

Millstone River Basin, Flood Control and Ecosystem Restoration Feasibility Study

**Existing Conditions
Hydrology and Hydraulics**

Introduction

- Project area is located within the Millstone and Raritan River Basins in Somerset County, NJ
- Recent large storms have caused severe flooding along the Millstone River near its confluences with the Raritan River and Royce Brook. Most recent and severe storm that caused flooding along these waterways is Tropical Storm Floyd (Sept. 15 to 17, 1999).
- The most significant flooding problems in the Millstone River Basin are in the Boroughs of Manville, Millstone, and Hillsboro.
- Hydrologic & Hydraulic analyses were conducted in order to analyze the flooding problems in the areas adjacent to these waterways and develop solutions to reduce or eliminate the flooding in these areas.

Project Study Area



Brief Summary of Hydrologic Analysis

- Calibration Points (USGS gages)
 - Raritan River at Manville, NJ
 - Millstone River at Blackwell Mills, NJ
 - Royce Brook tributary near Belle Meade, NJ (peak flows only)
 - Raritan River below Calco Dam at Bound Brook, NJ
- Historic calibration flood: Tropical Storm Floyd (15 to 17 September 1999)
 - Current flood of record (largest historical flood) at Raritan River at Manville & Bound Brook gages
 - Large historic flood at Millstone River and Royce Brook gages.
 - Calibration is to flood hydrographs @ Raritan River gages and Millstone River gage, peak flow @ Royce Brook tributary gage.

Brief Summary of Hydrologic Analysis (ctd.)

- Hypothetical Floods
 - 1 year to 500 year flood peaks @ gages from FFA (annual series) + partial duration calculations on historic flood peaks.
 - Driving input is hypothetical rain; Hydro-35, TP-40, and TP-49.
- Sub-basin unit hydrographs
 - Raritan River @ Manville (UHG optimization).
 - Millstone River @ Blackwells Mills (Historic Floods).
- Ungaged sub-basins
 - Raritan basin-wide regression equations developed especially for this study.

Brief Summary of Hydrologic Analysis (ctd.)

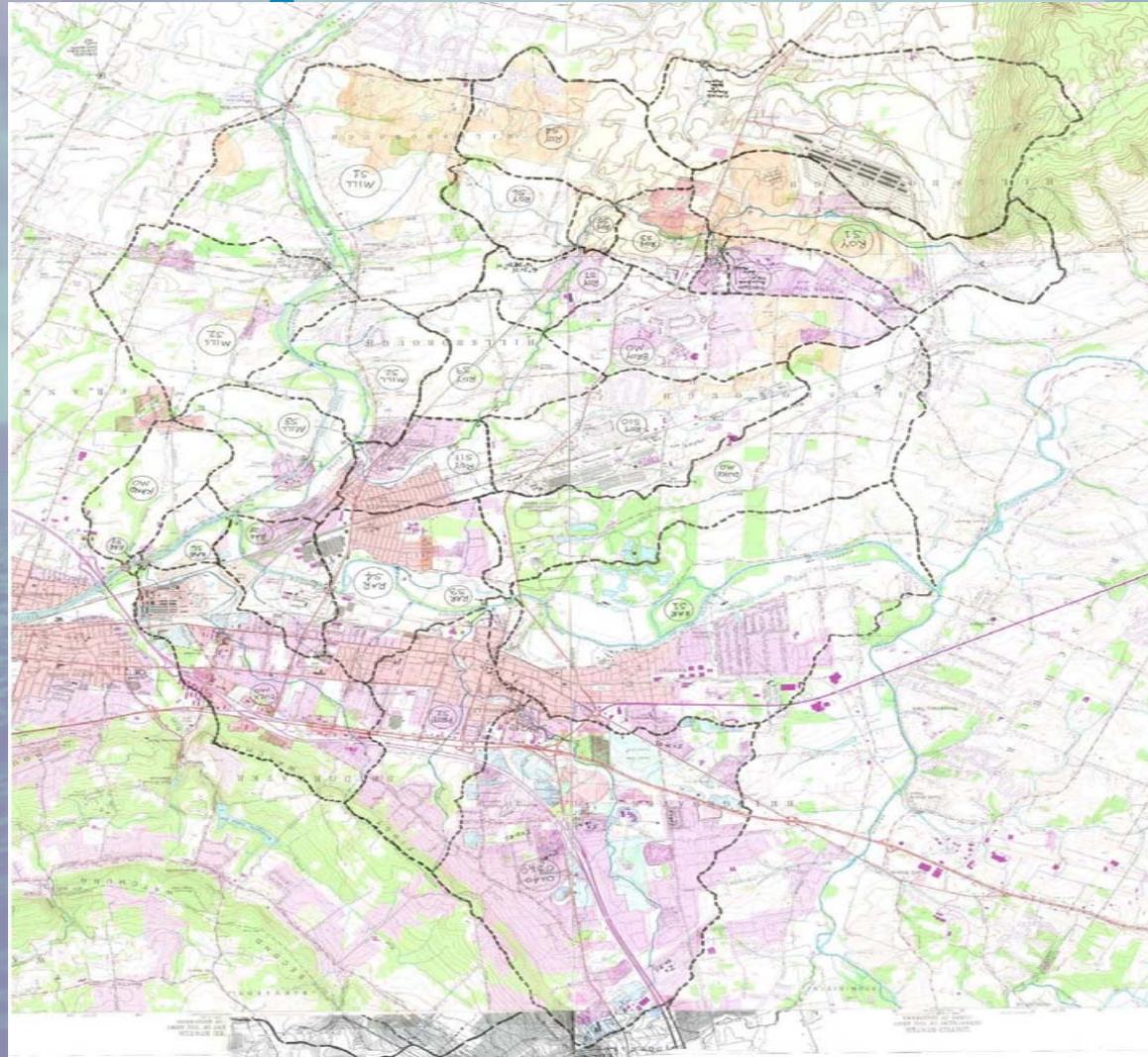
- Routing Methods for the reaches are given as follows:
 - Modified Plus with storage-discharge data from calibrated HEC-RAS output.
- Infiltration Loss Function
 - Initial Loss + Constant Rate + RTIMP (% impervious area)
 - RTIMP is based on USGS quad sheet, aerial photos, and home & building counts from available topographic survey.

