SELBY ON THE BAY DRAINAGE IMPROVEMENT COMPUTATION REPORT

ANNE ARUNDEL COUNTY, MARYLAND

Prepared For:

ANNE ARUNDEL COUNTY
DEPARTMENT OF PUBLIC WORKS
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65% Submittal

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1. Introduction

This report summarizes the drainage design procedures and computations for the Selby on the Bay Community in Anne Arundel County, Maryland. The design is based on recommendations made in the Selby on the Bay Drainage Study, previously prepared by Brightwater in 2009, and incorporates the review comments received from the Anne Arundel County Department of Public Works.

The Selby on the Bay Community is located at the intersection of Central Avenue (Rt. 214) and Selby Boulevard as shown in Figure 1. This is an older bay front community located in Southern Anne Arundel County. The topography ranges from a sea-level condition along Selby Bay to an elevation of approximately 70 feet at the Selby Ridge subdivision. Although some streets have roadside ditches, the majority of the community does not have an adequate storm drainage infrastructure. As a result of the combination of the low-lying areas, the proximity of the water table location at or near the surface, and the absence of an adequate storm drainage system, the residents of the community are experiencing frequent minor flooding conditions and have made the Department of Public works aware of this condition through a number of drainage complaints.

The recommendation was made to design for the 2-year storm event, which will alleviate the frequent minor flooding conditions and provide water quality benefits at a lower cost (compared to the 10-year design).

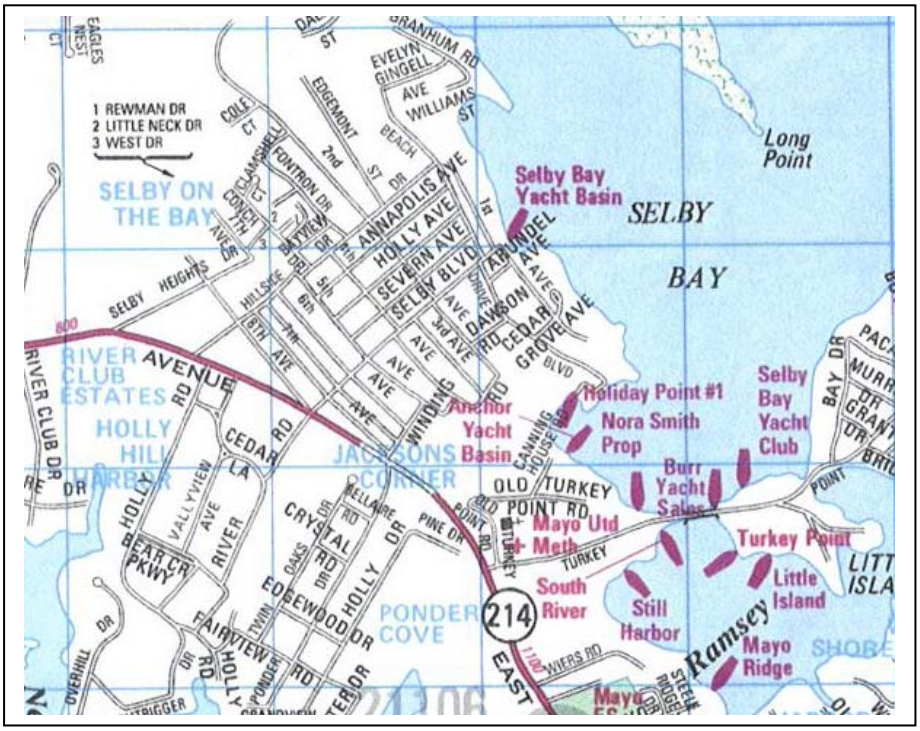

Figure 1. Selby on the Bay Vicinity Map

2. Design Area

Based on the site topography and contributing drainage area, the design encompasses the following roads:

- 5th Avenue
- 4th Avenue
- 2nd Avenue
- Fontron Dr
- Hillside Dr
- Annapolis Ave
- Holly Ave
- Selby Blvd

The flows from all contributing areas will be conveyed through a combination of grass or bioswales and underground storm drain system to an outfall releasing flows into an existing swale/wetland located between the Beach Drive and 1st Avenue. It is anticipated that the upland grass swales as well as the downstream swale/wetland sustem will provide water quality treatment of the storm runoff and will ultimately convey it into the Bay. Total contributing drainage area is aprroximately 40 (±) acres and consists of over 50 drainage sub-areas. In existing conditions, these sub-areas display a random use of drainage ditches along the roadside that are marginal with respect to flow capacity for computed flows. The recommended alternative for this area consists of installing a combination of grassed swales and a closed pipe collection and conveyance system and providing water quality through the combination of existing and proposed grassed swales and the existing swale/wetland system at the outfall before discharging into the Bay.

3. Topography

A topographic survey for approximately 7,500 (±) linear feet of the road sections as listed above, covering about 30' on each side from the centerline of the road was conducted in 2003. Due to the relatively flat site, a one foot contour interval was obtained in addition to spot elevations along the survey path and at important site features. This topography was supplemented in areas along Hillside and Selby Blvd, by McCrone, Inc. in 2009. County GIS files were used as background to delineate sub-drainage areas and determine the flow path to establish time of concentration (Tc) through each sub-drainage area. Aerial images from GoogleEarth taken in 2007 were used to identify structures added since the 2003 survey that were outside of the McCrone survey limits.

4. Soils

Table 1 provides a summary of the soil types for the Selby on the Bay community. Soil types are important in hydrologic analysis because together with the land use cover (i.e., pervious or impervious) they have a strong influence on the amount of rainfall that is either infiltrated or runs off the land surface. For hydrologic analysis soil types are grouped into four hydrologic soil group (HSG) categories; A, B, C, and D. A soils have the highest infiltration characteristics, while D soils have the lowest.

Based on the NRCS soil series mapping, the Selby on the Bay community is comprised of soils that fall in the HSG C category, with small areas of both B and D type soils. The dominant soil series is the Annapolis-Urban land complex (AuB) comprised of 50% well drained material consisting of loamy glauconitic fluviomarine sediments. Figure 5 presents the distribution of soil types within the Selby on the Bay study area.

Table 1. NRCS Soils Series and HSG Summary

Symbol	Name	HSG
AuB	Annapolis-Urban land complex, 0-5 percent slopes	B
Cka	Colemantown fine sandy loam, 0-2percent slopes	C/D
CnB	Colemantown-Urban land complex	C/D
DuB	Donlonton-Urban land complex, 0-5 percent slopes	C
MZA	Mispillion & Transquaking soils, 0 to 1 percent slopes, tidally flooded	D

To locate ESD opportunities, the first step was to determine where adequate infiltration capacity existed. Based upon the AACO soil mapping most of the soils were in hydrologic soil group C which does not allow for infiltration under Maryland standards.

In situ infiltration tests were conducted and surprisingly positive results were obtained as shown in Table 2. The infiltration tests were conducted on June 12, 2009. The weather was dry, but there had been thunderstorm activity the day before on June 11, 2009.

Table 2. Infiltration Tests Summary

	Street	**Infiltration Rate (in/hr)**	**DA**
1	Fontron (W)	**7.5**	SA 22
2	Hillside (NE)	**0.75**	SA 23
3	Hillside (NW)	**8.5**	SA 22
4	Hillside (NW)	**1.75**	SA 21
5	4th & Annapolis (NE)	**4**	SA 37
6	Annapolis (NW)	**3**	SA 18
7	Annapolis (NE)	**3.5**	SA 37
8	4th (SW, between Annapolis & Holly)	**1**	SA 16
9	Holly (NW)	**4**	SA 15
10	Holly (NE)	**0**	SA 35
11	Severn (SW)	**1**	SA 10& 11
12	Severn (NE)	**1**	SA 31

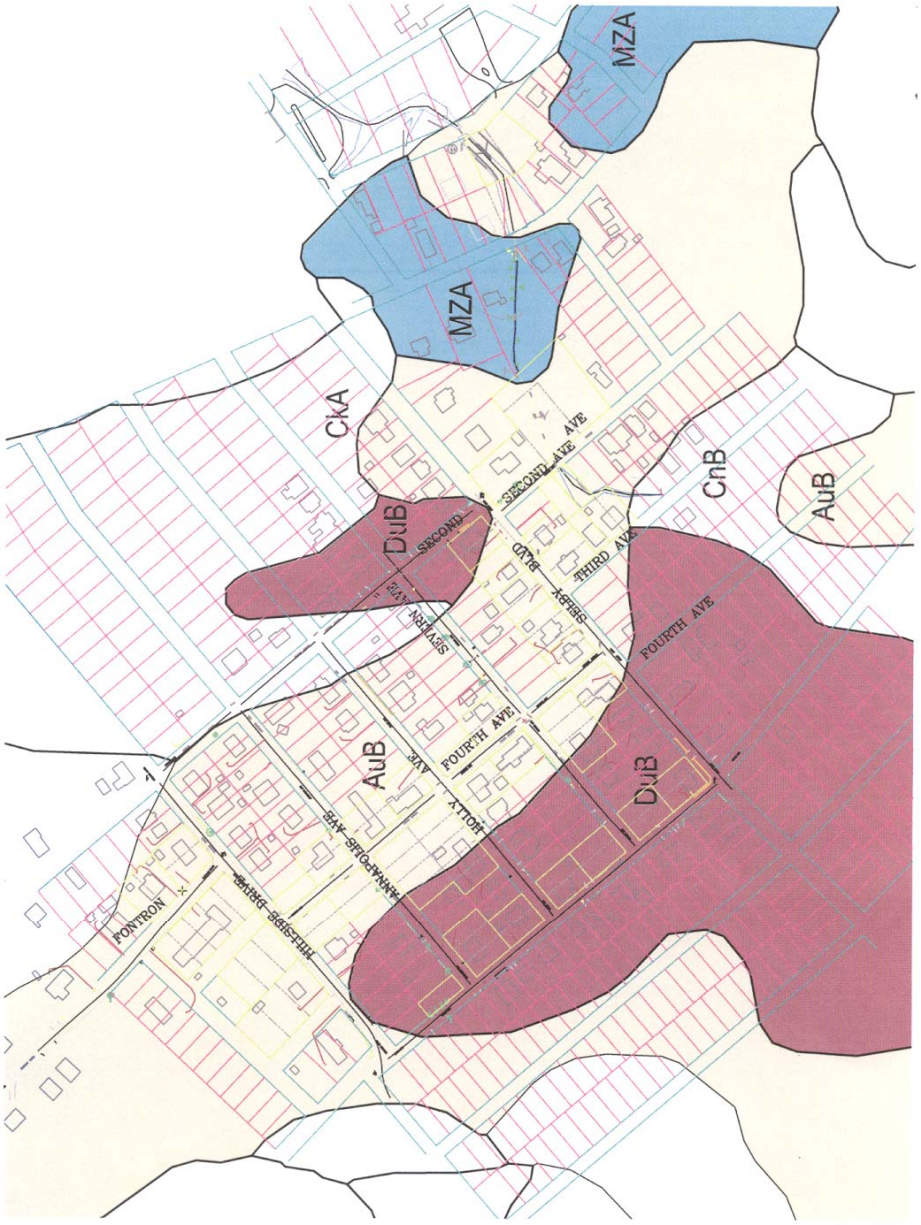

Figure 2. Soil Series Map

5. Hydrology

Drainage sub areas were delineated based on topographic survey information and multiple site visits to verify actual site conditions on ground. Most of the existing road infrastructure in this area is crowned in the middle thus distributing runoff on each side of the road. Total contributing drainage area has been further sub-divided into 51 sub-areas. Sub-area boundaries were developed based on the criteria that flow from each sub-area shall remain less than or equal to 5 cubic feet per seconds (cfs) for a 2-year flood event. Depending on the runoff and topography in some sub-areas, a proposed grass or bioswale will collect and convey runoff to the underground drainage system. An inlet is proposed at the low point in each sub-area to capture the surface runoff and receive flow from the swale(s).

