NINE PONDS SITE

CONCEPTUAL
STORMWATER MANAGEMENT
COMPUTATIONS

June 7, 2011

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PROJECT DESCRIPTION

The Town of University Park recently authorized Loiederman Soltesz Associates (LSA) to study the flooding and various storm events along Wells Run from Belcrest Road in Hyattsville to the connection with the North East branch in Riverdale Park (study area is approximately 12,000 linear feet). Wells Run is a stream that flows in a variety of conditions which include culverts under roads, concrete ditches, and cuts in stream flow. LSA evaluated the FEMA flood elevations, approved Prince George's county flood plain and the county-run topography to determine where the major flooding events along Wells Run are occurring. The intent was to determine where the significant flooding problems existed and to project a possible solution for those problems. As an aside, it was also noted during this evaluation that there are multiple structures and houses located in the 100 year floodplain established by Prince George's County.

The flooding along Wells Run is due to the increase of impervious area without the concurrent construction of compensatory stormwater and flood control devices. This was a common event during the suburbanization and growth of Prince George's County last century. The increase in impervious area is due to the construction of single-family residential, retail, commercial, and multi-family development. Most of the construction occurred prior to the 1994 storm water management regulations. Without storm water management in place it is common for large impervious areas to experience the generation of a large volume of water in a very short time frame, creating the high velocity, high volume wash outs currently being experienced in the Wells Run watershed.

After reviewing the existing site constraints, and at the suggestion of members of University Park, LSA evaluated the use of the 9 Pond site for relief of existing downstream flooding events. In order to determine the best design, LSA discussed the type of flooding and the future plans for Wells Run with the adjacent municipalities. It was determined that the stream flow through University Park is a standard flooding issue while in Riverdale Park it is more of an issue of aging infrastructure and a desire to restore the stream to a more natural condition. Based on this information, LSA determined that the solution that best fits the desired goals of flood control and stream naturalization was a solution that allowed for a reduction of the intense volume and velocity of water discharge at an optimal point while still allowing for a larger continuous base flow. This solution is intended to reduce the 2, 10 and 100 year storm events to the maximum extent possible. Because this proposed solution will also maintain the base flow in the 9 pond location, the pond will be designed for only Quantity Control, not Quality Control measures. Thus, because there will be no permanent pool associated with the 9 Pond solution, the upstream property owners will still need to provide a design for channel protection and water quality volume on any site that undergoes redevelopment.

In addition to the municipalities of University Park, Riverdale Park, and Hyattsville there are private landowner stakeholders that contribute drainage area to the Wells Run flooding concern. The major up-stream contributors include the Landy Property, University Town Center, the Belcrest Apartment site and Prince George's Plaza mall site. As part of the Detail Site Plan process the Belcrest Apartment site and the Landy

property met separately with University Park and PG DPW&T to discuss the issue of downstream flooding. As part of their approved SWM Concept plans, both sites are required to provide 100 year control onsite or at the 9 Pond site. With the construction of the 9 Pond site these stakeholders would not be required to provide 100 year control on their individual sites. Conversely if they provide 100 year control on site in any fashion, these redevelopment sites would not, from a regulatory and jurisdictional development approval aspect, need to participate in the 9 Pond flood control proposal. Currently, each of the above mentioned private landowners have plans to redevelop at some point. However, the timing on these redevelopment proposals is varied. Consistent amongst the desire to redevelop is the desire to gain significant additional density during the redevelopment process and so each property owner is required to, and appears to desire to address the 100 year stormwater management issue in the most efficient, and timely manner to meet the public facility requirement for storm water management.

Design Considerations

The 9 Pond site was identified early in the study as a possible location for a flood control measure in that the 9 Pond site is a reasonable location for a Wells Run flood event control measure. The site uses the area of land within the limit of the 100 year floodplain on property owned by the University Town Center to reduce the requirement to encumber otherwise developable land located on property owned by private property owners. The attached Drainage Area Map reflects several items of importance to the flooding concern. First, it identifies the overall drainage area and the 2 study points that are quantified in the attached TR-20 report. It also identifies the 100 year floodplain limits. The 9 Pond site has the advantage of being situated in a location that is able to control the stormwater runoff from each of the upstream redevelopment sites. This location allows it to capture approximately one third of the drainage area received by POI –B. In addition the captured drainage area is undoubtedly the most impervious of the contributing drainage area. However, the location is unable to control runoff contributed by the existing single family dwellings within the boundary of University Park as this portion of the drainage area is downstream of the proposed 9 Pond Stormwater Management facility. Additional design constraints include the amount of topography elevation change from the high point of the upstream portion of the drainage to POI-A, the location of the proposed pond outfall. The outfall structure itself is limited in design due to the need to cross the exiting Adelphi road.

