Sandy Run Creek Watershed Field Observations and Stormwater Management Improvements

By
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Field Observations

The updated hydrologic and hydraulic modeling and floodplain mapping for the Sandy Run watershed illustrates the continuing potential for flood damage from high flows in Pine and Rapp Runs. Extensive field observations were undertaken in these watersheds to identify sites where new or improved stormwater management could potentially be used to infiltrate or detain additional runoff as a means of lowering downstream flood crests. Culverts or other structures in need of repair or locations where potential erosion damage control is recommended were also identified. Tables 2, 3, 4, and 5 (provided at the end of this appendix) list the sites inventoried for Rapp Run, Pine Run, Bodenstein Creek, and the portion of Sandy Run south of the Pennsylvania Turnpike, respectively. A total of over 300 sites were identified and inspected in the field, with over 200 of the sites located in the Rapp and Pine Run watersheds. An identification code for mapping and evaluation was assigned to each of the sites, and an inventory of several hundred photographs was compiled to document inlet and outlet structures and general conditions at existing detention facilities, as well as other observations related to channel conditions or stream bank erosion. Areas for potential new development and opportunities at existing open space and parking areas for improved stormwater management were also identified. Field observations of site conditions that would promote or limit detention/infiltration, such as adjacent wetlands, potential for increasing berm heights, or high water table were documented. In addition, field observations were used to verify stream pathways where streams were piped or channels were altered by previous development. The field observations and documentation provided a basis for subsequent GIS mapping of the sites, preliminary estimates of potential new detention/infiltration volumes, facility cost estimates, and modeling of potential flood crest reductions provided by new stormwater detention.

Opportunities for Stormwater Management Improvements

Knowledge and documentation of site conditions developed from the field observations, and GIS mapping including the inventoried sites, ortho-photography, topographic data, and updated floodplains, were used to identify opportunities for stormwater management improvements. Since a major objective of the Fort Washington Study is to identify means to reduce flood damage potential, priority sites were selected and evaluated based on the potential to provide additional detention/infiltration storage for the watershed. These sites are highlighted in Tables 2 and 3 for Rapp Run and Pine Run, respectively, and are shown on the series of maps, Figures 1 - 4. The identification codes shown on the maps correspond to the codes in the two tables. Only two significant opportunities for stormwater detention were identified for the portion of Sandy Run south of the Pennsylvania Turnpike. The location of the two sites is shown in Figure 5.

Figure 1: Pine Run – Upper Portion of Watershed - Showing Potential Improvement Sites

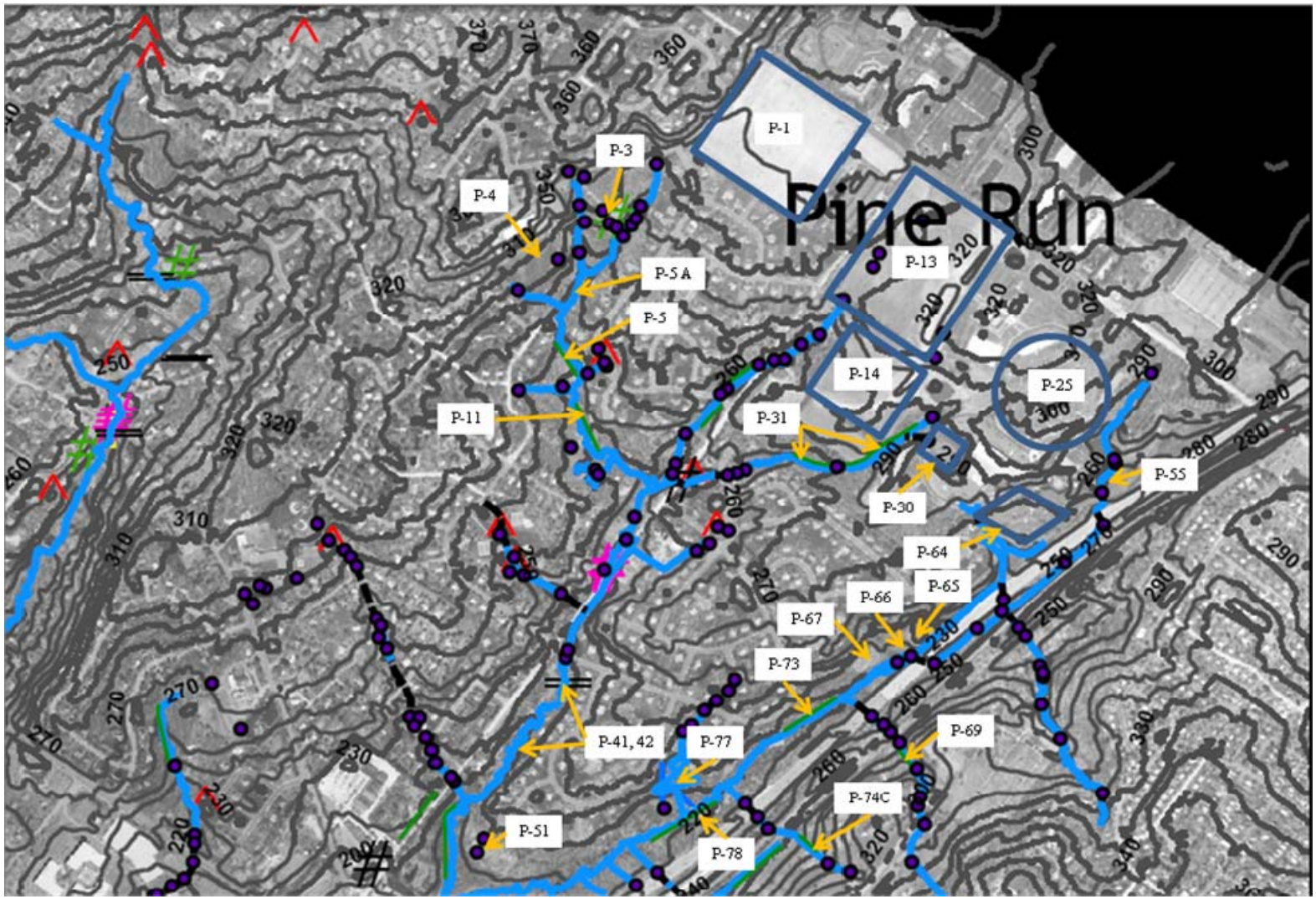


Figure 2: Pine Run – Middle and Lower Portion of Watershed Showing Potential Improvement Sites

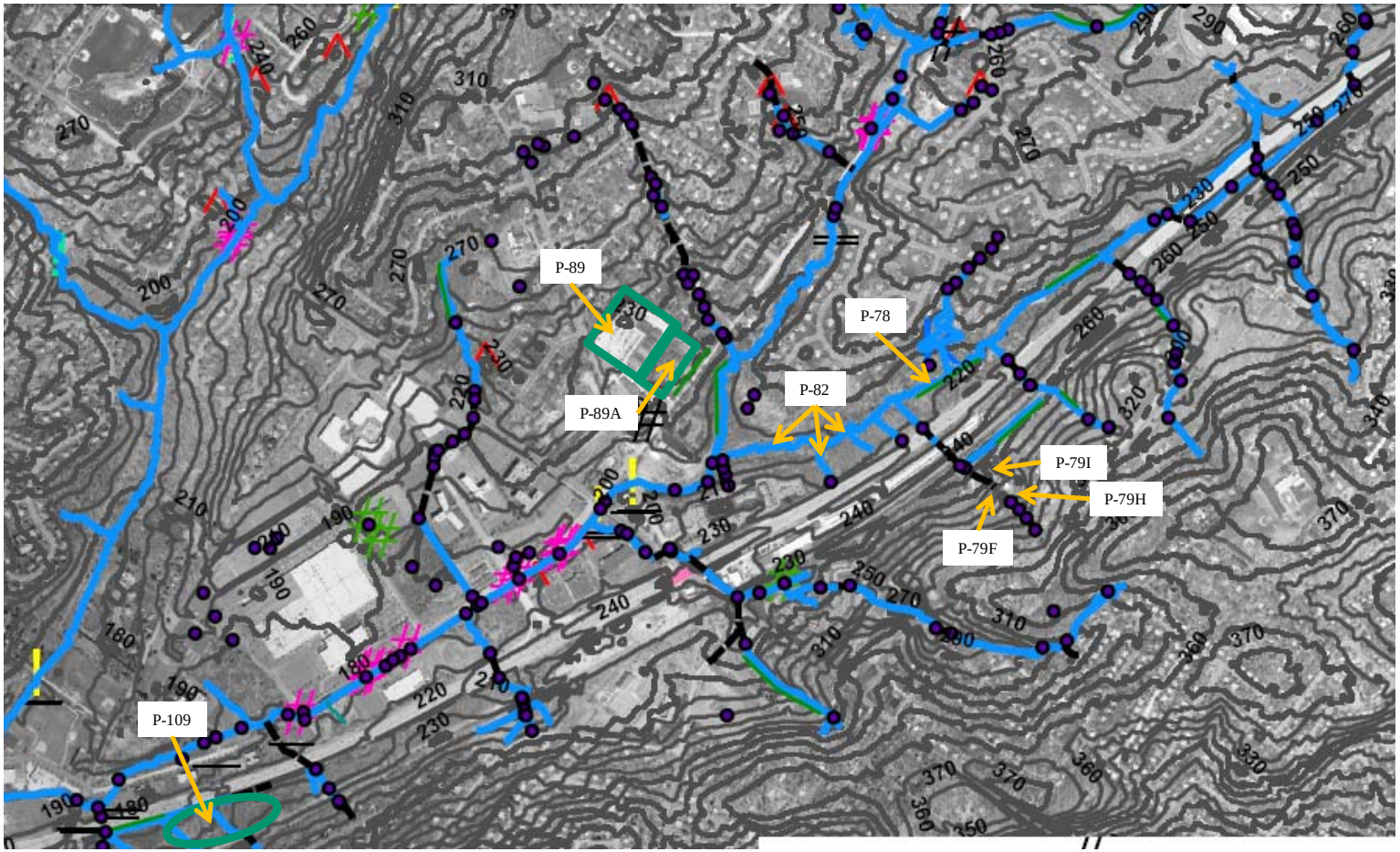


Figure 3: Rapp Run – Upper Portion of Watershed Showing Potential Improvement Sites

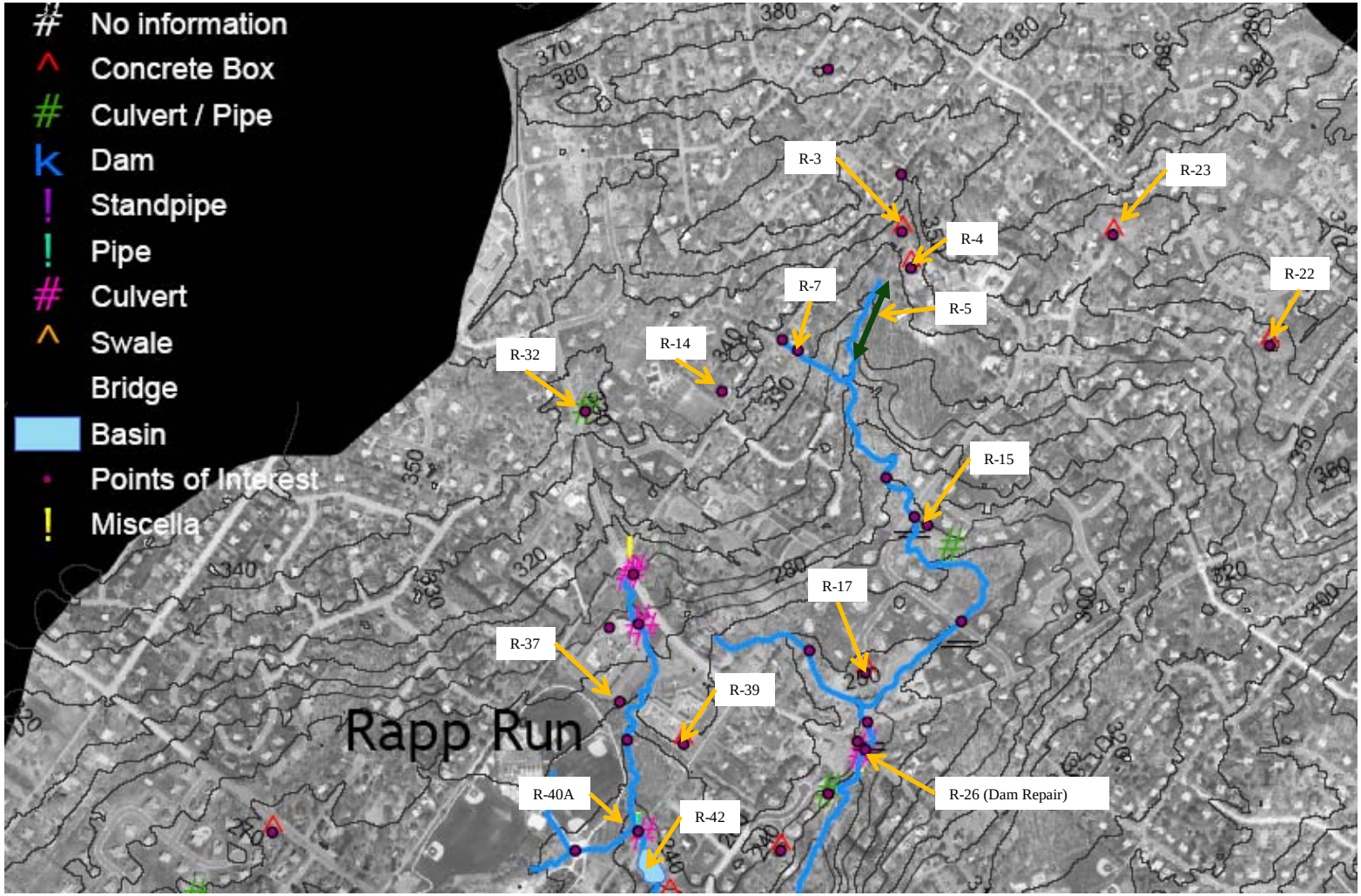


Figure 4: Rapp Run – Lower Portion of Watershed Showing Potential Improvement Sites

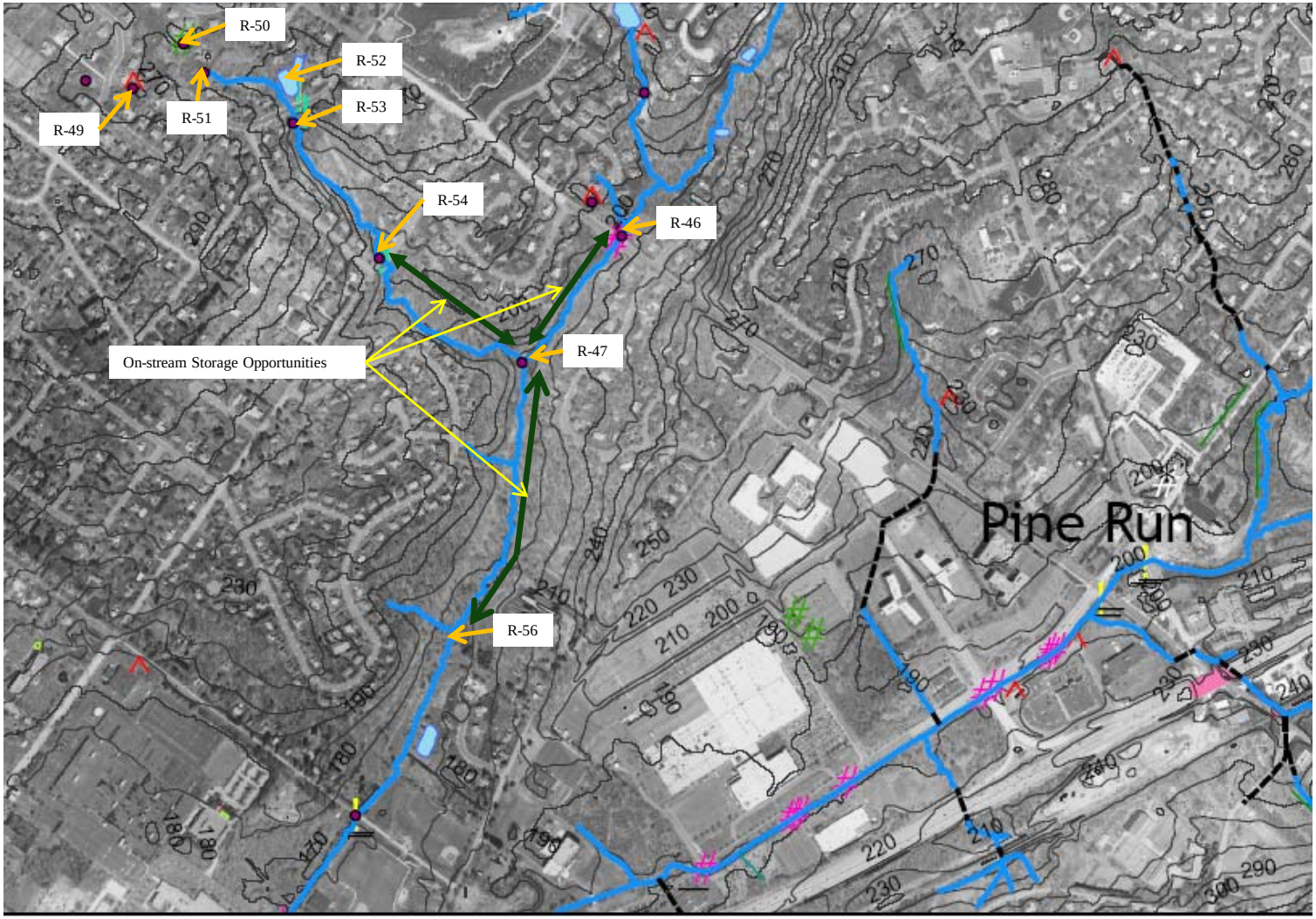


Figure 5: Locations of Potential Improvements in Sandy Run Watershed

In general, sites that were identified for improvement or repair of existing facilities, but which would not represent new detention storage, are not included as priority sites in the recommendations. Although not included as priority sites, addressing the deficiencies noted would continue the existing level of protection.

Four classes of storage related improvement sites were identified in evaluating the potential for additional detention/infiltration storage:

1) **Existing Tracts of Open Space Suitable for Development, and Parking Lot Improvements**
   New detention/infiltration facilities that would completely contain the 10 year rainfall event (5.2 inches) were assumed.

2) **New detention/infiltration facilities or existing facilities where improvements would increase available storage**
   The estimated surface area of the facility, field observations regarding potential berm/overflow height, and installation of infiltration galleries where feasible were considered to determine the potential increase in storage volume.

3) **Stream reaches suitable for installation of low head (3 ft. maximum height) dams to provide initial detention volume on ephemeral and perennial streams.**
   The storage volume available from these structures is limited in most areas by topography, stream slope, and existing development. Topographic maps were used to locate dams in series and estimate pool areas. The assumed average depth of the pool was one foot during maximum storage conditions. The dams would be installed to allow complete passage of average and low flows without ponding.

4) **Stream reaches for potential location of dams higher than 3 feet**
   Several stream reaches, particularly along the lower portions of Pine and Rapp Runs, offer topography and open space that would allow for the construction of large detention facilities. These were further analyzed by Temple's Civil Engineering Department for storage suitability and determination of economic dam height.

The estimated new detention storage for each facility is included in Tables 2 - 3. For reaches identified for potential location of dams higher than 3 feet, storage estimates and costs assuming both a 3 ft. dam height, and a conceptually designed larger facility are listed in the tables. The results of the engineering analysis for larger structures are discussed herein under the subheading 'Sandy Run Watershed – Detention Dam Analysis '. With the larger structures in place, the total combined additional storage provided by all facilities during the 2-Year storm would be approximately 260 acre-ft in the Pine Run and Rapp Run watersheds, with about 170 acre-ft of this total provided by the six detention facilities.