The TR-55 program was used to determine the 2-year discharge based on the soils, land use, and a cumulative drainage area and time of concentration (TC) at each proposed inlet on the longest travel path. The Hydrologic Soil Groups were adjusted to represent the high infiltration rates as determined through the field tests. The rates were adjusted as follows: The AuB soils down to the north side of Selby Blvd were identified as 'A' soils (Subareas with infiltration rates less than 0.52 in/hour were designated as 'B' soils). The DuB soils and areas south of Selby Blvd. were identified as B soils. Land use for the subareas is 1/3 acre lots or right of ways (paved and open ditch). As shown on Sheet T2, the longest travel path originates in SA 23A. The proposed bioswales in SA 23A and SA 22 provide attenuation and storage, which increases the Tc. From I-23 down, the travel path is within the main storm drain system. The velocity within the storm drain system is modeled as 3 fps. The hydraulic analysis shows that although the velocities fluctuate, a 3 fps estimate is reasonable.

The summary of flow computations for the 2-year storm event at each inlet along the longest travel path is attached in Appendix A :TR-55 Output Summary of flow computations by cumulative sub-area (longest travel path).

Based on computed flows, a network of drainage system was developed for the entire watershed to convey the 2-year design flows safely and efficiently to outfall without flooding. Every effort was made to avoid easements and maintain the horizontal and vertical clearance from existing utilities. It is worth noting that the site being extremely flat has most of the area within a slope range of 0.5% to 2% with predominantly most of the roads at or about 0.5% slope. The water table is high due to proximity with the Bay. Relatively high water table and flat slopes in combination with a parallel existing pressure sewer system running along the main drainage corridor, posed great challenges to design a functional and workable system. Corrugated Metal Pipe (CMP) was initially considered for the underground system during the design process; however, since most of the drainage pipes have slope less than or equal to 0.5%, the conveyance of even one year storm was not feasible using a higher Manning's "n" value of 0.024 through CMP. Therefore, concrete pipe is proposed and a Manning's "n" of 0.013 has been used for the design computations.

In general, with a few exceptions noted in the summary hydraulic grade line computations table provided in Appendix B, a minimum of one-foot cover has been maintained

throughout the system. Some of the existing low lying areas will be regraded to bring the grade up to provide adequate cover to the pipe in those areas, mostly along the road sides. In all cases pipes have a minimum of 0.5' cover in paved areas and 0.67' cover in remaining areas as directed by the County.

Due to the vertical clearance available and the need to maintain a minimum of one-foot cover, twin-pipes of smaller size are proposed to provide the required conveyance from Selby Blvd and Second (I-28) down. Some Sewer House Connections (SHC) on Selby Blvd. between I-8 and I-28 are in conflict with the proposed layout of drainage system and will have to be relocated. Portions of the force main along Selby Blvd. and Forth Ave. will also require relocation to accommodate the proposed storm drain crossing from I-9 to I-8 and I-28 to M-4.

Table 3: Summary of 2-year design discharge computation

TO	SA#	DA	∑DA	∑A row	∑B row	∑A 1/3	∑B 1/3	CN	∑CN	TC	∑Q2
	SA23A	3.27						57			
I-23A			3.27	-	-	3.27	-		57	1.01	0.33
	SA23	1.81						57			
I-23			5.08	-	-	5.08	-		57	1.02	0.52
	SA23B	2.47						57			
	SA22	2.23						57			
I-22			9.78	-	-	9.78	-		57	1.03	0.99
	SA49	3.34						57			
	SA21	1.68						57			
I-21			14.8	-	-	14.80	-		57	1.04	1.48
	SA20	0.38						83			
	SA38	1.08						57			
I-20			16.26	0.38	-	15.88	-		58	1.05	1.89
	SA19	0.44						57			
I-19			16.7	0.38	-	16.32	-		58	1.06	1.93
	SA18	1.64						57			
	SA46	0.66						57			
I-18			19	0.38	-	18.62	-		58	1.07	2.18
	SA37	1.37						57			
	SA36	1.27						57			
	SA17	0.2						83			
I-17			21.84	0.58	-	21.26	-		58	1.08	2.5
	SA16	0.86						57			
	SA45	0.09						72			
I-16			22.79	0.58	-	22.12	0.09		58	1.09	2.59
	SA15	1.07						57			
	SA44	0.58						72			
I-15			24.44	0.58	-	23.19	0.67		58	1.09	2.77
	SA35	1.15						72			
	SA 33	0.2						83			
	SA 14	0.14						83			
I-14			25.93	0.92	-	23.19	1.82		59	1.10	3.37
	SA 13	0.85						57			
	SA 43	0.07						72			
I-13			26.85	0.92	-	24.04	1.89		59	1.11	3.47

TO	SA#	DA	∑DA	∑A row	∑B row	∑A 1/3	∑B 1/3	CN	∑CN	TC	∑Q2
	SA12	1.2						57			
	SA 41	0.02						89			
	SA 42	0.05						89			
	SA 48	0.36						72			
I-12			28.48	0.92	0.07	25.24	2.25		59	1.12	3.66
	SA 32	0.84						57			
	SA 30	0.07									
	SA11	0.18						83			
I-11			29.57	1.17	0.07	26.08	2.25		59	1.12	3.79
	SA10	0.93						57			
I-10			30.5	1.17	0.07	27.01	2.25		59	1.13	3.89
	SA 47	0.37						72			
	SA 39	0.41						72			
	SA 40	0.17						72			
	SA9	0.49						72			
I-9			31.94	1.17	0.07	27.01	3.69		60	1.14	4.63
	SA 8	0.08						83			
	SA 29	0.03						83			
I-8			32.05	1.28	0.07	27.01	3.69		60	1.15	4.63
	SA 31a	0.14						83			
	SA 31	1.13						57			
	SA7	0.54						57			
I-7			33.86	1.42	0.07	28.68	3.69		60	1.16	4.84
	SA6	0.41						57			
	SA 5	0.9						57			
I-6			35.17	1.42	0.07	29.99	3.69		60	1.17	5.01
	SA 28	1.94						72			
	SA 28ABC	1.45									
I-28			38.56	1.42	0.07	29.99	7.08		61	1.18	6.17
M-4			38.56	1.42	0.07	29.99	7.08		61	1.18	6.17
	SA3	0.04						89			
I-3			38.6	1.42	0.11	29.99	7.08		61	1.20	6.17
	SA27	0.11						89			
	SA26	0.06						89			
	SA25	0.04						89			
	SA-WET	3.42						72			
	SA4	0.12						89			
I-2			42.35	1.42	0.44	29.99	10.50		62	1.20	7.53
	SA2	0.07						89			
	SA1	1.26						72			
I-1			43.68	1.42	0.51	29.99	11.76		62	1.21	7.73
OUTFALL			43.68	1.42	0.51	29.99	11.76		62	1.22	7.73
	SA Beach	2.73						72			
Beach Dr			46.41	1.42	0.51	29.99	14.49		63	1.24	8.99
	SA First	2.65						72			
1st St			49.06	1.42	0.51	29.99	17.14		63	1.27	9.37

6. Hydraulic Grade Line (HGL)

Based on the computed flows from each sub-area and cumulative flows routing through the system, hydraulic grade line computations were performed using a computer model. The hydraulic grade line computations for 2-year flows are provided in Appendix B – Hydraulic

Grade Line Computation Summary. The hydraulic grade line is also graphically shown on drainage profiles included in the construction drawings. Table 6 in Appendix C provided the HGL elevations and velocities for each pipe run. Velocities in the upper pipe runs (I-23A to I-19) are low due to the minimum 15" required pipe diameter, which is more than the required pipe diameter needed to convey the 2-year storm. Due to certain limitations of the model used for calculating the hydraulic grade line, the following procedure was adopted:

1. Beginning water surface elevation was assumed at the crown of the pipe at the outfall.
2. For reaches having twin-pipes, computed full flow was assumed split in half in each pipe and the model was run for half flows for single pipe.
3. Each contributing branch system connecting to the main system (Outfall to I-23A) was routed separately using starting water surface elevation at the respective inlet obtained from the HGL computations for the main system.

7. Bioswales

Bioswales in the upper sub drainage areas (23A and 22) along Fontron provide storage and attenuation of flow, which increases the time of concentration (Tc) and reduces peak discharges (necessary to achieve discharge and Tc as modeled). In addition, bioswales offer water quality benefits by filtering pollutants from the road surfaces. Typical bioswale sections are shown in Figure 3.

Where feasible, an innovative BMP, the in-situ bioswale has been proposed. The in-situ bioswale can be used where the existing soils have good infiltration rates. The in-situ bioswale is created by using a traditional grass swale but also includes deep disking of well aged organic materials such as composted leaf mulch into the existing soils to depth of 12 to 18 inches. This eliminates the costs of excavating and disposal of existing soils and thus is a far more environmentally sensitive and sustainable approach which can reduce construction costs by 50% or more.

The flows to each swale were calculated based on the individual subareas contributing to them using TR-55 or an assumed conservative flow (0.2 or 1 cfs depending on the subarea). Depth of water ranges from 1 to 4 inches for the 2-year discharges and from 2 to 8 inches for the 10 year discharges. Overflow elevations for swales were set at approximately the 2 year water surface elevation and enter inlets at either the grate elevation or invert of a throat opening or an overflow pipe connected to a perforated underdrain tied into the storm drain system. The swale dimensions were established to carry the 10 year storm event. Total depth of swales were set to either 0.5' or 0.75' with top widths equal to 4 or 5 feet, side slows of 2H:1V and bottom widths of 2 feet.