HYDRAULIC ANALYSIS

LSA defined two Points of Investigation (POI) – POI-A and POI-B. POI-A is located at the outfall of the Pond. The total drainage area to POI-A is 260.70 acres. POI-B, which is downstream from POI-A, is located in University Park where the flooding occurs. The total drainage area to POI-B is 601 acres. If discharge at POI-A can be reduced significantly by constructing the pond, then POI-B will directly benefit from it.

In order to maximize the storage volume of the pond, two cells are proposed – Pond 1A and Pond 1B. Pond 1A and Pond 1B are connected by a 42” RCP underdrain and an

overflow at the top of the dam. At the outfall of the pond, we also proposed 42" RCP outfall with a controller structure, which contains staged weir openings and an emergency spillway to release the runoff at a slower pace.

Based on the zoning requirement and the new landscape manual, we made a conservative assumption of 85% impervious percentage for the drainage area to POI-A. From our past experience, the impervious percentage is usually less than 85% because of the green space that is usually needed for grading, environmental site design facilities and landscaping. TR-20 methodology was used to evaluate how much discharge the pond can reduce. The results are listed below:

	1-yr Q (cfs)	2-yr Q (cfs)	10-yr Q (cfs)	100-yr Q (cfs)
Before (POI-B)	685	921	1,745	2,639
Before (POI-A)	506	635	1,061	1,506
After (POI-A)	80	127	453	864
Net Reduction	426	508	608	642
% of Reduction (POI-A)	84%	80%	57%	43%
% of Reduction (POI-B)	62%	55%	35%	24%

After the installation of the pond, the discharges on all four storm events can be reduced significantly at POI-B – ranges from **62% reduction** for a 1-year storm event to **24% reduction** on a 100-year storm event, which could potentially reduce the flooding condition significantly at University Park.

FUTURE EFFORTS

As has been discussed there are a variety of approvals required in order to gain the necessary rights to construct the proposed 9 Pond as designed. The following is a discussion of the various approvals, which agencies have jurisdictional control over that approval and how it fits within the larger scheme. In addition, we have provided a timeline should the project move forward into the design stage. This timeline helps to identify critical path design and review elements as well as identifying the length of time in design and the length of time the project is spent in review.

Conceptual Stormwater Management Plan

Initial design efforts require the completion of a (or revision of an existing) Stormwater Management Concept plan for the University Town Center site. This plan will seek to achieve the approval of the concept of a surface Stormwater Management facility within the wooded 100 year floodplain for the 9 Pond site located on the University Town Center property. This submittal will be made to the **Prince George's County Department of Public Works and Transportation** (DPW&T) for their review and approval. Generally, this type of surface facility is no longer allowed in the State of Maryland unless there are mitigating circumstances (such as the circumstances surrounding the 9 Pond concept) and the approval of the Concept Plan will cement the

local jurisdictional desire to solve the Wells Run issue by use of traditional flood control measure such as the type of surface facility discussed in the 9 Ponds concept.
Note that courtesy dictates that a concurrent submission to the City of Hyattsville is in order.

Natural Resource Inventory
The Natural Resource Inventory (NRI) is submitted to the **Maryland National Capital Park and Planning Commission** (MNCPPC). This document identifies, at the local level, the location of the jurisdictional non tidal wetlands, the 100 year floodplain, steep slopes, perennial streams and other environmental elements that are regulated by MNCPPC on behalf of the county. This plan does not identify the nature of any future construction activities on the project site; it merely sets the area of a project site that can be "developed" without disturbance of protected environmental features as administered by MNCPPC. This document is an administrative document and does not require a public hearing.