HEC-1/HEC-HMS hydrologic model

Stream	Sub-basins	Routing Reaches	Combining Points
Raritan River	10	4	10
Peters Brook	2	1	1
Millstone River	4	3	4
Royce Brook	12	6	11

Delineated Watershed with HEC-HMS

Schematic Representation of Watershed



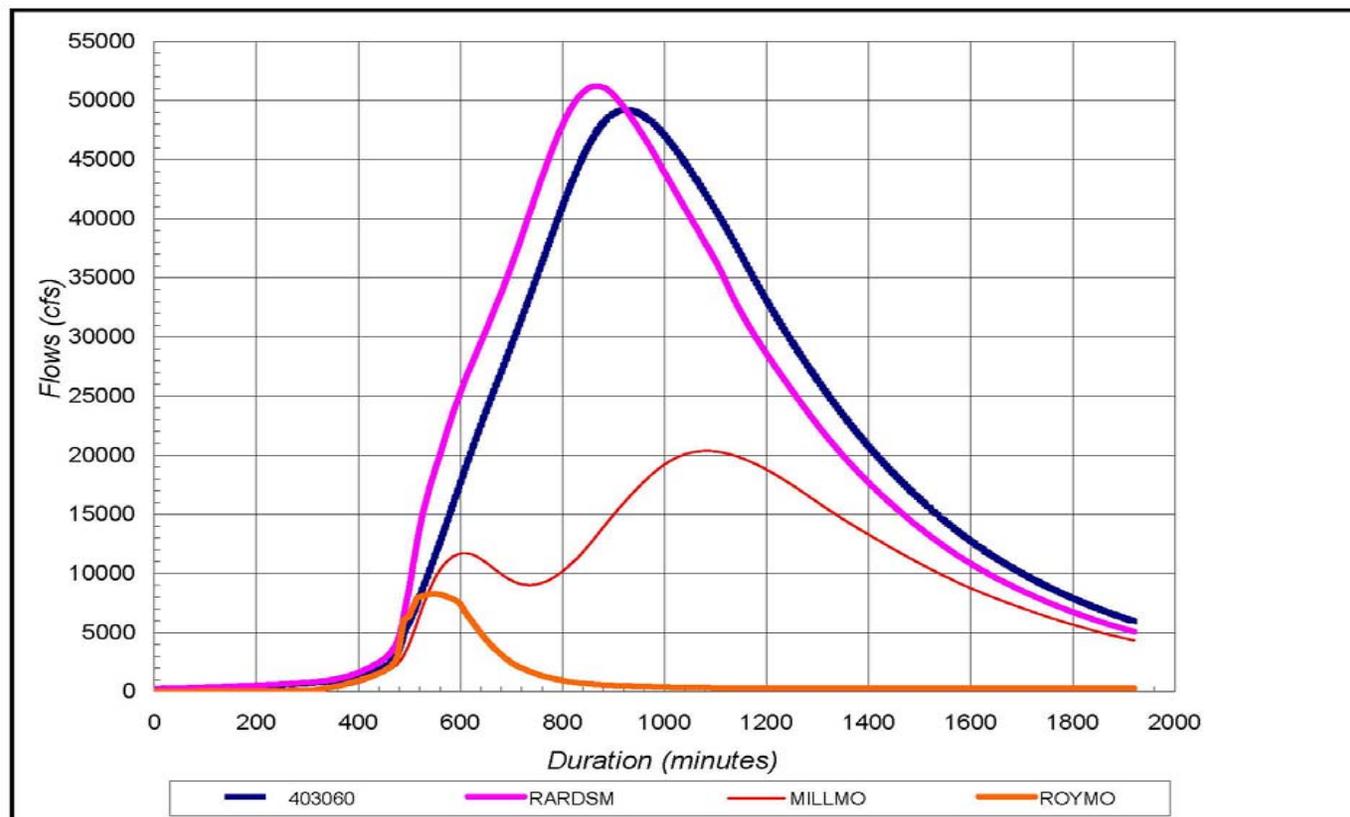
Peak Flows (cubic feet per second)

HEC-HMS Node	10-year return period	100-year return period	500-year return period	Tropical Storm Floyd
403060	32,810	49,200	62,100	67,000
RARDSM	33,300	51,200	64,670	68,150
MILLMO	11,210	20,370	28,450	23,760
ROYMO	3,670	8,250	12,820	8,160

Note: HEC-HMS Nodes are as follows:

- 403060 – USGS gage of Raritan River below Calco Dam at Bound Brook, NJ
- RARDSM – Raritan River Downstream of Millstone River
- MILLMO – Millstone River at mouth
- ROYMO – Royce Brook at mouth

100 year flood hydrographs at aforesaid selected locations



Conclusions of Hydrologic Analysis

- A schematic representation of Raritan and Millstone River Watersheds was developed, and with it, physical and meteorological parameters.
- The flows from the hydrographs developed from both watersheds will be used as input in the HEC-RAS model. Only the peak flow will be used for all reaches. This will give us the worst case scenario for water surface elevations in the project area.
- For future work, probably another HEC-1 (HMS) model calibration is needed to observe hydrograph data from October 18 to 19, 1996 Nor'easter flood.

Brief Summary of Hydraulic Analysis

- For the hydraulic analysis, the Millstone River, Raritan River and Royce Brook were divided into five reaches.
 - Raritan River (Lower): Below Millstone River
 - Raritan River (Upper): Above Millstone River
 - Millstone River (Lower): Below Royce Brook
 - Millstone River (Upper): Above Royce Brook
 - Royce Brook
- Hydraulic analysis was performed by using the HEC-RAS (River Analysis System) water surface profile computer program. Steady-state model was developed to study the five reaches.