Costs of Potential Stormwater Facilities

Costs of the potential stormwater improvement facilities Pine Run and Rapp Run watersheds were estimated and included in Tables 2 and 3. The total cost of the highlighted improvements in Tables 2 and 3 for Rapp and Pine Runs is estimated at $28,159,800. This figure includes six large detention dams that were conceptually designed in lieu of small check dams where significant storage could be provided by the larger structures. If these six dams were replaced by the smaller check dams, the total cost would be reduced to $17,362,200. However, this would significantly reduce the additional available storage and the potential reduction in the aerial extent and elevation of flooding during the 2-Year flood and smaller events. If the six larger detention facilities are included in the total project, two thirds of the costs ($18,794,000) are targeted towards the Pine Run sub-watershed. The balance of the costs ($9,365,800) is directed toward the Rapp Run sub-watershed. While there are improvements that can and should be implemented in the Sandy Run and Bodenstein Creek sub-watersheds, such improvements are not highlighted in this report because their effectiveness would be neglibible for addressing the flood problems in the Office Park.

Modeling of Potential Stormwater Improvements

In order to evaluate the impact of the potential stormwater improvement projects on flood levels, HEC-HMS and HEC_RAS model runs were completed by the Temple Engineering Department for the 2-Year, 10-Year, and 100-Year storms, for both pre and post improvement conditions. For the post improvement scenario, additional potential storage that could be provided by small facilities was aggregated by HEC-HMS subbasin and entered in the model as increased initial abstraction over and above the existing condition. For the larger detention facilities where preliminary dam sizes were calculated as described herein under the subheading "Sandy Run Watersehd – Detention Dam Analysis"', storage vs. discharge relationships were developed and entered into the HEC-RAS model for the respective reaches. The HEC-RAS model was then used to generate the post improvement discharges, which were subsequently input to HEC-RAS to generate post improvement flood elevations and flood maps for comparison to the pre-improvement flooding conditions. The Rapp Run and Pine Run watersheds provide the most significant opportunities for additional detention volume and the modeling of improvements focused on these watersheds.

The modeling results for the Rapp Run and Pine Run improvements indicate that the total detention volume of the improvements will offer significant flood level reduction during the 2-Year storm, but will not be effective in reducing flood inundation problems for the 10-Year event (10 percent chance in any year) and larger storms. The reaches of Pine and Rapp Runs in the Office Park vicinity would continue to be severely flooded by these events. For the 2-Year storm (50 percent chance in any year), the improvements do offer significant flood crest reduction, particularly along Pine Run, where the reduction exceeds 2 feet in several locations along Virginia Drive between Camp Hill and Susquehanna Roads. HEC-HMS results indicate that peak flows in this reach are reduced by as much as 40 percent (700 cubic feet per second) during the 2 Year storm. The flood crest reductions offered by the improvements can be illustrated using individual cross-sections in profile view, as well as maps showing the depth of inundation of roadways and buildings. . Cross Section information has been summarized and is presented in Table 1 for Pine, Rapp and Sandy Runs in the Office Park vicinity..

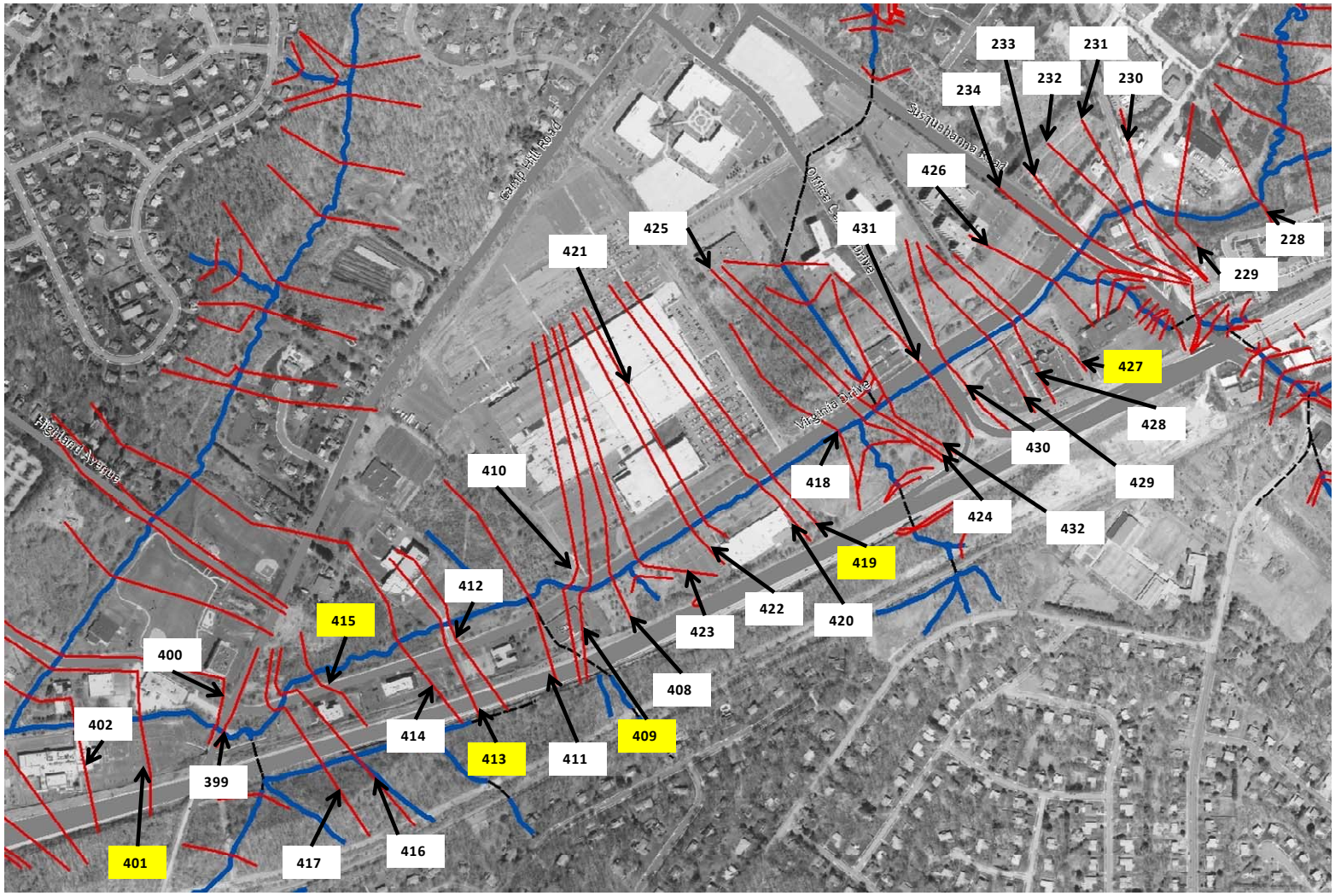
Figure 6 shows the locations of the HEC-RAS cross sections for Pine Run from the confluence with Rapp Run to the junction of the two branches of Pine Run upstream from Susquehanna Road. Virginia Drive is particularly susceptible to flooding in this area. The cross sections are labeled with the HEC-RAS model identification number (a total of 36 sections) . The six highlighted cross sections were selected for plotting based on the large reductions in water surface elevation due to the proposed improvements. Table 1 lists the HEC-RAS output, adjusted for backwater effects, for each of the Pine Run and Sandy Run cross sections in the Office Park vicinity. The table shows the pre and post improvement water surface elevations for the 2-Year, 10-Year, and 100 Year storms. In nearly all cases, the elevation reductions for the 10 and 100-Year storm are significantly less than for the 2-Year storm because of the increased flow volume for the larger events. The mean reductions in water surface elevation for all cross sections in Table 1, for the 2-Year, 10-Year, and 100 Year storms are 1.39 ft, 0.78 ft., and 0.53 ft., respectively. Reductions are as high as 3.75 ft for the 2-Year storm. The cross sections selected for plotting are highlighted in yellow on Figure 6 and in Table 1.

Cross section plots for the six highlighted locations showing the pre and post improvement flood elevations for the 2-Year, 10-Year, and 100-Year storms are provided in Figures 8 thru 13. The plots are oriented looking downstream, with the PA Turnpike to the left of the plot. The approximate location of Virginia Drive is also shown. The plots illustrate the relative magnitude of change in flood elevations for the 10-Year vs. the 2-Year storm when the potential improvements are considered. The results clearly indicate that despite significant reductions in elevations for 2-Year storm, the potential stormwater improvements evaluated do not provide enough volume to eliminate severe flooding in the Virginia Drive area during larger storm events.

A GIS flood depth mapping study for the Office Park was performed for the 2-Year storm and the results are shown in Figures 9 and 10_of the main report. The proposed improvements reduce flood elevations below the elevation of Virginia Drive along about 60 percent of the section between Camp Hill and Susquehanna Roads. A major portion of Delaware Drive is also dewatered during the 2-Year storm. Up to 2 ft of inundation remains in the vicinity of Office Center Drive and where Delaware Drive crosses Pine Run. Similar depth mapping for the 100-Year storm – before improvements – is shown in Figure 12 of the main report. The results show inundation in excess of 1 foot along of nearly all of Delaware and Virginia Drives and the Pennsylvania Turnpike interchange. Flood depths exceed 5 feet in approximately half of the flooded roadway sections. This level of flooding cannot be significantly reduced by the proposed stormwater improvements.

Field evaluation of the portion of the Sandy Run watershed south of the Pennsylvania Turnpike identified only two significant opportunities for additional detention, with estimated storage volumes of approximately 30 acre-ft for Site A and 10 acre-ft for Site B, as shown in Figure 5. The HEC-HMS model was used to determine the 2-Year storm flow reduction at the confluence with Pine Run in the Office Park due to these two improvements. The model showed a reduction in peak flow from 4,880 cfs to 4730 cfs, or about 3 percent. This would not provide significant flood stage reduction in the Office Park, although the facilities would provide stormwater control benefits in their respective subbasins within the Sandy Run watershed.

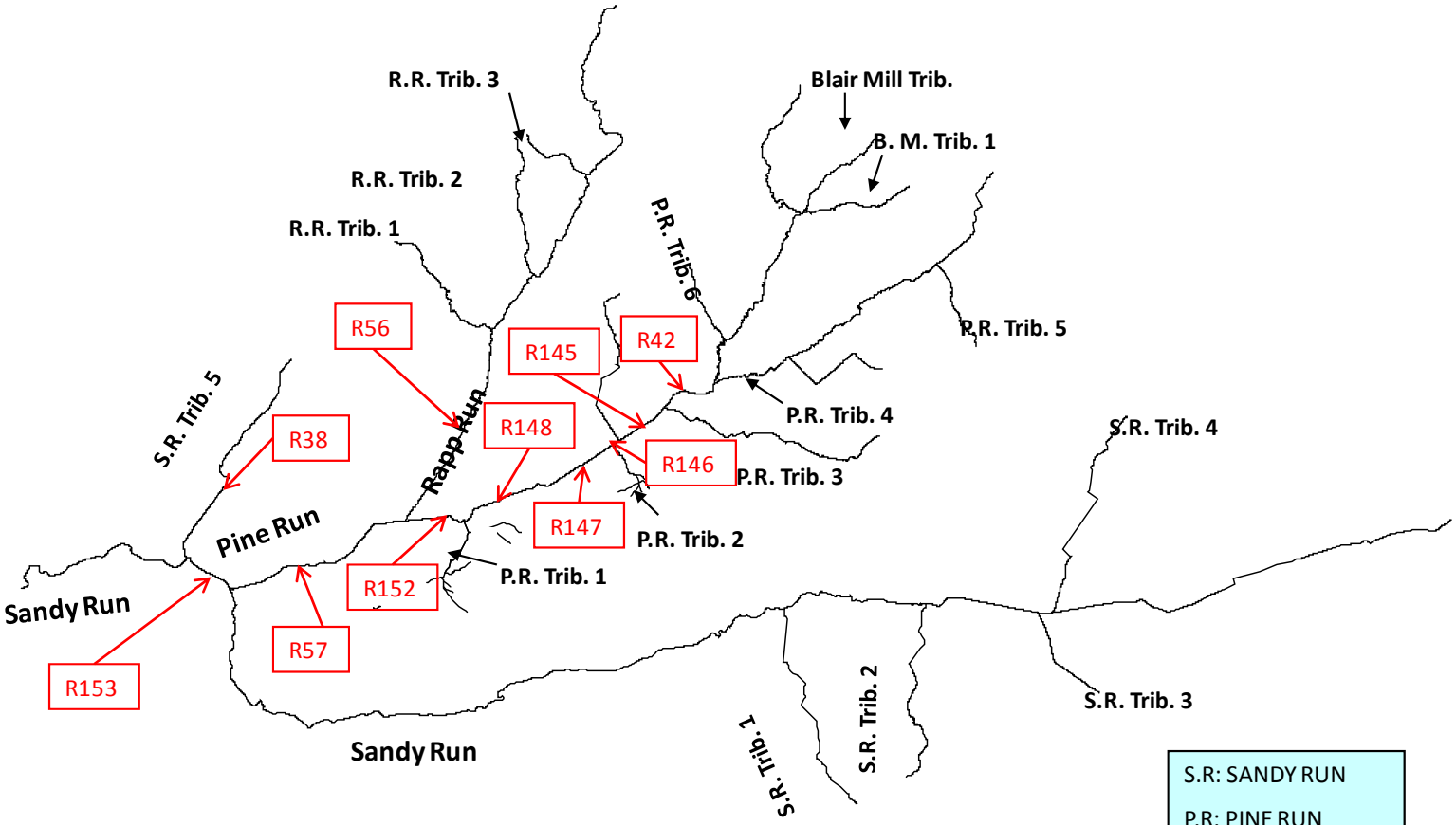
Figure 6: Pine Run Cross Sections Along Virginia Drive Upstream of Rapp Run
Cross Section Plots are Provided in Figures 8 thru 13 for the Highlighted Cross Sections



Labels indicate HEC-RAS Cross Section ID Number as Listed in Table 1

Figure 7: HEC-RAS Modeling Reaches for Office Park Vicinity

Cross Sections in Table 1 are grouped by Modeling Reach



SANDY RUN WATERSHED

Figure 8: Cross Section 401 Showing 2, 10, and 100 Year Flood Elevations Before and After Improvements
HEC_RAS Reach 152, Station 709.22

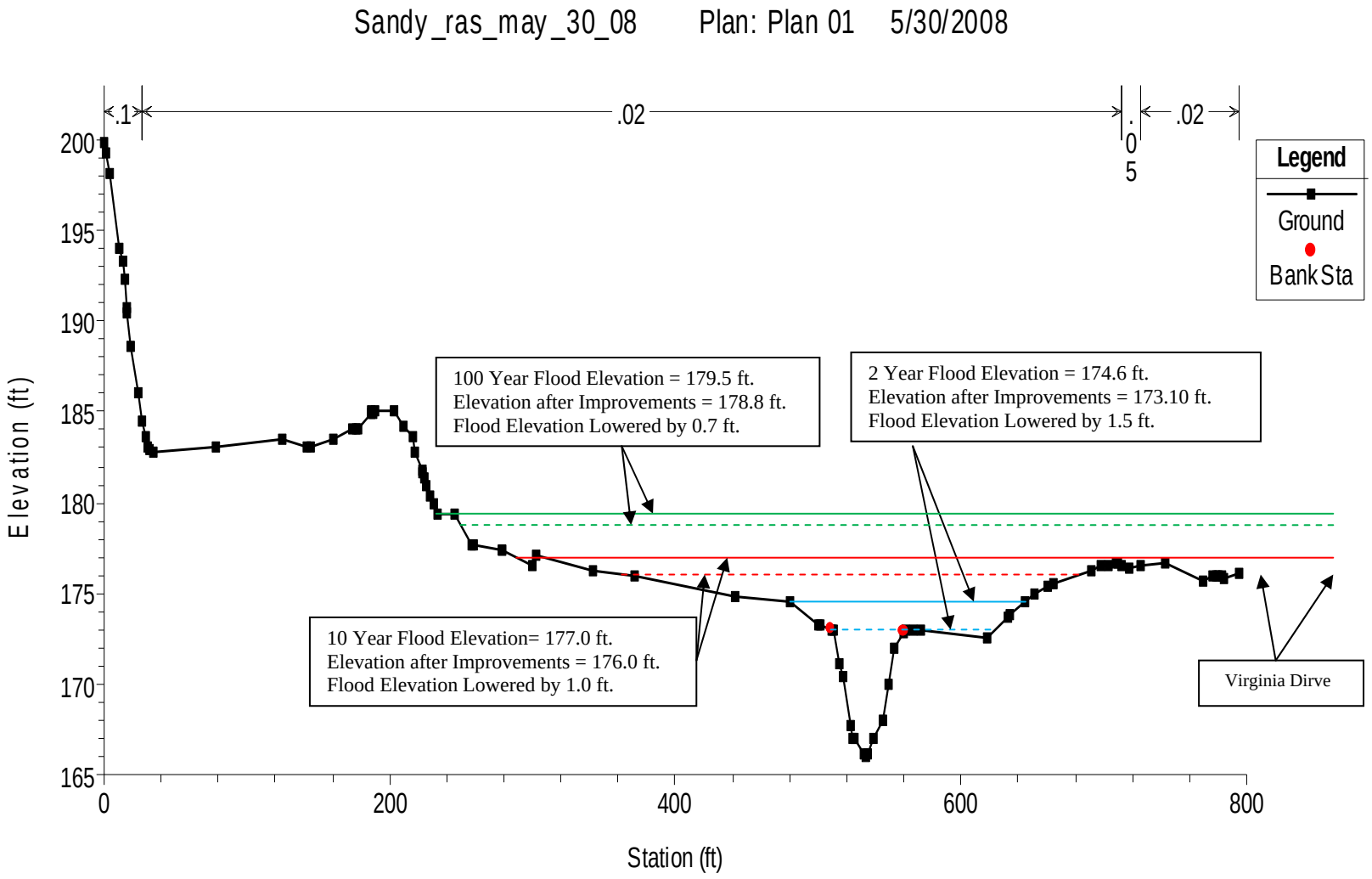


Figure 9: Cross Section 415 showing 2, 10, and 100 Year Flood Elevations Before and After Improvements
HEC_RAS Reach 148, Station 525.56

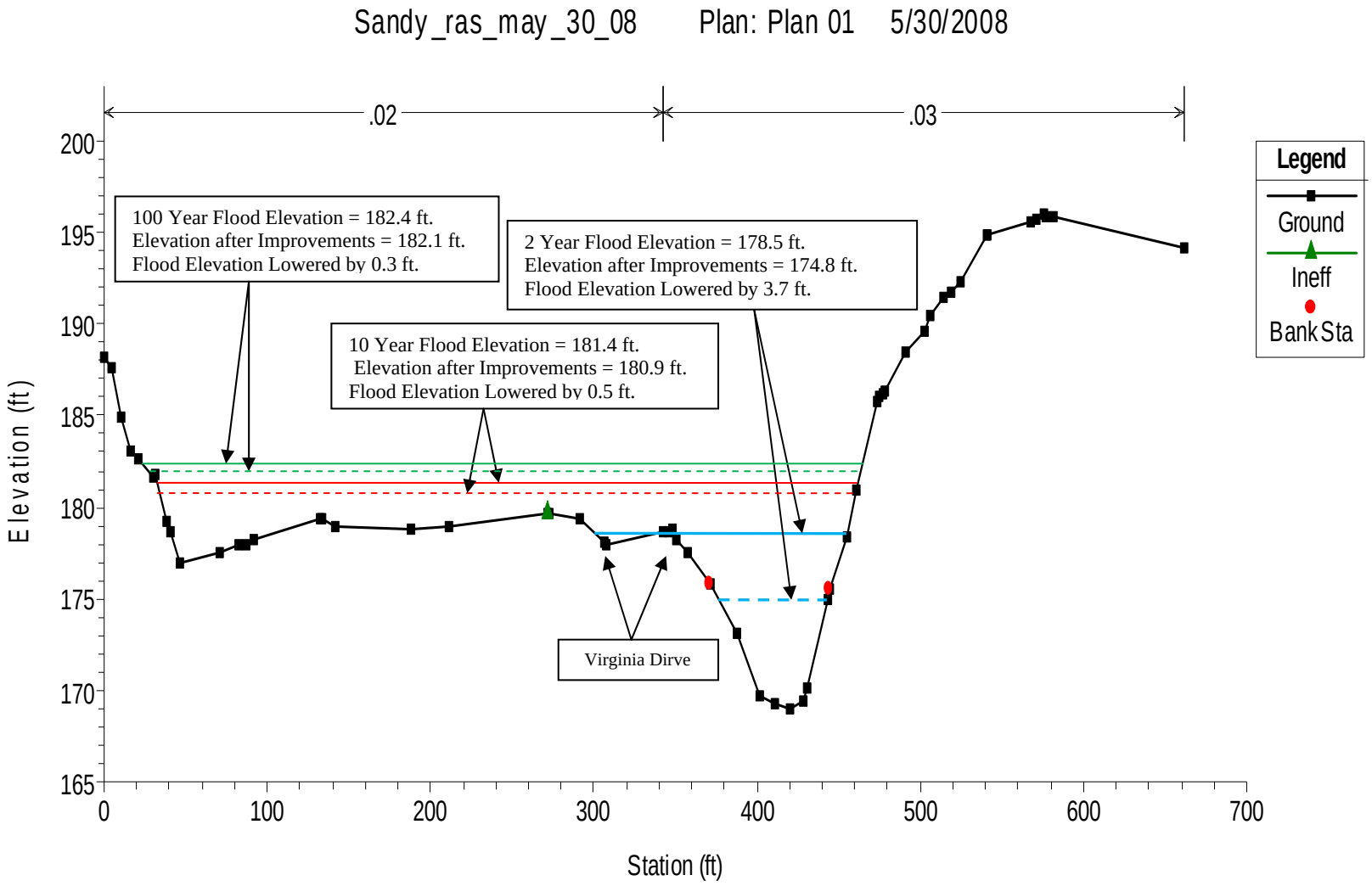


Figure 10: Cross Section 413 showing 2, 10, and 100 Year Flood Elevations Before and After Improvements
HEC_RAS Reach 148, Station 1331.50