Detailed Site Plan
The Detailed Site Plan (DSP) is submitted to the **Maryland National Capital Park and Planning Commission** (MNCPPC).This document identifies the construction activity proposed on the site and allows MNCPPC to provide comments regarding the application. Traditionally, MNCPPC limits itself to Subtitle 24, 25, and 27 which includes Subdivision, Environmental, and Zoning. Given, however, that some of the property that the 9 Pond solution is proposed on the land owned by the Commission, their property group under the umbrella of Parks and Recreation will want to review the plan as well. They will have multiple concerns. We expect that this review will lead to the proposal of a park like setting that will be required for approval and that will likely require the installation of walking paths and perhaps other typical park apparatus such as gazebos and benches. This application is part of a public process and will require a minimum of one public hearing in front of the Prince George's County Planning Board. It is difficult to predict, however, the County Council has the right to "call up" the Detailed Site Plan for review if they so desire. If they choose to exercise this right, then there will be another public hearing that could overturn any approval garnered at the Planning Board level (interestingly, should the Planning Board deny a 9 Ponds application, the County Council could also overturn this decision and approve the plan despite Planning Board objections). It is difficult to identify the length of time the application might spend with in a required District Council review process but it can be significant.
It is at this stage that an agreement of some sort should be in place with the various property owners involved. No DSP submittal should take place until the property concerns have at least been approached.

The DSP submittal will be referred to Hyattsville, University Park, and Riverdale Park by MNCPPC.

Landscape Plan
The Landscape Plan is part of the Detailed Site Plan submission and is also submitted to the **Maryland National Capital Park and Planning Commission** (MNCPPC). This

document identifies proposed landscape elements including required Stormwater Management plantings for water quality and/or aesthetic issues. It is reviewed with the DSP and follows the same review and approval process.

Technical Stormwater Management Plan
The Stormwater management Plan is submitted to the **Prince George's County Department of Public Works and Transportation** (DPW&T) for their review and approval. This plan is a construction plan and identifies the exact limits of the pond and supporting infrastructure. The plan identifies the grading and shape of the pond which in turn identifies the volume of water that the pond can store which directly correlates to the reduction of volume and the velocity at which water is released downstream into the receiving end of Wells Run (POI- A). The plan also identifies the amount and size as well as the material type of pipe to be used to collect and outlet the water which the pond is to control. This is the document that will be permitted with the various permit agencies. It is also the document which contractors will provide bids for the construction work on. Any easement that may be necessary will be depicted on the plan.

It is unlikely that the Stormwater Management Plan will be reviewed by the City of Hyattsville city council. However, it may be worth asking if they would like a courtesy copy.

Sediment Control Plan
The Sediment and Erosion Control Plan (E&S) will be reviewed by the **Prince George's County Sediment Control District** (SCD). This plan is also a construction document and lays out the sediment control measures as well as the sequence of construction.

Wetland Permit
This Wetland Permit application is made to the **Maryland Department of the Environment** (MDE). The application is a lengthy process that begins with the preparation of the permit document identifying the amount, location, and type of impacts to jurisdictional non tidal wetlands, their buffers, the 100 year floodplain, and perennial streams. The permit application must be supported with reams of documents including 100 year floodplain analysis, approved construction plans, impact plates, and wetland delineations. MDE will refer the application to the US Army Corps of Engineers for their review and comment. Additionally, within the permit application there must be significant analysis of alternative sites and solutions for the construction activity as well as minimization of disturbance analysis.

Traditionally, the type of activity that is being contemplated here is not allowed by MDE. In line pond design has been frowned upon for over a decade. It is likely that this permit application will be the hardest approval to receive and is likely to take the longest amount of time to successfully accomplish. It can be anticipated that non-engineering efforts will be necessary to obtain this approval.

If approved, there may be mitigation requirements that the applicant will have to obligate himself to.

Local Construction Permits
DPW&T will issue the construction permits necessary to obtain the permit to build. The above approvals will be necessary in order to obtain this permit.

TIMELINE
A brief schedule for planning purposes is as follows:

1) Preliminary Layout and Approval from PG DPW&T 3 Months
2) Entitlement of the Pond by MNCPPC 9 Months
3) Approval of Engineering Drawings 6 Months
4) Obtain Wetland Permit 1 Year

Ultimately the permit to construct the pond will take approximately 2 years 6 months to obtain a permit.