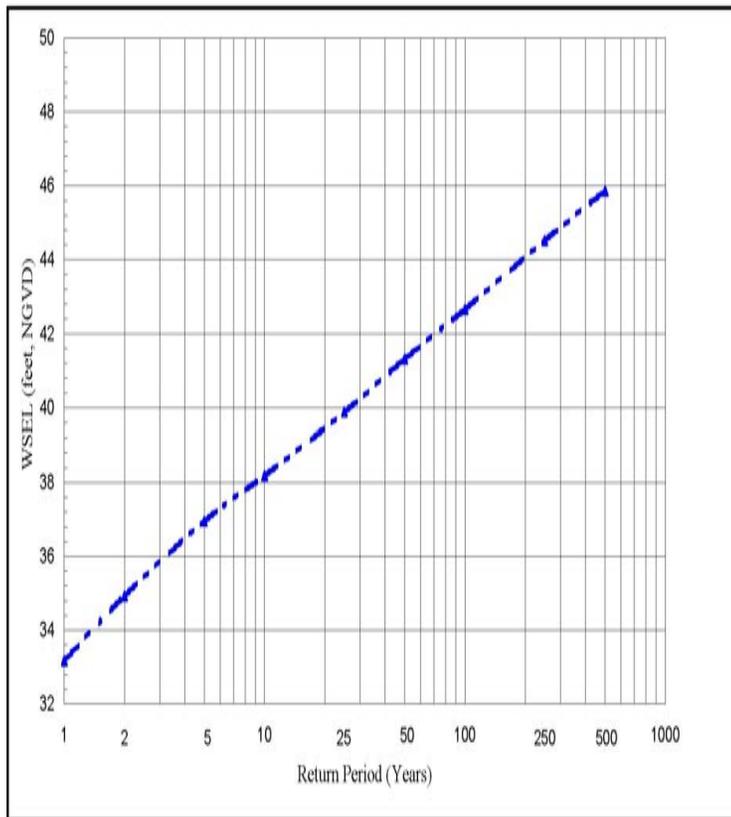
Brief Summary of Hydraulic Analysis (ctd.)

- The peak and coincidental flows of the hydrographs from the HEC-HMS (HEC-1) hydrologic model were used as inputs to HEC-RAS hydraulic model. To determine the maximum water surface elevations at these reaches (worst-case scenario), all peak flow for all reaches were considered to coincide (occur at the same time).
- The HEC-RAS model included a total of 142 channel cross-sections, 11 bridges and 4 weirs, representing all five river reaches.
- The model was calibrated to both flood marks and gage data obtained from the flood caused by Tropical Storm Floyd on September 15 to 17, 1999.

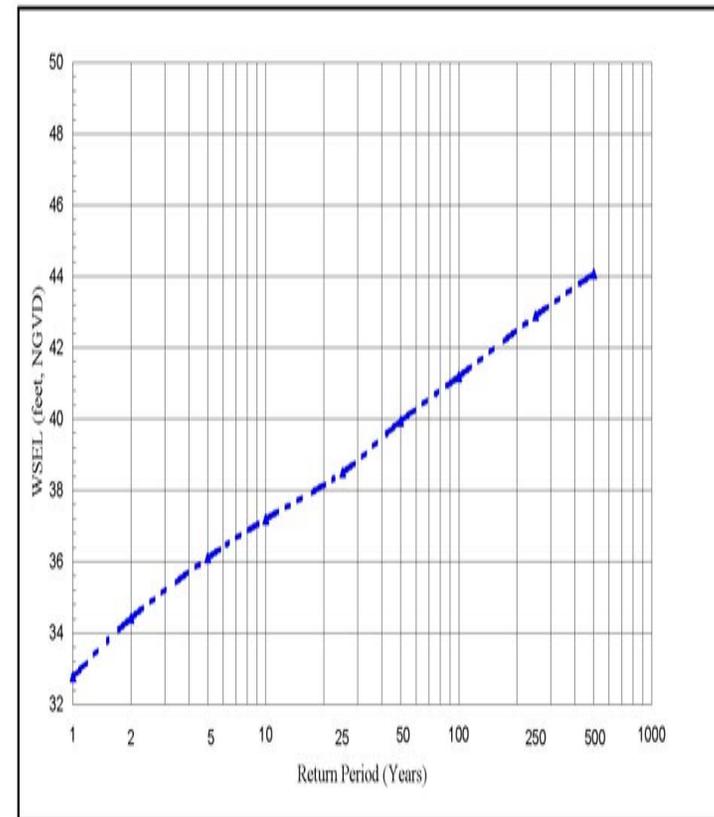
Brief Summary of Hydraulic Analysis (ctd.)