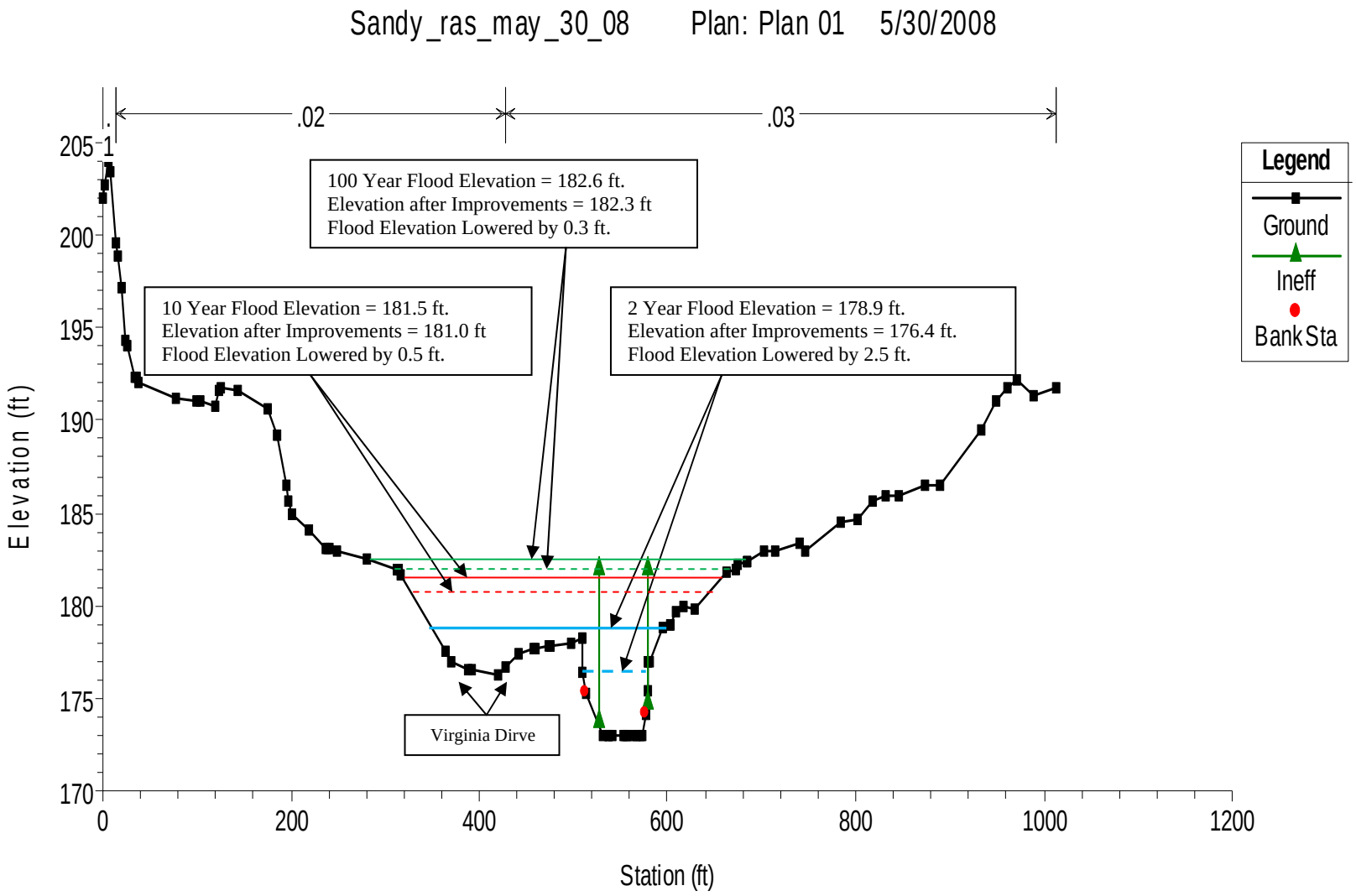


Figure 11: Cross Section 409 showing 2, 10, and 100 Year Flood Elevations Before and After Improvements
HEC_RAS Reach 148, Station 2198.24

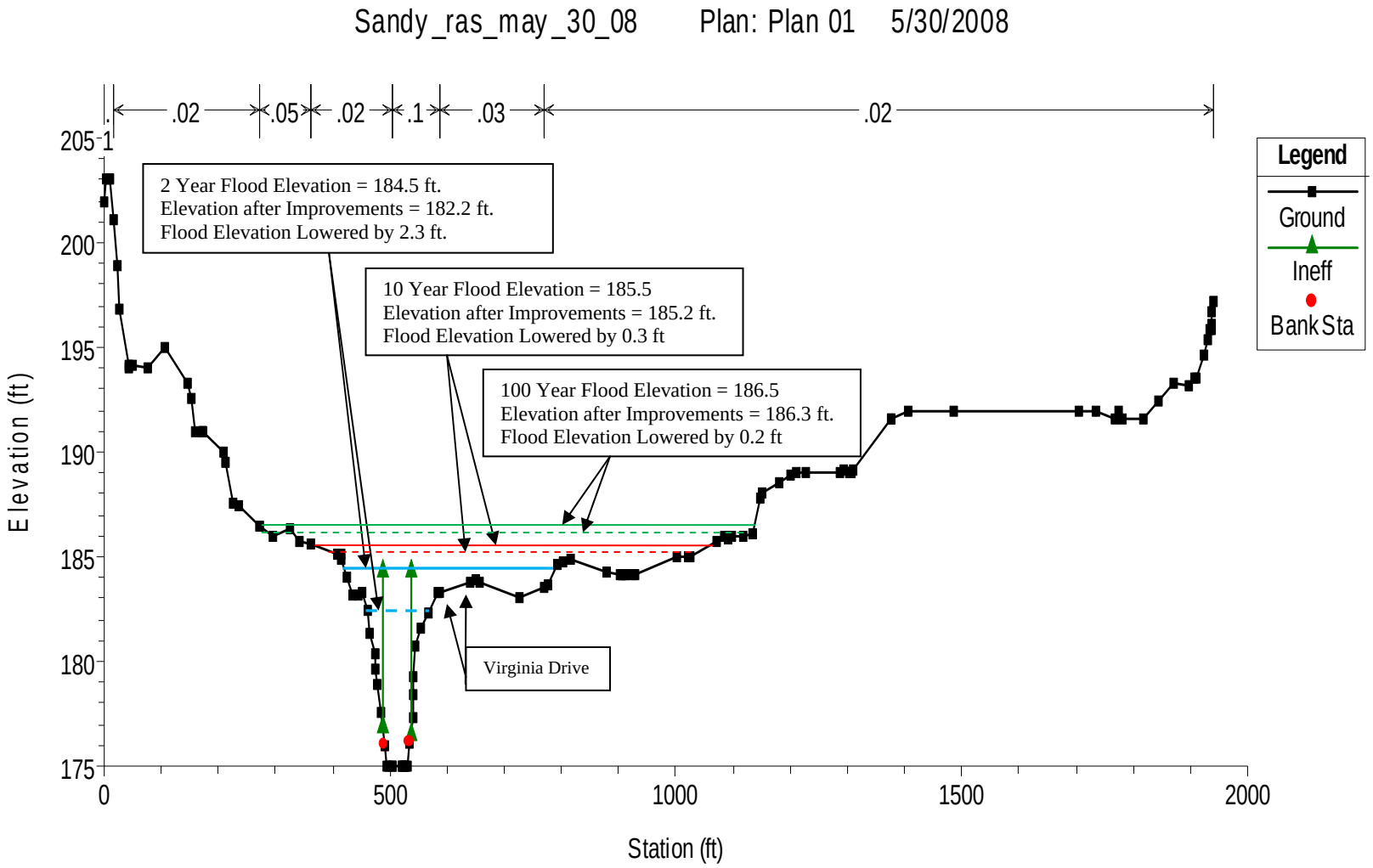


Figure 12: Cross Section 419 showing 2, 10, and 100 Year Flood Elevations Before and After Improvements
HEC_RAS Reach 147, Station 924.63

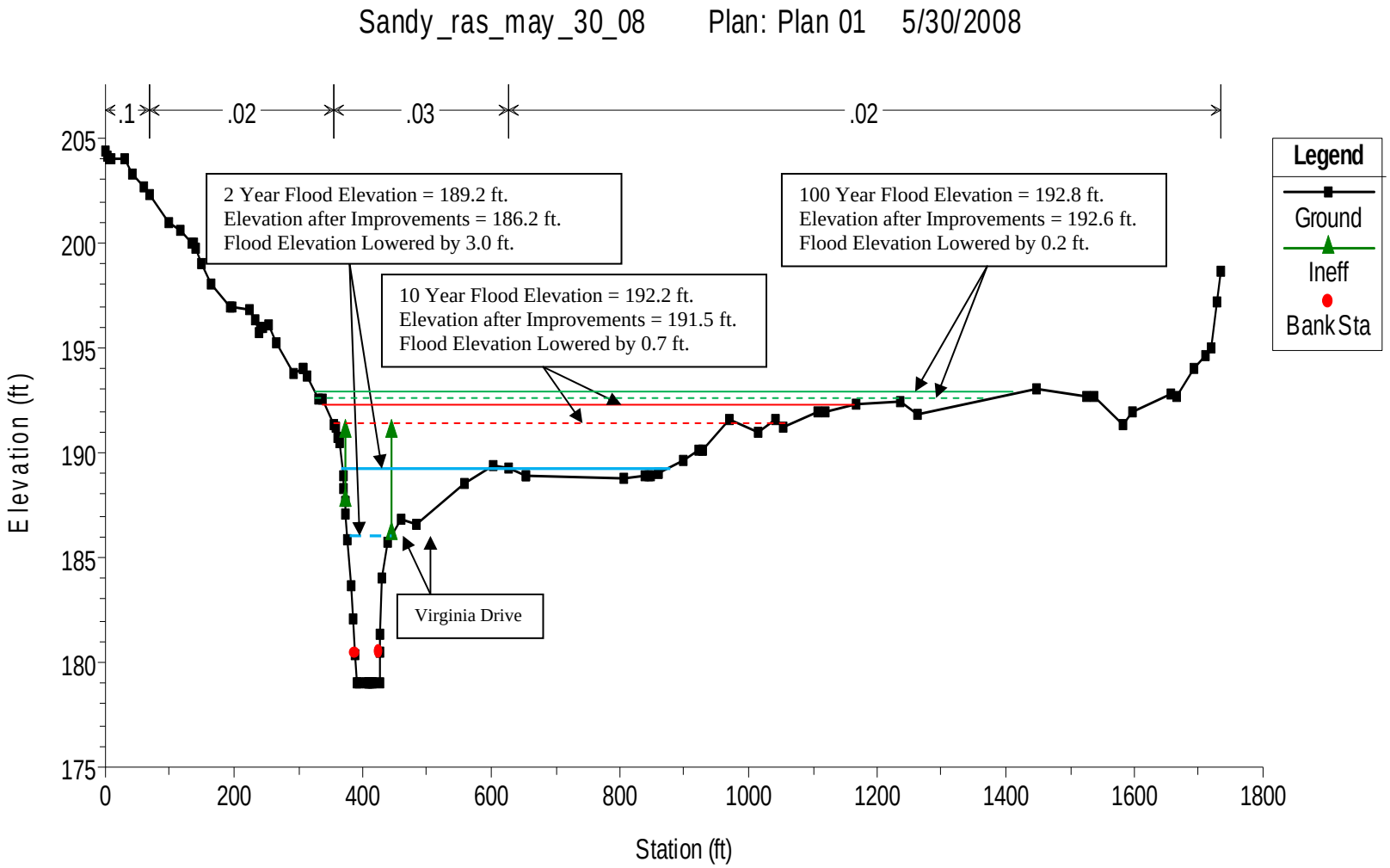


Figure 13: Cross Section 427 showing 2, 10, 1nd 100 Year Flood Elevations Before and After Improvements
HEC_RAS Reach 145, Station 924.66

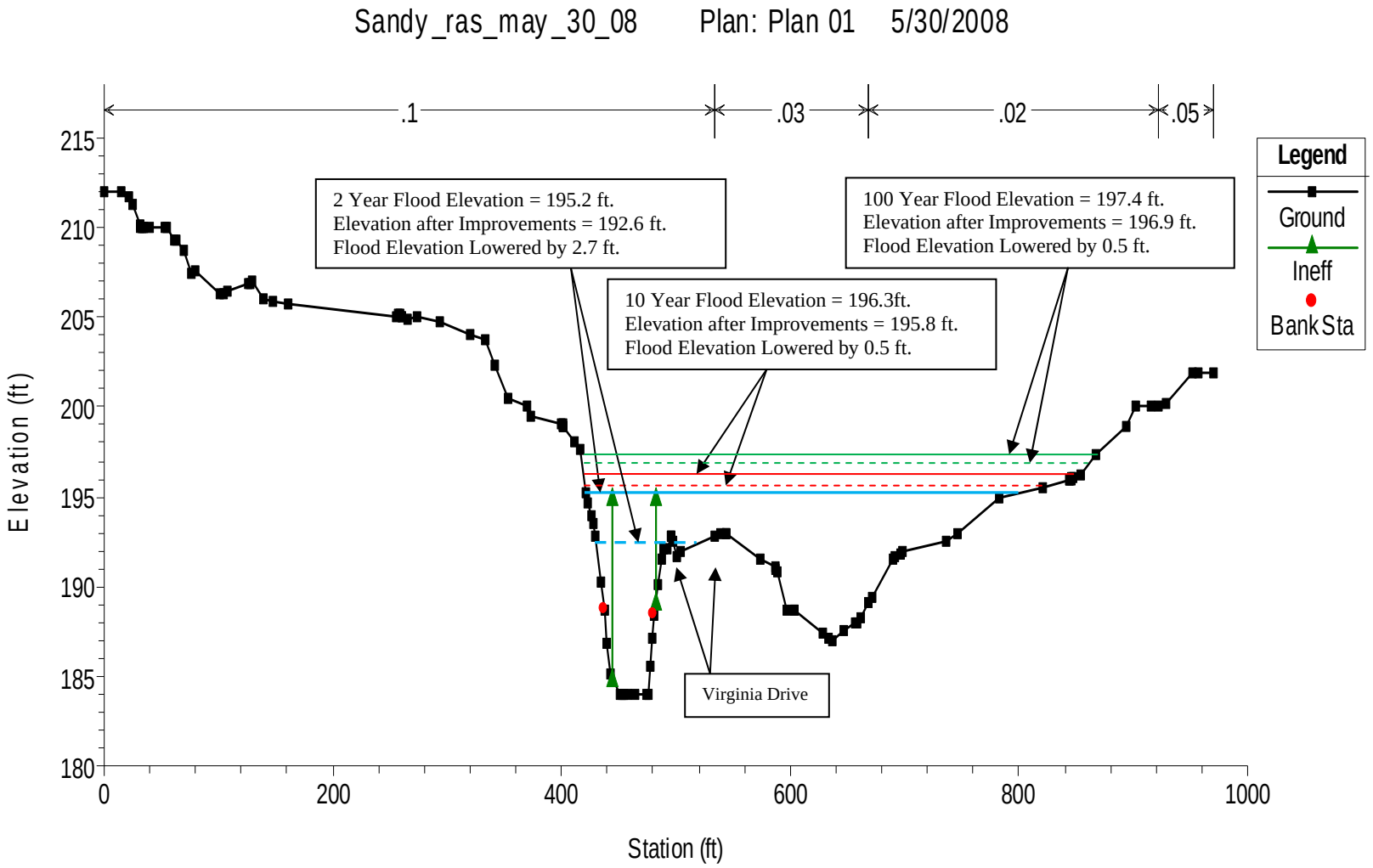


Table 1: Flood Elevations for 2-Yr, 10-Yr, and 100-Yr Storms Before and After Stormwater Improvements
Elevations in FT-NGVD

REACH_ID	STATION	XS_ID	2-Yr After	2-Yr Before	10-Yr After	10-Yr Before	100-Yr After	100-Yr Before
R57	4399.97	140	172.01	174.06	176.04	176.93	178.81	179.48
R57	3972.55	141	170.99	174.01	176.03	176.92	178.81	179.48
R57	3705.59	142	170.81	173.76	176.02	176.92	178.81	179.47
R57	3650.68	143	170.73	173.31	175.36	176.88	178.80	179.47
R57	3454.87	144	170.72	173.30	175.07	176.42	177.93	178.29
R57	3345.15	145	170.65	173.15	174.85	176.05	177.00	177.09
R57	3075.73	146	170.32	172.73	174.36	175.78	175.75	176.44
R57	2592.77	147	168.09	170.36	171.92	173.63	174.51	175.30
R57	1771.96	148	165.50	167.54	169.00	170.75	173.92	174.93
R57	1291.06	149	165.50	167.43	168.90	170.70	173.89	174.91
R57	862.28	150	165.50	167.02	168.50	170.48	173.72	174.72
R57	642.83	151	165.50	165.80	167.70	168.40	172.80	173.69
R57	461.70	152	165.50	165.80	167.70	168.20	171.50	172.00
R57	365.82	153	165.50	165.80	167.70	168.20	171.50	172.00
R57	219.88	154	165.50	165.80	167.70	168.20	171.50	172.00
R56	2311.53	155	177.10	177.63	178.13	178.51	179.21	179.45
R56	1725.98	156	173.92	174.62	176.05	177.00	178.82	179.50
R56	1440.38	157	173.80	174.60	176.05	177.00	178.82	179.50
R56	1391.06	158	173.31	174.50	176.05	177.00	178.82	179.50
R56	1028.85	159	173.25	174.38	176.05	177.00	178.82	179.50
R56	509.06	160	173.00	174.30	176.05	177.00	178.82	179.50
R56	413.16	161	172.60	174.30	176.05	177.00	178.82	179.50
R56	211.97	162	172.50	174.30	176.05	177.00	178.82	179.50
R42	1273.03	228	197.70	198.91	199.34	200.33	200.74	201.34

Table 1 Continued: Flood Elevations for 2-Yr, 10-Yr, and 100-Yr Storms Before and After Stormwater Improvements
Elevations in FT-NGVD