CONCLUSION

Loiederman Soltesz Associates is glad to have been able to assist the stakeholders throughout the process to date. We believe that there is a significant benefit to all of the stakeholders with the 9 Pond approach to the stormwater management needs of Wells Run. This initial effort demonstrates these benefits to University Park and Riverdale Park. The individual landowners and development partners can benefit by either reducing or eliminating their onsite water quantity stormwater management requirements. We have attempted to identify the difficulties and we believe the primary requirement is to finalize the construction of a consensus amongst the stakeholders that includes what each is expected to provide to the overall effort. This may require some governmental assurances.

Once again we appreciate the opportunity to participate in solving this unique issue.

APPENDIX

PEAK DISCHARGE SUMMARY				
JOB:	NINE PONDS			XY
DRAINAGE AREA NAME:	NINE PONDS - STUDY POINT A			7/8/2011
COVER DESCRIPTION	SOIL NAME	GROUP A,B,C,D?	CN from TABLE 2-2	AREA (In acres)
Commercial		C	94	85.80 Ac.
Commercial		D	95	174.90 Ac.
			AREA SUBTOTALS:	260.70 Ac.

IMPERVIOUS AREAS/URBAN DISTRICT				
AREA DESCRIPTION	CONNECTED IMPERVIOUS	UNCONN. IMPERV.	TOTAL SUBAREA	COMPOSITE CN
AREA SUBTOTALS:	0.00 Ac.	0.00 Ac.	0.00 Ac.	
				0.0%

Time of Concentration 2-Yr 24 Hr Rainfall = 3.3 In	Surface Cover Cross Section	Manning 'n' Wetted Per	Flow Length Avg Velocity	Slope Tt (Hrs)
Sheet Flow	short grass	'n'=0.15	100 Ft.	1.00% 0.212 Hrs
Shallow Flow (a)	UNPAVED		157 Ft. 4.84 F.P.S.	9.00% 0.009 Hrs
(b)	PAVED		415 Ft. 2.03 F.P.S.	1.00% 0.057 Hrs
Channel Flow Hydraulic Radius =2.20	X-S estimated	'n'=0.013 WP estimated	4.50 F.P.S.	0.000 Hrs
Hydraulic Radius =2.20	X-S estimated	'n'=0.013 WP estimated	3520 Ft. 5.50 F.P.S.	0.178 Hrs

SUMMARY OF RESULTS

Total Area in Acres =	260.70 Ac.	Total Sheet Flow=	Total Shallow Flow=	Total Channel Flow =
Weighted CN=	95			
Time Of Concentration =	0.46 Hrs.	0.212 Hrs	0.066 Hrs	0.178 Hrs
Pond Factor =	1	RAINFALL TYPE II		

STORM	*Precipitation* (P) inches	*Runoff* (Q)	Qp, PEAK DISCHARGE	TOTAL STORM Volumes
1 Year	2.7 In.	2.16 In.	487 CFS	2,041,424 Cu. Ft.
2 Year	3.3 In.	2.74 In.	620 CFS	2,595,685 Cu. Ft.
5 Year	4.3 In.	3.73 In.	842 CFS	3,527,104 Cu. Ft.
10 Year	5.3 In.	4.72 In.	1066 CFS	4,463,739 Cu. Ft.
25 Year	5.9 In.	5.31 In.	1200 CFS	5,027,194 Cu. Ft.
50 Year	6.6 In.	6.01 In.	1358 CFS	5,685,498 Cu. Ft.
100 Year	7.4 In.	6.80 In.	1537 CFS	6,438,752 Cu. Ft.

PEAK DISCHARGE SUMMARY				
JOB:	NINE PONDS			XY
DRAINAGE AREA NAME:	NINE PONDS - STUDY POINT B			7/8/2011
COVER DESCRIPTION	SOIL NAME	GROUP A,B,C,D?	CN from TABLE 2-2	AREA (In acres)
Commercial		C	94	85.80 Ac.
Commercial		D	95	174.90 Ac.
1/3 AC LOTS		C	81	200.00 Ac.
1/3 AC LOTS		D	86	141.00 Ac.
			AREA SUBTOTALS:	601.70 Ac.