- Results of the HEC-RAS model include water surface profiles for all five reaches at return periods of 1 to 500 years as well as Tropical Storm Floyd that occurred within the project area.
- Inundation mapping, developed for the 100 year and 500 year hypothetical event, will show the locations of potential flooding.

Stage Frequency Curves at selected cross-sections at damage locations

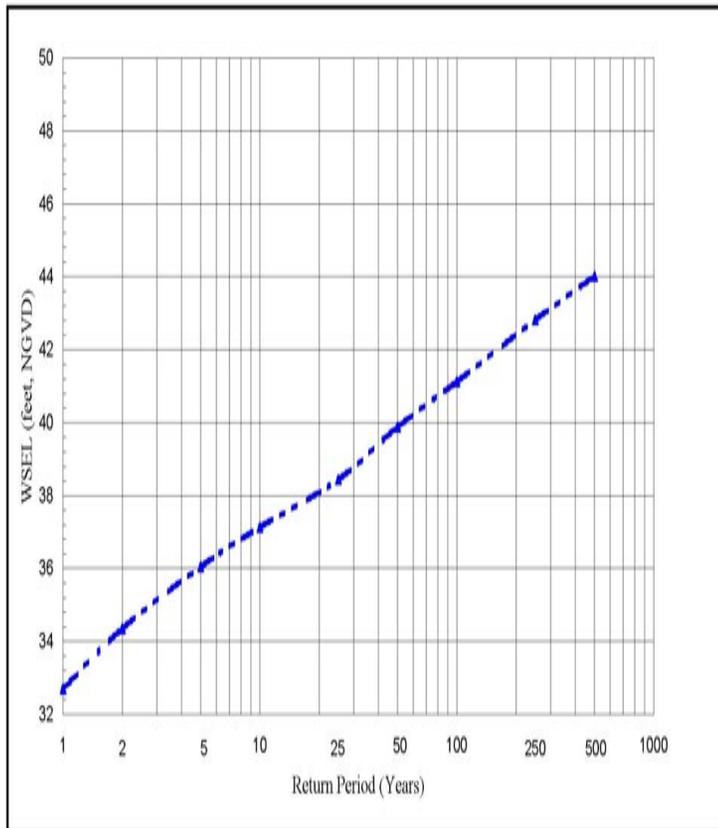


Sta. 2807 on Royce Brook

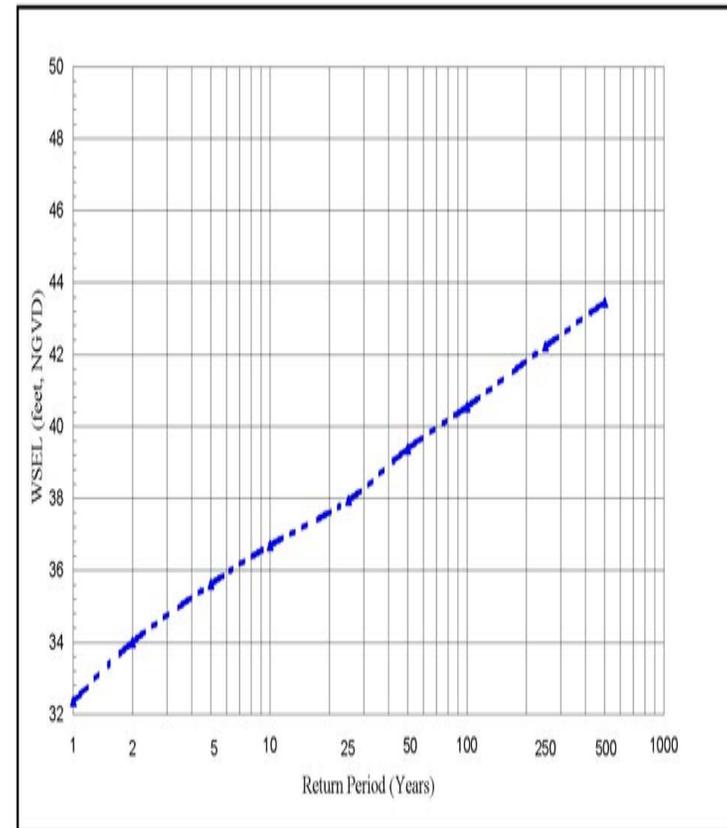


Sta. 98 on Millstone (Upper) River

Stage Frequency Curves at selected cross-sections at damage locations

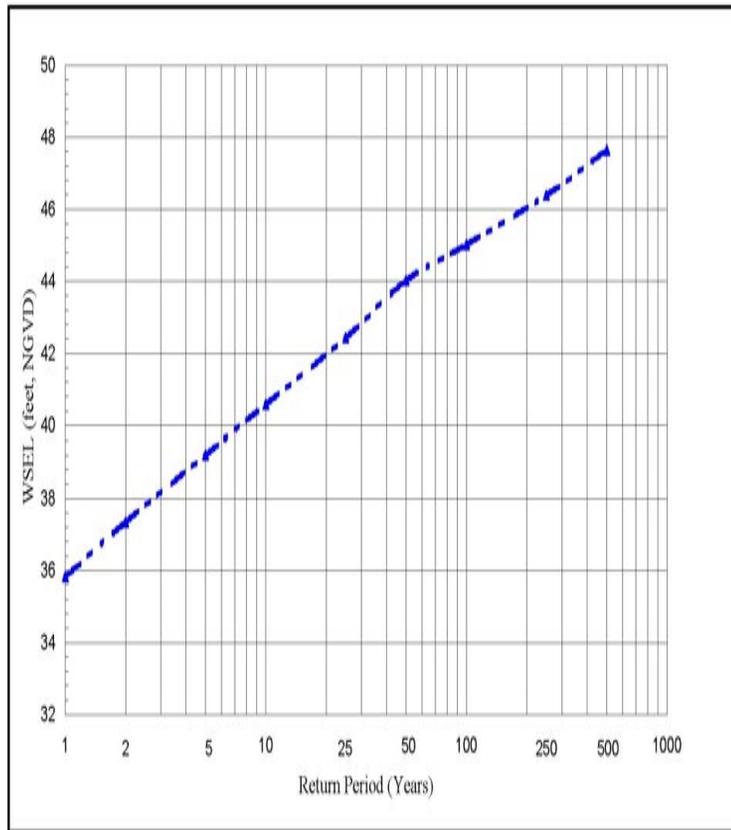


Sta. 7143 on Millstone (Upper) River

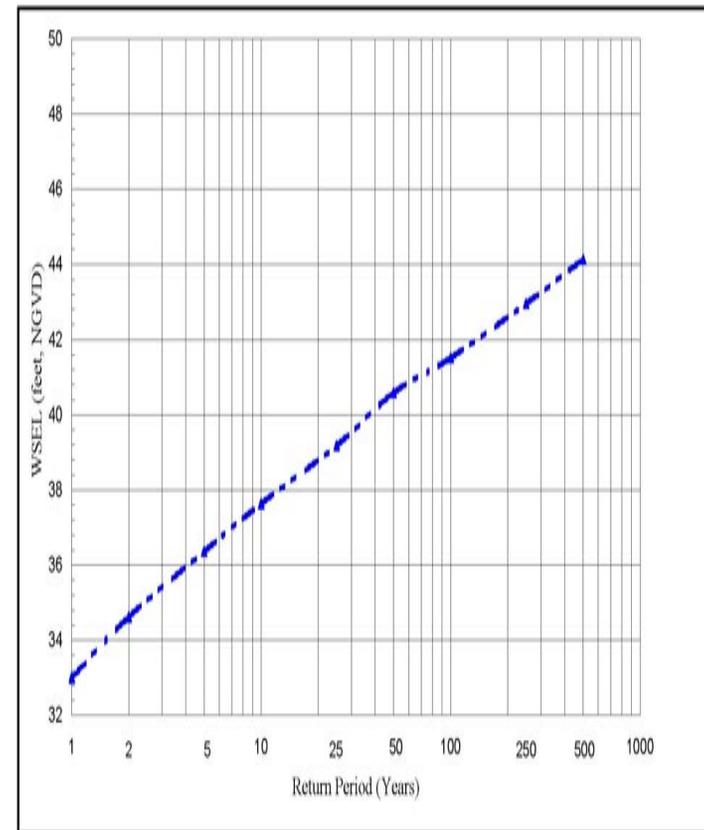