REACH_ID	STATION	XS_ID	2-Yr After	2-Yr Before	10-Yr After	10-Yr Before	100-Yr After	100-Yr Before
R42	797.23	229	197.02	198.47	198.81	199.88	200.11	200.56
R42	612.11	230	196.70	198.37	198.70	199.81	200.01	200.44
R42	538.44	231	195.90	196.70	195.68	196.75	198.01	198.29
R42	464.26	232	195.00	196.68	197.01	197.54	197.91	198.38
R42	233.30	233	194.88	196.64	196.95	197.42	197.74	198.18
R42	146.27	234	193.20	195.22	195.80	196.35	197.00	197.50
R38	3016.90	246	190.99	190.99	191.70	191.70	192.52	192.52
R38	2733.05	247	186.91	186.91	187.88	187.88	188.89	188.89
R38	2329.15	248	178.75	178.75	179.21	179.21	179.85	179.85
R38	1848.04	249	174.00	174.00	175.04	175.04	175.86	175.86
R38	1291.59	250	168.46	165.53	169.28	169.28	171.20	172.00
R38	800.74	251	165.23	165.53	167.70	168.20	171.20	172.00
R153	1288.34	394	165.48	165.79	167.70	168.20	171.50	172.00
R153	1126.55	395	165.41	165.71	167.70	168.20	171.50	172.00
R153	1030.65	396	165.41	165.71	167.70	168.20	171.50	172.00
R153	615.93	397	165.36	165.66	167.70	168.20	171.50	172.10
R153	212.97	398	165.23	165.52	167.70	168.20	171.50	172.00
R152	1204.14	399	173.84	175.16	176.04	177.00	180.50	181.70
R152	1148.49	400	173.75	175.00	176.04	177.00	178.82	179.50
R152	709.22	401	173.10	174.64	176.04	177.00	178.82	179.50
R152	355.95	402	172.58	174.27	176.04	177.00	178.82	179.50
R148	2361.37	408	183.24	184.66	185.40	185.80	186.50	186.60
R148	2198.24	409	182.20	184.50	185.20	185.50	186.30	186.50
R148	2096.87	410	182.20	183.24	185.00	185.10	185.50	185.90
R148	1840.43	411	180.72	181.73	183.60	184.10	185.20	185.60

Table 1 Continued: Flood Elevations for 2-Yr, 10-Yr, and 100-Yr Storms Before and After Stormwater Improvements
Elevations in FT-NGVD

REACH_ID	STATION	XS_ID	2-Yr After	2-Yr Before	10-Yr After	10-Yr Before	100-Yr After	100-Yr Before
R148	1380.09	412	178.02	179.80	182.93	183.89	184.85	185.16
R148	1331.50	413	176.35	178.90	180.97	181.48	182.29	182.64
R148	1076.02	414	175.94	178.88	180.97	181.48	182.29	182.64
R148	525.56	415	174.80	178.50	180.87	181.37	182.13	182.45
R148	325.94	416	174.53	178.28	180.86	181.35	182.11	182.43
R148	232.82	417	173.80	175.10	176.04	177.00	180.50	181.70
R147	1354.22	418	187.94	189.97	191.69	192.38	192.82	193.16
R147	924.63	419	186.25	189.24	191.52	192.19	192.56	192.83
R147	839.37	420	184.79	187.26	189.63	191.49	191.96	192.26
R147	477.11	421	184.59	187.11	189.54	191.43	191.87	192.15
R147	389.05	422	183.50	184.75	185.52	186.32	187.13	187.54
R147	55.16	423	183.19	184.60	185.50	185.74	186.58	187.09
R146	102.86	424	189.55	190.44	191.81	192.63	193.50	194.27
R146	18.49	425	189.37	190.23	191.73	192.55	193.42	194.19
R145	1181.90	426	193.10	195.21	195.78	196.33	196.94	197.48
R145	924.66	427	192.63	195.21	195.76	196.30	196.90	197.42
R145	863.60	428	192.04	193.15	193.50	193.75	194.16	194.60
R145	705.83	429	191.77	192.71	193.12	193.70	194.08	194.51
R145	440.36	430	191.35	192.69	193.11	193.68	194.05	194.48
R145	331.05	431	189.63	190.50	191.80	192.70	193.50	194.30
R145	59.97	432	189.60	190.50	191.80	192.70	193.50	194.30

SANDY RUN WATERSHED –DETENTION DAM ANALYSIS

Six Dams , three along Pine Run and three in the Rapp Run watershed, were conceptually designed. The general location of the dams is shown in Figures 1 and 2 for the Pine Run dams (sites 73, 78, and 82) and in Figure 4 for the Rapp Run facilities (between sites 46 and 47, between sites 54 and 47, and between sites 47 and 56). The storage discharge relation for each dam was determined based on GIS data and using the equations below.

For the weir:

$$Q_{weir} = C_w L_w (h - h_0)^{1.5}$$

Where:

Q_{weir} : Weir discharge (cfs)

C_w : Weir coefficient ($3.3\, ft^{0.5}/\sec$)

L_w : Weir length (ft)

h : Water surface elevation upstream of weir crest (ft).

h_0 : Weir crests elevation (ft).

For the Orifice:

$$Q_o = C_d A_o (2g(h - h_0))^{0.5}$$

Where:

Q_o : Orifice discharge (cfs).

C_d : Orifice coefficient (0.62).

A_o : Orifice opening area (sf).

G: Gravitational acceleration.

h : Water surface elevation (ft).

h_0 : Elevation of orifice centerline (ft).

Properties of Dams

Dam ID	R46	R54	R47	P-73	P-78	P-82
Dam Height (ft)	12	12	12	6	10	8
Orifice Diam(ft)	3	4	4	3	4	4
No. of Openings	2	1	1	1	2	1
Weir Length (ft)	60	60	60	60	60	60

From the dam properties above, the storage discharge relation for each dam is reported, and used in the HEC-HMS model.

Storage discharge relation for dam R46 (In reach between R46 and R47 on Figure 4)

Storage (acre-ft)	Discharge(cfs)
0.00	0.0
0.03	48.1
0.21	107.6
0.73	144.4
1.97	173.6
4.57	198.5
9.15	220.6
15.60	800.7
23.65	1843.2
33.44	3186.5
35.00	4773.0
37.00	6569.5

Storage discharge relation for dam R47 (In reach between R54 and R47 on Figure 4)

Storage (acre-ft)	Discharge (cfs)
0.000	0.0
0.036	0.0
0.242	85.6
0.802	121.0
1.963	148.2
4.019	171.2
7.202	191.4
11.666	769.6
17.644	1810.4
25.171	3152.0

Storage discharge relation for dam R56 (In reach between R47 and R56 on Figure 4)

Storage (acre-ft)	Discharge(cfs)
0.00	0.0
0.04	0.0
0.41	85.6
2.29	121.0
7.20	148.2
16.46	171.2
31.05	191.4
51.13	769.6
55.00	1810.4
57.00	3152.0
60.00	4737.0
60.00	6531.9

Storage discharge relation for dam P-73 (Refer to Figure 1 for general location).

Storage (acre-ft)	Discharge(cfs)
0.00	0.0
0.89	24.1
4.04	53.8
9.81	72.2
18.29	646.8
29.35	1683.2
43.53	3020.3
61.53	4600.6
82.97	6390.9

Storage discharge relation for dam P-78 (Refer to Figure 1 for general location)

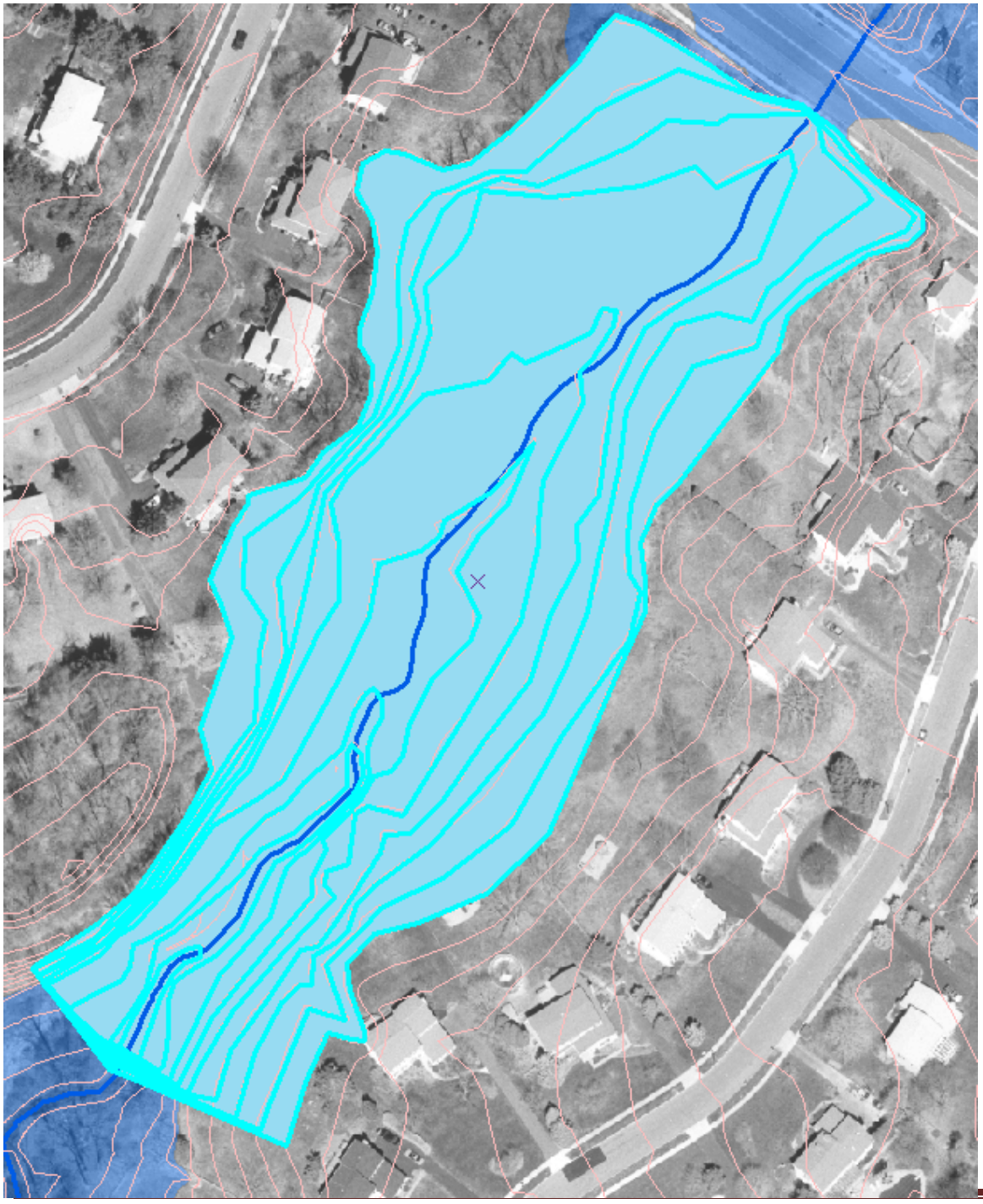
Storage (acre-ft)	Discharge (cfs)
0.00	0.0
0.01	0.0
0.10	21.4
0.54	30.3
4.14	37.1
13.40	42.8
28.00	607.9
47.93	1636.4
50.00	2966.6

Storage discharge relation for dam P-82 (Refer to Figure 1 for general location)

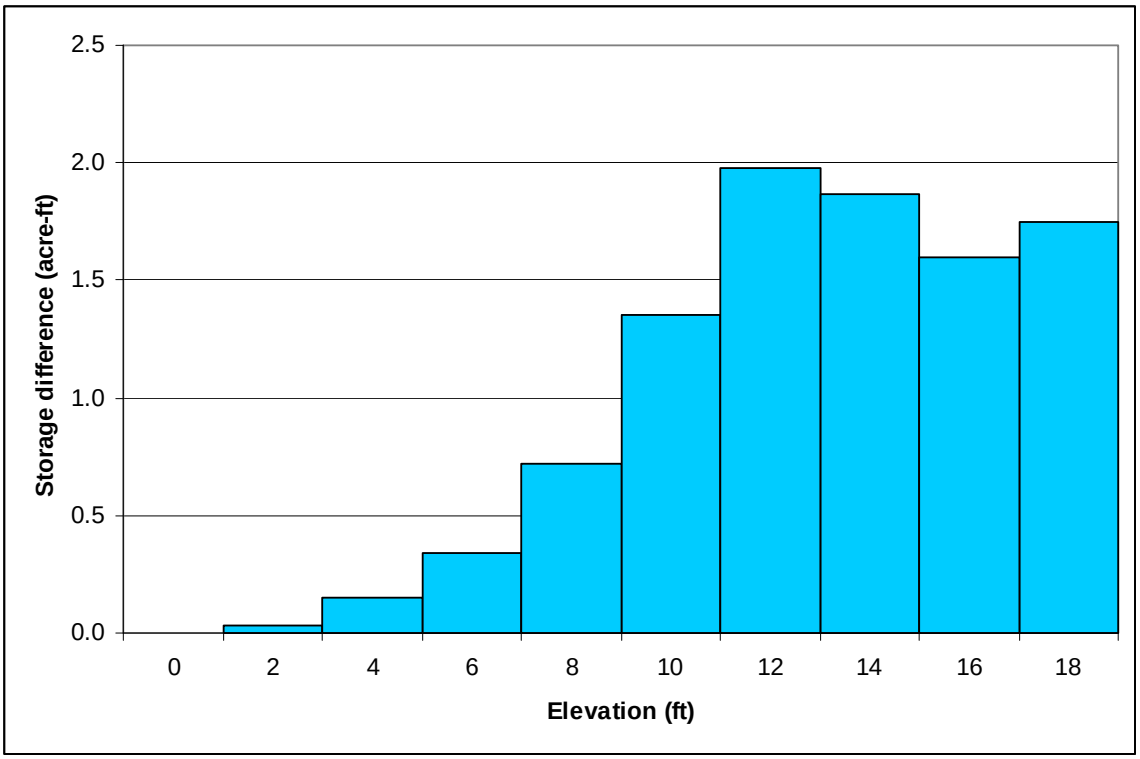
Storage (acre-ft)	Discharge (cfs)
0.00	0.0
0.14	0.0
2.16	85.6
8.69	121.0
20.20	148.2
36.85	731.2
38.00	1775.4
40.00	3119.6
42.00	4706.6

Dams were sized based on an analysis of incremental storage vs. dam height as shown in the following example:

The figure below shows the potential location of retention basin. Location coordinates (2686500 307101). There is a large increase in surface area between the 10 feet to the 12 feet contour.



The following graph shows the difference in storage volume at various stages. Note that the increase in storage decreases beyond 12 feet elevation. Therefore, the elevation of the dam should be less than 12 feet.



General Description of Detention Dam Operation

The dams would allow base flow in the creeks to pass through and would detain runoff from larger storm events. Accumulated storage behind the dams would vary depending on the discharge through the facility during a particular storm event. During the 2-Year storm event modeled, accumulated storage at the facilities would range from 10 to 50 acre-ft depending on the facility, based on the storage vs. discharge relationships developed during the preliminary design. All of the dams are proposed to be rock core, earthen dams with concrete spillways. Water detained would slowly be discharged until the stream recedes to base flow conditions. Cost estimates for the structures are included in Table 2 for the three Rapp Run dams and in Table 3 for the Pine Run facilities. Pictured below are views of a more elaborate structure in southeastern Pennsylvania that served exactly the same function as the proposed stormwater control dams for the Sandy Run watershed.

View facing downstream, note base-flow pipe at center of dam's upstream face

View of the detention area upstream from the dam. This structure is only a few years old and the trees and shrubs planted in the detention area are still quite young. The detention area has been observed to be completely full on occasion and there have been no deleterious effects on the

vegetation from being inundated for a couple of days while the detention area drains. So, in time the detention area will be reforested.

View of the downstream dam face. There is a small area downstream from the dam where sediment accumulates and then about 100 feet downstream from the dam, the stream channel reforms and is a natural channel.

View of the downstream dam face. There is a small area downstream from the dam where sediment accumulates and then about 100 feet downstream from the dam, the stream channel reforms and is a natural channel.

Table 2 – Rapp Run, Potential Stormwater Improvements					
ID	**Picture**	**Description and Picture Numbers**	**Recommendation**	**Estimated Volume (Acre-Ft)**	**Cost**
R-1	0425 0426	Views from Ft. Washington Ave. of typical landscape in residential areas			
R-2	0405 0406	3 ft. diameter culvert under Dillon Road Severe bank erosion & downcutting			
R-3		Large detention basin, approx. 90' × 120'		~1 AF *New Detention*	**Stormwater Basin $31,000**
	0402	Outlet 36" diam. in well			
	0403	Inflow over bedrock Height of berm 4' to 5' Bedrock(Stockton Fm.) is 1 to 2 ft. below bottom of basin			
	0404	View from Dillon Road	Possible candidate for retrofit to extended detention		
R-4	0407	Detention basin. Inflow		~1 AF *New Detention*	**Stormwater Basin $26,200**
	0408	Low flow outlet 8" square Intermediate outlet 4"H×19"W, 46" above grade Top of outflow 6ft. above grade Top of berm approx 10-11ft. above grade	Possible extended detention 4 ft above outflow		
R-5		Bedrock channel of intermittent steam through most of this stream segment. Opportunity for check dams along reach. Approximately 14 ft. of drop through section approximately 400 ft. in length.		~1 AF *New Detention*	**Check Dams $79,900**
R-6		3ft. diameter culvert under Dillon Road			
R-7	0401	Severe down cutting and bank erosion Much large flood debris Estimate 14 ft of drop through Section 300 ft. in length.	Need check dams and bank stabilization.	< 0.5 AF *New Detention*	**Check Dams $109,100**
R-8	0409	Low concrete dam/bridge, 3 openings 24"H×27"W	(If R-9 reconstituted, then this should be demolished and removed)		
R-9	0410	Old, badly deteriorated circular masonry pool; Completely filled with sediment and debris			

	0411	View of dam from downstream , Dam 6ft. H, and approx. 100ft upstream from confluence	Dam and pool could be rebuilt, but dam should be less than 5ft. H		
R-10	0412	Low concrete weir approx. 25ft. upstream from confluence			
R-11	0413	Bedrock channel through entire stretch Because of bedrock, channel is widening throughout this stretch.			
R-12	0414	Another example of bank erosion and stream widening Note bedrock ledge beneath undercut tree			
R-13		Box culvert under Lexington Ave. 23ft.W×5.5ft.H			
R-14		Maple Manor Swim Club parking lot No stormwater management . Dimension from map = 200x220 ft	Recommend infiltration trenches and/or bioretention swales around perimeter.	0.1 AF if first inch of runoff is retained	**Infiltration trench $66,700**
R-15	0415	Large detention basin. Corrugated steel, oval inlet 33"H × 65"W Outlet 12” diameter concrete.	Good candidate for retrofit to infiltration/extended detention, unless bedrock too shallow ~200ft.L × 60-70ft.W	~1.5 AF for 5 ft detention height	**Stormwater Basin $61,900**
R-16	0416	Box culvert under Lexington Ave. 24ft.W × 4.5ft.H Much sediment, including coarse gravel and cobbles Culvert partially blocked			
R-17	0417	Large dry detention basin. 5½ft.H Riprap spillway w/chain link stabilization	Good candidate for retrofit. Dimension ~ 120 ft x 160ft	Volume ~2.0 to 2.5 AF for 5 ft. depth	**Stormwater Basin $31,800**
	0418	5ft.H overflow w/ 9" square low flow outlet			
	0419	West inlet 33"H × 48"W			
	0420	East inlet 33"H × 48"W			
R-18	0421		Recommend revegetation of swale		
R-19		Box culvert under Jarrettown Road 14ft.W × 4.5ft.H (and also for culvert and road)	Recommend small impoundment immediately upstream to provide more protection for Dunn house in fork of Jarrettown & Limekiln Pike		
R-20	0427	Headwaters of northeast branch of Rapp Run Piped all the way to (assumed) outlet at R-24			

