
Report

Recommendation Report
for Westchester Joint Waterworks
Reservoir Dam and the
Village of Mamaroneck, NY

January 2005



Stearns & Wheeler
Companies

RECOMMENDATION REPORT
FOR WESTCHESTER JOINT WATERWORKS RESERVOIR DAM
AND THE VILLAGE OF MAMARONECK, NEW YORK

Prepared for

WESTCHESTER JOINT WATERWORKS and
THE VILLAGE OF MAMARONECK, NEW YORK

Prepared by

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January 2005

Project No. 4019010

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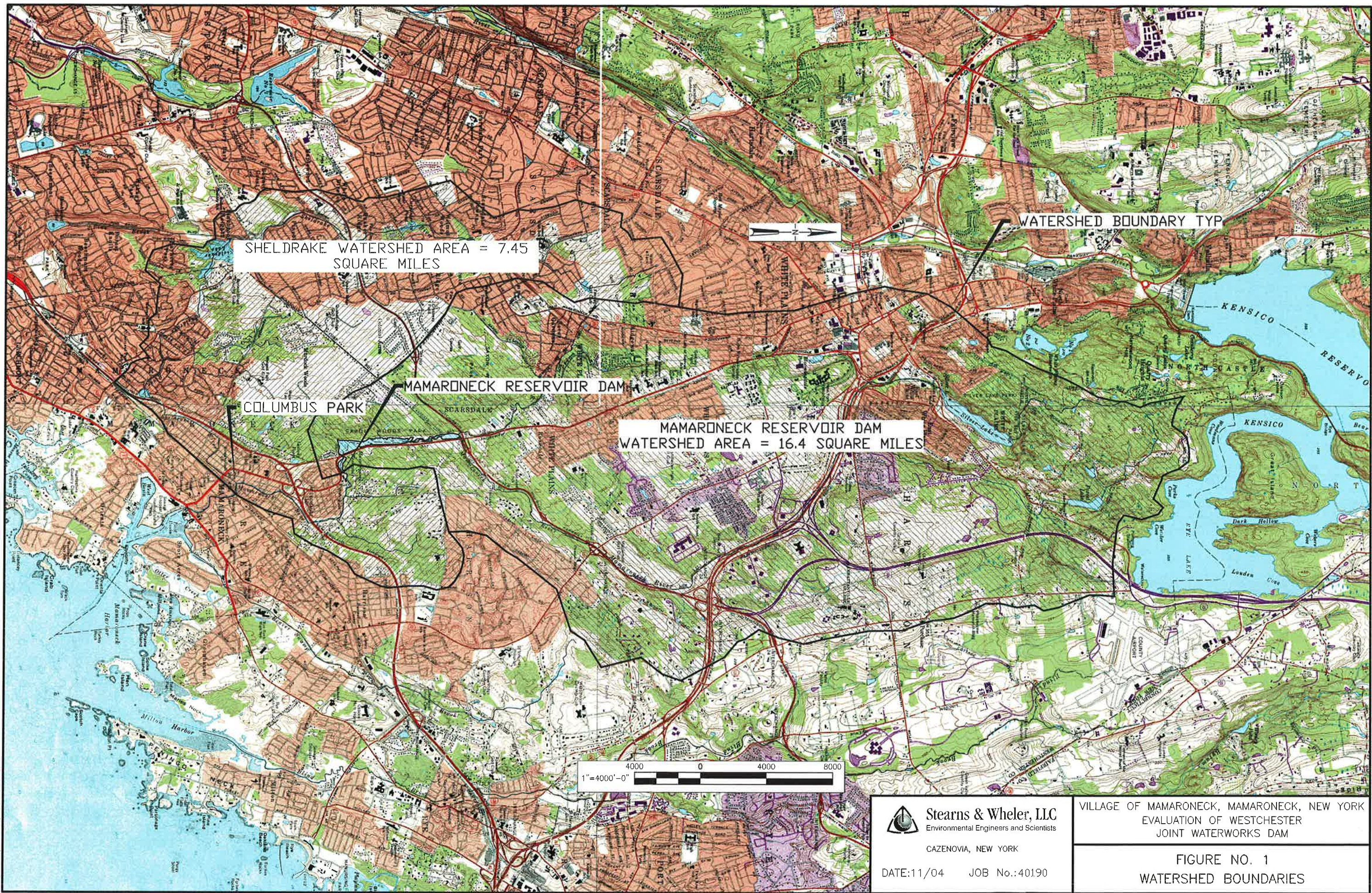
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NAME: 04/10_PSE_C12
DWG: 40190\FIGURES\40190P01.DWG



 **Stearns & Wheeler, LLC**
Environmental Engineers and Scientists
CAZENOVIA, NEW YORK
DATE: 11/04 JOB No.: 40190

VILLAGE OF MAMARONECK, MAMARONECK, NEW YORK
EVALUATION OF WESTCHESTER
JOINT WATERWORKS DAM

FIGURE NO. 1
WATERSHED BOUNDARIES

**RECOMMENDATION REPORT
FOR WESTCHESTER JOINT WATERWORKS RESERVOIR DAM
AND THE VILLAGE OF MAMARONECK, NEW YORK**

SECTION 1 - INTRODUCTION

Available records indicate that the Mamaroneck River Dam, as it was called, was constructed around 1900. The original dam was constructed of earth, rock, and timbers for the purpose of water supply. About 1930, the dam was replaced with a concrete structure. Additional ancillary facilities were constructed at that time which consisted of a pump house, an intake structure, and a filter house. The facility was utilized for water supply until the mid-1970s, at which time the water supply facilities were abandoned or converted to other uses and the dam was left in place to control runoff. The dam is classified as C-High Hazard due to the number of homes located downstream of the dam.

At the present time, the Westchester Joint Water Works (WJWW) owns the reservoir dam and the Village of Mamaroneck is under contract to maintain the dam. Based on available information, the reservoir appears to operate as a flow control structure during spring thaw or heavy rainfall events. The dam consists of a concrete buttress section (Ambursen) and an earth embankment section. The concrete dam structure is about 130 feet long and 19 feet high (elevation 40 msl), with 2.5-foot high flashboards. The dam is a hollow concrete shell with reinforced concrete buttresses. A low flow outlet is located upstream of the dam. The earth embankment section is about 55 feet long and 23 feet high (elevation 44 msl). According to previous reports, the embankment contains a concrete core wall at its downstream crest edge and the crest is covered with a 7-foot wide concrete slab.

In the late 1970s, two conduits were installed through the dam to maintain a lower normal pool elevation in the reservoir. This was done to dampen the effects of small storm events. In 2002 and 2004, Alon Dominitz of the New York State Department of Environmental Conservation (NYSDEC) performed visual inspections of the dam. Mr. Dominitz noted that: (1) the conduits were partly clogged; (2) the low level outlet drain was open and flowing; (3) the concrete of the dam showed some surficial spalling and cracking; and (4) the filter house was deteriorating, with woody vegetation established on it. In addition, Mr. Dominitz requested Maintenance and Emergency Action Plans be completed for the dam.

personnel took place to discuss the dam conditions observed and preliminarily review options for the dam repairs or decommissioning.

4. This report was prepared to discuss the use of the dam for flood control purposes and to outline the options and remedial actions for the dam. This report is a precursor to further actions of either decommissioning the dam structure or maintaining the dam structure with remedial repairs. An opinion of project costs associated with the recommended improvements is provided in the report.

SECTION 2 - BACKGROUND DATA SUMMARY

2.1 LIST OF REPORTS REVIEWED

The following reports were reviewed during our evaluation:

1. Long Island Basin, Mamaroneck Reservoir Dam, Westchester County, NY, Inventory No. N.Y. 111, Phase I Inspection Report National Dam Safety Program, July 1981 by New York District Corps of Engineers.
2. Report to Department of Planning, County of Westchester, NY, *Mamaroneck and Sheldrake River Basin Flood Management Study, Part A, Feasibility of Using Westchester Joint Water Works Reservoir for Mamaroneck River Flood Control*, August 1977, by Hazen and Sawyer.
3. Final Environmental Statement for Flood Control Project at Mamaroneck and Sheldrake Rivers Basin and the Byram River Basin, for the Town and Village of Mamaroneck, NY, by U.S. Army Engineer District, New York.
4. Flood Insurance Study, Village of Mamaroneck, NY Westchester County June 1977, by U.S. Department of Housing & Urban Development Federal Insurance Administration.
5. Westchester County, New York State, Department of Public Works, Division of Engineering, Office of the Commissioner of Public Works, Information for Bidders, General and Special Clauses, Specifications and Proposal for Modifications of Westchester Joint Water Works Dam, Village of Mamaroneck, NY, January 1978.

reduction not flood elimination.” From a cost-benefit approach, this report concluded the village would benefit from improvements to the dam in the form of control conduits constructed through the center of the dam. These conduits would allow the reservoir to be maintained at a lower level and create greater storage prior to a storm event. The report also concluded, as did the Army Corps report, that the dam could provide some control for 1-year, 2-year, and possibly 3-year storm events. However, it would not be very effective for storms of a greater magnitude.

3. Final Environmental Statement for Flood Control Project at Mamaroneck and Sheldrake Rivers Basin and the Byram River Basin, for the Town and Village of Mamaroneck, NY, by U.S. Army Engineer District, New York. January 1978.

a. This report was prepared as a “Final Environmental Statement,” examining the feasibility of the proposed improvements for the Mamaroneck, Sheldrake, and Byram River basins as prepared by the New York District Corps of Engineers. The report considers several floodprone areas below the WJWW Reservoir and generally identifies the flood control solutions using two broad categories of structural and non-structural. The non-structural measures considered such things as regulated development of the floodplain, floodproofing of structures, relocation of structures, raising of structures, and the buying out of structures. Structural measures included stream channel modifications, construction of levees and concrete channels/walls, construction of a diversion tunnel for the lower portion of the Sheldrake River, bridge replacement, and various combinations of each.

b. The report provides detailed spatial information on the Mamaroneck and Sheldrake River basins, which Stearns & Wheeler used to confirm some of the findings of our simplified model.

c. Some notable rainfall data was obtained from the report, specifically Tropical Storm Agnes (June 1972), which deposited 4.52 inches of rain into the drainage basin and caused over \$3 million in property damage. This flood completely submerged Columbus Park, 26 industrial structures, 33 commercial establishments, 5 public buildings, and 207 dwellings. This is worthy of noting because this equates to a 5-year storm event. According to available data, a storm event of this magnitude would overtop the existing reservoir dam in less than 20 hours.

c. The study provided hydrologic information that was utilized to develop a model of the drainage basin used to assess existing conditions. The model will be discussed later in this report.

5. Westchester County, New York State, Department of Public Works, Division of Engineering, Office of the Commissioner of Public Works, Information for Bidders, General and Special Clauses, Specifications and Proposal for Modifications of Westchester Joint Water Works Dam, Village of Mamaroneck, NY.

a. The drawings that accompanied this set of specifications provided dimensional information on the dam and were used in our evaluation.

SECTION 3 - HYDRAULIC ANALYSIS

3.1 APPROACH

This analysis evaluates the effectiveness of the Mamaroneck Reservoir Dam for flood control. Previous reports identified the following areas downstream of the reservoir dam as floodprone areas:

1. Along both banks of the Mamaroneck River between Ward Street and First Street.
2. Along the Mamaroneck River from First Street upstream to the New York State Thruway, flooding is confined to the west bank.
3. Along the Mamaroneck River between Chestnut Avenue and the Joint Water Works Dam, flooding is confined to the east bank.
4. Flooding occurs along both banks of the Sheldrake River upstream from the confluence with the Mamaroneck River to Fenimore Avenue.

Hydrologic conclusions could be drawn by looking at specific locations with, and without, the WJWW Reservoir Dam in place. To accomplish this, a simplified hydraulic model was developed using the HydroCad Stormwater Modeling System. The model was developed using hydraulic data from previous reports identified in Section 2. The model enabled us to project

However, due to a lack of detailed stream information, each portion of the model (Mamaroneck River to the WJWW Reservoir Dam and from WJWW Reservoir Dam to the confluence of the Sheldrake) was calibrated by adjusting the times of concentration until the volume flow rates established in the previous reports were approximately matched. For example, the discharge frequency curve from the Hazen and Sawyer report gives a 2-year peak flow of 980 cubic feet per second (cfs). Using rainfall data from U.S. National Weather Service Technical Paper 40, 3.5 inches of rainfall was input in the model, representing a 2-year, 24-hour storm. The time of concentration was then adjusted until the peak flow matched the 980 cfs reported in the Hazen and Sawyer report. The rainfall storm events were changed without adjusting the time of concentration and the results were compared to those provided in the above-mentioned report. The results varied by as much as 8 percent comparing the 1-year, 2-year, and 5-year storms. For the purposes of this analysis, an 8 percent margin of error was considered acceptable.