<u>Swale design criteria included:</u>

- Edge of swale at least 2' from edge of pavement
- Edge of swale does not encroach on private property
- 30-35% voids in Subgrade for Bioswales
- Top of swale at least 3' from proposed storm drain centerline
- Top of swale at or lower than surrounding grade

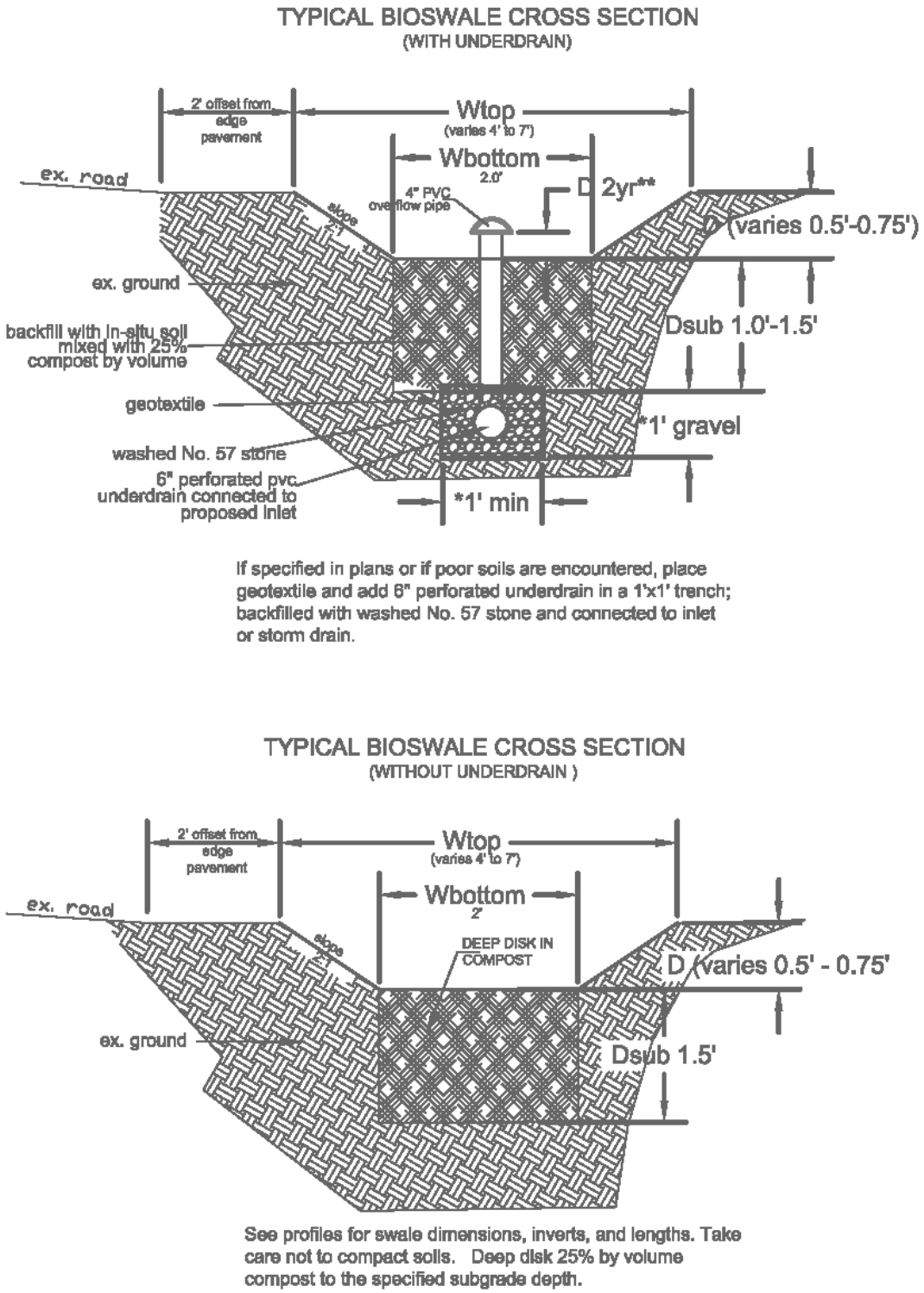

Figure 3: Bioswale Details

Table 4: Proposed Bioswale Summary

SA#	To Inlet	Length (ft)	Slope	Depth (ft)	Width Top (ft)	Q2 (cfs)	Depth 2yr (ft)	V2 (fps)	Overflow Structure	Q10 (cfs)	Depth 10 yr (ft)
SA23A	I-23A	95	0.95%	0.75	5	0.33	**0.16**	**0.87**	RIM	4.36	**0.68**
SA23	I-23	165	0.49%	0.75	5	0.52	**0.26**	**0.80**	O/F PIPE	2.77	**0.64**
SA22	I-22	178	0.60%	0.75	5	0.84	**0.37**	**1.10**	RIM	4.00	**0.73**
SA 49*	I-21	165	1.14%	0.75	7	1.13	**0.23**	**1.10**	THROAT	5.42	**0.57**
SA36	I-36	75	0.52%	0.50	4	0.32	**0.19**	**0.69**	THROAT	1.81	**0.51**
SA 17	I-17	160	0.57%	0.50	4	0.25	**0.16**	**0.67**	THROAT	1.00	**0.36**
SA 35	I-35	160	0.25%	0.50	4	0.31	**0.28**	**0.43**	THROAT	0.80	**0.47**
SA 15	I-15	183	0.45%	0.50	4	0.27	**0.18**	**0.63**	THROAT	1.03	**0.39**
SA 12	I-12	140	0.62%	0.50	4	0.41	**0.11**	**0.81**	RIM	1.57	**0.22**
SA 11	I-11	120	1.22%	0.50	4	0.20	**0.17**	**0.79**	RIM	0.41	**0.17**

*Existing swale

7. Inlets

Inlets were designed in accordance with the inlet design criteria of the Anne Arundel County Design Manual (Design Manual & Standard Specifications and Details for Construction, Anne Arundel County, Maryland, Department of Public Works). Most inlets are S-Type inlets with WR-reticular grates. Inlets set on the edge of the road are set at grade with throat openings to convey flows from swales where necessary. Inlets with throat openings are noted with an asterisk in the Structure Table. The throat invert is also given in the structure table.

Since the Selby on the Bay community is an older area of the County, many of the existing street standards do not comply with current County road standards, particularly with respect to paving width and the use of curb and gutters. In fact because this is an older subdivision, it actually displays many of the current better site planning design standards recommended in the 2000 Maryland Stormwater Design Manual. These features include narrow streets and grass swales. The proposed storm drain improvements reflect these conditions in the use of grass swales.

These existing conditions impacted the ability to comply with all aspects of the current inlet design criteria as noted below:

1. Location. Not all of the inlet locations were able to comply with the requirement to place inlets 5 feet from the P.C. or P.T. of curb (or proposed curb).

2. Spacing and spread.

   a) inlets are proposed in all sumps and at all intersections where conditions of street crown and/or quantity of flow require.

   b) inlets on grade were sized to intercept at least 85% of design flow.

c) inlets on sumps were designed to intercept 100 % of design flow, and sump inlets were designed such that overflow is directed so as not to cause damage to adjoining properties.

d) inlet spacing criteria were met including:

- Maximum allowable flow in streets is < than 5.0 cfs
- Maximum flow in side ditches is < 10 cfs, and velocities are non- erosive.
- Maximum flow across street intersections is < 2.0 cfs.

3. Sump Inlets. The capacity of sump inlets was based on the use of the formula recommended by SHA for orifice flow:

$$Q = 3.0(PH^{3/2})$$

where: Q = capacity (cubic feet per second, cfs).
P = perimeter of grate opening (ignoring bars, in feet).
H = head over grate (in feet).

4. Dimensions. Type S inlets require 3' minimum from top of grate to pipe invert. In some cases there is less than the 3 foot minimum between pipe invert and grate elevation due to existing utilities (sanitary sewer house connections and force mains, and flat topography). The depth from top of grate to pipe invert are identified in the Structure Table (Appendix C) in the "Depth to Invert" column. In addition, inlets not meeting the 3' minimum requirement are flagged in the Name column with a double asterisk (**).

A table which sumarizes inlet flow and capacity is provided in the Structure Table in Appendix C.

APPENDIX

DRAINAGE COMPUTATIONS

A- Hydrology: TR-55 Output Summary of Flow Computations by Cumulative Sub-Area (Longest Travel Path)

B- Hydraulic Grade Line Computations

C- Structures:

Table 5. Structure Table and Inlet Capacity Summary
Table 6. Storm Drain Pipe Summary

Appendix A- Hydrology: TR-55 Output Summary of Flow Computations by Cumulative Sub-Area (Longest Travel Path)

WinTR-55 Data Output

User: MLC>SCPL Date: 7/2/2010
Project: Selby2009 Units: English
SubTitle: Proposed Areal Units: Acres
State: Maryland
County: Anne Arundel
Filename: K:\Selby\2010 Design\H_H_2010\TR-55

INLET 23A

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
I-23A	0.33 12.71	1.80 12.55	4.36 12.53

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
I-23A	3.27	1.007	57	Outlet	1/3 ac lots

Total Area: 3.27 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
I-23A							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
Time of Concentration							1.007

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
I-23A	Residential districts (1/3 acre)	A	3.27	57
Total Area / Weighted Curve Number			3.27	57

INLET 23

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-I23	0.52 12.72	2.77 12.56	6.69 12.57

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I23	5.08	1.023	57	Outlet	1/3 ac lots

Total Area: 5.08 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I23							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	175					3.000	0.016
					Time of Concentration		1.023

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I23	Residential districts (1/3 acre)	A	5.08	57
	Total Area / Weighted Curve Number		5.08	57

INLET I-22

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-I22	0.99 5.32	12.85 12.57
	12.73 12.57	12.57

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I22	9.78	1.026	57	Outlet	1/3 ac lots

Total Area: 9.78 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Travel Time (hr)
SA-I22							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	208					3.000	0.019
					Time of Concentration		1.026

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I22	Residential districts (1/3 acre)	A	9.78	57
	Total Area / Weighted Curve Number		9.78	57

INLET 21

Hydrograph Peak/Peak Time Table

Sub-Area or Reach	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 2-Yr (cfs) (hr)
SUBAREAS	
SA-I21	1.48 12.74

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I21	14.80	1.044	57	Outlet	1/3 ac lots

Total Area: 14.80 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Travel Time (hr)
SA-I21							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	400					3.000	0.037
					Time of Concentration		1.044

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I21	Residential districts (1/3 acre)	A	14.8	57
	Total Area / Weighted Curve Number		14.8	57

INLET 20

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I20	Paved; open ditches (w/right-of-way)	A	.38	83
	Residential districts (1/3 acre)	A	15.88	57
	Total Area / Weighted Curve Number		16.26	58

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I20							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	440					3.000	0.041
					Time of Concentration		1.048

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I20	16.26	1.048	58	Outlet	1/3 ac lots

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)
SUBAREAS		
SA-I20	1.89	
	12.73	