		Inlet 13" diameter corrugated steel pipe. Series of grated, drop inlets flush with lawn down to R-21 w/ approx. 2ft. diameter pipes.			
R-21			Recommend daylighting and retrofitting to infiltration basin, or series of small infiltration basins with bioswales between.		
R-22		Large dry detention basin. Overflow grate 6ft. above grade, Spillway 7ft. to 8ft. above grade. Rest of basin approx. 9ft. above bottom grade Much debris and litter. Mowed, but otherwise poorly maintained Dimensions~160 ft. x 120 ft.	Good retrofit candidate for extended detention/infiltration	Volume ~ 3 AF for 6 ft. depth	**Stormwater Basin $29,600**
	0428	view from Spring Hill Rd.			
	0429	Inlet oval, corrugated 38"H × 58"W			
	0430	Outlet: Low flow outlet blocked by debris			
R-23		Retrofit candidate. Large basin Overflow 38" above bottom grade	Berm approx. 2ft. higher than overflow grate, but could easily be raised to provide more storage.	Volume ~6 AF for 5 ft depth	**Stormwater Basin $44,300**
	0431	Inlet, Oval 36"H × 64"W, Concrete			
	0432	Inlet, 15" diameter corrugated pipe			
	0433	Outlet: Low flow 8"H × 10"W (Actually larger, but partially blocked by large rock).			
R-24		Presumed location of outlet of piped NE branch of Rapp Run.			
R-25		Entire northeastern portion of Rapp Run watershed (i.e. NE of Limekiln Pike, and Meetinghouse Road) is covered by residential areas of varying densities (townhouses & apartments to large single-family), but all with extensive lawns, and relatively little forest.			
R-26	0394	View from upstream of box culvert beneath Limekiln Pike. Approx. 4ft. diameter semicircular low flow hole in 6ft.H concrete weir, which is	Recommend new stormwater management measures. Weir should be maintained/repaired to protect culvert	Repair needed to protect culvert.	**Stormwater Measures $109,100**

		approx. 14ft. in front of (upstream from) 8ft. wide by 10ft. high box culvert.			
R-27		Approximate high water mark from Allison 252ft. (+2ft. above 250' contour) at gazebo in angle of house of Lynn Dunn (Allison was ~18" above LR floor)			
R-28	0395 0396	Small detention basin ~36ft.W × 24ft.L from inlet to outlet. Outlet 14" diameter. Inlet 21" diameter. Top of berm 6ft. above bottom grade			
R-29		Small detention basin east of East Catlin Rd. (~90ft. × ~40ft.)	Leave as extended detention		
	0393	East inlet 15" diameter			
	0434	West inlet 27" diameter			
	0435	Outlet- Low flow 3" diameter, Overflow 6ft. above bottom (0435).			
R-30	0391 0392	Landscape pond, offline, Bright blue-green Approx. 3ft. to 4ft. of freeboard (Max, extra storage capacity less than ½ acre-foot) (0391), "Bridge out" sign (0392)			
R-31	0390	Location of wetland that was once a farm pond, but filled with sediment, Owner of property, Mr. Thomas Schultz, said he has old map of property (circa 1980) that showed pond as already filled. (0390)	Excellent location for large constructed shallow wet pond/wetland. (Mr. Schultz would welcome it)		
R-32	0424	Large detention basin on east side of Limekiln Pike, Approx. 180ft.L × 120ft.W 0424- Outlet. Low flow outlet 1ft. square. Berm approx. 6ft. above bottom grade. Apparently piped beneath berm and all the way down-gradient to R-33. Drop inlet ~36" diameter pipe in and out beneath Dillon Road. Berm approx. 4ft. above level of inlet grate.	Retrofit to extended detention	Volume~2 AF by resizing outlet and achieving 4 ft depth. *New Detention*	**Stormwater Basin $34,000**
R-33			Possible to daylight and retrofit as vegetated bioswale from R-32 to R-33		
R-34	0341 0340	Box culvert under Limekiln Pike 7ft.W × 3.5ft.H Outfall on southwest side of culvert (32" × 24")			

R-35	0339	Culvert under driveway off Limekiln leading into Temple Sinai property (0339), (Approx. 5ft.H × 4ft.W)			
R-36		Building, grounds, parking lots of Temple Sinai 0342- 0344- Drained to drop inlet at SE corner of parking lot.			
	0342-43	parking lot to NE, 0343- parking lot to N			
	0344-45	Total of Approx. 6 acres with no stormwater management.			
R-37	0346	Dimension of parking lot – 400 ft x 520 ft.	Recommend stormwater retention at SE corner of Temple Sinai property. Recommend series of small check dams from R-37 to just above R-40.	Volume ~ 2 AF if all Parking lot runoff stored from 10 Yr rain event. *New Detention*	**Extended Detention $102,000**
R-38	0347	Wooden footbridge in Mondauk Park 30ft. long, approx. 4ft. above channel bottom (0347)			
R-39	0348	Large detention basin (~150'L × ~70'W) (0348) Low flow outlet 5" diameter Intermediate outlet 6" at 3ft. above bottom grade Overflow grate at 5ft. above bottom Berm approx. 2ft. to 3ft. above overflow.	Possible candidate for retrofit	Potential for ~2 AF for 8 ft depth.	**Stormwater Basin $36,300**
R-40	0384	View from upstream 48"H × 67" W from downstream (SE)side)			
	0382 & 0349	Culvert beneath Broad Street			
	0383	view upstream from culvert			
R40A		Athletic fields 800 ft. x1400 ft. drain to area.	Recommend detention facility between R-40 and R-41. Each inch of runoff yields 2 A-F of volume. Potential area for 1 acre facility with 4 ft depth.	Volume ~ 4 AF *New Detention*	**Stormwater Basin $260,200**
R-41	0350	in Mondauk Park			
R-42	0385	Large pond SE of Broad St. Approx. ¾ acre Much sediment, ~1ft. to 2ft. average depth	Good opportunity to deepen, and also to raise dam by 1ft. to 2ft. Could produce	Volume ~2 AF if dam	**Extended Detention**

		Much aquatic life (frogs, etc), but also much algae. Concrete dam with concrete spillway in fair condition Approx. 18" high from toe of dam.	1 to 2 ac/ft. of extra storage.	Is raised by 2 ft. *New Detention*	**$50,200**
R-43	0386 0387	Two large culverts under private drive Each 5ft. diameter, West (0386) set 2.5ft. higher than East culvert (0387), which carries low flow	Opportunity for small impoundment 50ft. to 100ft. upstream		
R-44	0388	Bedrock channel from just below R-43 to approx. 300ft. downstream, causing lateral movement and severe bank erosion, ~6' high cut bank. Attempts evident throughout segment to control erosion. (plastic netting)			
	0389	bedrock ledge in channel, approx. 3ft. high			
R-45	0399	Foot bridge to front door of 1433 Gentleman's Way property of Mr. & Mrs. Wm. Berlinghof. Large detention basin south of house is their property & maintained solely by them. Note: Allison H.W. mark at approx. 210ft. Outlet has low flow ~9" diameter	Recommend approaching them about possibility of retrofitting as infiltration basin. They would like it to drain faster so they can use it for recreational purposes.		
	0436	Overflow at 7ft. above grade			
R-46		Box culvert under Susquehanna Rd. 7ft.H × 18ft.W			
R-47	0364	Broad floodplain from R-46 to R-47 (Confluence of mainstem with west branch of Rapp Run)	Opportunity for small flood control dam between sites R-46 and R-47. Opportunities for series of small check dams to create more floodplain storage between sites R-46 and R-47.. Opportunity for small stormwater feature in side drainage on East side below R-47	Assuming a 12-foot dam, 440-foot long, 60-foot spillway, and two 3- foot outlet pipes. Volume ~ 15AF. for 2-Yr Storm or Volume ~1.5 AF Assuming four 3 ft structures in	**Flood Control Dam $2,380,000** **or** **Check Dams $86, 500**

				reach.	
	0356	Floodplain forest from West			
	0357	Confluence (R-47)			
	0358	View downstream from R-47			
	0359	View of R-47 from North			
	0355	View upstream from point midway between R-47 and R-55			
R-48	0379	2ft. × 4ft. drop inlet flush with lawn in back yard of residences on Tressler Rd.	Would probably be a hard sell to convert to infiltration/ extended detention, but would otherwise be a good candidate.		
R-49	0381	Medium sized detention basin. Approx. 60ft. × 100ft. Outlet 40" diameter Inlets: Right (North) 25" × 32 " Left (South) 34" × 47"	Good retrofit candidate for extended detention, not infiltration, standing water in bottom. Deepen to intersect water table. Make into vegetated extended detention/wet pond.	Volume ~1 AF for 6 ft. depth. *New Detention*	**Stormwater Basin $45,500**
R-50	0378	Large detention basin (Approx. 200ft.L × 75ft.W) Inlet	Good candidate for infiltration retrofit	Volume ~2 AF for 6 ft. of depth	**Stormwater Basin $68,400**
	0377	Outlet- Low flow 18" × 18" Overflow 58" above grade			
R-50B		Detention basin W inlet 30"H × 42”W South inlet 12"H × 19”W Outlet: low flow 12" square, overflow 4' H, Spillway ~5'H Spillway directly to Susquehanna Road	Candidate for retrofit		

R-51			Possible opportunity for small infiltration basin or wet pond	Volume ~1 AF *New Detention*	**Infiltration Basin** **$1,417,000**
R-52	0368&0369	Mondauk Waters -Wentz Pond- Upper Dublin Township Park System. Lawn areas closely mowed on south and east sides of pond. Virtually unusable because of abundant goose droppings, which are evident in bordering residential lawns and sidewalks also. Dragonflies and other mosquito predators evident. Outflow structure	Bypass channel- could install small additional detention feature. Recommend allowing fringe of taller grasses and other vegetation along bank of pond to deter geese. Recommend consideration of allowing a little more low flow to maintain stream health, but raising level of overflow structure by 1-1½ft. to produce more stormwater storage capacity.	Volume ~0.5 AF if overflow is raised by 1.5 ft. *New Detention*	**Stormwater Basin** **$44,400**
	0370	outflow from east side of pond			
	0371	low flow pipe outlet			
	0372-0373	Outfall from pond on south side of Dillon Road ~3ft. diameter			
R-53	0374	0374- View upstream showing bedrock channel and large slabs of Stockton Foundation carried by high flows.	From immediately below outfall of pipe from R-52 to just above R-54 (culvert beneath Pinetown Road) there are abundant opportunities for a series of check dams, which must, however, be carefully designed to maintain base flow. Note broad floodplain to left (east) of stream. Check dams through this reach would help to spread water into floodplain forest, increasing storage.	Volume ~1.5 AF Series of seven 3 ft dams. *New Detention*	**Check Dams** **$119,000**
	0375	Storm sever outfall on west bank from subdivisions to west. Note bedrock ledges in channel			
	0376	View of stream downstream from above storm sewer outfall.			
R-54	0363 0360	Culvert beneath Pinetown Road (72"W × 56”H) Culvert from north (upstream). Storm sewer outfall from southwest, 3ft. diameter	R-54 to R-47 (confluence of west branch with main stem). Bedrock channel (0360 is typical of this segment) Again, multiple opportunities for check dams to spread water into floodplain.	Assuming a 12-foot dam, 310-foot long, 60-foot spillway, and one 4- foot outlet pipe.	**Flood Control Dam** **$1,680,000**

				Volume ~10 AF for 2-Yr storm or Volume ~2 AF Series of six 3 ft dams	**or** **Check Dams $116,000**
	0362	Culvert from south (downstream)			
	0361	Severe bank erosion. Again, because of bedrock channel, stream widening rapidly.			
R-55	0354 0365	Small ephemeral riprap channel draining residential areas to west of stream (0354)			
R-56		Residential areas well back and uphill from stream on both sides. Extensive, well forested floodplains and side slopes of valley.	Many opportunities along main stem of Rapp Run between R-47 and R-56 for significant series of impoundments, especially in stretch between R-55 and R-56 (0365 is typical view of channel in this stretch).	Assuming a 12-foot dam, 550-foot long, 60-foot spillway, and one 4- foot outlet pipe. Volume ~50 AF for 2-Yr storm or Volume ~5 AF Series of four 3 ft high dams.	**Flood Control Dam $2,630,000** **Check Dams $107,200**
R-57	0366	Pond (groundwater fed). Approx. 1ft. of freeboard on (0366- July 9, 2007). Surface outlet for overflows. Reach from R-56 to R-57 includes floodplain properties	Additional opportunity for stormwater management facilities from R-56 to vicinity of R-57, but floodplain on east side occupied by back yards of residences.		

R-58	0351	Box culvert beneath Highland Ave. 24ft.W × 5ft.H (Top 2ft. high) Photo is from right bank upstream			
	0352	View upstream approx. 400’ upstream from culvert			
	0353	Remains of breached small dam. Note bedrock in channel in foreground.			

Table 3: Pine Run, Potential Stormwater Improvements					
I.D.	**Picture**	**Description**	**Recommendation**	**Estimated Volume (Acre-Ft)**	**Cost**
P-1	0469	Field in SE quadrant of Welsh Rd (rte 63) & Jarrettown Rd. Dimensions of field: 1000 ft. x 1100 ft = 25 acres. Presently cultivated, but slated for development. In headwaters of two branches of Pine Run.	Must have complete retention of design storms. New stormwater facilities strongly recommended.	For complete retention of 10 year storm, (5.2 inches of rainfall), retained volume would be 10.8 Acre-Ft. Estimate 10 A-F of *New Detention* over and above existing infiltration at field (~0.5")	**Stormwater Basin $553,100**
P-2	0470	Twin 24"-diam. Pipes Outfall of road drainage and runoff from subdivision surrounding Holly Hill (U. Dublin Open Space.)			
P-3A	0471 0472	Entry to Dublin Open Space Large detention basin. Dimensions: Approx 180 ft. x 210 ft. = 0.87 acres Easy access via gravel road from Jarrettown Rd.	Very good candidate for retrofit to infiltration/extended detention.	Existing depth is 8 ft. to spillway. Existing capacity ~7 A-F. ~0.9 A-F of *New Detention* for each Additional foot of depth/infiltration added. * More detailed analysis is needed to assess potential additional detention. For 4 ft. of additional berm height: ~4 A-F of *New Detention* would result.	**Stormwater Basin $22,200**
P-3B	0473	Outlet retrofitted w/ street plate – low flow aperture 12 in-diam.			
P-3C	0474	Inlet 40 in-diam. Berm approx 10 ft. above bottom Rip-rap spillway approx. 8 ft above bottom.			
P-3D	0475	Drop inlet Approx 34 in-diam. pipes in and out			
P-3E	0495	No defined channel			
P-3F	0496	Spring/seepage pool is beginning of channel. Below pool stream is perennial. Bedrock close to bottom of channel.	Opportunities for series of small check dams.	Significant drop in this reach. Volume available from check dams appears to be small.	**Check Dams $41,100**

P-3G	0497	Wooden footbridge. Approx. 18 ft span, clearance above stream approx. 4 ft.			
P-3H	0500	Rip-rap outfall channel from detention basin			
P-3I	0501	Outfall from basin – 18 in diam. (retrofitted inside to 12”-diam.)			
P-3J	0502 0503	Severe stream bank erosion upstream from outfall channel			
P-3K	0504	Large root of mature tree (34 in-diam. trunk) bridging stream. Channel approx. 4- feet deep, demonstrating severity of erosion caused by upstream subdivision runoff.			
P-4A	0498	Playing field of New Horizons Montessori School. Dimensions: 280 x 440 ft. Area ~ 2.8 acres	Opportunities for infiltration trenches along south side of field.	If complete infiltration of 10 yr storm is achieved, *New Detention* ~ 1.2 A-F	**Infiltration Trench** **$644,400**
P-4B	0499	Ephemeral channel/ditch along west side of field			
P-5	0847		Opportunities for check dams throughout this stretch of stream.	Assume two 3 ft check dams. Total Pond Area ~ 0.2 acre *New Detention* ~ 0.2 A-F for 1 ft average depth	**Check Dams** **$63,900**
P-5A			Opportunities for check dams throughout this stretch of stream.	Assume two 3 ft check dams Total pond area ~ 0.5 Acres *New Detention* ~ 0.5 A-F for 1 ft average Depth.	**Check Dams** **$69,600**
P-6			Good retrofit candidate for extended detention/infiltration/or wetland.		
P-6A	0476	24 inch diam. outfall from street drop inlets			
P-6B	0477	Outlet structure. Approx 10-in. low-flow, partly blocked by large rocks. Standing water. Bottom of overflow notch 46” to 48” above grade. Notch is 18 in-wide by 12 in-high Top of grate 5 ft above grade. Top of berm/street approx 8ft-9ft above bottom.			

P-6C	0478	Wet bottom of basin with some inflow. 36 in- diam. inlet to basin.			
P-7	0846	42-inch diam. outfall from basin @ P-6.			
P-8	0848	3 ft-diam. outfall from Dublin Rd. & Arran Way			
P-9	0849		Opportunity for check dams from here upstream.		
P-10		Mowed to edge of east bank. No riparian buffer.			**Check Dam** **$74,900**
P-11	0845 0844 0843	Severe bank erosion through whole stretch.	Good ops for check dams and floodplain storage from P-10 to P-11.	Assume single 3 ft. check dam. A second check dam may not be feasible due to home location. Pond Area ~ 0.75 acres *New Detention* ~ 0.75 A-F for 1.0 ft average depth.	**Check Dams** **$48,600**
P-12	0842		Ops for check dams		
P-13	0817 0818	Large field obviously slated for development. (Drainage already at least partly installed.) Drop inlets and pipes already in place apparently demonstrate intent to drain directly to headwaters of Pine Run.	Retention imperative. Area of field ~ 27.5 acres	For complete retention of 10 year storm, (5.2 inches of rainfall), retained volume would be 11.9 Acre-Ft. Assume initial abstraction for existing field is .5" or 1.1 A-F. Could attain ~10.8 A-F of *New Detention* if complete retention of 10 yr storm is achieved.	**Stormwater Basin** **$553,100**
P-13A	0862	Approx. location of drop inlet			
P-13B		Outfall from P-13A			
P-13C	0861	Ponded area.	Good location for BMP.		

P-14		Large field. Drains directly to Pine Run Headwaters.	As with P-13, must have BMPs. One of few remaining headwater opportunities for effective stormwater management. Area of field ~ 12 acres	For complete retention of 10 year storm, (5.2 inches of rainfall), retained volume would be 5.2 Acre-Ft. Assume initial abstraction for existing field is 0.5" or 0.5 A-F. Could attain ~4.7 A-F of *New Detention* if complete retention of 10 yr storm is achieved.	**Stormwater Basin $300,200**
P-15	0816	Approx. location of small pond.	Could be retrofitted to larger constructed wetland or wet pond.		
P-16	0815 0814	Wetland.	Possible low check dams for spreading into flood plain. Possible location for larger constructed wetland		
P-17	0812	Culvert under Dreshertown Rd. 54-inch wide oval.			
P-18	0813	Detention Basin.	Potential candidate for infiltration and/or extended detention.		
P-19	0808	Outfalls of storm sewer (left- ~ 2 ft diam., drainage from west side of Dreshertown Rd) and culvert under Dreshertown Rd. (Right hand - 3 ft wide x 2 ft. high oval)			
P-20A	0809	Already wetland.	Very good opportunities for check dams and enhanced floodplain storage between P-19and P-21.		
P-20B	0811	Downstream toward P-21			
P-21	0810	from downstream Box Culvert under Tuckerstown Rd. 12 ft wide x 52 inches high			
P-22	0807		Potential locations for check dams and/or enhanced wetland area.		