3.3 HYDRAULIC ANALYSIS

Using our calibrated hydraulic model (Figure 2), two different scenarios were simulated. The model was initially run to represent the existing conditions considering the confluence of the Sheldrake River as the point of interest (Figures 2 and 3). The model was then changed to remove the dam (pond node was removed in the model), but all other parameters remained the same. The dam was removed from the model to determine what effect it would have on the volume flow rate in the vicinity of Columbus Park. The results are presented in Table 1. The HydroCad modeling data are included in Appendix B.

Detailed cross-sectional information for the river was not available ~~information~~ from the previous reports. Detailed cross sections at key points along the river could better determine the flood elevations for each section. For the confluence of the Mamaroneck and Sheldrake Rivers, a trapezoidal cross section was approximated based on information in the previous report. Other cross sections could not reasonably be determined. Given known bank elevations, hydraulic calculations could be applied to approximate the elevation at which flooding would occur based on a volume flow rate (volume of liquid flowing past a section ^o of river per unit of time). With a known volume flow rate, it would be possible to determine what level of protection the dam actually provides for the rainfall event. These conditions were approximated for the confluence of the Mamaroneck and Sheldrake Rivers in this evaluation.

For example, from Table 1, a 5-year, 24-hour storm deposits 4.5 inches of rain over the watershed which generates a volume flow rate of approximately 2400 cfs. When using this data to compare the peak depth of the water at this location, the increase in depth of the water is less than 1/2 foot for a 1-year event, 1/10 foot for a 2-year event, and no change for greater events.

Based on available information (without the cross-sectional information), the percent increase in flow at the confluence is minimal for storm events beyond a 2-year, 24-hour rainfall. However, the model indicates that the removal of the dam will result in increased flows for both the 1-year, 24-hour storm (38 percent increase) and the 2-year, 24-hour storm (6 percent increase). The magnitude and impact of this increase in flow on the flooding of downstream facilities can only be determined with more detailed cross-sectional information.

There was an approximate 10-year, 24-hour event in September 2004 with a rainfall of 5.25 inches. There was flooding within Columbus Park, and surrounding homes required evacuation. Based on our analysis, this flooding could have occurred whether the dam was in place or not.

We recommend that a surveyor be procured to survey cross sections along the river at specific "trouble spots." These trouble spots should be selected based on conversations with local residents, business owners, and historical data. This information could be used to approximate the level of flooding for the 1- to 2-year storm events with the dam being decommissioned. In addition, the cross-sectional data would be used to make recommendations for modifications necessary to minimize flooding in the trouble spots for the 1- to 2-year storm events. These recommendations could form the basis for decommissioning the dam and making modifications to minimize flooding to those areas that may flood during the lesser storm events, where minimal flooding occurs at the present time.

SECTION 4 - STRUCTURAL CONSIDERATIONS

The structural stability of the existing dam structure was completed for the Phase I Inspection Report completed in July 1981. TAMS Engineers and Architects completed the stability analyses for four loading conditions in accordance with recommended Corps of Engineers guidelines. The four conditions were:

As presented in 1981, the visual observations made during the 2004 inspection did not indicate serious problems which would adversely affect the adequacy of the dam at the present time.

The NYSDEC Guidelines for Design of Dams requirements for a structural stability analysis include a seismic loading condition. Typically, the structural analysis is completed for modifications and rehabilitation of the dam. When the analysis was completed in 1981 by the Army Corp of Engineers, a seismic analysis was not required. Therefore, the stability analysis for the seismic loading condition should be completed for the dam.

SECTION 5 - CONCLUSIONS AND RECOMMENDATIONS

Based on the information reviewed and the results of our hydraulic analysis, it can be concluded that the WJWW Reservoir Dam provides limited flood control for the downstream areas up to a 3-year, 24-hour rainfall event (4 inches). There is insufficient data available to determine what effect the removal of the dam would have on floodprone areas for the lesser storm events and on the upstream portion of the reservoir. If the dam was removed, further study would be necessary to determine the amount of stream restoration. The necessity for erosion control for the downstream portion of the Mamaroneck River would need to be determined.

There have been previous recommendations for flood control along the Mamaroneck and Sheldrake Rivers. In a discussion with Alon Dominitz, NYSDEC Dam Safety Unit, the decommissioning of the dam would be completed through the permit process and may be similar to a stream restoration project if the complete dam was to be removed. There are other options of creating a breached dam that could then be classified as a low hazard dam. These potential options could be reviewed for the decommissioning of the dam.

In addition, structural and hydraulic analyses completed in 1981 identified inadequate spillway capacity and potential sliding concerns for the dam at the higher loading conditions (1/2 PMF). The remedial activities for these conditions should be analyzed to determine the need for further action and potential costs. The NYSDEC Dam Safety Unit will approve dams where it can be resolved that there are limited remedial actions that will provide adequate safety at the higher loading conditions.

Two options are outlined below: maintaining the dam structure and decommissioning the dam. For both options, there are recommended further analyses and remediation efforts. We

3. **Permit.** Permits to decommission the dam will be necessary from NYSDEC Dam Safety, ACOE, NYSDEC Environmental Assessment Process (i.e., SEQRA), Federal Environmental Assessment Process, and local regulatory agencies.

4. **Dam Removal.** Plans and specifications for the dam removal and stream restoration activities would need to be developed. The construction activities would include demolition of the existing dam and associated structures, channel modifications above the dam, removal of sediments from the existing reservoir, restoration of surrounding areas, and erosion control measures.

5. **Flood Control Measures.** In addition to the dam removal activities, there may be some flood control measures that are needed downstream that are not directly connected to the dam decommissioning.

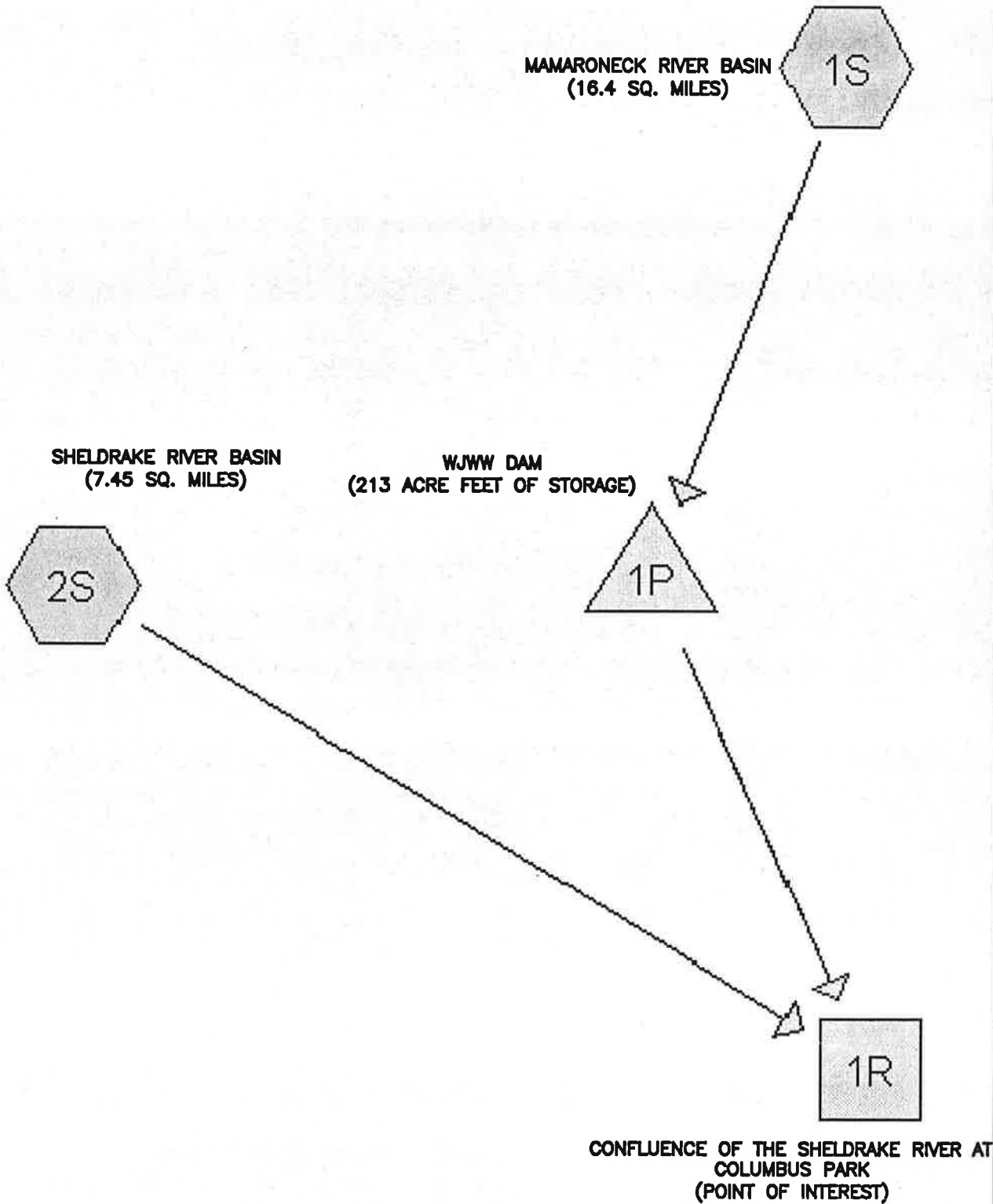
5.3 OPINION OF PROBABLE COSTS

An opinion of probable cost for these options is provided based on order of magnitude project costs. Preparation of an opinion of probable cost estimate requires making a number of assumptions as to the actual conditions that will be encountered on site, the actual construction methods that will be necessary to perform the recommended activities, and other factors over which we have no control at this time. The opinions of probable costs presented in Table 2 are broad-ranged values that correspond to the major components outlined under Options 1 and 2. A more accurate opinion of probable cost can be determined after the analyses have been completed for each option.

For the option of maintaining the dam, the necessary remediation will be dependent on the conditions under which the dam will slide, overturn, or erode to failure. The dam could remain without meeting guidelines if the NYSDEC Dam Safety Unit agrees with the recommendations from the hydraulic evaluation and the sliding and overturning evaluation. Since the remediation requirements are not known at this time, an allowance has been established for each remediation. The allowances are based on the possibility of placing rock anchors, adding mass concrete, further increasing the spillway depth by creating larger conduits, or another method of changing the dam. The allowances are meant to be order-of-magnitude costs.

For the option of decommissioning the dam, the effort required for the permitting and environmental impact assessment will be dependent on the local and public participation necessary to achieve approval of decommissioning the dam. The effort required for the dam removal plans and specifications, downstream flood control construction, and dam removal construction would be dependent on the recommendations resulting from the downstream section analysis. In addition, downstream flood controls necessary for the dam decommissioning will be dependent on public input as to flooding concerns. Dam removal construction costs will be dependent on the number of stream restoration measures necessary for the reservoir and immediate downstream reach of the Mamaroneck River. The allowances provided for decommissioning of the dam are meant to be order-of-magnitude costs.