INLET I-19

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I19	Paved; open ditches (w/right-of-way)	A	.38	83
	Residential districts (1/3 acre)	A	16.32	57
	Total Area / Weighted Curve Number		16.7	58

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA-I19							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	610					3.000	0.056
					Time of Concentration		1.063

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I19	16.70	1.063	58	Outlet	1/3 ac lots

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)
SUBAREAS		
SA-I19	1.93	
	12.75	

INLET I-18

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I18	Paved; open ditches (w/right-of-way)	A	.38	83
	Residential districts (1/3 acre)	A	18.62	57
	Total Area / Weighted Curve Number		19	58

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA-I18							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	720					3.000	0.067
					Time of Concentration		1.074

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I18	19.00	1.074	58	Outlet	1/3 ac lots

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)
SUBAREAS	
SA-I18	2.18 12.76

INLET 17

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I17	Paved; open ditches (w/right-of-way)	A	.58	83
	Residential districts (1/3 acre)	A	21.26	57
	Total Area / Weighted Curve Number		21.84	58

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I17							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	760					3.000	0.070
					Time of Concentration		1.077

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I17	21.84	1.077	58	Outlet	1/3 ac lots

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)
SUBAREAS		
SA-I17	2.50	
	12.76	

INLET I16

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I16	Paved; open ditches (w/right-of-way)	A	.58	83
	Residential districts (1/3 acre)	A	22.12	57
	Residential districts (1/3 acre)	B	.09	89
	Total Area / Weighted Curve Number		22.79	58

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA-I16							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	860					3.000	0.080
					Time of Concentration		1.087

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I16	22.79	1.087	58	Outlet	1/3 ac lots

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)
SUBAREAS		
SA-I16	2.59	12.77

INLET 15

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA-I15	2.77
	12.77

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA-I15							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	920					3.000	0.085
					Time of Concentration		1.092

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I15	Paved; open ditches (w/right-of-way)	A	.58	83
	Residential districts (1/3 acre)	A	23.19	57
	Residential districts (1/3 acre)	B	.67	89
	Total Area / Weighted Curve Number		24.44	58

INLET 14
SA-I14 3.37
12.76

REACHES

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I14	25.93	1.101	59	Outlet	1/3 ac lots

Total Area: 25.93 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA-I14							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1010					3.000	0.094
					Time of Concentration		1.101

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I14	Paved; open ditches (w/right-of-way)	A	.92	83
	Residential districts (1/3 acre)	A	23.19	57
	Residential districts (1/3 acre)	B	1.82	72
	Total Area / Weighted Curve Number		25.93	59

INLET 13

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA-I13	3.47 12.77

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I13	26.85	1.110	59	Outlet	1/3 ac lots

Total Area: 26.85 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I13							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1110					3.000	0.103
					Time of Concentration		1.11

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I13	Paved; open ditches (w/right-of-way)	A	.92	83
	Residential districts (1/3 acre)	A	24.04	57
	Residential districts (1/3 acre)	B	1.89	72
	Total Area / Weighted Curve Number		26.85	59

INLET 12

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA-I12	3.66
	12.78

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA-I12							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1210					3.000	0.112

Time of Concentration 1.119

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I12	Paved; open ditches (w/right-of-way)	A	.92	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	25.24	57
	Residential districts (1/3 acre)	B	2.25	72
	Total Area / Weighted Curve Number		28.48	59

INLET 11

Hydrograph Peak/Peak Time Table

SUBAREAS
SA-I11 3.79
12.75

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I11	29.57	1.123	59	Outlet	1/3 ac lots

Total Area: 29.57 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Travel Time (hr)
SA-I11							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1250					3.000	0.116

Time of Concentration 1.123

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I11	Paved; open ditches (w/right-of-way)	A	1.17	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	26.08	57
	Residential districts (1/3 acre)	B	2.25	72
	Total Area / Weighted Curve Number		29.57	59

INLET 10

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA-I10	3.89
	12.79

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I10							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1350					3.000	0.125
					Time of Concentration		1.132

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I10	Paved; open ditches (w/right-of-way)	A	1.17	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	27.01	57
	Residential districts (1/3 acre)	B	2.25	72
	Total Area / Weighted Curve Number		30.5	59

INLET 9

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA-I9	4.63
	12.77

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I9							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1450					3.000	0.134
Time of Concentration							1.141

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I9	Paved; open ditches (w/right-of-way)	A	1.17	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	27.01	57
	Residential districts (1/3 acre)	B	3.69	72
	Total Area / Weighted Curve Number		31.94	60

INLET 8

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA-I8	4.63
	12.78

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA-I8							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1500					3.000	0.139
Time of Concentration							1.146

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I8	Paved; open ditches (w/right-of-way)	A	1.28	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	27.01	57
	Residential districts (1/3 acre)	B	3.69	72
	Total Area / Weighted Curve Number		32.05	60

INLET 7

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-I7	4.84 12.79	20.84 12.65	46.55 12.62

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I7	33.86	1.162	60	Outlet	1/3 ac lots

Total Area: 33.86 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I7							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1670					3.000	0.155
Time of Concentration							1.162

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I7	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	28.68	57
	Residential districts (1/3 acre)	B	3.69	72
	Total Area / Weighted Curve Number		33.86	60

INLET 6

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-I6	5.01 12.80	21.56 12.65	48.15 12.63

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I6	35.17	1.168	60	Outlet	1/3 ac lots

Total Area: 35.17 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I6							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1740					3.000	0.161

Time of Concentration 1.168

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I6	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	3.69	72
	Total Area / Weighted Curve Number		35.17	60

INLET 28

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-I28	6.17 12.79	24.92 12.71	54.51 12.63

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I28	38.56	1.184	61	Outlet	1/3 ac lots

Total Area: 38.56 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I28							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	1910					3.000	0.177
Time of Concentration							1.184

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I28	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.07	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	7.08	72
	Total Area / Weighted Curve Number		38.56	61

INLET 3

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA-I3	6.12
	12.80

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I3							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	2050					3.000	0.190
					Time of Concentration		1.197

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I3	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.11	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	7.08	72
	Total Area / Weighted Curve Number		38.6	61

INLET 2

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-I2	7.53 12.79	28.86 12.68	61.53 12.62

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I2	42.35	1.202	62	Outlet	1/3 ac lots

Total Area: 42.35 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Travel Time (hr)
SA-I2							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	2110					3.000	0.195

Time of Concentration 1.202

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I2	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.44	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	10.5	72
	Total Area / Weighted Curve Number		42.35	62

INLET 1

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-I1	7.73 12.79	29.58 12.69	63.17 12.64

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-I1	43.68	1.212	62	Outlet	1/3 ac lots

Total Area: 43.68 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-I1							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	2210					3.000	0.205
Time of Concentration							1.212

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-I1	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.51	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	11.76	72
	Total Area / Weighted Curve Number		43.68	62

OUTFALL

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
OUTFALL	7.68	29.41 62.79
	12.80	12.71 12.67

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
OUTFALL	43.68	1.221	62	Outlet	1/3 ac lots

Total Area: 43.68 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
OUTFALL							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	2310					3.000	0.214
Time of Concentration							1.221

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
OUTFALL	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.51	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	11.76	72
	Total Area / Weighted Curve Number		43.68	62

BEACH

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
SA-BEACH	8.99 12.80	32.64 12.67	68.46 12.66

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-BEACH	46.41	1.243	63	Outlet	

Total Area: 46.41 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-BEACH							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100				0.050		0.556
CHANNEL	2550				3.000		0.236

Time of Concentration 1.243

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-BEACH	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.51	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	14.49	72
	Total Area / Weighted Curve Number		46.41	63

FIRST

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs)	100-Yr (cfs)
	(hr)	(hr)
SUBAREAS		
SA-FIRST	9.37	34.03 71.09
	12.82	12.71 12.65

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA-FIRST	49.06	1.269	63	Outlet	

Total Area: 49.06 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA-FIRST							
SHEET	100	0.0160	0.400				0.385
SHALLOW	485	0.0160	0.050				0.066
CHANNEL	100					0.050	0.556
CHANNEL	2830					3.000	0.262

Time of Concentration 1.269

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA-FIRST	Paved; open ditches (w/right-of-way)	A	1.42	83
	Paved; open ditches (w/right-of-way)	B	.51	89
	Residential districts (1/3 acre)	A	29.99	57
	Residential districts (1/3 acre)	B	17.14	72
	Total Area / Weighted Curve Number		49.06	63

INLET 37 ***SIDE RUNS***

Watershed Peak Table

Sub-Area Peak Flow by Rainfall Return Period
or Reach ANALYSIS:
Identifier (cfs)

SUBAREAS
SA37 0.16
Identifier (cfs)
(hr)

SUBAREAS
SA37 0.16
12.50

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA37	1.37	0.774	57	Outlet	1/3 acre lots

Total Area: 1.37 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA37							
SHEET	100	0.0500	0.150				0.111
SHALLOW	334	0.0120	0.050				0.052
CHANNEL	110					0.050	0.611

Time of Concentration .774

INLET 36

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA36	0.32 12.51

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA36							
SHEET	100	0.0500	0.150				0.111
SHALLOW	334	0.0120	0.050				0.052
CHANNEL	110					0.050	0.611
CHANNEL	36					3.000	0.003

Time of Concentration .777

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA36	Residential districts (1/3 acre)	A	2.64	57
Total Area / Weighted Curve Number			2.64	57

INLET 35

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA35	0.31
	13.42

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
SA35							
SHEET	100	0.0300	0.150				0.137
SHALLOW	90	0.0200	0.050				0.011
CHANNEL	378					0.050	2.100
Time of Concentration							2.248

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA35	Residential districts (1/3 acre)	B	1.15	72
Total Area / Weighted Curve Number			1.15	72

INLET 33

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA33	0.31 13.43

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA33							
SHEET	100	0.0300	0.150				0.137
SHALLOW	90	0.0200	0.050				0.011
CHANNEL	378					0.050	2.100
CHANNEL	41					3.000	0.004
					Time of Concentration		2.252

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA33	Paved; open ditches (w/right-of-way)	A	.02	83
	Residential districts (1/3 acre)	B	1.15	72
	Total Area / Weighted Curve Number		1.17	72

INLET 32

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA32	0.25 12.06

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
SA32	.84	0.184	57	Outlet	1/3 ACRE LOTS

Total Area: .84 (ac)

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA32							
SHEET	100	0.0300	0.150				0.137
SHALLOW	333	0.0150	0.050				0.047

Time of Concentration .184

INLET 30

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: (cfs) (hr)
SUBAREAS	
SA30	0.36
	12.06

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
SA30							
SHEET	100	0.0300	0.150				0.137
SHALLOW	333	0.0150	0.050				0.047
CHANNEL	30					3.000	0.003
					Time of Concentration		.187

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
SA30	Paved; open ditches (w/right-of-way)	A	.07	83
	Residential districts (1/3 acre)	A	.84	57
	Total Area / Weighted Curve Number		.91	59

