN	Description
12.980	98	Paved parking, HSG A
23.170	61	>75% Grass cover, Good, HSG B
17.220	74	>75% Grass cover, Good, HSG C
10.210	70	Woods, Good, HSG C
0.310	55	Woods, Good, HSG B
63.890	73	Weighted Average
50.910		79.68% Pervious Area
12.980		20.32% Impervious Area

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

Summary for Pond 22P: C5 (STA 900) POND

Inflow Area = 63.890 ac, 20.32% Impervious, Inflow Depth > 2.69" for 100-YEAR event
Inflow = 108.80 cfs @ 12.46 hrs, Volume= 14.325 af
Outflow = 92.51 cfs @ 12.67 hrs, Volume= 13.983 af, Atten= 15%, Lag= 12.6 min
Primary = 92.51 cfs @ 12.67 hrs, Volume= 13.983 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 3.04' @ 12.67 hrs Surf.Area= 0.843 ac Storage= 2.325 af

Plug-Flow detention time= 34.4 min calculated for 13.983 af (98% of inflow)
Center-of-Mass det. time= 21.1 min (883.0 - 861.9)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	3.158 af	**150.00'W x 200.00'L x 4.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**120.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 0.00' / -0.40' S= 0.0200 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 78.54 sf

Primary OutFlow Max=92.49 cfs @ 12.67 hrs HW=3.04' (Free Discharge)
↑**1=Culvert** (Barrel Controls 92.49 cfs @ 6.86 fps)