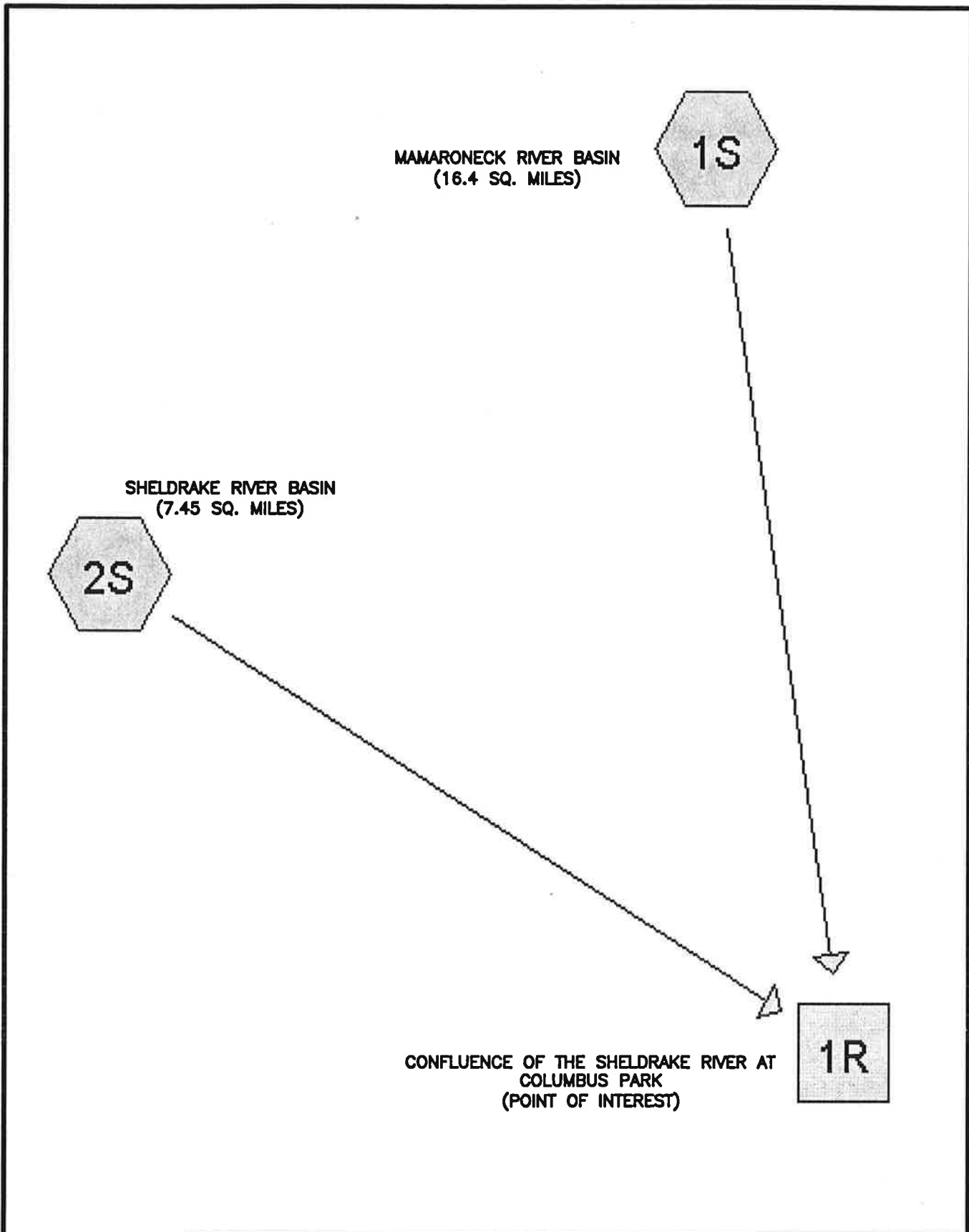
Based on a conversation with Alon Dominitz, NYSDEC Dam Safety Unit, it was discussed that there are grants available for the decommissioning of the dam. For example, there is a NYSDEC Clean Water/Clean Air Bond Act Dam Safety Project grant that could provide a maximum \$300,000 in grant money for a local participation of \$100,000. There are other grants available for fish habitat restoration. The grant money would depend on the type of project and projected costs.




NONE
 CAZ FSE 12-04
 M:\40190\FIGURES\40190F02.DWG


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 DATE: 12-04 JOB No.: 40190

TOWN OF MAMARONECK
 WESTCHESTER COUNTY, NEW YORK
 MAMARONECK RESERVOIR DAM REPORT
FIGURE NO. 2
SCHEMATIC DIAGRAM OF HYDRAULIC MODEL



NONE
 CAZ_FSE_12-04
 M:\40190\FIGURES\40190F02.DWG

 Stearns & Wheeler, LLC ENVIRONMENTAL ENGINEERS & SCIENTISTS CAZENOVIA, NEW YORK
DATE: 12-04 JOB No.: 40190

TOWN OF MAMARONECK WESTCHESTER COUNTY, NEW YORK MAMARONECK RESERVOIR DAM REPORT
FIGURE NO. 3 SCHEMATIC DIAGRAM OF HYDRAULIC MODEL

APPENDICES

APPENDIX A
PHOTOGRAPHS

APPENDIX A
PHOTOGRAPHS

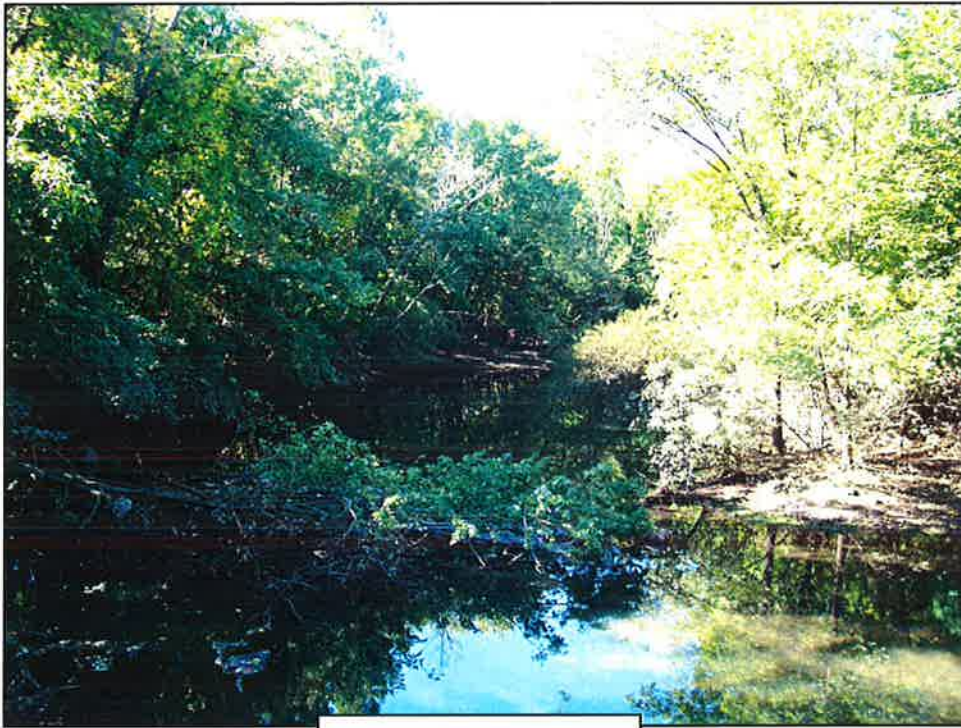


#1. Gatehouse (Filter House) on the Embankment Dam



#2. Moss on Dam – Debris on Conduit

APPENDIX A (continued)



#3. Upstream of Dam



#4. Missing Flashboard

APPENDIX A (continued)



#5. Dam with Overhanging Trees from the Embankment



#6. Downstream of Dam

APPENDIX A (continued)



#7. Gatehouse (Filter House) and Dam Joint



#8. Spalling of Concrete on Dam

APPENDIX A (continued)



#9. Looking Upstream Through Conduit



#10. Under the Downstream Slab

APPENDIX A (continued)



#11. Under the Downstream Slab at Buttress Location with Bedrock in Place

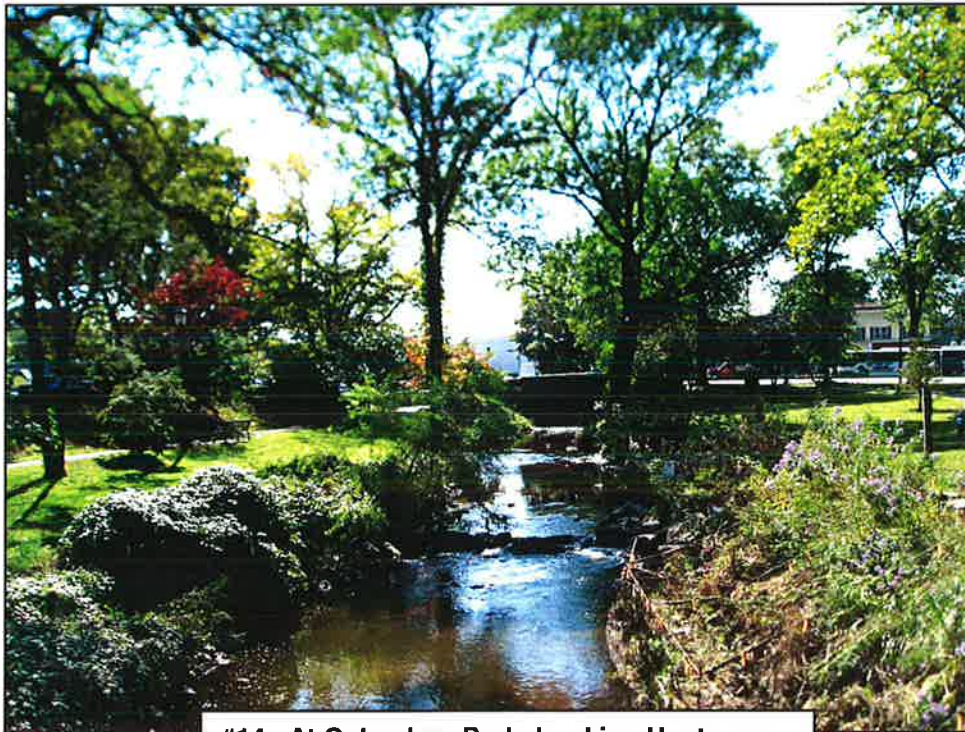


#12. Tree Roots Affected by Flowing Water

APPENDIX A (continued)



#13. Downstream Bank of Embankment

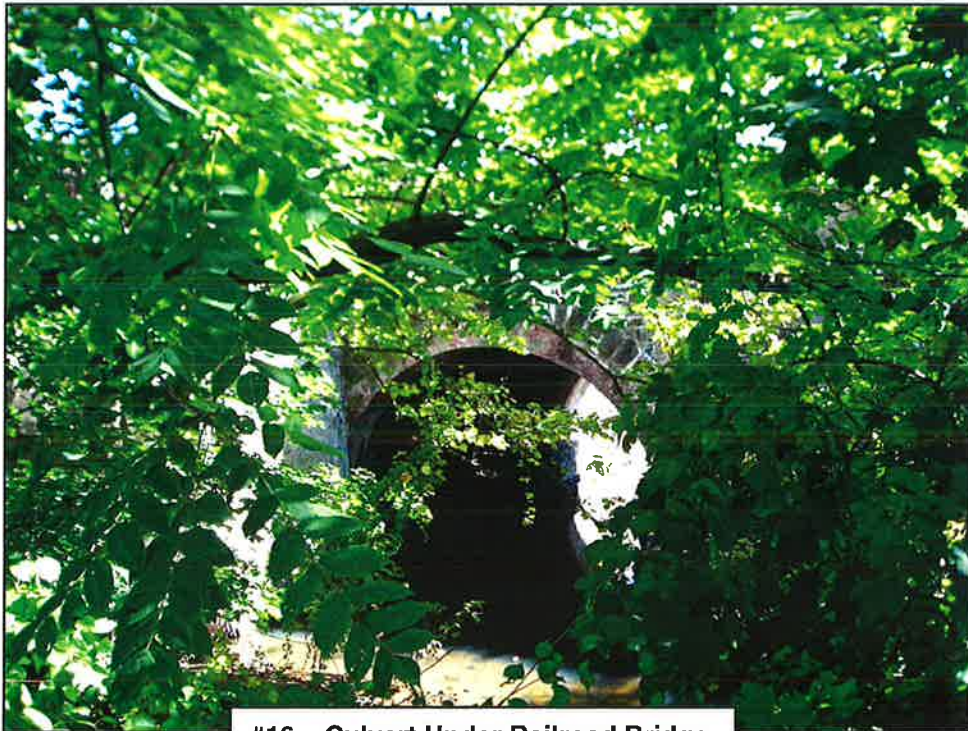


**#14. At Columbus Park, Looking Upstream
of Sheldrake River at Mamaroneck River**

APPENDIX A (continued)



**#15. Columbus Park, Looking Downstream of Mamaroneck River
Toward Confluence With Sheldrake River**



#16. Culvert Under Railroad Bridge

APPENDIX A (continued)



#17. At Columbus Park, Looking Downstream Sheldrake River Toward Mamaroneck River Confluence

APPENDIX A (continued)