P-23		New Pond not shown on ortho-photo. Very little freeboard			
P-23A	0803	Dam/weir			
	0804	View upstream from dam			
P-23B	0805	Driveway bridge culvert (opening under bridge 10 ft wide by 4 ft high)			
P-23C	0806	Culverts under back driveway			
P-24			Potential location for small check dam.		
P-25		Large parking area ~ 11 acres.	Strongly recommend redesign of parking lots with infiltration facilities.	For complete retention of 10 year storm, (5.2 inches of rainfall), retained volume would be 4.8 Acre-Ft. Assume initial abstraction for existing lot is zero. Could attain ~4.8 A-F of *New Detention* if complete retention of 10 yr storm is achieved.	**Redesign Parking Lot Infiltration $2,521,000**
P-26		Parking lots at P-25 and Parking garage at P-26 drain to large wet pond at P-28 via P-27			
P-27A	0863	Approx location of inlet to large pond at P-28			
P-27B	0864	View up swale from P-27			
P-28	0820	Large SW wet pond			
P-29	0821	Outfall from P-28			
P-30	0822 0823 0824 0825	Large shallow detention basin, maximum depth approx. 6 ft. Dimensions: 280 x 320 ft. Area ~ 2.1 acres Low island in middle. Barren expanse of grass. Good mosquito habitat. Outlet structure – low flow outlet 16-inch diam. Overflow approx 6 ft above bottom.	Very good candidate for constructed wetland or infiltration/extended detention. Good place for small park, boardwalk to island, picnic tables for workers.	Could obtain ~2 A-F of additional detention for each additional ft of depth or infiltration gallery capacity. Assuming additional 4 ft of depth/infiltration capacity, a total of 8 A-F of *New Detention* could be achieved.	**Infiltration / Extended Detention $4,136,000**

P-31		Good opportunities for check dams throughout this stream segment.		Assume a series of nine 3 ft dams in this reach. Total pond area~2.0 acres. 2.0 A-F *New Detention*	**Check Dams $177,600**
P-31A	0826	Stream intermittent or perennial			
P-31B	0827	Bedrock in channel			
P-31C	0829	View downstream from east of Sara Court			
P-31D	0830 0787	Attempt at bank stabilization below house on east side of Sara Ct.			
P-31E	0786	Culvert under Sara Court – 2 ft. diam.			
P-32		Good example of extended detention retrofit of basin between Sara Court and Dreshertown rd.			
P-32A	0788	Inlet 40 in. diam. – Perennial flow			
P-32B	0789	Outlet structure ~ 6 ft high, low flow outlet retrofitted with steel plate with 8 in. diam. aperture. Intermediate flow at 4-ft above grade, with 1- ft. diam.			
P-32C	0790	22-inch diam. outlet through berm from 0789 outlet stand pipe.			
P-32D	0791	15 – inch diam. inlet to culvert under Dreshertown Rd			
P-32E	0792 0793	Cattail and sedge wetland created by retrofit to extended detention.			
P-32F	0794	View of wetland from Sara Court			
P-32G	0801	Outlet of culvert under Dreshertown rd. from Sara Court. 2- ft. diam.			
P-33	0800	New Pond (not shown on ortho-photo)			
P-33A	0799	Notched weir creating pond. Approx. 2-ft. of freeboard.			
P-33B	0831	City Park. Aidenn Lair Woods. Severe bank erosion. Need bank stabilization.			
P-34		Detention Basin at intersection of Nicole Dr. and Castlewood Dr.			
P-34A	0795	Inlet 28-in. diam.			

P-34B	0796	Outlet has been retrofitted with steel plate to 15-in. diam. Overflow at 5 ft. above bottom.	Good candidate for future retrofitting to infiltration/extended detention as done at P-32.		
P-34C	0797	Outfall from P-33 basin. Oval 33in W x 23in H + 30-inch diam. drain from Nicole Dr.			
P-35	0798	Immediately downstream from P-34.	Check dams could enhance wooded floodplain area.		
P-36	0840	Box culvert under Dreshertown Rd. Approx 15 ft wide x 30-32 inches high			
P-37		Small detention basin,	Candidate for retrofit to infiltration/ extended detention, but should be shallow and ephemeral because of nearby playground		
P-37A	0850	Outlet 36 inch W x 24 inch H			
P-37B	0851	Outlet with low flow 12 inch diam., overflow at 44 in above bottom. Concrete spillway at approx 5 ½ ft above grade			
P-38		Large detention basin.	Candidate for retrofit, but very steep sided so may not be safe with children in playground and playing fields.		
P-38A	0852	Inlet from SW side 21 inch W x 14 inch H			
P-38B	0853	Outlet structure: low flow 6 inch diam. Over flow 84 inch above bottom Concrete spillway~ 2ft. higher than overflow	Make small extended detention pool, and plant with emergent vegetation		
P-38C	0854	Outfall of low flow pipe below spillway			
P-39	0855	Inlet to pipe under Dreshertown Rd ~46 inch W x 28 inch H corrugated			
P-40		Box culvert under Beacon Hill Drive, just east of Dreshertown Rd. 12 ft. W x 4 ft. H			

	0775	Downstream side of culvert			
	0776	Upstream side of culvert			
	0777 0778	View upstream from Beacon Hill Dr. Note lawn mowed right to edge of stream No riparian buffer			
P-41	0832 ~ 0838	Downstream from P-40 Broad floodplain, Already jurisdictional wetland, with abundant cattails, etc throughout area.	Good opportunity for enhanced floodplain storage. Can enlarge wetlands, especially on west side, along east side of Dreshertown Rd.	Assume two 3 ft. check dam to spread flow into floodplain. Ponded Area ~ 1.0 acres *New Detention* ~ 1.0 A-F for 1 ft average depth.	**Check Dams** **$92,000**
P-42	0839	More wetlands. Much of area from P-41 to P-42 appears to be made land. Probably heterogeneous fill from widening and grading of Dreshertown Road. (Trees young and quite uniform in age and size)	Additional opportunities for enhanced wetland/floodplain storage.	Assume two 3ft. check dam to spread flow into floodplain. Ponded Area ~ 1.0 acres *New Detention* ~ 1.0 A-F for 1 ft average depth.	**Check Dams** **$122,400**
P-43	0714 0715	Good floodplain storage. Banks undercut, but otherwise in reasonably good condition. Lawn mowed right to top of bank on both sides.	Should plant more riparian vegetation to stabilize.		
P-44A	001 002	Jarrettown Elementary School	Opportunities for small SW improvements along south edge of S. parking lot and swale south of & below it.		
P-44B	003	Small outfalls in lawn (left 8"diam., right 6")	Can be led to shallow retention/ infiltration in lawn area at P44C		
P-44C	004				
P-44D	005	Outlet: low flow 12 inch W x 7 inch H, Overflow 35 inch above bottom.	Can be retrofitted to extended detention.		
P-44E	006 007 008	Extended detention basin. Outlet overflow 58 inch above bottom. Intermediate outlet 5 inch W x 2 inch H 36 inch above bottom. Very well vegetated	Very good example of extended detention.		
P-44F	009	Inlet to 14 inch diam. corrugated pipe, which receives runoff from playing fields at P-44G and from north parking lot.			

P-44G			Recommend infiltration trenches along south and east edges of field.		
P-44H		Drop inlets in lawn to piped outflow from P-44E and P-44F.			
P-45		Outfall of storm sewer from P-44, 30 inch-diam. concrete pipe			
P-46	0701	High water mark from Floyd and Allison at south corner of Spring house. Outfall of 30 inch-diam. pipe			
P-47			Retrofit candidate. Wet pond can be retrofitted to have extended detention.		
	0703 0704	Outlet structure: Top of grate approx. 5 ft. above bottom. Three approx. 9 inch diam. low flow outlets approx. 18 inch above bottom.	Possibly close two holes?		
P-47A	0705 0706	Two 29 inch diam. outfalls from pond at p-47, into one 23 inch diam. Pipe (0706)			
P-48	0707	Grate of drop inlet over~ 32 inch diam. storm sewer. Flow perennial. Installed~ 2years ago. According to the resident.			
P-48A	0708	Despite storm sewer recently installed, runoff still ponds in area indicated, according to resident of adjacent home.	Still may be possible to make a small pocket wetland, or at least a substantial rain garden. (Possibly with sealed bottom to alleviate wet basements of neighboring houses on Glen Echo Lane)		
P-48B		Grate over outfall of two 27 inch-diam. pipes that then go into one 54 inch-oval			
P-48C		Drop inlet over 54 inch-oval storm sewer.			
P-48D	0709	Outfall of 54 inch wide oval corrugated steel pipe. Perennial flow.			

	0710	Channel relatively stable, though some bank erosion. Fairly well vegetated. Mature trees on banks undercut.			
P-49	0711	Culvert under Dreshertown Rd. ~30 Inch-diam. corrugated steel let into masonry and concrete.	Opportunity between P-49 and P-48D for small wet pond or wetland, especially since already have restricted flow under Dreshertown Rd.		
P-49A	0712 0713	36 inch-diam. outfall of culvert under Dreshertown Rd.			
P-50 (line file)	013 014 015	In floodplain SE of Dreshertown Mall and Dreshertown Rd. Banks relatively stable, but with some lateral movement.	Many opportunities for small check dams and more floodplain storage. Floodplain forest/ jurisdictional wetlands. Must not allow development.		
P-51	043 044	Large detention basin. Standing water 3 to 4 inches deep. Already a wetland, but grass mown short, so is probably prime mosquito habitat. Dimensions: 180 x 280 ft. Area ~ 1 acre	Very good candidate for retrofit as extended detention/ permanent wet pond or constructed wetland. (Draft flood map shows that facility is out of 100yr floodplain.)	Each additional foot of berm height would provide 1 A-F of storage. If out of floodplain, could increase berm height. Assume 4 ft. additional berm height. Potential *New Detention* = 4 Acre-Ft	**Stormwater Basin $85,600**
P-51A	045 046	Outlet two- 2ft. diam. holes approx. 3 ft. above bottom of concrete weir. Low flow outlet one- 1 ft. diam. hole.			
P-51B	047	Inlet to basin-5 ft. wide oval outfall			
P-51C	0779	View of detention basin from above outfall. (Cul-de-sac of Rapp Run Road)			
P-52			Opportunity for small BMP.		
P-53		Wheel stops instead of continuous curbs allow runoff into wooded swale. (Many invasives, but at least thickly vegetated)	Good example of SW management on parking lot.		

P-54A	0869	Large, but apparently shallow aerated pond.			
P-54B	0870	Very little or no freeboard.			
P-55		Large depression. Dimensions: 200 x 200 ft. Area ~ 0.2 acres	Very good candidate for retrofit to extended detention or retention pond.	Each foot of depth would provide 0.2 A-F of storage. If 5 ft. of additional depth can be acquired through retrofitting, *New Detention* ~ 1.0 A-F	**Stormwater Basin $36,900**
P-55A	0867	Outfall of pipe from aerated pond at P-54~3 ft. diam. concrete			
	0868	View downstream from P-55A			
P-55B	0865	Outflow from depression, perennial flow, through 32 inch-diam. pipe.			
	0866	View upstream from P-55B			
P-56	1002	Box culvert under Turnpike (from Prudential Campus N of Tpk) Approx. 8 ft. W x 4 ft. H Perennial flow			
P-57	1001	Deeply incised meanders, considerable perennial flow. Turnpike embankment to left.			
P-58	1000	Twin 44 inch diam. iron pipes (half filled with sediment) under railroad embankment.			
P-58A	0999	Approx. 3 ft diam. culvert outfall from under Tpk. - flows S to join Westward flowing stream along pipeline right-off-way.			
P-59		Twin masonry culverts under powerline road right of way (R.O.W.), then into twin ironpipes (P-58).			
	1005	View from downstream. Note missing blocks.	Clear and repair..		
	1007	Upgradient side of culvert. Twins ~ 6 ft. H x 4 ft W Perennial flow.			
P-60	1008	Box culvert under Twining Road. 8 ft W x 4 ft. H. Note gabioned bank.			

P-60A	1009	10 to 12 ft. high cut bank.	Should stabilize. Good opportunity for bank and floodplain storage upgradient from Twining Rd culvert. (Series of check dams upstream from this point.)	Degree of slope limits opportunity for significant storage.	
P-60B	1010		Additional opportunity for check dam and spreading of runoff into adjacent floodplain on east.	Degree of slope limits opportunity for significant storage.	
P-60C	1011	Note remnants of cinder block dam, broken by fallen tree.	Additional opportunity for check dam and spreading of runoff.	Degree of slope limits opportunity for significant storage.	
P-61	1012	Outfalls (Left (east) – 36 in. diam., Right (west) – 16 in. diam.) Flow through 16in. is perennial			
P-62	0998	Stream crosses pipeline R.O.W.			
P-63		Box culvert under Turnpike 9 ft W X 6 ft H. Significant perennial flow.			
P-63A	0997	Downgradient side of culvert, which fed pond @ P-66 before stream cut a bypass channel, shown in photo 036			
P-64	039	Prudential parking lots. Dimensions: 400 x 400 ft Area~3.7 acres	Better SW management needed for large parking lots upgradient. Potential for infiltration of parking lot runoff.	Assume initial abstraction for existing lot is zero. Could attain ~1.6 A-F of *New Detention* if complete retention of 10 yr storm (5.2") is achieved.	**Infiltration Facility $857,700**
P-65	038	Detention basin upgradient from pond (P-66) Dimension = 120 ft diameter Area ~ 0.25 acres	Potential candidate for retrofit to infiltration/extended detention.	If 4 ft. can be added to berm height, *New Detention* ~ 1 A-F	**Stormwater Basin $112,700**
P-66		Pond with approx. 3 to 4 ft. of freeboard, Dimension = 120 ft diameter Area ~ 0.25 acres	Freeboard could be retrofitted/raised by another 3 feet or more.	If 4 ft. can be added to berm height, *New Detention* ~ 1 A-F	**Stormwater Basin $77,400**
	035	Outlet of pond			

P-67	034	Large area, already wet in spots. Dimensions: 240 x 160 ft. Area~0.9 acres	Suitable for large storage wetland or wet pond. (Could divert overflow from P-66.)	If 4 ft. can be added to berm height, *New Detention* ~ 3.5 A-F	**Constructed Wetland $163,500**
P-67A	040	Pond with ~ 4 ft of freeboard. Outlet standpipe at ~ 2 ft below berm.			
P-67B		Lower pond dry at time of observation (11/29/07). Outlet ~ 5 ft. above bottom.			
P-68	0982 0984	Culvert under Twining Road. 46 in. wide X 30 in. high			
P-68A	0986	4 pipes under golf cart path.			
	0987	Corrugated culvert (3 ft. diam.) under gravel road to cell phone antenna facility.	Small opportunity for detention here.		
P-68B	0988 0989	Outfall of pipe from P-68A. Attempt to stabilize bank (Photo 0989)	Good opportunity for retention immediately down gradient from outfall. (Photo 0988 – 1/10/08)		
P-68C	0990	Wooden check dam.	Rebuild as concrete or masonry.		
P-69	0991	Gneiss bedrock and boulder (up to 3 ft. diam.) channel. Stream here is intermittent or ephemeral.	Many opportunities for check dams.	Based on slope, combined volume for check dams in reach from P-68A to P-70 appears to be small. *New Detention* ~ 0.3 A-F from a series of 3 ft. dams.	**Check Dams $33,300**
P-70	0992 0993	Masonry culvert under power line road 52 in. high X 32” wide.			
P-71	0994	Culvert under railroad embankment 46 in – diameter iron pipe.			
P-71A	0995		Opportunity for small retention facility below outfall of P-71.		
P-72	0996	Culvert under Tpk. Approx. 4 ft diam. concrete pipe			

P-73			Opportunities throughout stretch for flood control dam or multiple check dams and enhanced floodplain storage.	Assuming a 6-foot dam, 290-foot long, 60-foot spillway, and one 3-foot outlet pipe. Volume ~25 AF for 2-Yr strom. or Assume series of four 3 ft. check dams to spread flow into floodplain. Ponded Area ~ 4.0 acres Approximately 4.0 A-F of	**Flood Control Dam** **$1,070,000** **or** **Check Dams** **$198,900**
P-74A P-74B	0976 0979 0980	Drainage is ephemeral or intermittent, but channel well defined below P-74B (see photo 0976).	Opportunities for small retention, infiltration, or extended detention BMPs. Can be deepened.		
P-74C			Check dams needed throughout stretch.	Assume series of five 3 ft. dams . Total Storage ~ 0.2 A-F due to slope. *New Detention.*	**Check Dams** **$48,200**
P-75A	0978	Outfall (~ 3 ft – diam.) from under railroad embankment. Small perennial flow.			
P-75B		Culvert under Tpk. (~3 ft. diam.)			
P-75C	033	Outfall (~3 ft. diam.) of culvert under Tpk.			
P-76	0782 0780 0781	Much of area from Beacon Hill Dr. N through Oakwood to Castlewood and Nicole Drives drained to and through drop inlets to outfall at P-76A (~ 3 ft – diam.)			
P-76B	0783	Open channel. Downcutting.			
P-76C	0784	Footbridge over channel.			
P-77	041	Dublin Hunt (U. Dublin Twp. Open Space) Large shallow detention basin. Dimensions: ~60 x 360 ft. Area = 0.5 acres	Good candidate for retrofit to extended detention/ephemeral wet pond or enhanced wetland.	Additional 4 ft. berm height would provide 2 A-F *New Detention*	**Stormwater Basin** **$119,000**
	0785	Channel enters basin around berm. Perennial flow. Much standing water. Good mosquito habitat.			

	042	Outlets from basin. All three holes ~ 3 ft – diam.			
P-78		Scattered Wetlands throughout area	Opportunity for larger flood control dam or two 3 ft dams to spread flow.	Assuming a 10-foot dam, 570-foot long, 60-foot spillway, and two 4-foot outlet pipes. Volume~35 AF for 2-Yr storm. or Assume two 3 ft. dams. Total Ponded Area ~ 2.5 acres	**Flood Control Dam $2,360,000** **or** **Check Dams $184,400**
P-79A		B, C, D, and E were destroyed by storm on Sept. 8, 1996	Not feasible to raise freeboard of pond (A). Negligible increase in retention. Multiple opportunities for restoration and/or retrofit of detention and retention ponds P-79B through P-79I.		
P-79B	0968		Restore		
P-79C	0969		Restore		
P-79D	0970		Restore		
P-79E	0971		Restore		
P-79F	0972	Golf course Irrigation lake almost filled with sediments. Dimensions: 100 x 200 ft. Area = 0.5 acres	Dredge and raise freeboard to provide more storage.	Assume 4 ft depth increase from dredging and 2 ft additional freeboard if berm height. can be increased by 2 ft. *New Detention* ~ 3 A-F	**Stormwater Basin $119,000**
P-79G	0973	Former pond, filled with sediments and cattails.	Dredge and restore..		
P-79H	0974	Pond, Area ~ 0.1 acres	Raise freeboard 1 to 2 ft?	*New Detention* ~ 0.2 A-F	**Constructed Wet Pond $82,800**
P-79I	0975	Pond, Area ~ -.2 acres	Raise freeboard 2 to 3 ft.?	*New Detention* ~ 0.4 A-F	**Constructed Wet Pond $101,500**

P-79J		Culverts under power line R.O.W., then under railroad R.O.W., then under Tpk.			
P-79K		Hillside above (to S) contributes considerable sheet flow.	Need many small check dams along ditch.		
P-80	032	Well defined perennial channel from culvert under Tpk. (Could not access culvert to observe or measure.) Evidence of some downcutting and bank erosion, but not severe. Relatively mature trees on banks, but not undercut.			
P-81	031	Wetland and beginning of channel formation by drainage from culvert under Tpk.			
P-82	030	S. Branch of Pine Run. Nice forest of mature oaks, shagbark hickory, etc., but many invasives.	Opportunities for more floodplain storage/spreading.	Assuming an 8-foot dam, 390-foot long, 60-foot spillway, and one 4-foot outlet pipe. Volume~35 AF for 2-Yr storm. or Assume three 3 ft. dams. Ponded Area ~ 3.7 acres	**Flood Control Dam $1,540,000** **or** **Check Dams $169,400**
P-83	028	~ 2 ft diam. culvert or roadway drain outfall from Tpk.			
	029	Severe downcutting of channel from above outfall. Stream is perennial.	Should install check dams to spread stormwater into floodplain forest.		
P-84		Dresher Woods (Townhouse development)			
P-84A	019	Drop inlet in N parking lot ~ 10 feet deep, ~ 2 ft diam. Pipe directly via outfall at P-84C, to creek. No onsite SW management other than drains directly to neighboring streams.			
P-84B	018	View of floodplain from just north of P-84A			
P-84C	029	Outfall from inlets in N parking lot. ~ 2 ft. diam.			
P-84D	016 017	Wetlands in floodplain. Outfall at P-84C contributes to maintenance of these jurisdictional wetlands.			

P-85	021	Confluence of NW and SE branches of Pine Run. Good floodplain forest and storage. Can be enhanced by check dams immediately south of confluence @ P-86.			
P-86	022		Good potential location for check dam to enhance floodplain storage.		
P-87	023		Another good location for check dam.		
P-88	025	Box culvert (Limekiln Pike over Pine Run) 30 ft. wide x 5 ft high.			
	024	View upstream from P-88. Mercedes-Benz dealership and Dresher P.O. to N of Pine Run. Floodplain mostly paved. Note large area of reeds and sedges to right (adjacent to stream).			
P-89		Dreshertown Plaza. Dimensions: 520 x 520 ft. Area=6.2 acres	Many opportunities for BMPs. Especially when parking areas are repaved. Potential for infiltration galleries beneath parking lots, or at least infiltration trenches or bioswales along edges of lots.	Assume retrofitting to retain 50% of runoff from 10 yr storm (5.2 inches) using pervious paving and infiltration galleries. *New Detention* ~ 2.7 A-F	**Infiltration/Extended Detention** **$1,412,000**
P-89A (line file)	012	Open parcel adjacent to Dreshertown Plaza. Dimensions: 520 x 360 ft. Area = 4.3 acres	If parcel immediately to SE (P-89A) is developed must install effective BMPs, especially along its SE edge along Dreshertown Rd., which otherwise would probably be piped directly to Pine Run.	Assume all runoff is retained for 10-yr storm. New Detention ~ 1.7 A-F assuming that Existing abstraction is 0.5”	**Extended Detention** **$488,700**
P-90		In U. Dublin Twp. Park, Burn Brae Park. (E end of park, off Dundee Dr., just N of Burn Brae)			
	0961	View downstream, showing perennial flow in headwaters.			