Appendix B: Hydraulic Grade Line Computations

HYDRAULIC GRADIENT PROGRAM
VERSION 1.1
MARCH 1988
Baltimore County Method

DESIGNER : S.LUCAS PAGE = 1
PROJECT : SELBY_2010 RUN TIME: 19:44:57
PROJECT NO. : 06-109 (2YR HGL) RUN DATE: 07-07-2010

STARTING WATER SURFACE ELEVATION = 3.10
PARTIAL FLOW VELOCITY AT THE EXIT = 1.96

FROM OUTFALL TO I-1
PIPE SIZE = 21
PIPE LENGTH = 102.00

		PIPE SLOPE	= 0.0007
		GRADIENT SLOPE	= 0.0006
INVERT DOWNSTREAM	1.35	DEPTH OF FLOW	= 1.34
INVERT UPSTREAM	1.42	FRICTION HEAD	= 0.06
DOWNSTREAM VELOCITY	1.61		
UPSTREAM VELOCITY	1.61	HG BELOW I-1	= 3.16

DOWNSTREAM FLOW	3.87	A LOSS =	0.01
UPSTREAM FLOW	3.87	B LOSS =	0.00
INCOMING FLOW	0.00	C LOSS =	0.00
		D LOSS =	0.00
PARTIAL DEPTH	1.34		---
PARTIAL VELOCITY	1.96	TOTAL LOSS =	0.01
CRITICAL DEPTH	0.72	CALCULATED GRAD	= 3.17
CRITICAL VELOCITY	4.17	HG ABOVE I-1	= 3.21 * 2 *

FROM I-1 TO I-2
PIPE SIZE = 21
PIPE LENGTH = 105.00

		PIPE SLOPE	= 0.0006
		GRADIENT SLOPE	= 0.0006
INVERT DOWNSTREAM	1.46	DEPTH OF FLOW	= FULL
INVERT UPSTREAM	1.52	FRICTION HEAD	= 0.06
DOWNSTREAM VELOCITY	1.61		
UPSTREAM VELOCITY	2.13	HG BELOW I-2	= 3.27

DOWNSTREAM FLOW	3.87	A LOSS =	0.05
UPSTREAM FLOW	3.77	B LOSS =	-0.11
INCOMING FLOW	0.10	C LOSS =	0.00
		D LOSS =	0.00

		TOTAL LOSS =	0.00
		HG ABOVE I-2	= 3.27

FROM I-2 TO I-3
PIPE SIZE = 18
PIPE LENGTH = 55.00

INVERT DOWNSTREAM 1.57
INVERT UPSTREAM 1.70

DOWNSTREAM VELOCITY 2.13
UPSTREAM VELOCITY 1.75

DOWNSTREAM FLOW 3.77
UPSTREAM FLOW 3.09
INCOMING FLOW 0.68

PIPE SLOPE = 0.0024
GRADIENT SLOPE= 0.0013
DEPTH OF FLOW = FULL
FRICTION HEAD = 0.07

HG BELOW I-3 = 3.34

A LOSS = 0.02
B LOSS = 0.02
C LOSS = 0.03
D LOSS = 0.01

TOTAL LOSS = 0.09

HG ABOVE I-3 = 3.43

FROM I-3 TO M-4
PIPE SIZE = 18
PIPE LENGTH = 113.00

INVERT DOWNSTREAM 1.80
INVERT UPSTREAM 2.15

DOWNSTREAM VELOCITY 1.75
UPSTREAM VELOCITY 1.75

DOWNSTREAM FLOW 3.09
UPSTREAM FLOW 3.09
INCOMING FLOW 0.00

PARTIAL DEPTH 0.77
PARTIAL VELOCITY 3.36
CRITICAL DEPTH 0.67
CRITICAL VELOCITY 4.06

PIPE SLOPE = 0.0031
GRADIENT SLOPE= 0.0009
DEPTH OF FLOW = 0.77
FRICTION HEAD = 0.10

HG BELOW M-4 = 3.53

A LOSS = 0.02
B LOSS = 0.00
C LOSS = 0.00
D LOSS = 0.00

TOTAL LOSS = 0.02
CALCULATED GRAD = 3.54
HG ABOVE M-4 = 3.75 * 2 *

FROM M-4 TO I-28
PIPE SIZE = 18
PIPE LENGTH = 45.00

INVERT DOWNSTREAM 2.25
INVERT UPSTREAM 2.36

DOWNSTREAM VELOCITY 1.75
UPSTREAM VELOCITY 3.49

DOWNSTREAM FLOW 3.09
UPSTREAM FLOW 3.09
INCOMING FLOW 0.00

PARTIAL DEPTH 0.83
PARTIAL VELOCITY 3.07
CRITICAL DEPTH 0.67
CRITICAL VELOCITY 4.06

PIPE SLOPE = 0.0024
GRADIENT SLOPE= 0.0009
DEPTH OF FLOW = 0.83
FRICTION HEAD = 0.04

HG BELOW I-28 = 3.79

A LOSS = 0.06
B LOSS = -0.14
C LOSS = 0.08
D LOSS = 0.00

TOTAL LOSS = 0.00
CALCULATED GRAD = 3.79
HG ABOVE I-28 = 3.96 * 2 *

FROM I-28 TO I-6
PIPE SIZE = 18
PIPE LENGTH = 170.00

INVERT DOWNSTREAM 2.46
INVERT UPSTREAM 2.85

DOWNSTREAM VELOCITY 3.49
UPSTREAM VELOCITY 2.84

DOWNSTREAM FLOW 6.17
UPSTREAM FLOW 5.01
INCOMING FLOW 1.16

PIPE SLOPE = 0.0023
GRADIENT SLOPE= 0.0034
DEPTH OF FLOW = FULL
FRICTION HEAD = 0.58

HG BELOW I-6 = 4.54

A LOSS = 0.06
B LOSS = 0.06
C LOSS = 0.04
D LOSS = 0.02

TOTAL LOSS = 0.19

HG ABOVE I-6 = 4.74

FROM I-6 TO I-7
PIPE SIZE = 18
PIPE LENGTH = 71.00

INVERT DOWNSTREAM 2.95
INVERT UPSTREAM 3.15

DOWNSTREAM VELOCITY 2.84
UPSTREAM VELOCITY 2.74

DOWNSTREAM FLOW 5.01
UPSTREAM FLOW 4.84
INCOMING FLOW 0.17

PIPE SLOPE = 0.0028
GRADIENT SLOPE= 0.0023
DEPTH OF FLOW = FULL
FRICTION HEAD = 0.16

HG BELOW I-7 = 4.90

A LOSS = 0.04
B LOSS = 0.01
C LOSS = 0.00
D LOSS = 0.00

TOTAL LOSS = 0.05

HG ABOVE I-7 = 4.95

FROM I-7 TO I-8
PIPE SIZE = 18
PIPE LENGTH = 160.00

INVERT DOWNSTREAM 3.25
INVERT UPSTREAM 3.74

DOWNSTREAM VELOCITY 2.74
UPSTREAM VELOCITY 2.62

DOWNSTREAM FLOW 4.84
UPSTREAM FLOW 4.63
INCOMING FLOW 0.21

PIPE SLOPE = 0.0031
GRADIENT SLOPE= 0.0021
DEPTH OF FLOW = FULL
FRICTION HEAD = 0.34

HG BELOW I-8 = 5.29

A LOSS = 0.04
B LOSS = 0.01
C LOSS = 0.00
D LOSS = 0.00

TOTAL LOSS = 0.05

HG ABOVE I-8 = 5.34 * 2 *

FROM I-8 TO I-9
PIPE SIZE = 18
PIPE LENGTH = 26.00

INVERT DOWNSTREAM	3.84	PIPE SLOPE	= 0.0038
INVERT UPSTREAM	3.94	GRADIENT SLOPE	= 0.0019
		DEPTH OF FLOW	= 0.93
DOWNSTREAM VELOCITY	2.62	FRICTION HEAD	= 0.05
UPSTREAM VELOCITY	2.62	HG BELOW I-9	= 5.39
DOWNSTREAM FLOW	4.63	A LOSS	= 0.04
UPSTREAM FLOW	4.63	B LOSS	= 0.00
INCOMING FLOW	0.00	C LOSS	= 0.00
		D LOSS	= 0.00
PARTIAL DEPTH	0.93	TOTAL LOSS	= 0.04
PARTIAL VELOCITY	4.00	CALCULATED GRAD	= 5.43
CRITICAL DEPTH	0.83	HG ABOVE I-9	= 5.54 * 2 *
CRITICAL VELOCITY	4.64		

FROM I-9 TO I-10
PIPE SIZE = 18
PIPE LENGTH = 110.00

INVERT DOWNSTREAM	4.04	PIPE SLOPE	= 0.0031
INVERT UPSTREAM	4.38	GRADIENT SLOPE	= 0.0019
		DEPTH OF FLOW	= 1.01
DOWNSTREAM VELOCITY	2.62	FRICTION HEAD	= 0.21
UPSTREAM VELOCITY	2.20	HG BELOW I-10	= 5.75
DOWNSTREAM FLOW	4.63	A LOSS	= 0.04
UPSTREAM FLOW	3.89	B LOSS	= 0.03
INCOMING FLOW	0.74	C LOSS	= 0.05
		D LOSS	= 0.01
PARTIAL DEPTH	1.01	TOTAL LOSS	= 0.13
PARTIAL VELOCITY	3.67	CALCULATED GRAD	= 5.88
CRITICAL DEPTH	0.83	HG ABOVE I-10	= 5.98 * 2 *
CRITICAL VELOCITY	4.64		