IMPERVIOUS AREAS/URBAN DISTRICT				
AREA DESCRIPTION	CONNECTED IMPERVIOUS	UNCONN. IMPERV.	TOTAL SUBAREA	COMPOSITE CN
AREA SUBTOTALS:	0.00 Ac.	0.00 Ac.	0.00 Ac.	
				0.0%

Time of Concentration 2-Yr 24 Hr Rainfall = 3.3 In	Surface Cover Cross Section	Manning 'n' Wetted Per	Flow Length Avg Velocity	Slope Tt (Hrs)
Sheet Flow	short grass	'n'=0.15	100 Ft.	1.00% 0.212 Hrs
Shallow Flow (a)	UNPAVED		157 Ft. 4.84 F.P.S.	9.00% 0.009 Hrs
(b)	PAVED		415 Ft. 2.03 F.P.S.	1.00% 0.057 Hrs
Channel Flow Hydraulic Radius =2.50	X-S estimated	'n'=0.013 WP estimated	4.50 F.P.S.	0.000 Hrs
Hydraulic Radius =2.50	X-S estimated	'n'=0.013 WP estimated	6900 Ft. 5.50 F.P.S.	0.348 Hrs

SUMMARY OF RESULTS

Total Area in Acres =	601.70 Ac.	Total Sheet Flow=	Total Shallow Flow=	Total Channel Flow =
Weighted CN=	88			
Time Of Concentration =	0.63 Hrs.	0.212 Hrs	0.066 Hrs	0.348 Hrs
Pond Factor =	1	RAINFALL TYPE II		

STORM	*Precipitation* (P) inches	*Runoff* (Q)	Qp, PEAK DISCHARGE	TOTAL STORM Volumes
1 Year	2.7 In.	1.55 In.	685 CFS	3,394,536 Cu. Ft.
2 Year	3.3 In.	2.09 In.	921 CFS	4,558,640 Cu. Ft.
5 Year	4.3 In.	3.01 In.	1327 CFS	6,571,231 Cu. Ft.
10 Year	5.3 In.	3.95 In.	1745 CFS	8,637,516 Cu. Ft.
25 Year	5.9 In.	4.53 In.	1998 CFS	9,893,476 Cu. Ft.
50 Year	6.6 In.	5.21 In.	2297 CFS	11,369,518 Cu. Ft.
100 Year	7.4 In.	5.98 In.	2639 CFS	13,067,100 Cu. Ft.

Loiederman Soltesz Associates

NINE PONDS

DATE: 7/8/2011
BY: XY
CK:

CHANNEL PROTECTION STORAGE VOLUME

NINE PONDS

FROM TR-55 GRAPHICAL PEAK DISCHARGE METHOD 1-YEAR STORM EVENT:

SUBAREA:	**NINE PONDS**	
DRAINAGE AREA (A) :	260.70 Acres	= 0.40734 sq.mi.
TIME OF CONCENTRATION (Tc.):	0.46 Hrs.	
RUNOFF (Qa):	2.16 in.	
UNIT PEAK DISCHARGE (q_u):	0.867 cfs/acres/in	= 555 csm
PEAK DISCHARGE (q_i):	487 cfs	

RATIO OF OUTFLOW TO INFLOW (q_o / q_i) = 0.032

RATIO OF STORAGE TO RUNOFF VOLUME:

$$Vs / Vr = 0.683 - 1.43 (qo / qi) + 1.64 (q_o / q_i)^2 - 0.804 (q_o / q_i)^3 = 0.6389$$

EXTENDED DETENTION STORAGE VOLUME:
Vs = Vr (Qa) (1/12) (A) = **29.941 Ac-ft.**

EXTENDED DETENTION WEIR ELEVATION: 194.00
PERMANENT POOL ELEVATION: 190.40
(Based on Stage-Storage Computations)

MAXIMUM RELEASE RATE: qo = (qo / qi) qi = 15.60 cfs

ORIFICE AREA: $Ao=qo/(4.81*h_o^{0.5})$ 1.746 SF h_o = 3.45 ft.