P-91	0962	Outfall of storm sewer from Burn Brae Drive and SE of Drive. 3 ft wide x 2 ft high corrugated steel.			
	0963	Immediately downstream from outfall. Deeply incised channel. Note undercutting of mature trees on left bank.	Need stabilization of banks.		
P-91A	0964		Opportunity for check dam and bank stabilization.		
P-92	0966	4 ft. – diam. corrugated steel culvert under Twining Road. (Easy access just N of pump station @ intersection of Ayr La. and Twining.)	Opportunity for low (~ 2 to 3 ft. H) check dam and enhanced bank and floodplain storage approx 50 ft upstream from culvert.	Estimate of volume from small check dam is 0.25 A-F	
P-92A	0965	In channel ~ 400 ft. upstream from P-92 No visible flow, but very moist sand and gravel in channel bottom, indicates shallow interflow.			
P-92B	0967	Outfall of culvert from P-92 immediately W of golf cart path in foreground.			
P-93		Lake on golf course (Twining Valley Golf Club) drained because of perceived threat to downstream townhouse development			
P-93A		Approx. location of bridge over deep ravine.			
	0954	View upstream from bridge.	Very good opportunity for extended detention. Could install series of small check dams, but must be carefully engineered and installed.		
P-94	0955	Box culvert under Green Valley (Circle or Court) Approx. 12 ft wide x 4 ft high. Note attempt at stabilization of embankment above culvert, probably evidence of fragment overlapping and erosion.			
P-94A	0956	Immediately downstream from P-94. Channel is being widened by increased flows due to removal of impoundment at P-93.	Opportunity for some small check dams.		

P-95	0957	Poorly designed and functioning detention basin. Very wet bottom.	Should be retrofitted to extended storage wetland and planted with appropriate vegetation.		
P-95A	0958	Inlet from Cul-de-sac to South. (3 – ft. diam.). Outlet structure on right of photo.			
P-96	0959	Outfall from P-95 (~ 3 ft diam. on right). Outfall on left from ditch between P-95 and railroad embankment on north.			
P-97	0953	Ditch from SW. Downcut 3 to 4 ft.	Need check dams to slow and spread runoff.		
P-98 (line file)			Opportunities throughout stretch for multiple check dams and spreading of runoff, bank and floodplain storage.	Due to slope, combined volume for series of 5 ft. check dams is estimated to be 0.5 A-F or less.	
	0952	Channel filled with brush, limbs, debris.			
	0951	View upgradient. Bedrock channel. Perennial or intermittent flow.			
	0950	View downstream. Mature beech, hickory, tulip poplar forest.			
	0949	View upstream. Mature beech, hickory, tulip poplar forest.			
	0948	View upstream.	More opportunities for check dams		
	0947	View downstream.	More opportunities for check dams		
P-99	0946	At S corner of parking lot of Korean Presbyterian Church. Inlet to pipe under Limekiln Pike to N side of Susquehanna Road. Pipe – 3 ft diam.			
P-100	0945	Dresher Presbyterian Church			

P-100A		Large wet pond/detention. Little freeboard.	Not good candidate for retrofitting, but recommend planting sides with appropriate tall grasses and sedges to discourage Canada Geese and improve water quality of discharge.		
P-101	0960	Partially collapsed masonry box culvert under RR embankment. ~ 6 ft. H x 3 ft W.	Clear and repair.		
P-101A		Culvert under Turnpike			
P-102	026	Box culvert under Limekiln Pike & Susquehanna Rd. 12 ft W x 4.5 ft H.			
	027	Gabions. Obviously placed because of severe erosion undermining road.			
P-103A		RR bridge over unnamed stream.			
	0939	View from S side of RR bridge to W along backwater in ditch along S side of tracks.			
	0940	View upstream (S-ward) toward bend of Dreshertown Rd			
P-103B	0941	Confluence of two swales.	Good opportunity for check dam and spreading of runoff from Dreshertown Rd outfall at P-103B.	Slope appears too steep to allow for significant storage volume from a check dam.	
	0942	View upgradient along SW swale.			
	0943	View upstream toward outfall at P-103B.			
P-103C	0944	Outfall of 3 ft. diam. Storm sewer from under Dreshertown Rd. Perennial flow.			
P-104A		Downstream side of bridge at P-103.			
	0874	Perennial flow.			
	0873	Flow between RR embankment (on left) and Sunoco pipeline R.O.W.			
P-104B	0875	Culvert under Tpk (6 ft. wide x 4 ft high)			

	0876	Upstream from P-104B. Perennial flow.	Opportunity for BMP between TPK and pipeline R.O.W.		
	0877	View eastward along pipeline R.O.W.			
P-105A	0937	Outfall of ~ 2 ft diam. Storm sewer from Applewood Drive. Intermittent flow (observed to flow 12/18/07)			
P-105B		Outfall of pipe from P-105A			
P-105C	0938	Masonry box culvert under RR ~ 5 ft W x 4 ft H			
P-106	0879	Culvert under Tpk. Corrugated steel oval 4 ft wide x 32 inch H.			
	0878	Channel with perennial flow upstream from Tpk culvert.	Significant opportunity for BMPs upgradient from Tpk.		
P-107	0880	Masonry box culvert under pipeline R.O.W. ~ 4 ft wide & ~ 5' ft H (?)			
	0881	Downstream from culvert. Deeply incised (4 to 5 ft deep) channel with perennial or intermittent flow	Opportunities for significant BMPs		
	0886	Looking S from RR embankment. Culvert & outfall on residential property.			
P-108	0882	Outfall of culvert under pipeline R.O.W.			
	0885	View SE from RR embankment			
P-109		Already abundant scattered wetland areas. Dimensions~ 800 x 200 ft. Area=3.7 acres	Very significant opportunities for BMPs such as storage wetlands, etc.	This area could store runoff from tributaries south of the PA Turnpike, and may be affected by backwater from Pine Run. Assuming 4 ft depth, New Detention ~ 15 A-F	**Stormwater Basin $664,600**
P-110	0906	Rip-Rapped channel. Note undercut trees in foreground			

P-110A	0905	Deeply incised. Young beech tree (~15"diam.) undercut. Bedrock channel. Stream intermittent.			
P-110B	0904	Bank stabilized with wall of tires. Note outfall at bottom of wall.			
	0903	View Downstream. Stream intermittent.			
	0902	Attempt to deflect and stabilize channel.			
P-111	0901	Left (east) swale ephemeral; Right (west) from P-110 is perennial/intermittent.	Opportunity for small check dam at confluence of two swales.		
P-111A	0899	Outfall of storm sewer from Camp Hill – 28 inch diam.			
P-112					
P-112A	0900	Twin inlets to culvert under Heller Way. Each 4ft Wx 30 inch H oval. Partly filled with sediment			
P-112B	0896	Outfalls of culvert under Heller Way.			
	0897	Right (west) ~1/3 filled; Left ~1/5 filled with sediment. Small drain on far right (w) ~ 15 inch diam. from Camphill and Heller Way.			
P-113	0891	Large detention basin. Low flow outlet ~ 6 in-diam., but partially blocked.	Extended detention basin. Improve and vegetate.		
P-113A	0892	Outlet structure. Overflow at 4 ft above bottom. (groundwater is entering outlet below level of blocked low-flow outlet).			
P-113B	0893	Inlet from Heller Way. 31 in diam.			
P-113C	0894	Surface inlet from ditch between RR embankment and houses N of Leah Drive			

P-113D	0895	Outfall from basin. 26 in diam. Basin is already extended detention.	Retrofit to storage wetland. Groundwater just below bottom, so planting with wetland species will improve habitat and water quality.		
P-114A	0898	Upstream side of twin masonry box culverts under RR embankment, each 4 ft W x 3 ft H. Perennial flow.			
P-114B	0907	Downstream side of culverts form P-114A			
P-115	0908	Swamp Perennial flow.	Significant opportunities throughout area (like P-109, immediately to east) for BMP's		
P-116	0912	Concrete culvert under dirt road (power line R.O. W) 4 ft diam.			
	0911	View upstream from P-116.	Opportunities for check dams and BMP's.		
P-117	0913	Box culvert under PA turnpike. ~5ft W x 4 ft H			
P-117A		Perennial flow in ditch along S side of Tpk, fed from P-108 through P-109.			
P-118	0914	Many flags in front just SE of Tpk interchange.	Proposed for development? If so, must observe wetland areas (P-118A) and insist on BMPs.		
P-119	0916	Bedrock channel (ephemeral or intermittent) incised 5 to 6 feet deep. (Depth obviously controlled by bedrock floor of channel. Therefore, now cutting banks to enlarge channel cross-section)			
	0917		Significant opportunities for check dams and spreading into floodplain, but must be careful of nearby house at (P-120).		
P-120	0918	View upstream from front yard (uphill side) of house @ P-120. Perennial flow.			

	0919	View upstream from back yard of house at P-120.			
P-121		Masonry culvert under RR embankment 8 feet wide. Semicircular arch (8'diam.) atop 3 foot high vertical wall			
P-121A			Opportunity upstream from culvert for check dams		
P-122		Wetland SW of eastbound exit ramp of Tpk			
P-123	0924	View upstream along Pine Run from its confluence with main stem of Sandy Run			
P-124		North of Susquehanna Rd & Virginia Drive			
P-124A	010	Wetland area head of tributary drainage, just off edge of lawn bordering parking lot at rear of complex of Chelten Baptist Church and Child Development Center.	Opportunity for enhanced wetland. Also opportunities for biofiltration swales or infiltration trenches along SW edge of parking lot or along NW & SW edges between lawn and wooded area to west.		
P-124B	011	At SE corner of parking lot.	Opportunity for bio-retention or rain garden @ down slope edge of lot.		
P-125		Upper Dublin Open Space.	Many oppor. For check dams and small impoundments throughout stretch, especially toward headwaters.		
P-126	0453	Box culvert under drive to private residence (3'H x 9'W)			
	0454	View of culvert from downstream. Note bedrock in channel. Bedrock channel throughout most of stream segment above and below P-126.			

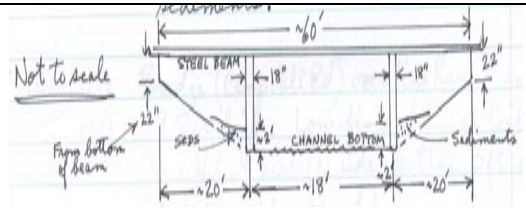
P-127	0455 0456	Detention basin (120'L x 60' W). N inlet 30" diam., E inlet 18" diam. W-outflow structure – Low-flow 8" diam. Intermediate 6" square (46"-52" above bottom), overflow 69" above bottom. Spillway 9'-10' above bottom.	Good candidate for retrofit to extended detention/infiltration.		
P-127A		Large houses on small lots.	Little to be done except to encourage to install rain gardens, or other small BMP's.		
P-128	0457 0458	Detention basin at nursing home on Susquehanna Road. Already filling with sediment. Need pretreatment and periodic dredging to maintain capacity. Abundant algae. Standing water ~6" to 12" deep. If there is a low flow outlet, it must already be blocked. Overflow ~3 to 3.5ft. above bottom. Outfall 18" diam. directly into stream channel immediately upstream from P-129.			
P-129	0459 0460	46 inch-diam., inlet to culvert under Susquehanna Rd. Top of berm (sidewalk immed to west of it, along Susq) 10' to 12' above top of inlet pipe			
P-129A-H		Drop inlets along piped tributary			
P-130	0461	Outfall of piped tributary from P- 129. More than half full of sediment. (5 ft diam.). Open channel/ditch to P-131			
P-131	0462	Culvert under Virginia Drive. 6'W x 3.5 H' corrugated oval steel pipe. Bottom filled with ~ 6"mud.			
P-131A	0463	Outfall of culvert from P-131 into Pine Run.			

	1254 1256	Culvert (P-131A) from new Road to P-135.			
P-132		Large shallow detention basin NE of intersection of Virginia Drive and Office Center drive.			
P-132A	0464	Inlet from N			
P-132B	0465	Outlet structure low flow 15" diam., outflow 38 ' above bottom	Retrofit to wetland with emergent vegetation so as to discourage geese and improve water quality.		
	0467	Note geese and standing water			
	0468	View E toward intersection of Susquehanna and Virginia			
P-133		Box culvert from P-104B under Tpk 6ftW x4ftH			
	1248	Perennial flow			
	1249	Immediately downstream from culvert. Badly cut banks, deeply incised. Bedrock in channel, so any additional enlargement of channel cross-section will be by widening.			
P-134	1251	View of channel upstream			
	1252	Confluence of tributary with Pine Run			
P-135	1250	Parcel between P-133 and Tpk slip ramps under development			
P-135A		New Road entrance to P-135			
	1253	Road is over 3 corrugated culverts stacked. Each 4 ft diam.			
	1255	Road across Virginia Drive			
P-136	1257	Box culvert under tpk slip ramp ~6 ft H x 20 ft W.			

P-137	1277	Bridge to LA Fitness from Virginia Drive ~27'W x ~8'H			
P-138		Detention Basin. Top of outflow structure 7ft above bottom. Already extended detention. (low flow at bottom 6 in- diam.)			
P-138A		3 ft diam. outfall from P-138			
P-139	1280	Twin 40" diam. concrete culverts under entry drive to Operating Engineers site			
	1279	Downstream from top of culvert			
P-140		Old stone arch bridge/culvert (road abandoned) ~4.5ft W			
P-141A	1282	Pedestrian bridge over Pine Run			
P-141B	1283	Box culvert carrying Susquehanna Road over Pine Run (20'W x 7'H)			
P-142	1258	Site clearing. Apparently under development. There are jurisdictional wetlands throughout parcel			
P-143	1260 1261	Wetpond (probably water table). Good habitat. (many spring peepers, mallards).	If not in floodplain, can perhaps enhance storage by raising freeboard a few feet.		
P-144	1259	Detention basin E of GMAC. Wet bottom. Outlet structure to right. Overflow at 82 inches above bottom. No low flow outlet visible; if there is one, it is blocked by sediments. Obviously intersecting water table; Poorly maintained.	Good candidate for retrofit to wet pond/extended detention. Excavate 1 or 2 feet to create permanent pool and vegetate.		
P-144A	1262	16 inch – diam. drain, but no apparent outfall in N side of P-144 basin.			
P-145		In parking lot uphill N of GMAC.			
	1212 1213 1214 1215	Views N- westward to N- eastward			

	1216 1217 1218 1219	Views Southeastward to south to sw			
P-145A	1220	Breakthrough of groundwater seep in parking lot 4th row of parking spaces N of rail along crest of embankment.			
P-145B	1221	Breakthrough of groundwater seep in parking lot in 5th row of spaces N of rail along crest of bank.			
P-146	1225	Heliport NW of GMAC bldg. Note groundwater breakthrough in foreground.			
P-146A	1226	S end of heliport/parking lot. Again note groundwater outflow.			
	1227 1228 1229	More views of groundwater outflow.			
P-146B	1230	Parking lot W of GMAC property. Note broken pavement, because of groundwater seepage and freeze/thaw damage.			
			Because of obvious groundwater discharge zones at P-145A, B and P-146A, B, must put aside ideas of infiltration facilities in these areas.		
P-146C	1231	Ponded water by outbuilding.			
P-147	1232 1233 1234 1235	Clearly jurisdictional wetlands, but many survey flags, which may indicate plans for development.	If so, should have wetlands delineated and preserved.		
P-148	1246 1247	Twin culverts under E driveway to ADP Left (N) ~ 15'W x 8'H Right (S) ~ 15'W x 8'H, but badly blocked by sediments so only high flows allowed.	These blocked culverts and those downstream at P-150 should be cleared and dredged.		

P-148A	1245	Bedrock noted in channel bottom			
P-149	1244	Outfall of storm sewers from E side of GMAC site. ~ 4 ft diam.			
P-149A	1243	Bedrock in N bank.			
P-150	1241 1242	Twin corrugated steel Culverts under W driveway to ADP, Each ~ 15'W x 8'H Left (N) flowing Right (S) bottom filled with Sediments, so can only pass high flows.	Should be dredged and cleared so can pass more of high flows.		
P-151	1236	Box culvert under Virginia Drive ~ 40 ft W x 5 ft H.			
P-151A	1238	Outfall of storm sewers from W side of GMAC site. ~ 5.5 ft diam.			
P-151B	1237	Outfall of 48 inch diam. steel pipe. Presumed drain from Turnpike.			
	1239	View upstream along Pine Run from P-151 culvert			
	1240	View toward Turnpike along small tributary drainage			
P-152	1276	4 ft diam. culvert from under Turnpike from P-106. Perennial/intermittent flow			

P-153	1263	Bridge over Pine Run @ entrance to Verizon.			
	1264	60 ft span with 2 – 18 inch piers. Largely filled with sediments.			
					
P-153A		~ 2 ft diam. outfall of storm sewer from east side of Verizon site			
P-153B	1265	~ 2 ft diam. outfall of storm sewer from west side of Verizon site			
	1266	Banks relatively stable through this stretch. Some past undercutting & widening.			
	1267 1269	Much agradation. Gravel and sand bars			
P-153C	1268	~ 16 in diam. outfall (culvert or road drain) perennial or intermittent flow			
P-154	1270 1271	Box culvert under Virginia Drive ~ 33 ft W x 8 ft H Gravel and sand bars under culvert.			
P-155	1274	Box culvert outfall from under Turnpike from P-117. 8 ft W x 5 ft H. Perennial flow.			
	1275	View eastward along drainage ditch along N side of Turnpike. Perennial flow			
P-155A		Box culvert under access road (8 ft W x 5 ft H)			

P-156	1272 1273	Bridge (Camp Hill Rd) over Pine Run. Center pier 9.5 ft high. Low flow channel to left(S) (To right of pier (N side) bottom 3 ft covered by sand bar in foreground.) Left side (S.) 12.5 ft from bottom of wall to bottom of steel beams supporting road deck.			
	1284	Upstream through bridge. ~ 4 to 5 ft. of sediments in left (North) span			
P-156A	1285	NE corner of parking lot (K&S = Kulick & Soffa Entire site, building & parking lots, drained directly to Pine Run			
P-156B	1286	Debris dam in creek caused by fallen tree			
P-157A	1287	Confluence of Rapp Run w/ Pine Run			
	1296	Small weir in Pine Run approx 20 ft. downstream from confluence of Rapp & Pine			
P-157B	1292	Just above (N) of confluence of ditch from NW w/ Pine Run			
	1293	Reeds in wetland at edge of parking lot (and partly on it)			
	1294 1295	Confluence of ditch and Pine Run			
P-158	1291	Outfall of storm sewer ~ 6 ft diameter (half-filled with sediment) from beneath Virginia Dr. Perennial flow.			
P-159	1298	Approx. 4 ft wide inlet to storm sewer that drains to P-158. May daylight between this point and Virginia Dr., but is fenced off between properties.)	May be opportunities along course of drainage to daylight and install small BMPs.		
P-160	1312	Pond in front of office building. No extra storage capacity.			
P-161	1299 1300	Detention basin.	Good opportunity for retrofit across from Ft. Washington Post Office. Enlarge and make extended detention/infiltration.		