FROM I-10 TO I-11
PIPE SIZE = 18
PIPE LENGTH = 98.00

INVERT DOWNSTREAM	4.48	PIPE SLOPE	= 0.0031
INVERT UPSTREAM	4.78	GRADIENT SLOPE	= 0.0014
		DEPTH OF FLOW	= 0.90
DOWNSTREAM VELOCITY	2.20	FRICTION HEAD	= 0.13
UPSTREAM VELOCITY	2.14	HG BELOW I-11	= 6.11
DOWNSTREAM FLOW	3.89	A LOSS	= 0.02
UPSTREAM FLOW	3.79	B LOSS	= 0.00
INCOMING FLOW	0.10	C LOSS	= 0.00
		D LOSS	= 0.00
PARTIAL DEPTH	0.90	TOTAL LOSS	= 0.03
PARTIAL VELOCITY	3.53	CALCULATED GRAD	= 6.14
CRITICAL DEPTH	0.75	HG ABOVE I-11	= 6.38 * 2 *
CRITICAL VELOCITY	4.37		

```
FROM I-11       TO I-12
PIPE SIZE   = 18
PIPE LENGTH =  35.00                PIPE SLOPE    = 0.0031
                                    GRADIENT SLOPE= 0.0013
INVERT DOWNSTREAM      4.88         DEPTH OF FLOW =   0.88
INVERT UPSTREAM        4.99         FRICTION HEAD =   0.05

DOWNSTREAM VELOCITY    2.14
UPSTREAM VELOCITY      2.98         HG BELOW I-12     =   6.43
                                                      ----------
DOWNSTREAM FLOW        3.79         A LOSS =   0.05
UPSTREAM FLOW          3.66         B LOSS =  -0.07
INCOMING FLOW          0.13         C LOSS =   0.00
                                    D LOSS =   0.00
PARTIAL DEPTH          0.88                       ----------
PARTIAL VELOCITY       3.54         TOTAL LOSS =          0.00
CRITICAL DEPTH         0.74
CRITICAL VELOCITY      4.34         HG ABOVE I-12     =   6.43
                                                      ----------

FROM I-12       TO I-13
PIPE SIZE   = 15
PIPE LENGTH = 104.00                PIPE SLOPE    = 0.0030
                                    GRADIENT SLOPE= 0.0032
INVERT DOWNSTREAM      5.09         DEPTH OF FLOW = FULL
INVERT UPSTREAM        5.40         FRICTION HEAD =   0.33

DOWNSTREAM VELOCITY    2.98
UPSTREAM VELOCITY      2.83         HG BELOW I-13     =   6.76
                                                      ----------
DOWNSTREAM FLOW        3.66         A LOSS =   0.05
UPSTREAM FLOW          3.47         B LOSS =   0.01
INCOMING FLOW          0.19         C LOSS =   0.00
                                    D LOSS =   0.01
                                                      ----------
                                    TOTAL LOSS =          0.07

                                    HG ABOVE I-13     =   6.82
                                                      ----------

FROM I-13       TO I-14
PIPE SIZE   = 15
PIPE LENGTH =  96.00                PIPE SLOPE    = 0.0031
                                    GRADIENT SLOPE= 0.0029
INVERT DOWNSTREAM      5.50         DEPTH OF FLOW = FULL
INVERT UPSTREAM        5.80         FRICTION HEAD =   0.28

DOWNSTREAM VELOCITY    2.83
UPSTREAM VELOCITY      2.75         HG BELOW I-14     =   7.10
                                                      ----------
DOWNSTREAM FLOW        3.47         A LOSS =   0.04
UPSTREAM FLOW          3.37         B LOSS =   0.01
INCOMING FLOW          0.10         C LOSS =   0.00
                                    D LOSS =   0.00
                                                      ----------
                                    TOTAL LOSS =          0.05

                                    HG ABOVE I-14     =   7.15  * 2 *
```

```
FROM I-14       TO I-15
PIPE SIZE   = 15
PIPE LENGTH =  41.00                PIPE SLOPE    = 0.0024
                                    GRADIENT SLOPE= 0.0027
INVERT DOWNSTREAM      5.90         DEPTH OF FLOW = FULL
INVERT UPSTREAM        6.00         FRICTION HEAD =   0.11

DOWNSTREAM VELOCITY    2.75
UPSTREAM VELOCITY      2.26         HG BELOW I-15     =   7.26
                                                      ------------
DOWNSTREAM FLOW        3.37         A LOSS =   0.04
UPSTREAM FLOW          2.77         B LOSS =   0.04
INCOMING FLOW          0.60         C LOSS =   0.00
                                    D LOSS =   0.01
                                                      ------------
                                    TOTAL LOSS =          0.09

                                    HG ABOVE I-15     =   7.35
                                                      ------------
FROM I-15       TO I-16
PIPE SIZE   = 15
PIPE LENGTH = 101.00                PIPE SLOPE    = 0.0037
                                    GRADIENT SLOPE= 0.0018
INVERT DOWNSTREAM      6.10         DEPTH OF FLOW =   0.78
INVERT UPSTREAM        6.47         FRICTION HEAD =   0.18

DOWNSTREAM VELOCITY    2.26
UPSTREAM VELOCITY      2.11         HG BELOW I-16     =   7.54
                                                      ------------
DOWNSTREAM FLOW        2.77         A LOSS =   0.03
UPSTREAM FLOW          2.59         B LOSS =   0.01
INCOMING FLOW          0.18         C LOSS =   0.00
                                    D LOSS =   0.00
PARTIAL DEPTH          0.78                           ------------
PARTIAL VELOCITY       3.46         TOTAL LOSS =          0.04
CRITICAL DEPTH         0.67         CALCULATED GRAD   =   7.58
CRITICAL VELOCITY      4.15         HG ABOVE I-16     =   7.82  * 2 *
                                                      ------------

FROM I-16       TO I-17
PIPE SIZE   = 15
PIPE LENGTH = 100.00                PIPE SLOPE    = 0.0040
                                    GRADIENT SLOPE= 0.0016
INVERT DOWNSTREAM      6.57         DEPTH OF FLOW =   0.72
INVERT UPSTREAM        6.97         FRICTION HEAD =   0.16

DOWNSTREAM VELOCITY    2.11
UPSTREAM VELOCITY      2.04         HG BELOW I-17     =   7.98
                                                      ------------
DOWNSTREAM FLOW        2.59         A LOSS =   0.02
UPSTREAM FLOW          2.50         B LOSS =   0.00
INCOMING FLOW          0.09         C LOSS =   0.00
                                    D LOSS =   0.00
PARTIAL DEPTH          0.72                           ------------
PARTIAL VELOCITY       3.52         TOTAL LOSS =          0.03
CRITICAL DEPTH         0.64         CALCULATED GRAD   =   8.01
CRITICAL VELOCITY      4.06         HG ABOVE I-17     =   8.32  * 2 *
                                                      ------------
```

FROM I-17 TO I-18
PIPE SIZE = 15
PIPE LENGTH = 37.00

INVERT DOWNSTREAM	7.07	PIPE SLOPE	= 0.0041
INVERT UPSTREAM	7.22	GRADIENT SLOPE	= 0.0015
		DEPTH OF FLOW	= 0.70
DOWNSTREAM VELOCITY	2.04	FRICTION HEAD	= 0.06
UPSTREAM VELOCITY	1.78	HG BELOW I-18	= 8.38
DOWNSTREAM FLOW	2.50	A LOSS	= 0.02
UPSTREAM FLOW	2.18	B LOSS	= 0.02
INCOMING FLOW	0.32	C LOSS	= 0.00
		D LOSS	= 0.01
PARTIAL DEPTH	0.70	TOTAL LOSS	= 0.04
PARTIAL VELOCITY	3.51	CALCULATED GRAD	= 8.42
CRITICAL DEPTH	0.63	HG ABOVE I-18	= 8.57 * 2 *
CRITICAL VELOCITY	4.01		

FROM I-18 TO I-19
PIPE SIZE = 15
PIPE LENGTH = 102.00

INVERT DOWNSTREAM	7.32	PIPE SLOPE	= 0.0039
INVERT UPSTREAM	7.72	GRADIENT SLOPE	= 0.0011
		DEPTH OF FLOW	= 0.65
DOWNSTREAM VELOCITY	1.78	FRICTION HEAD	= 0.12
UPSTREAM VELOCITY	1.57	HG BELOW I-19	= 8.69
DOWNSTREAM FLOW	2.18	A LOSS	= 0.02
UPSTREAM FLOW	1.93	B LOSS	= 0.01
INCOMING FLOW	0.25	C LOSS	= 0.00
		D LOSS	= 0.00
PARTIAL DEPTH	0.65	TOTAL LOSS	= 0.03
PARTIAL VELOCITY	3.36	CALCULATED GRAD	= 8.72
CRITICAL DEPTH	0.59	HG ABOVE I-19	= 9.07 * 2 *
CRITICAL VELOCITY	3.83		

FROM I-19 TO I-20
PIPE SIZE = 15
PIPE LENGTH = 100.00

INVERT DOWNSTREAM	7.82	PIPE SLOPE	= 0.0060
INVERT UPSTREAM	8.42	GRADIENT SLOPE	= 0.0009
		DEPTH OF FLOW	= 0.54
DOWNSTREAM VELOCITY	1.57	FRICTION HEAD	= 0.09
UPSTREAM VELOCITY	1.54	HG BELOW I-20	= 9.16
DOWNSTREAM FLOW	1.93	A LOSS	= 0.01
UPSTREAM FLOW	1.89	B LOSS	= 0.00
INCOMING FLOW	0.04	C LOSS	= 0.00
		D LOSS	= 0.00
PARTIAL DEPTH	0.54	TOTAL LOSS	= 0.01
PARTIAL VELOCITY	3.82	CALCULATED GRAD	= 9.17
CRITICAL DEPTH	0.55	HG ABOVE I-20	= 9.77 * 2 *
CRITICAL VELOCITY	3.69		

FROM I-20 TO I-21
PIPE SIZE = 15
PIPE LENGTH = 30.00

INVERT DOWNSTREAM	8.52	PIPE SLOPE	= 0.0077
INVERT UPSTREAM	8.75	GRADIENT SLOPE	= 0.0009
		DEPTH OF FLOW	= 0.50
DOWNSTREAM VELOCITY	1.54	FRICTION HEAD	= 0.03
UPSTREAM VELOCITY	1.21	HG BELOW I-21	= 9.80
DOWNSTREAM FLOW	1.89	A LOSS	= 0.01
UPSTREAM FLOW	1.48	B LOSS	= 0.01
INCOMING FLOW	0.41	C LOSS	= 0.00
		D LOSS	= 0.00
PARTIAL DEPTH	0.50	TOTAL LOSS	= 0.03
PARTIAL VELOCITY	4.15	CALCULATED GRAD	= 9.83
CRITICAL DEPTH	0.55	HG ABOVE I-21	= 10.10 * 2 *
CRITICAL VELOCITY	3.66		

FROM I-21 TO I-22
PIPE SIZE = 15
PIPE LENGTH = 191.00

INVERT DOWNSTREAM	8.85	PIPE SLOPE	= 0.0047
INVERT UPSTREAM	9.75	GRADIENT SLOPE	= 0.0005
		DEPTH OF FLOW	= 0.50
DOWNSTREAM VELOCITY	1.21	FRICTION HEAD	= 0.10
UPSTREAM VELOCITY	0.81	CALCULATED GRAD	= 10.20
DOWNSTREAM FLOW	1.48	HG BELOW I-22	= 10.25 * 1 *
UPSTREAM FLOW	0.99	A LOSS	= 0.01
INCOMING FLOW	0.49	B LOSS	= 0.01
		C LOSS	= 0.01
		D LOSS	= 0.00
PARTIAL DEPTH	0.50	TOTAL LOSS	= 0.03
PARTIAL VELOCITY	3.25	CALCULATED GRAD	= 10.28
CRITICAL DEPTH	0.48	HG ABOVE I-22	= 11.10 * 2 *
CRITICAL VELOCITY	3.40		