#18. Mamaroneck River 90° Bends at Railway and Railroad Bridge

Mamaroneck Basin Without Dam

Type III 2-Year, 24-hr Rainfall

Prepared by Stearns & Wheeler, LLC

Page 1

HydroCAD® 6.10 s/n 002371 © 1986-2002 Applied Microcomputer Systems

12/20/2004

Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=3.50"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=1.18"
Tc=685.0 min CN=73 Runoff= 962.35 cfs 1,032.176 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=1.43"
Tc=635.0 min CN=77 Runoff= 573.67 cfs 568.384 af

Reach 1R: Rivers at Columbus Park Peak Depth= 3.06' Max Vel= 5.5 fps Inflow= 1,525.13 cfs 1,600.560 af
n=0.030 L=7,914.0' S=0.0030 '/ Capacity=3,491.92 cfs Outflow= 1,523.63 cfs 1,600.559 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 1,600.560 af Average Runoff Depth = 1.26"

Mamaroneck Basin Without Dam

Type III 2-Year, 24-hr Rainfall

Prepared by Stearns & Wheler, LLC

Page 3

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Subcatchment 2S: Sheldrake River Basin

Runoff = 573.67 cfs @ 20.52 hrs, Volume= 568.384 af, Depth= 1.43"

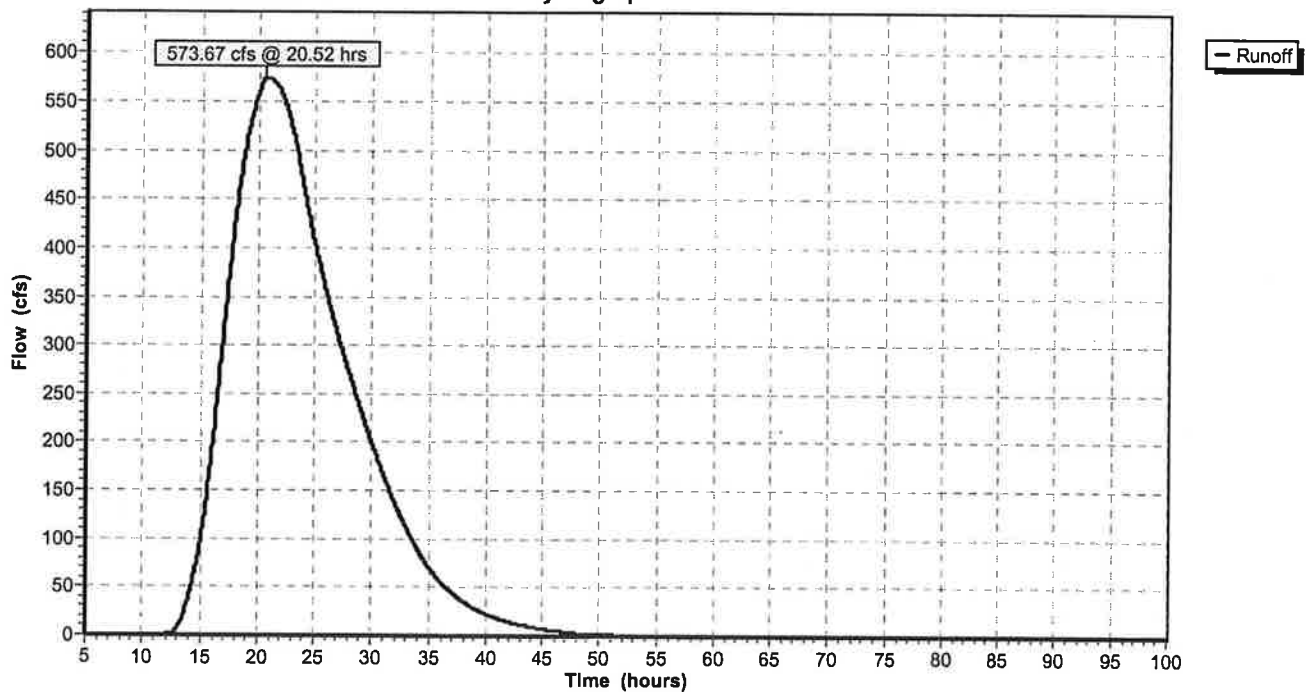
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=3.50"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Rive Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin Without Dam

Type III 5-Year, 24-hr Rainfall

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Page 1

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12/20/2004

Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=4.50"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=1.90"
Tc=685.0 min CN=73 Runoff= 1,562.15 cfs 1,658.716 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=2.21"
Tc=635.0 min CN=77 Runoff= 900.26 cfs 878.350 af

Reach 1R: Rivers at Columbus Park Peak Depth= 4.06' Max Vel= 6.5 fps Inflow= 2,450.63 cfs 2,537.066 af
n=0.030 L=7,914.0' S=0.0030 '/ Capacity=3,491.92 cfs Outflow= 2,447.40 cfs 2,537.065 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 2,537.066 af Average Runoff Depth = 1.99"

Mamaroneck Basin Without Dam

Type III 5-Year, 24-hr Rainfall

Prepared by Stearns & Wheeler, LLC

Page 3

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12/20/2004

Subcatchment 2S: Sheldrake River Basin

Runoff = 900.26 cfs @ 20.49 hrs, Volume= 878.350 af, Depth= 2.21"

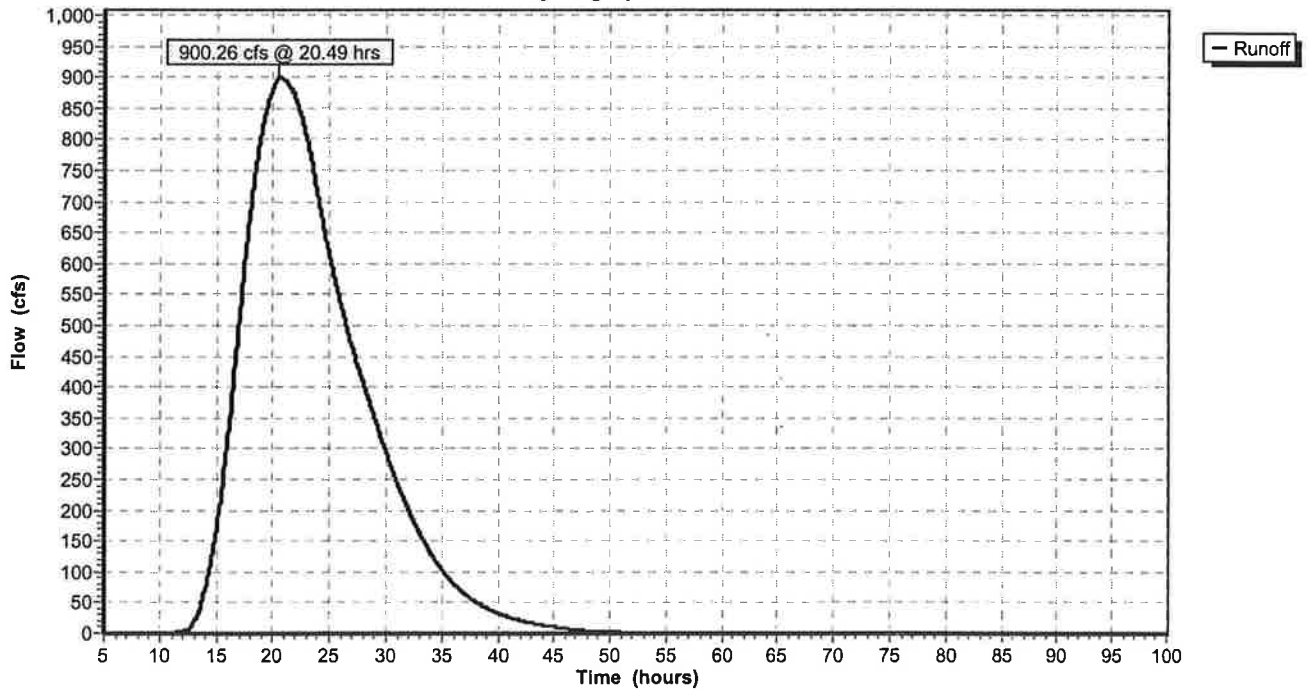
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.50"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Rive Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin Without Dam

Type III 10-Year, 24-hr Rainfall

Prepared by Stearns & Wheeler, LLC

Page 1

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12/20/2004

Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=5.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=2.28"
Tc=685.0 min CN=73 Runoff= 1,888.72 cfs 1,995.399 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=2.62"
Tc=635.0 min CN=77 Runoff= 1,073.26 cfs 1,042.201 af

Reach 1R: Rivers at Columbus Park Peak Depth= 4.52' Max Vel= 6.9 fps Inflow= 2,946.48 cfs 3,037.600 af
n=0.030 L=7,914.0' S=0.0030 '/ Capacity=3,491.92 cfs Outflow= 2,943.93 cfs 3,037.599 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 3,037.600 af Average Runoff Depth = 2.39"

Mamaroneck Basin Without Dam

Prepared by Stearns & Wheler, LLC

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Type III 10-Year, 24-hr Rainfall

Page 3

12/20/2004

Subcatchment 2S: Sheldrake River Basin

Runoff = 1,073.26 cfs @ 20.48 hrs, Volume= 1,042.201 af, Depth= 2.62"

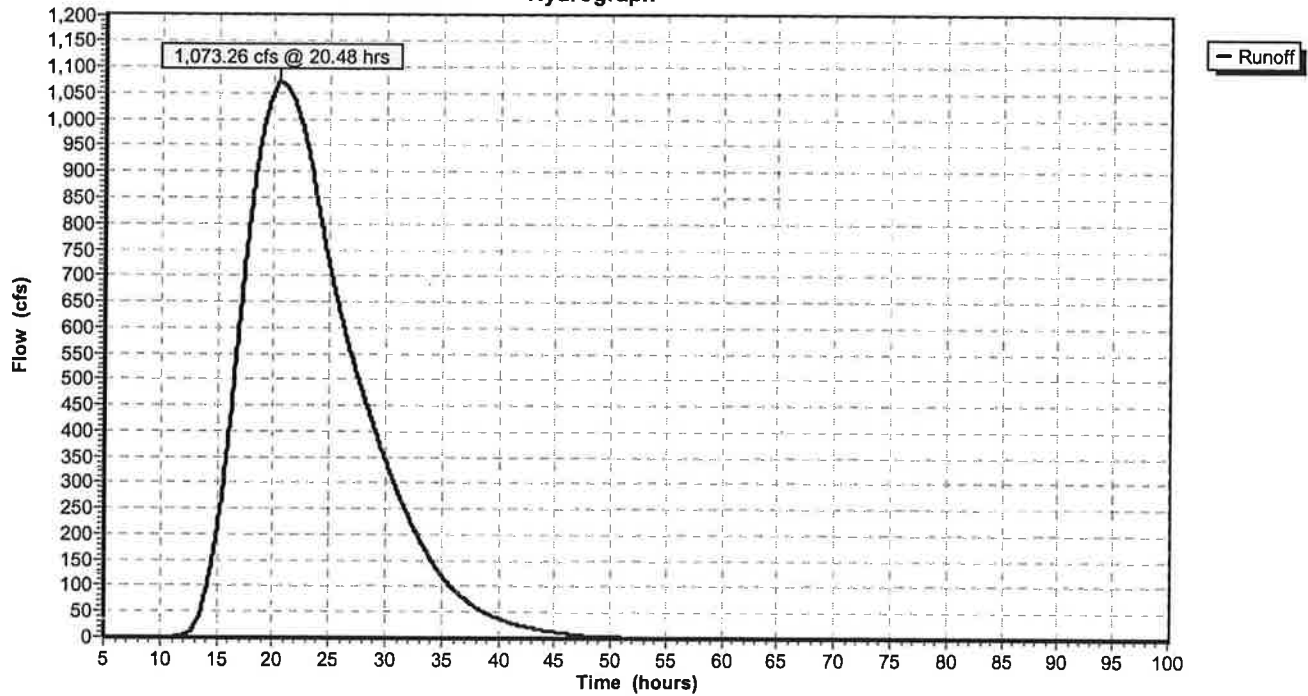
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=5.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Rive Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin Without Dam

Prepared by Stearns & Wheeler, LLC

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Type III 25-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 1,432.22 cfs @ 20.47 hrs, Volume= 1,382.351 af, Depth= 3.48"