ORIFICE DIAMETER: do = ((4*Ao)/π) 1.49 ft. = 17.9 in

EXT. DET.
P:\00270700\HYD\NINEPONDS\NinePonds_comp.xls

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NINE PONDS
NINE PONDS

BY: XY DATE: 7/8/2011
CHK: MS DATE:

POND1A - 1-100 YEAR STORM
ELEVATION DISCHARGE RATING TABLE

WSEL in Pond	**42.0 in**	Orifice at	**68.00**	Weir at							Weir at							**25 ft**	Emergency Spillway at	**80.00**	**42" Barrel**		TOTAL Q (CFS)
	H from			Breadth of Weir Crest is 1.0 ft							Breadth of Weir Crest is 0.0 ft							Breadth of Crest is		10.0 ft			
	69.75	Eff. Head	Q	C	H1	H2	H2/H1	**Q1**	**Q/Q1**	**Q2**	C	H1	H2	H2/H1	**Q1**	**Q/Q1**	**Q2**	**C**	**H1**	**Q3**	Elev. In Riser	Q in Barrel	
69.76	0.01		4.63																		69.02	4.63	**4.63**
70.00	0.25	0.10	14.65																		69.90	14.65	**14.65**
72.00	2.25	0.75	40.12																		71.25	40.12	**40.12**
74.00	4.25	1.74	61.11																		72.26	61.11	**61.11**
76.00	6.25	2.78	77.24																		73.22	77.24	**77.24**
78.00	8.25	3.85	90.90																		74.15	90.90	**90.90**
80.00	10.25	4.95	103.07															2.49	0.00	0.00	75.05	103.07	**103.07**
82.00	12.25	6.05	113.95															2.64	2.00	186.68	75.95	113.95	**300.63**
84.00	14.25	7.10	123.44															2.64	4.00	528.00	76.90	123.44	**651.44**
86.00	16.25	8.15	132.25															2.64	6.00	970.00	77.85	132.25	**1102.25**
88.00	18.25	9.20	140.51															2.64	8.00	1493.41	78.80	140.51	**1633.92**

Q=4.81*π*(R^2)*(H)^0.5
Eff. Head = Elev. in pond-Elev. In Riser
Eff. Head is then used in the orifice equation to get the adjusted submerged

Q1=CLH^1.5
H1=WS-Weir elevation)

When the Elev. In Riser is greater than the Weir elevation, the weir becomes submerged.
Therefore, H2 has to be used to compute the reduced discharge.
H2=Elev. In Riser-Weir Elevation
Q/Q1 is from "Handbook of Hydraulics" by Brater & King
Q2 = Q1*Q/Q1

Q3=CLH^1.5
H1=WS-Weir Elevation
C values for Broadcrested Weirs were obtained from "Handbook of Hydraulics" by Brater & King

Therefor, Q in Barrel = Q(Orifice)+Q2(Weir)+Q3(Spillway)

Note: Elev. In Riser is obtained from rating tables for the proposed **42" Barrel** outfall pipe with a tailwater situation set at the 100 year Floodplain (FPS#200522) Elevation of 188.14
See Attached Culvert Master Routing Report

Loiederman Soltesz Associates

NINE PONDS

TR-20 INPUT DATA FOR **POND1A - 1-100 YEAR STORM**

DATE: 7/8/2011
BY: XY
CK:

NINE PONDS

TR-20 INPUT

Stage	Area Sq. Ft.	Elev. Diff. Ft.	Interval Volume Cu.-Ft.	Volume Total Cu.-Ft.	Volume Total Ac.-ft.
68.00	26358			0	0.000
		1.76	49632		
69.76	30043			49632	1.139
		0.24	7271		
70.00	30545			56903	1.306
		2.00	65310		
72.00	34765			122213	2.806
		2.00	74099		
74.00	39334			196312	4.507
		2.00	83552		
76.00	44218			279864	6.425
		2.00	93539		
78.00	49321			373403	8.572
		2.00	104007		
80.00	54686			477410	10.960
		2.00	114988		
82.00	60302			592398	13.600
		2.00	126470		
84.00	66168			718868	16.503
		2.00	138456		
86.00	72288			857324	19.681
		2.00	150949		
88.00	78661			1008273	23.147

From Elev. Disch. Chart

ELEVATION	DISCHARGE (cfs)	VOLUME (ac-ft)
68.00	**0.00**	0.000
69.76	**4.63**	1.139
70.00	**14.65**	1.306
72.00	**40.12**	2.806
74.00	**61.11**	4.507
76.00	**77.24**	6.425
78.00	**90.90**	8.572
80.00	**103.07**	10.960
82.00	**300.63**	13.600
84.00	**651.44**	16.503
86.00	**1102.25**	19.681
88.00	**1633.92**	23.147