P-161A	1311	Outlet from P-161 basin ~ 3 ft diam.			
P-161B	1301 1302	Outfall from pond @ P-162 from under Highland Ave. ~ 4 ft diam. On left is ~ 4 ft diam. outfall from Highland Ave. street drains. Perennial flow. Bedrock in channel bottom			
P-162	1304 1305	Decorative pond. No freeboard. No additional storage			
P-162A	1306	Inlet pipe to pond			
P-162B	1307	Surface inlet			
P-163	1308	Detention basin on NE side of Ft. Washington Post Office. Several inches of standing water.			
	1309	Overflow structure ~ 4 ft high, with ~ 1 ft square low flow outlet.	Make extended detention.		
P-164	1310	Pond on NE side of Highland Ave. No extra freeboard. Piped under Highland Ave. to P-163			
P-165	1288 1289	Bridge over Pine Run. Span approx 54 ft W x 9 ft H (maximum height above channel bottom. Downstream left (S) side partly blocked by gravel and sand deposits			
P-165A	1290	Outfall of storm sewer ~ 2 ft diam.			
P-166	1317 1318	Turnpike Ramp Bridge			
P-167	1314	One of five inlets along NE edge of URS parking lot			
P-168	1313	28 inch diam. inlet to storm sewer along E side of Route 309 retaining wall.			

Table 4: Bodenstein Run, Potential Stormwater Improvements			
.D.	Picture	Description	Recommendation
B-1		Entire area NE of Wallace Dr. is storm sewered	
B-1A		Drop inlets @ corner Stevens Dr. & Wallace Dr.	
B-1B		Perennial flow noted in drop inlets along/beneath Stevens Dr.	
B-2A		Culvert under Highland Ave. 44 in. W x 33 in. H Corrugated steel. Perennial flow from outfall at B-2B	
B-2B		Outfall of storm sewers from B-1, B-1A, B-1B	
B-2C		Small landscape pond. Perennial flow out. Inlet not visible	
B-3			Potential location of dry dam. Good opportunity with little impact on adjacent properties. However, it is on private property.
B-4		Twin corrugated steel oval culverts under Hartranft Ave. 45 in. W x 32 in H. Debris partly blocking both culverts.	
B-5		Extended detention basin. Standing water with emergent vegetation. Slopes evidencing some erosion/gullying, but much volunteer vegetation. (Constructed as part of Rte 309 expansion.) Some multiflora rose and other invasives already apparent. Intermediate outflow ~ 3.5 ft high (~ 9 in diam) Overflow ~5 ft above bottom Emergency spillway ~ 8 ft above bottom Berm height ~ 10 ft	
B-5A		Outlet from basin 42 – inch diam. Perennial flow (groundwater discharge from basin)	
B-5B		Perennial flow from NE of Highland to box culvert under Rte 309 (6 ft W x 6 ft H square concrete)	
B-6A	1319	Downstream outlet of culvert under Rte 309 from B-5B. Perennial flow	
B-6B	1320	Outfall of 2-ft. diam. storm sewer (presumably from roadway of 309)	
B-6C	1321	Twin corrugated steel oval culverts under driveway to 1206 & 1207 Prospect Ave. 6 ft W x 4 ft H	
	1322	View upstream south of B-6	
B-7	1323	Corrugated steel culvert under Spring Ave. 64 inch diam.	
B-7A	1324	Outfall of stormsewer from Spring Ave. Approx 3 ft diam.	
B-8	1325	Broad floodplain	
B-8A			Possible opportunity for check dam

B-8B	1326, 1327	Encroachment in floodplain and construction of channel by grading and filling associated with new house.	
B-9A	1328	Stream emerges alongside Commerce Drive and is channelized all the way to Pennsylvania Ave.	
B-9B	1329	Old sewer pipe exposed in bed of channelized stream	
B-10	1330, 1331, 1332	Twin corrugated steel oval culverts under Commerce Dr. ~ 6 ft W x ~ 40 inch H. ~ ¼ filled with sediments	
B-10A	1333	Drop inlets at Penn. Ave. & Commerce Dr.	
B-11	1334	Outfall of Bodenstein Run. Piped from intersection of Pennsylvania Ave. & Commerce Dr. Perennial flow.	
B-12	1335, 1336	Railroad Bridge over Sandy Run.	
	1337	Upper concrete blocks, which support uprights of RR power lines are 4 ft high.)	

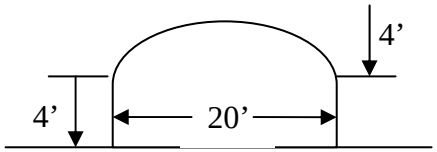
Table 5: Sandy Run, Potential Stormwater Improvements			
I.D.	Picture	Description	Recommendation
S-1		Headwaters of Sandy Run presumed entirely sewered upgradient from inlet boxes at intersection of E. Moreland Road & Cleveland Ave.	
S-2	031	Piped beneath Cleveland Ave to outfall at S-2	Many opportunities for infiltration trenches, bioswales and reestablishment of riparian vegetation on both sides of channel from S-2 to S-7. Opportunities for small check dams in channel.
	030	Severe channel erosion. Ephemeral or intermittent flow	
	029	Ditch from south side of channel.	
S-3	028	Bridge over corrugated oval culvert ~ 4'W x 3'H	
S-4		Inlet of North pipe outfall @ S-5 Open channel from S-2 to S-4	
S-5	025	Outfalls. Left (N) oval 68"W x 44"H	
	026, 027	Right (S) 2' diam.	
S-6	023, 024	Culvert (4' diam.) beneath small stone bridge at end of Silver Ave.	
S-7	022	Box culvert under Cleveland Ave. at Roberta Ave. 5'H x 5'W. Open ditch from S-5 to S-7. Stream piped from S-7 to S-8	
S-8	021	Outfall in box culvert under west side of Old Welsh Rd. Box 6'W. Timber walls of channel ~ 36"H.	
S-9	020	Sandy Run at Tucker Ave. 14" diam. outfall from storm sewer	
S-10	019	Box culvert under Rte. 611 (East side) ~6ft W X 4 ft H. Top of box 2 ft. thick.	
S-11		Piped from S-10 to S-11	
	016	Oval concrete outfall west side of Ferndale Ave. 8 ft. wide. Walls on N side of channel 7'-8'H.	
	017	Outfall from Ferndale Ave. sewers on south side of channel 20 in. diam.	
	018	View downstream from Ferndale Ave. outfall	
S-12	0587	Masonry culvert under Rockwell Road ~ 10.5 ft W x 6 ft H Arch	
	0588	(Alice ~ 5' 4" tall ~ 6 ft in front of arch) Upstream from culvert	
S-13	0593	View upstream from RR culvert. Channel ~ 10-15 ft deep from culvert to Rockwell Rd.	
	0589	RR culvert from Rockwell Rd.	

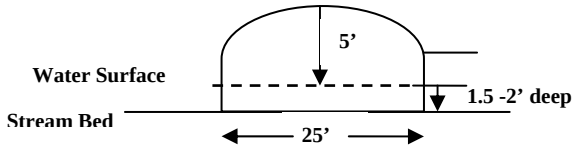
	0590	Close-up of RR culvert. 7 ft H x 8 ft W.	
	0591	Inside culvert. Smooth concrete walls & floor	
	0592	Right (north) outfall – concrete pipe 5 ft diam. Rectangular southern tunnel continues ~ 15 ft, then turns sharply west (right) and goes into another 5 ft diam. concrete pipe. The two 5 ft diam. pipes then come next to each other just before they outfall into rectangular concrete basin under grates shown in photo 0595.	
S-14	0595	Grates over approximately 20 ft long by ~ 12 ft wide, 8-10 ft deep basin, which contains the twin 5 – ft. diam. pipes from under RR embankment Basin fed by two 5 ft pipes, then goes into one 5 ft diam. pipe, which goes out to beneath intersection of Washington Ave & Hamilton Ave, and thence southwestward under Washington Ave. (Could not determine where single pipe joined by second, but probably from under Prospect Ave.)	
S-14A	0594	Drop inlet in lawn (backyard) of houses on Washington Ave, northeast of Hamilton Ave. Approx. 6 inch diam. pipe plus surface drainage into 3 ft diam. pipe out to storm sewer pipe under Washington Ave. NE of Hamilton.	
S-15	0584, 0586	View downstream from above outfalls	
	0583	Twin 5-ft diam. concrete outfalls carrying main stem of Sandy Run. Perennial flow.	
	0585	Gabion walls of channel approx 30 in. to 34 in. high. Stones in gabions up to 9 inch blocks. Channel ~ 20 ft wide, concrete bottom.	
S-16		From Evergreen Manor Park & Willow Hill School (1700 Coolidge Ave, Abington) to Woodland Rd. in Abington.	Opportunities for extended detention within park and significant infiltration beneath school properties. Entire area beneath playing fields could be infiltration galleries or beds.
	0552	42 in- diam. outfall from under playing fields of Willow Hill Elementary School. Perennial flow.	
S-17	0551	Head of ravine. Severe bank erosion and down-cutting of channel. Typical view of channel, choked with trash, debris, shopping cart, etc. Forest throughout Evergreen Manor Park in poor-to very poor condition. Many invasives. Poorly maintained. Found no formal trails.	
S-18	0550	Inlet to pipe culvert under Phipps Ave. from Evergreen Manor Park. 4-ft. diam. pipe into 5.5 ft W x 3.5 ft H oval concrete pipe. Bottom of channel/pipe ~ 6 ft below street grade. Flow perennial.	Good opportunity for constructed wetland.
S-19	0553	Outfall of oval pipe from S-18.	
S-20	0554	Open channel from S-19 to S-21, but concrete-lined from S-20 to S-21. Channel varies from 3.5 to 4 ft W x 3 to 4 ft deep	
S-21		Approx. end of hardened channel.	

S-22	0555	Twin 42 inch diam. pipes. Right (west) ~ 9 inches higher than left (east) Note – storm sewers under centerlines of Patane Ave. and Lindbergh Ave. Large laterals reach Lindbergh storm sewer ~ 100 ft. south of intersection with Pershing Ave. Sewer from Patane Ave. curves southwestward under St. Charles Place, then joins the sewer under Lindbergh as shown.	
S-23	0556	Box culvert under Woodland Road. 12 ft W x 5 ft H. Road surface approx. 1.5 ft. above roof of box.	
	0557	Outfall of 5- ft diam. pipe. Presumed to be outfall of sewer from under Lindbergh Ave. via Woodland. (Car in photo is on Woodland Ave.) Masonry courses are 18 inches in height (for scale of channel walls)	
S-24	0558	Box culvert/bridge. 12 ft W x 54 inches H. 29 inch curb & parapet above roof of box. Perennial flow.	Minor opportunities upstream for enhanced storage.
S-25		In Ardsley Burial park (a.k.a. Hillside Cemetery)	
	0528	8 to 10 ft. deep ravine at head of tributary	
	0529	No outfall visible at head of ravine, but is presumed to be there. Mat of roots and debris ~ 10 ft in lateral extent prevents closer examination.	Should provide energy dissipation, channel stabilization, and vegetation.
S-26	0530	Ephemeral wetland.	Opportunity for enhanced storage
S-27	0531	Shallow, rocky channel. Approx. 8 ft W x 1 to 2 ft deep. Dry. (Ephemeral)	
S-28	0532	Channel ~ 8 ft W x 4.5 ft deep. Rocky bed (but not bedrock). Still dry.	
S-29	0533	Plunge pool, clay bottom. No standing water, but moist clay at bottom. Channel ~ 5 ft W at top, 8 ft deep.	
S-30	0534		From approx. S-28 to S-30 many opportunities for check dams.
S-31	0535	Large detention basin/ wet pond. Constructed since Aero2 flew watershed. Already filling with sediment because of rapid erosion of channel from location S-25 all the way to pond.	
	0536	Outlet and Spillway of basin. Low flow outlet is 3 ft. diameter concrete pipe. No outflow noted at time of visit (9/4/07). Level of water just below bottom of pipe. Spillway approx 10 ft above bottom of outlet. Depth of standing water estimated at 1 to 2 feet (too turbid to see more than a few feet offshore).	Major retrofit opportunity. Should consider making extended detention and expanding storage area southward to S-30.
S-31A	0537	Tributary gully from SW.	
S-32	0538	Spillway, outfall, and gabion – walled catch basin	
	0539	Catch basin ~ 5 – 6 feet deep from top of gabion	
	0540	Channelized and rip-rapped all the way from outlet of catch basin to S-33.	
S-33	0541, 0542	5 ft. diam. concrete pipes. Right hand one (east), ~ 9 inches higher than left (west)	

S-33A	0543	Ditch entering from SW approx. 6 ft W	
S-34	0544	Drop inlet grate in lawn S of Meyer Ave. Street inlet boxes at both curbs of Meyer Ave. Pipes ~ 10-12 ft below street grade.	
S-35	0545	Twin 5 ft diam. outfalls.	
	0546	Masonry walls of channel 6 to 6.5 ft H	
S-36	0547	Confluence with main stem of Sandy Run. No flow in tributary channel, only backwater from main stem. Mouth of channel approx 8 to 10 ft W.	
S-36A	0548	Low weir in channel of main stem	
	0549	10 to 12 ft downstream from confluence. Two steps in weir – 1st (Upstream) ~ 10" H - 2nd (Downstream) ~ 12" H	
S-37	0527	View NW from Harrison Ave to drop inlet on Monroe Ave.	
S-38	0526	View NW from inlet on Monroe Ave.	
S-39	0525	Outfall into concrete channel from beneath Maple Ave. 6 ft W x 4 ft H. Piped from SE of Jackson Ave (SE of S-37) to here.	
S-39A		Concrete open channel from Maple Ave. to Cricket Ave. (6.5 ft W x 3 ft deep)	
S-40		Culvert under Cricket Ave 6 ft W x 4 ft H.	
S-41	0522	Concrete bottom channel from Central Ave. north to Cricket Ave. (~10 ft. W x 30" deep)	
	0523	Inlet to Storm sewer under Central Ave.	
	0524	Arch 6 ft W x 50 inches H 22-inch diam. pipe enters from left (south) (from uphill under Central Ave.) Inside arch – storm sewer 75 inch W x 47 inch H oval concrete pipe northeastward under Central Ave to intersection with Woodrow Ave., thence due north to Garfield Ave, then northwestward to S-42 (outfall NW of Penn Ave.)	
S-42	0521	Outfall NW of Penn Ave. 6 ft W x 4.5 ft H Masonry, concrete, and wood retaining walls	
S-43	0518, 0519, 0520	Open channel ~ 6 ft W, bears away to SE, then S, with occasional wood retaining wall. Wood retaining wall ~ 5' H on one side of channel between Spears Ave. and Avenue G.	
S-44	0517	New outfall from under Spear Ave. 22-inch. diam. plastic pipe.	
S-45	0516	Culvert under Ave. H 60" W x 40" H.	
S-46	0515	Culvert under Ave. J 60" W x 38" H.	
S-47	0512	Outfall of pipe from S-46 60" W x 44" H. Outfall (looking S) of stream flowing from S-46 (N of Spear, below Ave J and North Hills Ave).	

S-48	0513, 0514	Inlet (60” W x 40” H) of channelized stream from S-47 enters storm sewer under North Hills Ave.	
S-49	0511	East side of North Hills Ave. South side of asphalt parking lot of Queen of Peace Catholic School. Shallow ditch carrying surface drainage from SE of school.	
S-50	0505, 0506	Inlets at SE side of intersection of Fitzwatertown Rd & North Hills Ave.	
S-51	0507	View S (upstream) at outfall from box culvert under Fitzwatertown Rd. (12 ft W x 4 ft H) carries outflow from twin oval pipes each ~4 ft W x 3 ft H from below grates at S-50	
	0508	Inside culvert S-51 showing outfalls of pipes from S-50	
	0509	2 ft diam. outfall (one on each side of box carrying road drainage from inlets E & W along Fitzwatertown Rd	
S-52	1400	(@ LuLu Country Club) 2-ft square culvert under North Hills Avenue into 2-ft diam. pipe directly to pond at S-53	
	1401	Brown grass shows path of pipe	
S-53	1404	Pond (approx. 7000 sq. ft. area).	Moderate retrofit potential. Could raise freeboard by 3 ft., which would result in ~ ½ ac-ft. of additional retention.
	1402	Inlet to pond ~ 2 ft diam.	
	1405	Outlet from pond 8” diam.	
S-54	1406	Large debris pile in south quadrant of intersection of Fitzwatertown Road and Jenkintown Road. Inlet to storm sewer under Limekiln Pike hidden by debris. Debris pile probably acts as a sort of permeable dam. Drop inlets at corners of intersection.	Good potential location for large retention facility for much of drainage from golf course east of Limekiln Pike and upgradient residential areas SE of N. Hills Ave. (>40 acres)
S-54A		Drop inlet with one ~ 12 inch diam. outfall from under debris pile (S-54) and one ~ 12 in. diam. from under Limekiln Pike. Approx. 18 in. diam. outflow pipe northward under Limekiln to S-55.	
S-54B		Drop inlet on NE side of Jenkintown Rd. ~ 20” diam. pipe under road from S-54.	
S-55	1407	30-inch diam. outfall of storm sewer under Limekiln Pike from S-54.	

	1408	Bridge/culvert over Sandy Run  **Stream Bed**	
S-56	1398	Box culvert under Twining Rd. Length of span ~ 42 ft Angle to flow ~ 30°	
	1399	View upstream from culvert	
S-57		Approx. high water mark from tropical storm Floyd. Tennis court to SW was under 4 ft of water. HW was at elevation of 204 ft.	
S-57A		Box culvert under access road to Sandy Run Middle School & Library 30’W~8’H above stream bed	
S-57B		Manufacturer’s Golf and Country Club (MGCC) green 17 was lowered ~ 2-3 ft & floodplain widened in 2007.	
S-58	1393, 1394, 1395	New small detention basin. 2ft diam. outlet. ~ 3-4 ft dip in top of berm. Receives surface drainage from south (along NW edge of driving range) and NE (from golf course).	Good opportunity for retrofit to extended detention. Can be enlarged upgradient. (Must be careful to prevent overtopping, to protect residences immediately down gradient.)
S-59	1396, 1397	View SE (up fairway of hole 17). Brown strip of dead grass over piped drainage to tee-17. Drop inlet to drain, which then goes under Twining Road to S-59A and thence by pipe to S-60 and on to outfall beneath stone bridge at S-61.	
S-59A		Perennial flow at bottom of drop inlet at SE corner of curve in Twining Road.	
S-59B		Abandoned quarry	Major opportunity for large retention facilities in floors of quarries at either S-59B or S-60. Could divert flows from storm sewers serving residential areas and golf course areas SW of S-58 and S-59.
S-60	1447	Abandoned quarry. Another of several abandoned quarries on MG & CC property	
	1448	View northward. Shallow drop inlets on either side of golf cart path, which receive surface flow from path and quarry. Both dry at time of visit.	
S-60A	1449	Drop inlet beneath fairway.	

S-61	1445	Stone arch bridge  	
	1450	Outfall in base of bridge of storm sewer from S-59 and S-60	
	1446	View upstream from bridge. Masonry channel walls up to 7 ft high	
S-62	1436	Irrigation pond.	Freeboard can be raised by 2-3 ft., providing as much as 3 ac-ft of additional storage for smaller, higher frequency events.
S-63	1442	Detention basin.	
	1443	Outlet of basin 4 ft high. Much debris, low-flow outlet ~ 6" H x 9" W is completely blocked by debris. 18 in-diam. inlet.	Effectively is extended detention, but should be retrofitted to make it so, and maintained properly.
S-64	1437	Dam (old mill pond?). If fails, stream gradient from this point upstream will be steepened, leading to accelerated bank erosion throughout stretch from S-61 to S-64.	Should be repaired and maintained.
	1438, 1439	Views upstream from S-64.	Banks can be lowered and floodplain widened throughout entire stretch from S-61 to S-64, as was done at S-57B (green 17). Would provide more floodplain storage and help to restore natural regimen of stream.
S-64A	1440	Land clearing. Assumed for residential building site.	
S-65	1416		Area N of stream, between Walnut Ave & RR presents opportunity for significant storage of higher frequency flows, but is squarely in 100-year floodplain.
S-66	1414	Box culvert under Walnut Ave. ~ 12 ft W x ~ 2 ft H above stream bed.	
	1415	Water storage basin for Sandy Run Country Club course.	
S-67	1409	Culvert under E. Valley Green Road. ~ 75 ft W span	
	1410	View southwestward along course of drain pipe.	
	1411	Outfall of pipe 3 ft diam.	

	1412	Riparian wetland between banks of stream and Walnut Ave built by Penn DOT, when rebuilt intersection and S-66 culvert.	
	1413	Outfall of drainage from intersection of East Valley Green Road & Camp Hill Road.	