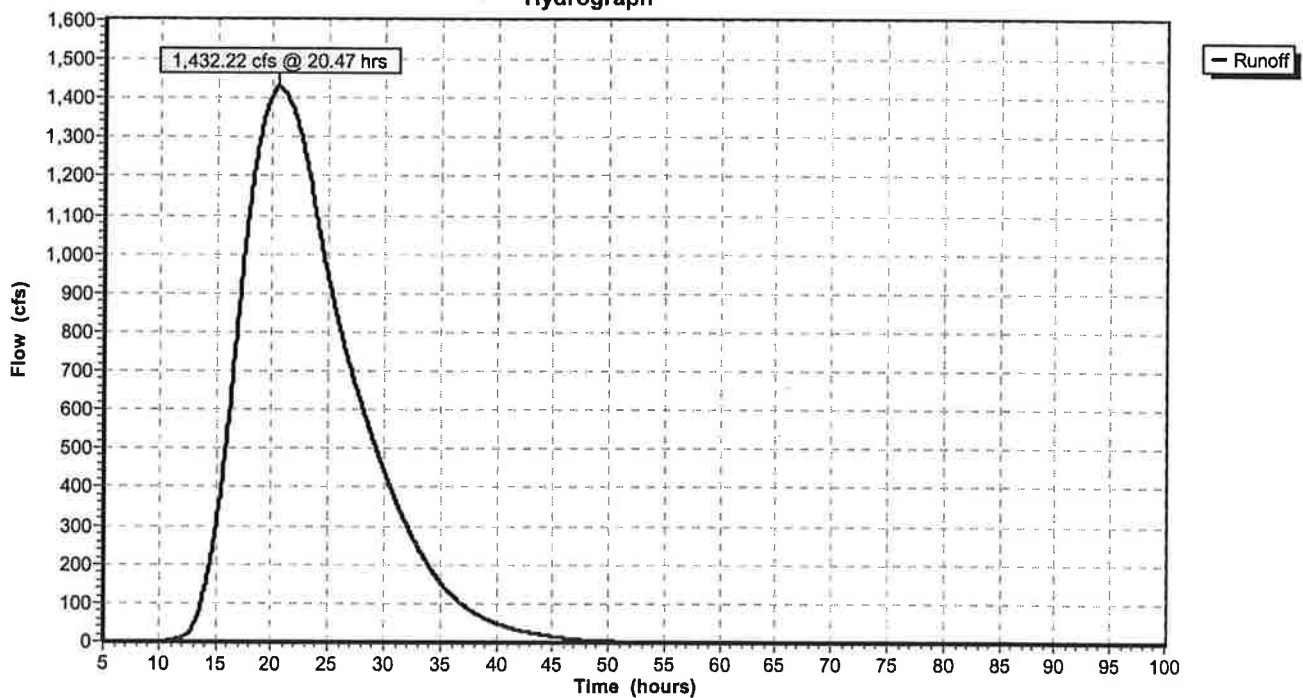
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=6.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Rive Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin Without Dam

Type III 50-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=7.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=3.94"
Tc=685.0 min CN=73 Runoff= 3,297.58 cfs 3,443.366 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=4.37"
Tc=635.0 min CN=77 Runoff= 1,802.96 cfs 1,734.682 af

Reach 1R: Rivers at Columbus Park Peak Depth= 6.33' Max Vel= 8.2 fps Inflow= 5,078.57 cfs 5,178.048 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,491.92 cfs Outflow= 5,069.81 cfs 5,178.047 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 5,178.048 af Average Runoff Depth = 4.07"

Mamaroneck Basin Without Dam

Type III 50-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 1,802.96 cfs @ 20.46 hrs, Volume= 1,734.682 af, Depth= 4.37"

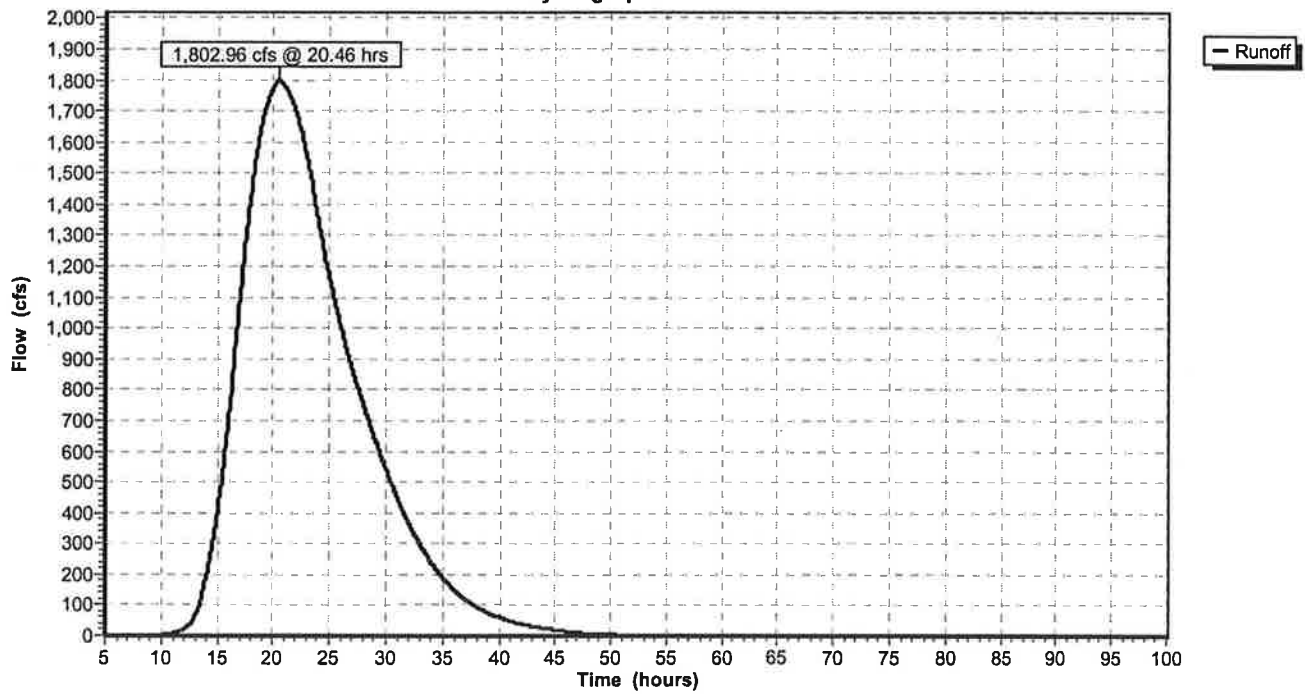
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=7.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Rive Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin Without Dam

Type III 100-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points

Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=8.00"

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=4.81"
Tc=685.0 min CN=73 Runoff= 4,040.82 cfs 4,208.690 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=5.27"
Tc=635.0 min CN=77 Runoff= 2,181.54 cfs 2,095.675 af

Reach 1R: Rivers at Columbus Park Peak Depth= 7.28' Max Vel= 8.7 fps Inflow= 6,207.02 cfs 6,304.365 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,491.92 cfs Outflow= 6,190.83 cfs 6,304.364 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 6,304.365 af Average Runoff Depth = 4.95"

Subcatchment 2S: Sheldrake River Basin

Runoff = 2,181.54 cfs @ 20.46 hrs, Volume= 2,095.675 af, Depth= 5.27"

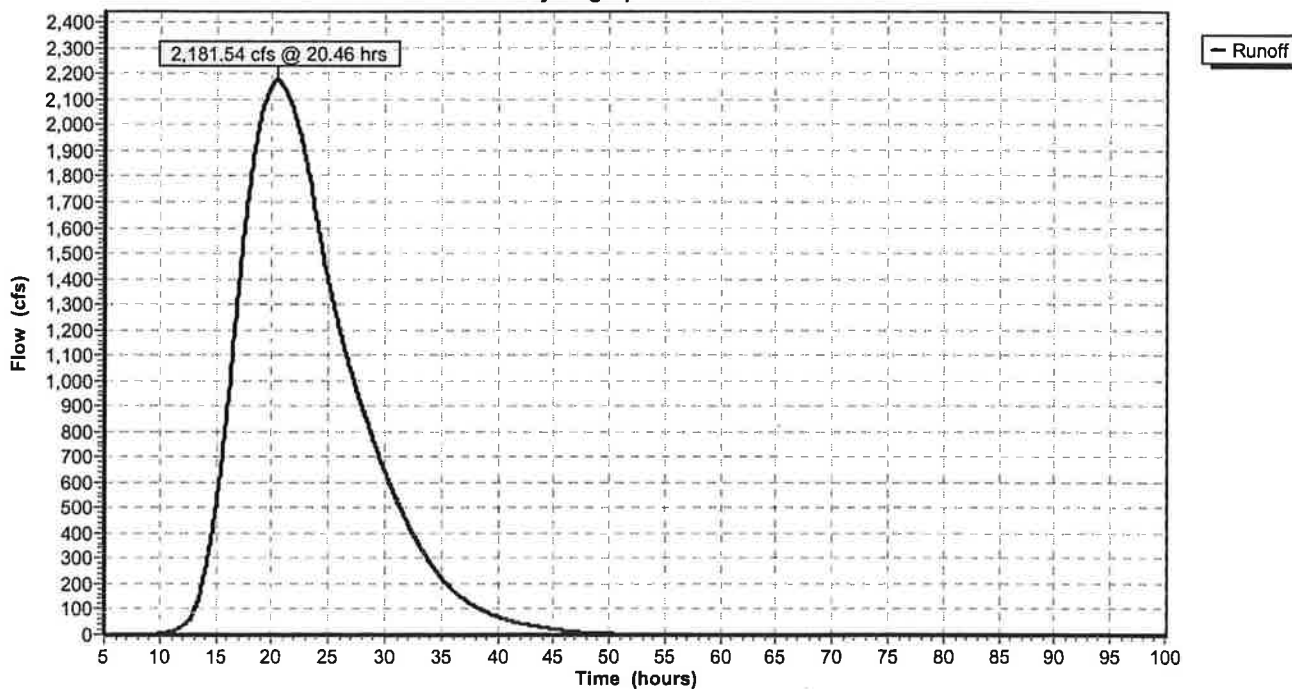
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=8.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Rive Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 1-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=3.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=0.86"
Tc=685.0 min CN=73 Runoff= 692.79 cfs 750.177 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=1.07"
Tc=635.0 min CN=77 Runoff= 424.99 cfs 425.559 af

Reach 1R: Rivers at Columbus Park

Peak Depth= 2.11' Max Vel= 4.3 fps Inflow= 807.83 cfs 1,170.732 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,472.95 cfs Outflow= 806.24 cfs 1,170.724 af

Pond 1P: Mamaroneck Reservoir

Peak Storage= 178.818 af @ 42.71' Inflow= 692.79 cfs 750.177 af
Primary= 459.51 cfs 739.417 af Secondary= 36.40 cfs 5.757 af Outflow= 495.91 cfs 745.173 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 1,175.736 af Average Runoff Depth = 0.92"

Mamaroneck Basin With Dam

Type III 1-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 424.99 cfs @ 21.14 hrs, Volume= 425.559 af, Depth= 1.07"

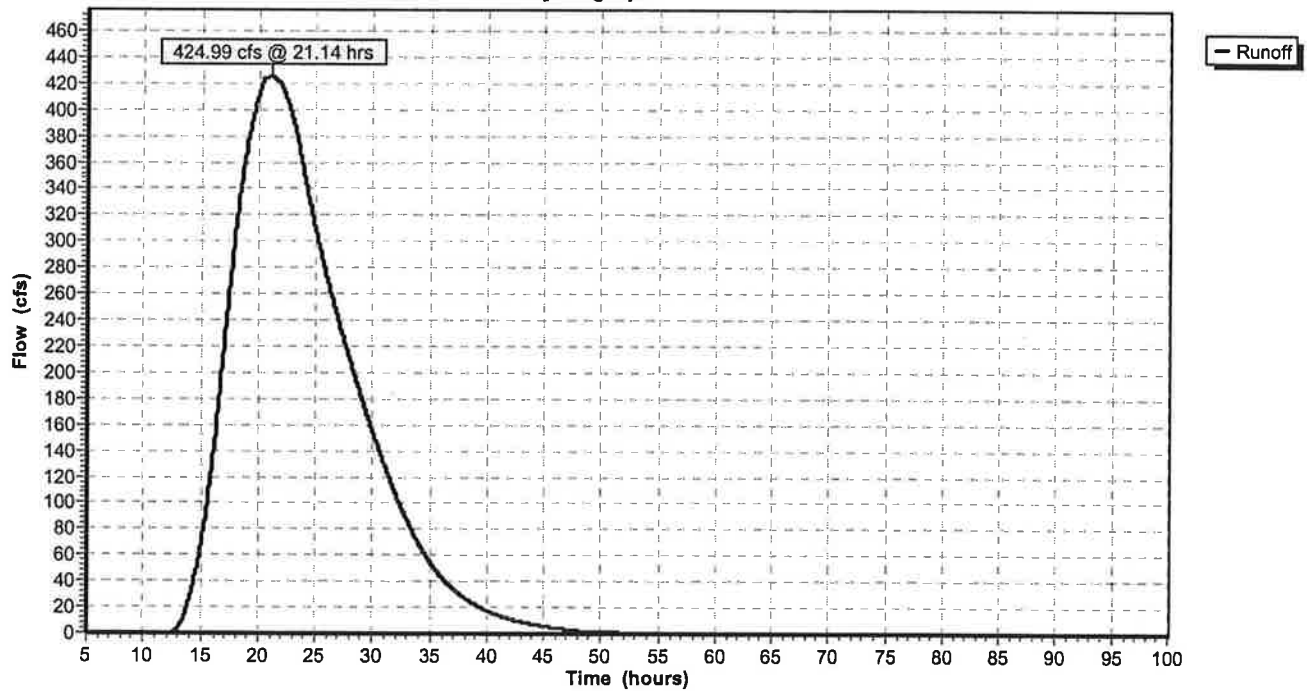
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=3.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 1-Year, 24-hr Rainfall