Drainage Area (Sq. Mi.) =	**0.40734**
CN Value =	**95**
Time of Concentration (Hrs.) =	**0.46**
Computation Starting Elevation =	**68.00**

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NINE PONDS
NINE PONDS

BY: XY DATE: 7/8/2011
CHK: MS DATE:

POND1B- 1-100 YEAR STORM
ELEVATION DISCHARGE RATING TABLE

WSEL in Pond	**42.0 in** Orifice at		**67.50**	**10 ft** Weir at **72.00**							**10 ft** Weir at **74.00**							**20 ft** Emergency Spillway at **78.00**			**42" Barrel**		TOTAL Q (CFS)
	H from	Eff. Head	Q	Breadth of Weir Crest is 1.0 ft							Breadth of Weir Crest is 0.0 ft							Breadth of Crest is		10.0 ft	Elev. In Riser	Q in Barrel	
	69.25			C	H1	H2	H2/H1	**Q1**	**Q/Q1**	**Q2**	C	H1	H2	H2/H1	**Q1**	**Q/Q1**	**Q2**	**C**	**H1**	**Q3**			
69.26	0.01		4.63																			4.63	**4.63**
70.00	0.75		40.12																			40.12	**40.12**
71.00	1.75		61.28																			61.28	**61.28**
72.00	2.75		76.82	2.69	0.00			0.00														76.82	**76.82**
73.00	3.75		89.71	2.98	1.00			29.80														119.51	**119.51**
74.00	4.75		100.96	3.30	2.00			93.34			2.69	0.00			0.00							194.30	**194.30**
75.00	5.75		111.08	3.32	3.00			172.51			2.98	1.00			29.80							313.39	**313.39**
76.00	6.75		120.36	3.32	4.00			265.60			3.30	2.00			93.34							479.30	**479.30**
77.00	7.75		128.96	3.32	5.00			371.19			3.32	3.00			172.51							672.66	**672.66**
78.00	8.75		137.03	3.32	6.00			487.94			3.32	4.00			265.60			2.49	0.00	0.00		890.57	**890.57**
79.00	9.75		144.65	3.32	7.00			614.87			3.32	5.00			371.19			2.68	1.00	53.60		1130.71	**1184.31**
																						0.00	
																						0.00	
																						0.00	

Q=4.81*π*(R^2)*(H)^0.5
Eff. Head = Elev. in pond-Elev. In Riser
Eff. Head is then used in the orifice equation to get the adjusted submerged

Q1=CLH^1.5
H1=WS-Weir elevation)

When the Elev. In Riser is greater than the Weir elevation, the weir becomes submerged.
Therefore, H2 has to be used to compute the reduced discharge.
H2=Elev. In Riser-Weir Elevation
Q/Q1 is from "Handbook of Hydraulics" by Brater & King
Q2 = Q1*Q/Q1

Q3=CLH^1.5
H1=WS-Weir Elevation
C values for Broadcrested Weirs were obtained from "Handbook of Hydraulics" by Brater & King

Therefor, Q in Barrel = Q(Orifice)+Q2(Weir)+Q3(Spillway)

Note: Elev. In Riser is obtained from rating tables for the proposed **42" Barrel** outfall pipe with a tailwater situation set at the 100 year Floodplain (FPS#200522) Elevation of 188.14
See Attached Culvert Master Routing Report

Loiederman Soltesz Associates

NINE PONDS

TR-20 INPUT DATA FOR **POND1B- 1-100 YEAR STORM**

DATE: 7/8/2011
BY: XY
CK:

NINE PONDS

TR-20 INPUT

Stage	Area Sq. Ft.	Elev. Diff. Ft.	Interval Volume Cu.-Ft.	Volume Total Cu.-Ft.	Volume Total Ac.-ft.
67.50	141300			0	0.000
		2.50	372646		
70.00	156817			372646	8.555
		1.00	159965		
71.00	163114			532612	12.227
		1.00	166262		
72.00	169410			698873	16.044
		1.00	172629		
73.00	175849			871503	20.007
		1.00	179068		
74.00	182287			1050570	24.118
		1.00	185584		
75.00	188882			1236155	28.378
		1.00	192179		
76.00	195476			1428333	32.790
		1.00	198851		
77.00	202226			1627184	37.355
		1.00	205601		
78.00	208976			1832785	42.075
		1.00	212429		
79.00	215883			2045215	46.952