FROM I-22 TO I-23
PIPE SIZE = 15
PIPE LENGTH = 31.00

INVERT DOWNSTREAM	9.85	PIPE SLOPE	= 0.0068
INVERT UPSTREAM	10.06	GRADIENT SLOPE	= 0.0002
		DEPTH OF FLOW	= 0.37
DOWNSTREAM VELOCITY	0.81	FRICTION HEAD	= 0.01
UPSTREAM VELOCITY	0.42	HG BELOW I-23	= 11.11
DOWNSTREAM FLOW	0.99	A LOSS	= 0.00
UPSTREAM FLOW	0.52	B LOSS	= 0.01
INCOMING FLOW	0.47	C LOSS	= 0.00
		D LOSS	= 0.00
PARTIAL DEPTH	0.37	TOTAL LOSS	= 0.01
PARTIAL VELOCITY	3.32	CALCULATED GRAD	= 11.12
CRITICAL DEPTH	0.39	HG ABOVE I-23	= 11.41 * 2 *
CRITICAL VELOCITY	3.02		

FROM I-23 TO I-23A
PIPE SIZE = 15
PIPE LENGTH = 175.00

		PIPE SLOPE	= 0.0056
		GRADIENT SLOPE	= 0.0001
INVERT DOWNSTREAM	10.16	DEPTH OF FLOW	= 0.28
INVERT UPSTREAM	11.14	FRICTION HEAD	= 0.01
DOWNSTREAM VELOCITY	0.42		
UPSTREAM VELOCITY	0.00	HG BELOW I-23A	= 11.42
DOWNSTREAM FLOW	0.52	A LOSS =	0.00
UPSTREAM FLOW	0.33	B LOSS =	0.00
INCOMING FLOW	0.00	C LOSS =	0.00
		D LOSS =	0.00
PARTIAL DEPTH	0.28		
PARTIAL VELOCITY	2.58	TOTAL LOSS =	0.00
CRITICAL DEPTH	0.28		
CRITICAL VELOCITY	2.53	HG ABOVE I-23A	= 11.42

OUTPUT NOTES

* 1 * THE GRADIENT WAS LESS THAN THE CROWN OF THE PIPE, THE GRADIENT WAS CALCULATED BY ADDING THE PARTIAL DEPTH TO THE PIPE INVERT

* 2 * THE GRADIENT WAS FOUND TO BE LESS THAN THE CROWN OF THE PIPE, THE GRADIENT HAS BEEN ADJUSTED TO EQUAL THE CROWN ELEVATION.

SIDE RUNS

STARTING WATER SURFACE ELEVATION = 3.27
PARTIAL FLOW VELOCITY AT THE EXIT = 6.36

FROM I-2 TO ES-1
PIPE SIZE = 15
PIPE LENGTH = 25.00

INVERT DOWNSTREAM	1.81	PIPE SLOPE	= 0.0112
INVERT UPSTREAM	2.09	GRADIENT SLOPE	= 0.0034
		DEPTH OF FLOW	= FULL
DOWNSTREAM VELOCITY	3.07	FRICTION HEAD	= 0.08
UPSTREAM VELOCITY	0.00	HG BELOW ES-1	= 3.35
DOWNSTREAM FLOW	3.77	A LOSS =	0.00
UPSTREAM FLOW	3.83	B LOSS =	0.00
INCOMING FLOW	0.00	C LOSS =	0.00
		D LOSS =	0.00
		TOTAL LOSS =	0.00
		HG ABOVE ES-1	= 3.35

STARTING WATER SURFACE ELEVATION = 4.08
PARTIAL FLOW VELOCITY AT THE EXIT = 6.36

FROM I-28 TO I-28A
PIPE SIZE = 15
PIPE LENGTH = 35.00

INVERT DOWNSTREAM	3.20	PIPE SLOPE	= 0.0171
INVERT UPSTREAM	3.80	GRADIENT SLOPE	= 0.0023
		DEPTH OF FLOW	= 0.52
DOWNSTREAM VELOCITY	2.52	FRICTION HEAD	= 0.08
UPSTREAM VELOCITY	0.00	HG BELOW I-28A	= 4.53
DOWNSTREAM FLOW	3.09	A LOSS =	0.00
UPSTREAM FLOW	1.00	B LOSS =	0.00
INCOMING FLOW	0.00	C LOSS =	0.00
		D LOSS =	0.00
PARTIAL DEPTH	0.52		
PARTIAL VELOCITY	6.36	TOTAL LOSS =	0.00
CRITICAL DEPTH	0.71		
CRITICAL VELOCITY	4.32	HG ABOVE I-28A	= 4.53

STARTING WATER SURFACE ELEVATION = 6.38
PARTIAL FLOW VELOCITY AT THE EXIT = 3.78

FROM I-11 TO I-30
PIPE SIZE = 15
PIPE LENGTH = 30.00

		PIPE SLOPE	= 0.0040
		GRADIENT SLOPE	= 0.0034
INVERT DOWNSTREAM	5.32	DEPTH OF FLOW	= 0.95
INVERT UPSTREAM	5.44	FRICTION HEAD	= 0.10
DOWNSTREAM VELOCITY	3.09		
UPSTREAM VELOCITY	3.38	HG BELOW I-30	= 6.67
		A LOSS	= 0.06
DOWNSTREAM FLOW	3.79	B LOSS	= -0.03
UPSTREAM FLOW	0.36	C LOSS	= 0.08
INCOMING FLOW	3.43	D LOSS	= 0.14
PARTIAL DEPTH	0.95	TOTAL LOSS	= 0.25
PARTIAL VELOCITY	3.78		
CRITICAL DEPTH	0.79		
CRITICAL VELOCITY	4.66	HG ABOVE I-30	= 6.92

FROM I-30 TO I-32
PIPE SIZE = 15
PIPE LENGTH = 24.00

		PIPE SLOPE	= 0.0067
		GRADIENT SLOPE	= 0.0041
INVERT DOWNSTREAM	5.54	DEPTH OF FLOW	= FULL
INVERT UPSTREAM	5.70	FRICTION HEAD	= 0.10
DOWNSTREAM VELOCITY	3.38		
UPSTREAM VELOCITY	0.00	HG BELOW I-32	= 7.02
		A LOSS	= 0.00
DOWNSTREAM FLOW	4.15	B LOSS	= 0.00
UPSTREAM FLOW	0.25	C LOSS	= 0.00
INCOMING FLOW	0.00	D LOSS	= 0.00
		TOTAL LOSS	= 0.00
		HG ABOVE I-32	= 7.02

```
                STARTING WATER SURFACE ELEVATION  =  7.15
                   PARTIAL FLOW VELOCITY AT THE EXIT =  3.78


FROM I-14       TO I-33
PIPE SIZE   = 15
PIPE LENGTH =  25.00                PIPE SLOPE    = 0.0020
                                    GRADIENT SLOPE= 0.0027
INVERT DOWNSTREAM      5.95         DEPTH OF FLOW = FULL
INVERT UPSTREAM        6.00         FRICTION HEAD =   0.07

DOWNSTREAM VELOCITY    2.75
UPSTREAM VELOCITY      3.00         HG BELOW I-33     =   7.27
                                                        -------------
DOWNSTREAM FLOW        3.37         A LOSS =   0.05
UPSTREAM FLOW          0.31         B LOSS =  -0.02
INCOMING FLOW          3.06         C LOSS =   0.06
                                    D LOSS =   0.11
                                                        -------------
                                    TOTAL LOSS =          0.20

                                    HG ABOVE I-33     =   7.60  * 2 *

                              -------------

FROM I-33       TO I-35
PIPE SIZE   = 15
PIPE LENGTH =  41.00                PIPE SLOPE    = 0.0051
                                    GRADIENT SLOPE= 0.0032
INVERT DOWNSTREAM      6.35         DEPTH OF FLOW =   0.84
INVERT UPSTREAM        6.56         FRICTION HEAD =   0.13

DOWNSTREAM VELOCITY    3.00
UPSTREAM VELOCITY      0.00         HG BELOW I-35     =   7.73
                                                        -------------
DOWNSTREAM FLOW        3.68         A LOSS =   0.00
UPSTREAM FLOW          0.31         B LOSS =   0.00
INCOMING FLOW          0.00         C LOSS =   0.00
                                    D LOSS =   0.00
PARTIAL DEPTH          0.84                             -------------
PARTIAL VELOCITY       4.18         TOTAL LOSS =          0.00
CRITICAL DEPTH         0.77
CRITICAL VELOCITY      4.61         HG ABOVE I-35     =   7.73
                                                        -------------
```

```
                    STARTING WATER SURFACE ELEVATION  =  8.32
                    PARTIAL FLOW VELOCITY AT THE EXIT =  3.78


     FROM I-17       TO I-36
     PIPE SIZE   = 15
     PIPE LENGTH =  25.00              PIPE SLOPE    = 0.0040
                                       GRADIENT SLOPE= 0.0015
     INVERT DOWNSTREAM      7.07       DEPTH OF FLOW = FULL
     INVERT UPSTREAM        7.12       FRICTION HEAD =   0.04

     DOWNSTREAM VELOCITY    2.04
     UPSTREAM VELOCITY      2.30       HG BELOW I-36     =   8.36
                                                         -------------
     DOWNSTREAM FLOW        2.50       A LOSS =   0.03
     UPSTREAM FLOW          0.32       B LOSS =  -0.02
     INCOMING FLOW          2.18       C LOSS =   0.04
                                       D LOSS =   0.07
                                                         -------------
                                       TOTAL LOSS =          0.11

                                       HG ABOVE I-36     =   8.47
                                                         -------------

     FROM I-36       TO I-37
     PIPE SIZE   = 15
     PIPE LENGTH =  36.00              PIPE SLOPE    = 0.0019
                                       GRADIENT SLOPE= 0.0019
     INVERT DOWNSTREAM      7.17       DEPTH OF FLOW = FULL
     INVERT UPSTREAM        7.24       FRICTION HEAD =   0.07

     DOWNSTREAM VELOCITY    2.30
     UPSTREAM VELOCITY      0.00       HG BELOW I-37     =   8.54
                                                         -------------
     DOWNSTREAM FLOW        2.82       A LOSS =   0.00
     UPSTREAM FLOW          0.16       B LOSS =   0.00
     INCOMING FLOW          0.00       C LOSS =   0.00
                                       D LOSS =   0.00
                                                         -------------
                                       TOTAL LOSS =          0.00

                                       HG ABOVE I-37     =   8.54

OUTPUT NOTES

      * 1 *  THE GRADIENT WAS LESS THAN THE CROWN OF THE PIPE, THE GRADIENT
             WAS CALCULATED BY ADDING THE PARTIAL DEPTH TO THE PIPE INVERT

      * 2 *  THE GRADIENT WAS FOUND TO BE LESS THAN THE CROWN OF THE PIPE,
             THE GRADIENT HAS BEEN ADJUSTED TO EQUAL THE CROWN ELEVATION.
```