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Pond 1P: Mamaroneck Reservoir

Inflow Area = 10,500.000 ac, Inflow Depth = 0.86"

Inflow = 692.79 cfs @ 22.07 hrs, Volume= 750.177 af

Outflow = 495.91 cfs @ 26.48 hrs, Volume= 745.173 af, Atten= 28%, Lag= 264.6 min

Primary = 459.51 cfs @ 26.48 hrs, Volume= 739.417 af

Secondary = 36.40 cfs @ 26.48 hrs, Volume= 5.757 af

Routing by Stor-Ind method, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs

Peak Elev= 42.71' Storage= 178.818 af

Plug-Flow detention time= 204.1 min calculated for 745.173 af (99% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
30.00	0.000
33.00	5.000
37.00	18.000
39.00	50.000
40.00	107.000
44.00	213.000

Primary OutFlow Max=459.51 cfs @ 26.48 hrs HW=42.71' (Free Discharge)

↳2=Culvert (Controls 459.51 cfs)

Secondary OutFlow Max=35.12 cfs @ 26.48 hrs HW=42.71' (Free Discharge)

↳1=Broad-Crested Rectangular Weir (Controls 35.12 cfs)

#	Routing	Invert	Outlet Devices
1	Secondary	42.50'	130.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
2	Primary	33.00'	6.30' x 3.00' x 20.0' long Culvert X 2.00 RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 33.00' S= 0.0000 '/ n= 0.013 Cc= 0.900

Mamaroneck Basin With Dam

Type III 2-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=3.50"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=1.18"
Tc=685.0 min CN=73 Runoff= 962.35 cfs 1,032.176 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=1.43"
Tc=635.0 min CN=77 Runoff= 573.67 cfs 568.384 af

Reach 1R: Rivers at Columbus Park Peak Depth= 2.96' Max Vel= 5.3 fps Inflow= 1,439.25 cfs 1,595.556 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,472.95 cfs Outflow= 1,430.19 cfs 1,595.547 af

Pond 1P: Mamaroneck Reservoir

Peak Storage= 200.069 af @ 43.51' Inflow= 962.35 cfs 1,032.176 af
Primary= 481.54 cfs 851.197 af Secondary= 439.87 cfs 175.974 af Outflow= 921.41 cfs 1,027.172 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 1,600.560 af Average Runoff Depth = 1.26"

Mamaroneck Basin With Dam

Type III 2-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 573.67 cfs @ 20.52 hrs, Volume= 568.384 af, Depth= 1.43"

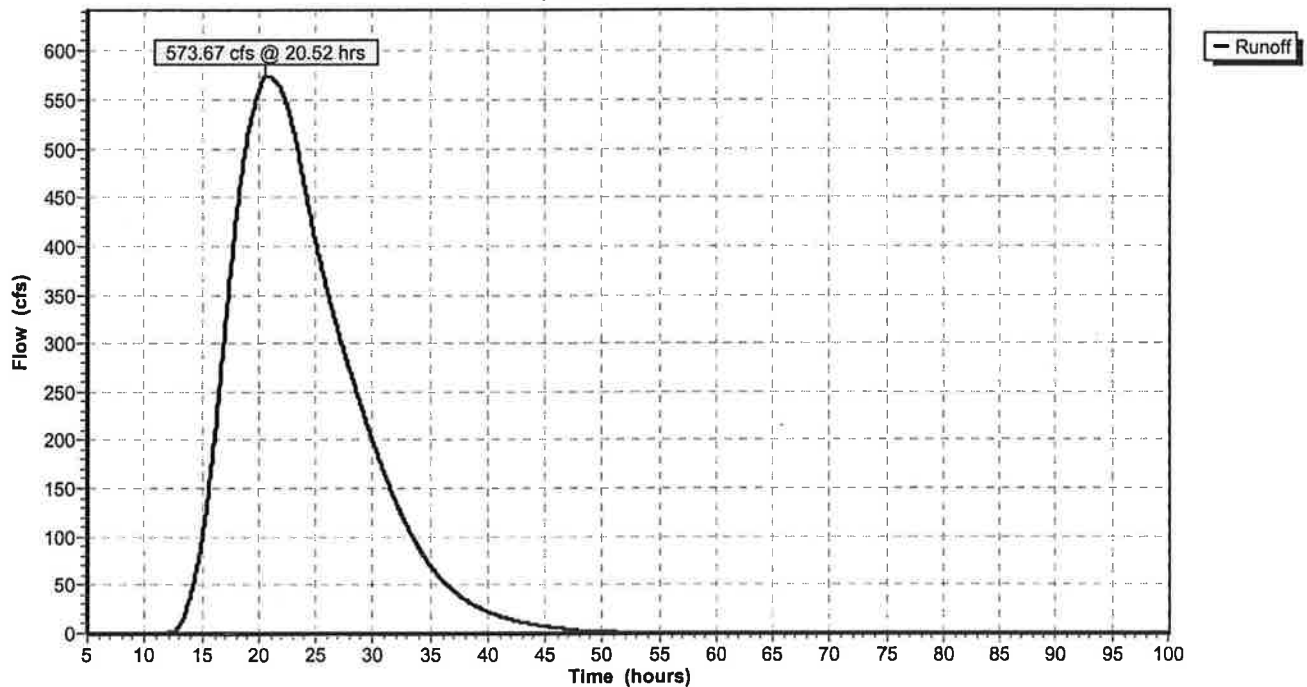
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=3.50"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 2-Year, 24-hr Rainfall

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Pond 1P: Mamaroneck Reservoir

Inflow Area = 10,500.000 ac, Inflow Depth = 1.18"

Inflow = 962.35 cfs @ 22.05 hrs, Volume= 1,032.176 af

Outflow = 921.41 cfs @ 23.27 hrs, Volume= 1,027.172 af, Atten= 4%, Lag= 73.3 min

Primary = 481.54 cfs @ 23.27 hrs, Volume= 851.197 af

Secondary = 439.87 cfs @ 23.27 hrs, Volume= 175.974 af

Routing by Stor-Ind method, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs

Peak Elev= 43.51' Storage= 200.069 af

Plug-Flow detention time= 190.1 min calculated for 1,026.631 af (99% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
30.00	0.000
33.00	5.000
37.00	18.000
39.00	50.000
40.00	107.000
44.00	213.000

Primary OutFlow Max=481.54 cfs @ 23.27 hrs HW=43.51' (Free Discharge)

↳2=Culvert (Controls 481.54 cfs)

Secondary OutFlow Max=439.39 cfs @ 23.27 hrs HW=43.51' (Free Discharge)

↳1=Broad-Crested Rectangular Weir (Controls 439.39 cfs)

#	Routing	Invert	Outlet Devices
1	Secondary	42.50'	130.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
2	Primary	33.00'	6.30' x 3.00' x 20.0' long Culvert X 2.00 RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 33.00' S= 0.0000 '/' n= 0.013 Cc= 0.900

Mamaroneck Basin With Dam

Type III 5-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=4.50"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=1.90"
Tc=685.0 min CN=73 Runoff= 1,562.15 cfs 1,658.716 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=2.21"
Tc=635.0 min CN=77 Runoff= 900.26 cfs 878.350 af

Reach 1R: Rivers at Columbus Park

Peak Depth= 4.05' Max Vel= 6.4 fps Inflow= 2,430.00 cfs 2,532.062 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,472.95 cfs Outflow= 2,427.54 cfs 2,532.053 af

Pond 1P: Mamaroneck Reservoir

Peak Storage= 221.969 af @ 44.34' Inflow= 1,562.15 cfs 1,658.716 af
Primary= 503.34 cfs 992.975 af Secondary= 1,054.89 cfs 660.736 af Outflow= 1,558.24 cfs 1,653.712 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 2,537.066 af Average Runoff Depth = 1.99"

Mamaroneck Basin With Dam

Type III 5-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 900.26 cfs @ 20.49 hrs, Volume= 878.350 af, Depth= 2.21"

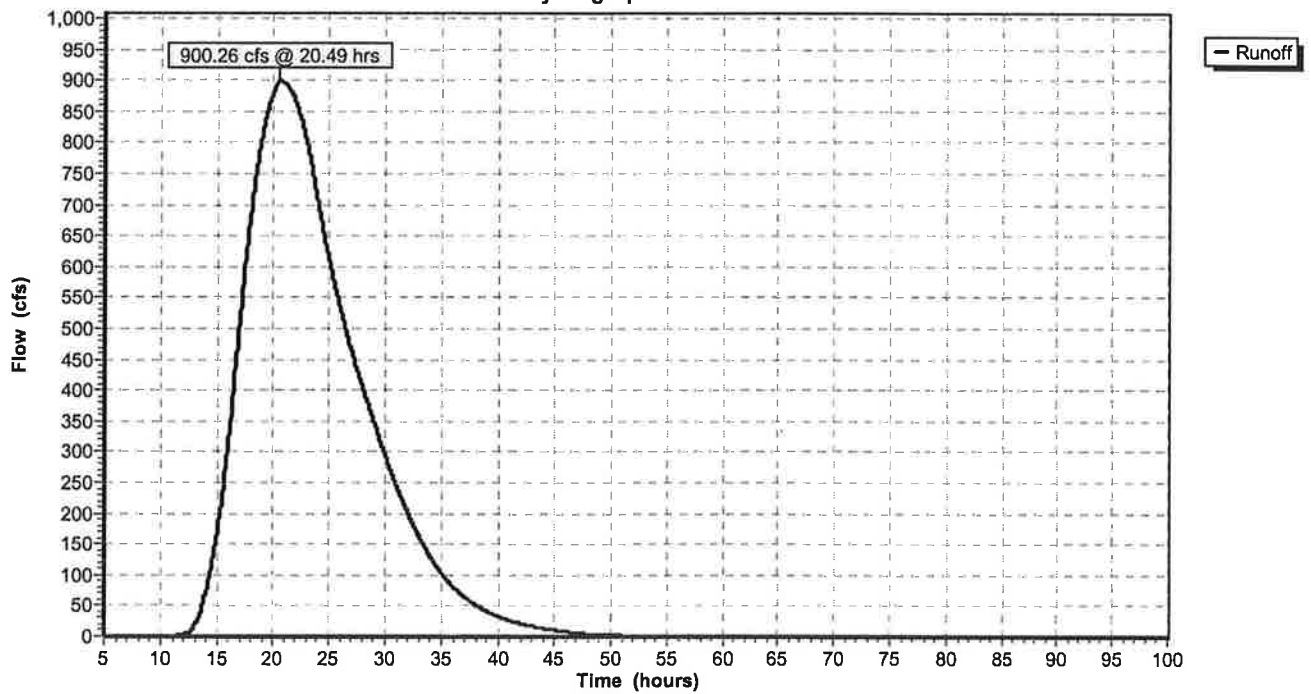
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=4.50"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 5-Year, 24-hr Rainfall

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Pond 1P: Mamaroneck Reservoir

[91] Warning: Storage range exceeded by 0.34'