From Elev. Disch. Chart

ELEVATION	DISCHARGE (cfs)	VOLUME (ac-ft)
67.50	**0.00**	0.000
70.00	**40.12**	8.555
71.00	**61.28**	12.227
72.00	**76.82**	16.044
73.00	**119.51**	20.007
74.00	**194.30**	24.118
75.00	**313.39**	28.378
76.00	**479.30**	32.790
77.00	**672.66**	37.355
78.00	**890.57**	42.075
79.00	**1184.31**	46.952

Drainage Area (Sq. Mi.) =	**0.40734**
CN Value =	**95**
Time of Concentration (Hrs.) =	**0.46**
Computation Starting Elevation =	**67.50**

4266 Forbes Boulevard, Suite B, Lanham, MD 20706 p. (301) 794-7555 f. (301) 794-7656

NINEPONDS-1-100year.out
NINE PONDS
1-100 YEAR DISCHARGE

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STORM 2 Year

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
Area3	0.407		2.742		12.15	634.55	1557.78
Reach1	0.407	Upstream	2.742		12.15	634.55	1557.78
Reach1	0.407	Downstream	2.740	83.06	12.30	487.04	1195.66
reach2	0.407	Upstream	2.740		12.30	487.04	1195.66
reach2	0.407	Downstream	2.734	73.10	12.94	126.76	311.20
OUTLET	0.407		2.734		12.94	126.76	311.20

STORM 5 Year

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
Area3	0.407		3.727		12.14	849.80	2086.21
Reach1	0.407	Upstream	3.727		12.14	849.80	2086.21
Reach1	0.407	Downstream	3.725	84.35	12.26	731.31	1795.34
reach2	0.407	Upstream	3.725		12.26	731.31	1795.34
reach2	0.407	Downstream	3.719	74.62	12.69	268.33	658.73
OUTLET	0.407		3.719		12.69	268.33	658.73

STORM 10 Year

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
Area3	0.407		4.716		12.13	1060.71	2604.00
Reach1	0.407	Upstream	4.716		12.13	1060.71	2604.00
Reach1	0.407	Downstream	4.715	85.34	12.22	954.37	2342.94
reach2	0.407	Upstream	4.715		12.22	954.37	2342.94
reach2	0.407	Downstream	4.709	75.84	12.57	453.01	1112.11
OUTLET	0.407		4.709		12.57	453.01	1112.11

STORM 100 Year

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
Area3	0.407		6.803		12.14	1506.19	3697.62
Reach1	0.407	Upstream	6.803		12.14	1506.19	3697.62
Reach1	0.407	Downstream	6.801	87.10	12.23	1395.96	3427.02
reach2	0.407	Upstream	6.801		12.23	1395.96	3427.02
reach2	0.407	Downstream	6.796	77.88	12.46	863.60	2120.10
OUTLET	0.407		6.796		12.46	863.60	2120.10

STORM 1 Year

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
Area3	0.407		2.156		12.14	505.77	1241.64
Reach1	0.407	Upstream	2.156		12.14	505.77	1241.64
Reach1	0.407	Downstream	2.154	82.11	12.35	319.81	785.12
reach2	0.407	Upstream	2.154		12.35	319.81	785.12
reach2	0.407	Downstream	2.148	72.08	13.94	80.06	196.55
OUTLET	0.407		2.148		13.94	80.06	196.55

NINE PONDS
1-100 YEAR DISCHARGE

Area or Drainage ---------- Peak Flow by Storm ----------

Reach Identifier	Area (sq mi)	Alternate	2 Year (cfs)	5 Year (cfs)	10 Year (cfs)	100 Year (cfs)	1 Year (cfs)
Area3	0.41		634.5	849.8	1060.7	1506.2	505.8
Reach1	0.41		634.5	849.8	1060.7	1506.2	505.8
DOWNSTREAM			487.0	731.3	954.4	1396.0	319.8
reach2	0.41		487.0	731.3	954.4	1396.0	319.8
DOWNSTREAM			126.8	268.3	453.0	863.6	80.1
OUTLET	0.41		126.8	268.3	453.0	863.6	80.1