STARTING WATER SURFACE ELEVATION = 9.77
PARTIAL FLOW VELOCITY AT THE EXIT = 3.01

FROM I-20 TO I-38
PIPE SIZE = 15
PIPE LENGTH = 31.00

		PIPE SLOPE	= 0.0032
		GRADIENT SLOPE	= 0.0009
INVERT DOWNSTREAM	8.52	DEPTH OF FLOW	= 0.64
INVERT UPSTREAM	8.62	FRICTION HEAD	= 0.03
DOWNSTREAM VELOCITY	1.54		
UPSTREAM VELOCITY	0.00	HG BELOW I-38	= 9.80
DOWNSTREAM FLOW	1.89	A LOSS =	0.00
UPSTREAM FLOW	0.26	B LOSS =	0.00
INCOMING FLOW	0.00	C LOSS =	0.00
		D LOSS =	0.00
PARTIAL DEPTH	0.64		
PARTIAL VELOCITY	3.01	TOTAL LOSS =	0.00
CRITICAL DEPTH	0.55		
CRITICAL VELOCITY	3.66	HG ABOVE I-38	= 9.80

STARTING WATER SURFACE ELEVATION = 10.10
PARTIAL FLOW VELOCITY AT THE EXIT = 4.18

FROM I-21 TO I-49
PIPE SIZE = 15
PIPE LENGTH = 167.00

		PIPE SLOPE	= 0.0078
		GRADIENT SLOPE	= 0.0009
INVERT DOWNSTREAM	9.73	DEPTH OF FLOW	= 0.49
INVERT UPSTREAM	11.04	FRICTION HEAD	= 0.14
DOWNSTREAM VELOCITY	1.54	CALCULATED GRAD	= 11.12
UPSTREAM VELOCITY	0.00	HG BELOW I-49	= 11.53 * 1 *
DOWNSTREAM FLOW	1.89	A LOSS =	0.00
UPSTREAM FLOW	1.13	B LOSS =	0.00
INCOMING FLOW	0.00	C LOSS =	0.00
		D LOSS =	0.00
PARTIAL DEPTH	0.49		
PARTIAL VELOCITY	4.18	TOTAL LOSS =	0.00
CRITICAL DEPTH	0.55		
CRITICAL VELOCITY	3.66	HG ABOVE I-49	= 11.53

OUTPUT NOTES

* 1 * THE GRADIENT WAS LESS THAN THE CROWN OF THE PIPE, THE GRADIENT WAS CALCULATED BY ADDING THE PARTIAL DEPTH TO THE PIPE INVERT

Appendix C: Structures:

Table 5: Structure Table and Inlet Capacity Summary

Table 6: Storm Drain Pipe Summary

Table 5. Structure Table and Inlet Capacity Summary

Name	∑DA	∑Q2	Grate Ele	Depth to Invert	Structure Type	Inlet Capacity	County Detail	Throat Invert	Northing	Easting
I-23A**	3.27	0.33	13.50	2.36	S	9.55	D-40	NA	452799	1449043
I-23	5.08	0.52	13.07	3.01	S	2.12	D-40	NA	452642	1449215
I-22**	9.78	0.99	12.53	2.78	S	2.12	D-40	NA	452621	1449194
I-21	14.80	1.48	12.50	3.75	Double S*	2.12	D-42	11.6/11.8	452494	1449047
I-20	16.26	1.89	12.11	3.69	S	2.12	D-40	NA	452475	1449072
I-19	16.70	1.93	11.20	3.48	S	4.44	D-28	NA	452398	1449137
I-18	19.00	2.18	11.25	4.03	S*	2.12	D-40	10.00	452320	1449204
I-17	21.84	2.50	10.84	3.87	S*	2.12	D-40	9.88	452292	1449228
I-16	22.79	2.59	9.50	3.03	S	2.41	D-40	NA	452215	1449293
I-15	24.44	2.77	10.00	4.00	S*	2.12	D-40	9.50	452138	1449359
I-14	25.93	3.37	9.28	3.48	S	9.55	D-40	NA	452107	1449386
I-13	26.85	3.47	9.00	3.60	S	6.83	D-40	NA	452034	1449448
I-12	28.48	3.66	9.00	4.01	S	8.42	D-40	NA	451954	1449515
I-11	29.57	3.79	8.70	3.92	S	4.44	D-40	NA	451928	1449537
I-10	30.50	3.89	8.40	4.02	S	8.42	D-40	NA	451854	1449602
I-9	31.94	4.63	8.25	4.31	S*	2.12	D-40	7.00	451770	1449672
I-8	32.05	4.63	7.75	4.01	S	9.55	D-40	NA	451786	1449692
I-7	33.86	4.84	6.50	3.35	S	9.55	D-40	NA	451890	1449814
I-6**	35.17	5.01	5.60	2.75	S	6.83	D-40	NA	451936	1449867
I-28	38.56	6.17	6.60	4.24	Double S Mod*	2.12	D-42 Mod	5.30	452046	1449996
M-4	38.56	6.17	6.30	4.15	B Mod	2.12	D-13 Mod	NA	452002	1450004
I-3**	38.60	6.17	4.60	2.90	S Mod*	2.12	D-40 Mod	4.00	451924	1450086
I-2**	42.35	7.53	4.04	2.52	S Mod	2.12	D-40 Mod	NA	451884	1450122
I-1	43.68	7.73	4.50	3.08	S Mod*	2.12	D-40 Mod	3.80	451916	1450225
Outfall**			2.70	2.70	Cutoff Wall Mod		D-81 Mod	NA	451968	1450313
Beach In**	46.41	8.99	3.40	NA	A Headwall Mod	9.09	D-55 Mod	NA	451974	1450595
Beach Out**	46.41	8.99	3.40	NA	A Headwall Mod	9.09	D-55 Mod	NA	451978	1450632
1st St In**	49.06	9.37	3.00	NA	A Headwall Mod	9.51	D-55 Mod	NA	452083	1450846
1st St Out**	49.06	9.37	3.00	NA	A Headwall Mod	9.51	D-55 Mod	NA	452104	1450872
I-49**	3.34	1.13	14.00	2.96	S*	2.12	D-40	13.50	452382	1448921
I-38	1.08	0.26	11.75	3.13	S	5.59	D-40	NA	452497	1449095
I-37	1.37	0.16	11.00	3.67	S*	2.12	D-40	10.20	452337	1449217
I-36	2.64	0.32	10.70	3.58	S*	2.12	D-40	10.10	452308	1449242
I-35	1.15	0.31	9.84	3.28	S*	2.12	D-40	9.20	452150	1449378
I-33	1.17	0.31	9.80	3.80	S*	2.12	D-40	8.50	452120	1449402
I-32	0.84	0.25	9.00	3.30	S*	2.12	D-40	8.00	451967	1449533
I-30	0.91	0.36	8.00	2.56	S	9.55	D-40	NA	451947	1449553
I-28A	1.45	1.00	7.00	5.87	S*	2.24	D-40	6.00	452070	1450023
ES-1	3.42	3.83	4.00				D-74/75		451873	1450100

* Throat opening 18" wide to invert elevation.

** Less than minimum depth from top of grate (or structure) to invert of pipe

Table 6. Storm Drain Pipe Summary

FROM Inlet	TO Inlet	Q2	L	s	Pipe Diam (in)	No. Pipes	inv. ds	inv. us	HGL ds	HGL us	V fps
23A	23	0.33	233	0.42%	15	1	10.16	11.14	11.42	11.42	0.42
23	22	0.52	30	0.70%	15	1	9.85	10.06	11.11	11.41	0.81
22	21	0.99	194	0.46%	15	1	8.85	9.75	10.25	11.10	1.21
21	20	1.48	30	0.77%	15	1	8.52	8.75	9.80	10.10	1.54
20	19	1.89	100	0.60%	15	1	7.82	8.42	9.16	9.77	1.57
19	18	1.93	102	0.39%	15	1	7.32	7.72	8.69	9.07	1.78
18	17	2.18	37	0.41%	15	1	7.07	7.22	8.38	8.57	2.04
17	16	2.50	100	0.40%	15	1	6.57	6.97	7.98	8.32	2.11
16	15	2.59	101	0.37%	15	1	6.10	6.47	7.54	7.82	2.26
15	14	2.77	41	0.24%	15	1	5.90	6.00	7.26	7.35	2.75
14	13	3.37	96	0.31%	15	1	5.50	5.80	7.10	7.15	2.83
13	12	3.47	104	0.30%	15	1	5.09	5.40	6.76	6.82	2.98
12	11	3.66	35	0.31%	18	1	4.88	4.99	6.43	6.43	2.14
11	10	3.79	98	0.31%	18	1	4.48	4.78	6.11	6.38	2.20
10	9	3.89	110	0.31%	18	1	4.04	4.38	5.75	5.98	2.62
9	8	4.63	26	0.38%	18	1	3.84	3.94	5.39	5.54	2.62
8	7	4.63	160	0.31%	18	1	3.25	3.74	5.27	5.34	2.74
7	6	4.84	71	0.28%	18	1	2.95	3.15	4.90	4.95	2.84
6	28	5.01	170	0.23%	18	1	2.46	2.85	4.54	4.74	3.49
28	4	6.17	45	0.24%	18	**2**	2.25	2.36	3.79	3.96	1.75
4	3	6.17	113	0.31%	18	**2**	1.80	2.15	3.53	3.75	1.75
3	**2**	6.17	55	0.24%	18	**2**	1.57	1.70	3.34	3.43	2.13
2	1	7.53	105	0.06%	21	**2**	1.46	1.52	3.27	3.27	1.61
1	OUT	7.73	102	0.07%	21	**2**	1.35	1.42	3.16	3.21	1.61
Beach		8.99	36	0.08%	18	**3**	1.05	1.08	2.29	2.32	1.92
First		9.37	33	0.09%	18	**3**	0.73	0.76	1.95	1.98	2.03
49	21	1.13	167	0.78%	15	**1**	9.73	11.04	11.53	11.53	1.54
38	20	0.26	31	0.32%	15	**1**	8.52	8.62	9.80	9.80	1.54
37	36	0.16	36	0.31%	15	**1**	7.22	7.33	8.54	8.54	2.30
36	17	0.32	25	0.20%	15	**1**	7.07	7.12	8.36	8.47	2.04
35	33	0.31	41	0.51%	15	**1**	6.35	6.56	7.73	7.73	3.00
33	14	0.31	25	0.20%	15	**1**	5.95	6.00	7.27	7.60	2.75
32	30	0.25	28	0.57%	15	**1**	5.54	5.70	7.02	7.02	3.38
30	11	0.36	30	0.40%	15	**1**	5.32	5.44	6.67	6.92	3.09
28A	28	1.00	35	1.71%	15	**1**	3.20	3.80	4.53	4.53	2.52
ES1	2	3.83	25	1.12%	15	**1**	1.81	2.09	3.35	3.35	3.07

All pipes are Reinforced Circular Concrete Pipes