Inflow Area = 10,500.000 ac, Inflow Depth = 1.90"
 Inflow = 1,562.15 cfs @ 22.05 hrs, Volume= 1,658.716 af
 Outflow = 1,558.24 cfs @ 22.14 hrs, Volume= 1,653.712 af, Atten= 0%, Lag= 5.6 min
 Primary = 503.34 cfs @ 22.14 hrs, Volume= 992.975 af
 Secondary = 1,054.89 cfs @ 22.14 hrs, Volume= 660.736 af

Routing by Stor-Ind method, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs

Peak Elev= 44.34' Storage= 221.969 af
 Plug-Flow detention time= 151.7 min calculated for 1,653.712 af (100% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
30.00	0.000
33.00	5.000
37.00	18.000
39.00	50.000
40.00	107.000
44.00	213.000

Primary OutFlow Max=503.23 cfs @ 22.14 hrs HW=44.34' (Free Discharge)
 ↑2=Culvert (Controls 503.23 cfs)

Secondary OutFlow Max=1,075.84 cfs @ 22.14 hrs HW=44.34' (Free Discharge)
 ↑1=Broad-Crested Rectangular Weir (Controls 1,075.84 cfs)

#	Routing	Invert	Outlet Devices
1	Secondary	42.50'	130.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
2	Primary	33.00'	6.30' x 3.00' x 20.0' long Culvert X 2.00 RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 33.00' S= 0.0000 ' / ' n= 0.013 Cc= 0.900

Mamaroneck Basin With Dam

Type III 10-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=5.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=2.28"
Tc=685.0 min CN=73 Runoff= 1,888.72 cfs 1,995.399 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=2.62"
Tc=635.0 min CN=77 Runoff= 1,073.26 cfs 1,042.201 af

Reach 1R: Rivers at Columbus Park Peak Depth= 4.52' Max Vel= 6.9 fps Inflow= 2,925.10 cfs 3,032.596 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,472.95 cfs Outflow= 2,922.44 cfs 3,032.586 af

Pond 1P: Mamaroneck Reservoir

Peak Storage= 232.724 af @ 44.74' Inflow= 1,888.72 cfs 1,995.399 af
Primary= 513.99 cfs 1,046.605 af Secondary= 1,369.07 cfs 943.790 af Outflow= 1,883.06 cfs 1,990.395 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 3,037.600 af Average Runoff Depth = 2.39"

Mamaroneck Basin With Dam

Type III 10-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 1,073.26 cfs @ 20.48 hrs, Volume= 1,042.201 af, Depth= 2.62"

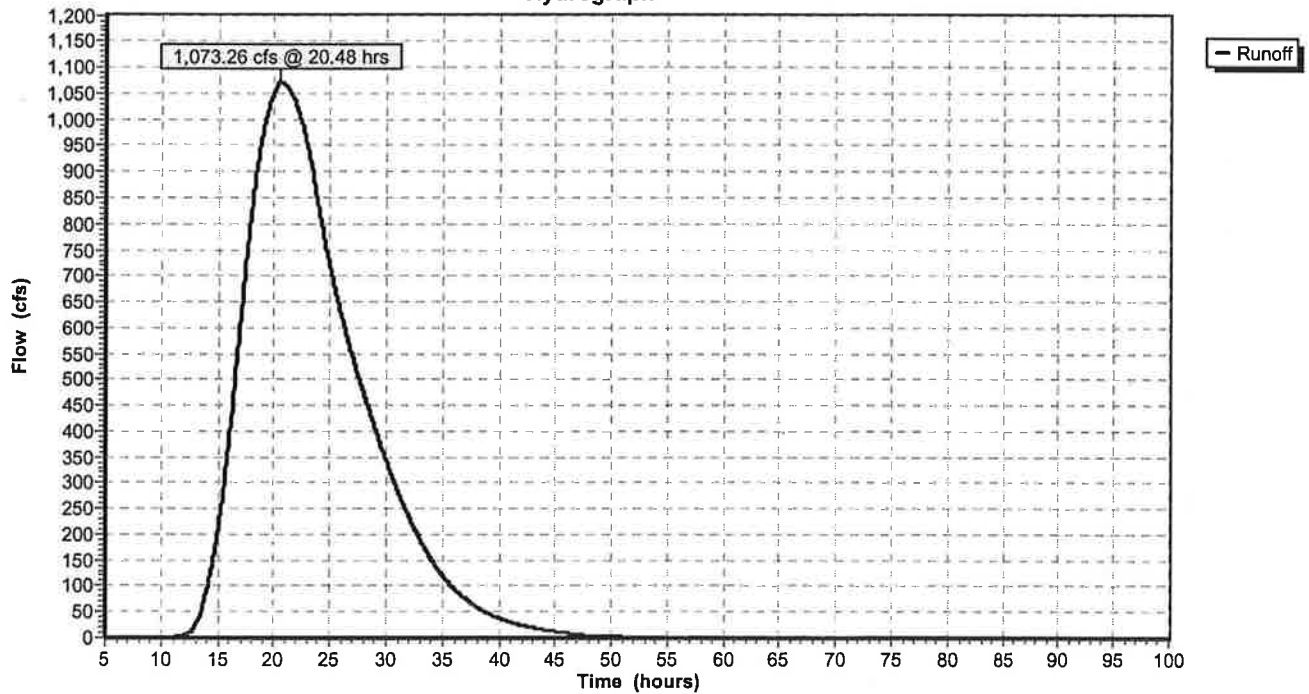
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=5.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 10-Year, 24-hr Rainfall

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Pond 1P: Mamaroneck Reservoir

[91] Warning: Storage range exceeded by 0.74'

Inflow Area = 10,500.000 ac, Inflow Depth = 2.28"
 Inflow = 1,888.72 cfs @ 21.35 hrs, Volume= 1,995.399 af
 Outflow = 1,883.06 cfs @ 22.08 hrs, Volume= 1,990.395 af, Atten= 0%, Lag= 44.0 min
 Primary = 513.99 cfs @ 22.08 hrs, Volume= 1,046.605 af
 Secondary = 1,369.07 cfs @ 22.08 hrs, Volume= 943.790 af

Routing by Stor-Ind method, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs

Peak Elev= 44.74' Storage= 232.724 af
 Plug-Flow detention time= 136.8 min calculated for 1,990.395 af (100% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
30.00	0.000
33.00	5.000
37.00	18.000
39.00	50.000
40.00	107.000
44.00	213.000

Primary OutFlow Max=513.55 cfs @ 22.08 hrs HW=44.74' (Free Discharge)
 ↑2=Culvert (Controls 513.55 cfs)

Secondary OutFlow Max=1,451.08 cfs @ 22.08 hrs HW=44.74' (Free Discharge)
 ↑1=Broad-Crested Rectangular Weir (Controls 1,451.08 cfs)

#	Routing	Invert	Outlet Devices
1	Secondary	42.50'	130.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
2	Primary	33.00'	6.30' x 3.00' x 20.0' long Culvert X 2.00 RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 33.00' S= 0.0000 '/' n= 0.013 Cc= 0.900

Mamaroneck Basin With Dam

Type III 25-Year, 24-hr Rainfall

Prepared by Stearns & Wheeler, LLC

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=6.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=3.09"
Tc=685.0 min CN=73 Runoff= 2,576.99 cfs 2,702.526 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=3.48"
Tc=635.0 min CN=77 Runoff= 1,432.22 cfs 1,382.351 af

Reach 1R: Rivers at Columbus Park Peak Depth= 5.41' Max Vel= 7.6 fps Inflow= 3,959.48 cfs 4,079.873 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,472.95 cfs Outflow= 3,956.02 cfs 4,079.863 af

Pond 1P: Mamaroneck Reservoir

Peak Storage= 255.332 af @ 45.60' Inflow= 2,576.99 cfs 2,702.526 af
Primary= 536.37 cfs 1,137.037 af Secondary= 2,029.48 cfs 1,560.485 af Outflow= 2,565.85 cfs 2,697.521 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 4,084.877 af Average Runoff Depth = 3.21"

Mamaroneck Basin With Dam

Type III 25-Year, 24-hr Rainfall

Prepared by Stearns & Wheler, LLC

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12/20/2004

Subcatchment 2S: Sheldrake River Basin

Runoff = 1,432.22 cfs @ 20.47 hrs, Volume= 1,382.351 af, Depth= 3.48"

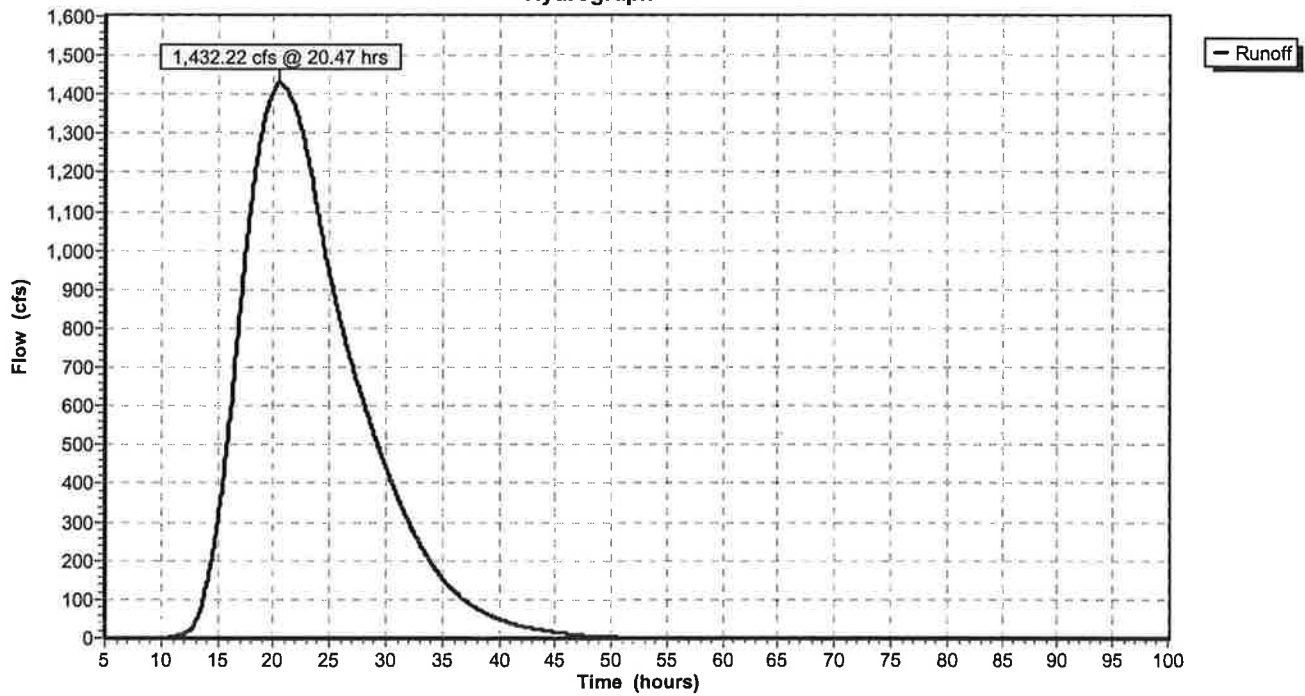
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=6.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 25-Year, 24-hr Rainfall

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Pond 1P: Mamaroneck Reservoir

[91] Warning: Storage range exceeded by 1.60'

Inflow Area = 10,500.000 ac, Inflow Depth = 3.09"

Inflow = 2,576.99 cfs @ 21.31 hrs, Volume= 2,702.526 af

Outflow = 2,565.85 cfs @ 21.79 hrs, Volume= 2,697.521 af, Atten= 0%, Lag= 28.6 min

Primary = 536.37 cfs @ 21.79 hrs, Volume= 1,137.037 af

Secondary = 2,029.48 cfs @ 21.79 hrs, Volume= 1,560.485 af

Routing by Stor-Ind method, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs

Peak Elev= 45.60' Storage= 255.332 af

Plug-Flow detention time= 114.9 min calculated for 2,697.521 af (100% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
30.00	0.000
33.00	5.000
37.00	18.000
39.00	50.000
40.00	107.000
44.00	213.000

Primary OutFlow Max=534.57 cfs @ 21.79 hrs HW=45.60' (Free Discharge)

↑2=Culvert (Controls 534.57 cfs)

Secondary OutFlow Max=2,352.79 cfs @ 21.79 hrs HW=45.60' (Free Discharge)

↑1=Broad-Crested Rectangular Weir (Controls 2,352.79 cfs)

#	Routing	Invert	Outlet Devices
1	Secondary	42.50'	130.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
2	Primary	33.00'	6.30' x 3.00' x 20.0' long Culvert X 2.00 RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 33.00' S= 0.0000 '/' n= 0.013 Cc= 0.900

Mamaroneck Basin With Dam

Type III 50-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=7.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=3.94"
Tc=685.0 min CN=73 Runoff= 3,297.58 cfs 3,443.366 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=4.37"
Tc=635.0 min CN=77 Runoff= 1,802.96 cfs 1,734.682 af

Reach 1R: Rivers at Columbus Park Peak Depth= 6.33' Max Vel= 8.2 fps Inflow= 5,040.23 cfs 5,173.043 af
n=0.030 L=7,914.0' S=0.0030 '/' Capacity=3,472.95 cfs Outflow= 5,034.93 cfs 5,173.032 af

Pond 1P: Mamaroneck Reservoir

Peak Storage= 279.097 af @ 46.49' Inflow= 3,297.58 cfs 3,443.366 af
Primary= 559.90 cfs 1,213.773 af Secondary= 2,723.69 cfs 2,224.588 af Outflow= 3,283.59 cfs 3,438.361 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 5,178.048 af Average Runoff Depth = 4.07"

Mamaroneck Basin With Dam

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Type III 50-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 1,802.96 cfs @ 20.46 hrs, Volume= 1,734.682 af, Depth= 4.37"

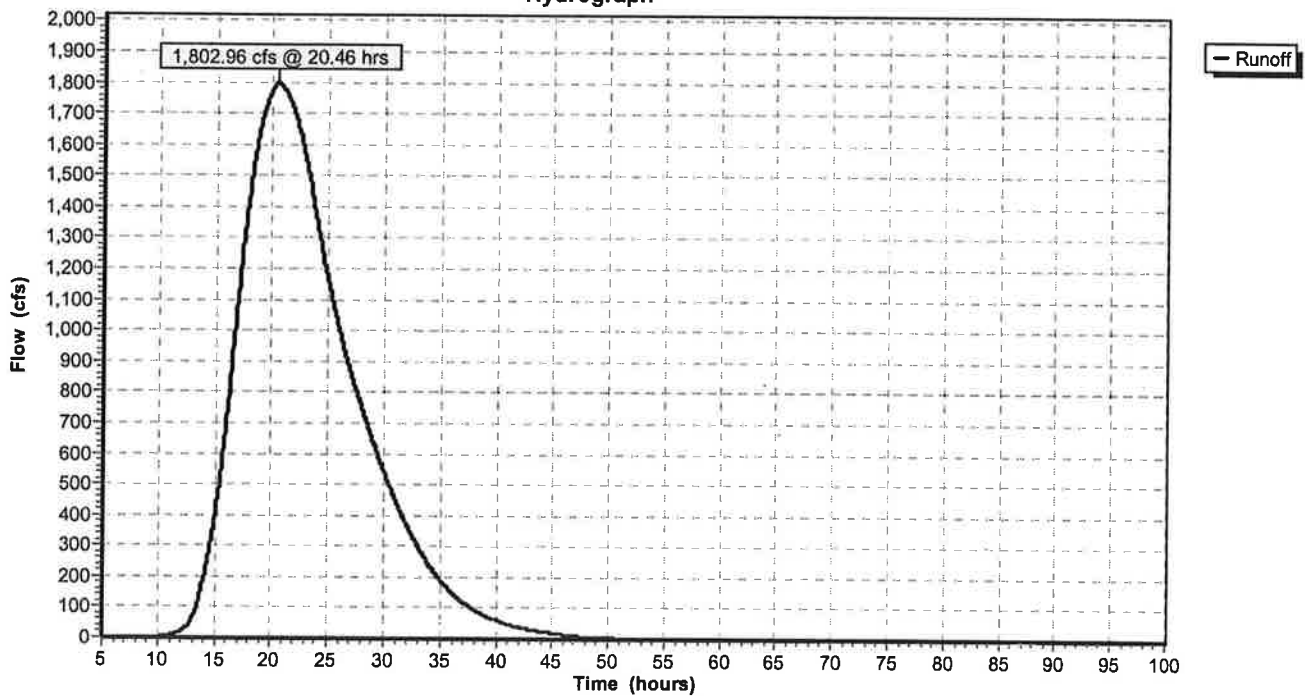
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=7.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 50-Year, 24-hr Rainfall

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Pond 1P: Mamaroneck Reservoir

[91] Warning: Storage range exceeded by 2.49'

Inflow Area = 10,500.000 ac, Inflow Depth = 3.94"

Inflow = 3,297.58 cfs @ 21.30 hrs, Volume= 3,443.366 af

Outflow = 3,283.59 cfs @ 21.62 hrs, Volume= 3,438.361 af, Atten= 0%, Lag= 19.5 min

Primary = 559.90 cfs @ 21.62 hrs, Volume= 1,213.773 af

Secondary = 2,723.69 cfs @ 21.62 hrs, Volume= 2,224.588 af

Routing by Stor-Ind method, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs

Peak Elev= 46.49' Storage= 279.097 af

Plug-Flow detention time= 99.9 min calculated for 3,438.361 af (100% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
30.00	0.000
33.00	5.000
37.00	18.000
39.00	50.000
40.00	107.000
44.00	213.000

Primary OutFlow Max=555.81 cfs @ 21.62 hrs HW=46.49' (Free Discharge)

↳2=Culvert (Controls 555.81 cfs)

Secondary OutFlow Max=3,445.28 cfs @ 21.62 hrs HW=46.49' (Free Discharge)

↳1=Broad-Crested Rectangular Weir (Controls 3,445.28 cfs)

#	Routing	Invert	Outlet Devices
1	Secondary	42.50'	130.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
2	Primary	33.00'	6.30' x 3.00' x 20.0' long Culvert X 2.00 RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 33.00' S= 0.0000 '/' n= 0.013 Cc= 0.900

Mamaroneck Basin With Dam

Type III 100-Year, 24-hr Rainfall

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Time span=5.00-100.00 hrs, dt=0.05 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Type III 24-hr Rainfall=8.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Mamaroneck River Basin

Runoff Area=10,500.000 ac Runoff Depth=4.81"
Tc=685.0 min CN=73 Runoff= 4,040.82 cfs 4,208.690 af

Subcatchment 2S: Sheldrake River Basin

Runoff Area=4,768.000 ac Runoff Depth=5.27"
Tc=635.0 min CN=77 Runoff= 2,181.54 cfs 2,095.675 af

Reach 1R: Rivers at Columbus Park Peak Depth= 7.27' Max Vel= 8.6 fps Inflow= 6,152.68 cfs 6,299.360 af
n=0.030 L=7,914.0' S=0.0030 '/ Capacity=3,472.95 cfs Outflow= 6,146.22 cfs 6,299.350 af

Pond 1P: Mamaroneck Reservoir

Peak Storage= 303.668 af @ 47.42' Inflow= 4,040.82 cfs 4,208.690 af
Primary= 584.22 cfs 1,282.126 af Secondary= 3,441.42 cfs 2,921.559 af Outflow= 4,025.64 cfs 4,203.685 af

Total Runoff Area = 15,268.000 ac Runoff Volume = 6,304.365 af Average Runoff Depth = 4.95"

Mamaroneck Basin With Dam

Type III 100-Year, 24-hr Rainfall

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Subcatchment 2S: Sheldrake River Basin

Runoff = 2,181.54 cfs @ 20.46 hrs, Volume= 2,095.675 af, Depth= 5.27"

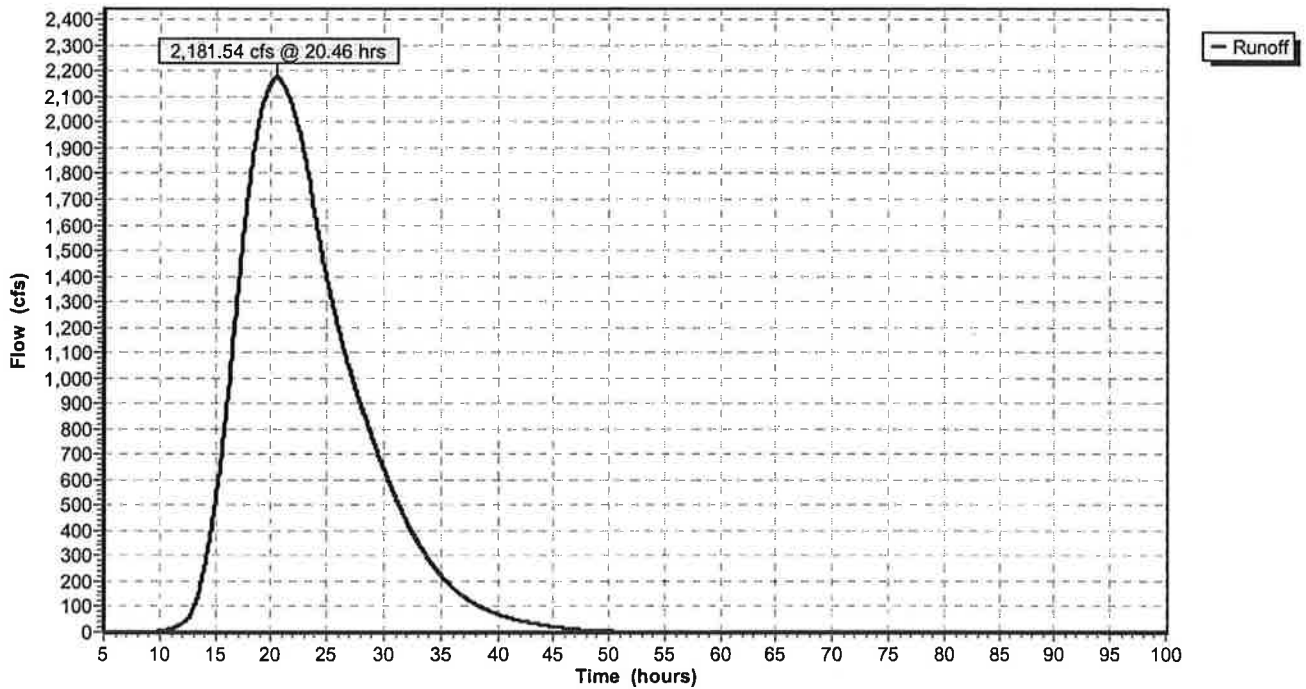
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=8.00"

Area (ac)	CN	Description
3,052.000	79	<50% Grass cover, Poor, HSG B
1,716.000	73	Woods/grass comb., Poor, HSG B
4,768.000	77	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
635.0					Direct Entry, Sheldrake Basin

Subcatchment 2S: Sheldrake River Basin

Hydrograph



Mamaroneck Basin With Dam

Type III 100-Year, 24-hr Rainfall

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Pond 1P: Mamaroneck Reservoir

[91] Warning: Storage range exceeded by 3.42'

Inflow Area = 10,500.000 ac, Inflow Depth = 4.81"
 Inflow = 4,040.82 cfs @ 21.28 hrs, Volume= 4,208.690 af
 Outflow = 4,025.64 cfs @ 21.53 hrs, Volume= 4,203.685 af, Atten= 0%, Lag= 14.5 min
 Primary = 584.22 cfs @ 21.53 hrs, Volume= 1,282.126 af
 Secondary = 3,441.42 cfs @ 21.53 hrs, Volume= 2,921.559 af

Routing by Stor-Ind method, Time Span= 5.00-100.00 hrs, dt= 0.05 hrs

Peak Elev= 47.42' Storage= 303.668 af
 Plug-Flow detention time= 88.3 min calculated for 4,201.474 af (100% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
30.00	0.000
33.00	5.000
37.00	18.000
39.00	50.000
40.00	107.000
44.00	213.000

Primary OutFlow Max=576.95 cfs @ 21.53 hrs HW=47.42' (Free Discharge)
 ↳2=Culvert (Controls 576.95 cfs)

Secondary OutFlow Max=4,712.03 cfs @ 21.53 hrs HW=47.42' (Free Discharge)
 ↳1=Broad-Crested Rectangular Weir (Controls 4,712.03 cfs)

#	Routing	Invert	Outlet Devices
1	Secondary	42.50'	130.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
2	Primary	33.00'	6.30' x 3.00' x 20.0' long Culvert X 2.00 RCP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 33.00' S= 0.0000 '/' n= 0.013 Cc= 0.900