Sta. 1450 on Millstone (Upper) River

Stage Frequency Curves at selected cross-sections at damage locations

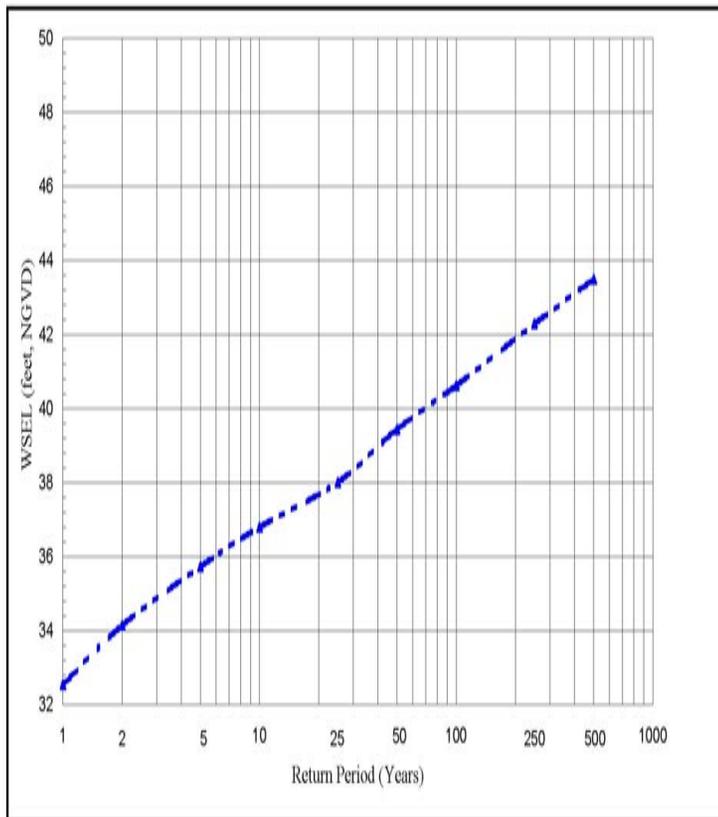


Sta. 10479 on Raritan (Upper) River

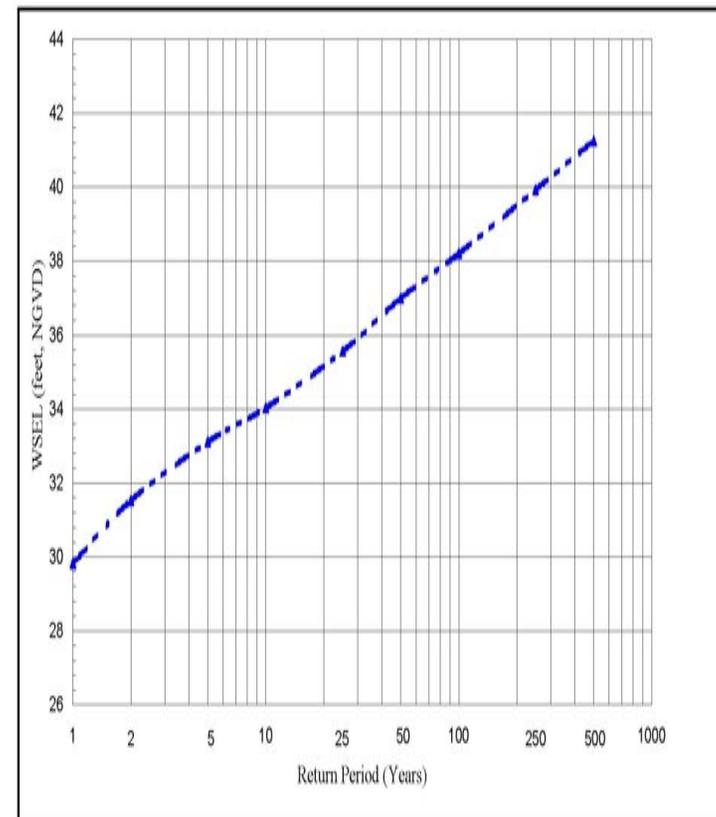


Sta. 2375 on Raritan (Upper) River

Stage Frequency Curves at selected cross-sections at damage locations

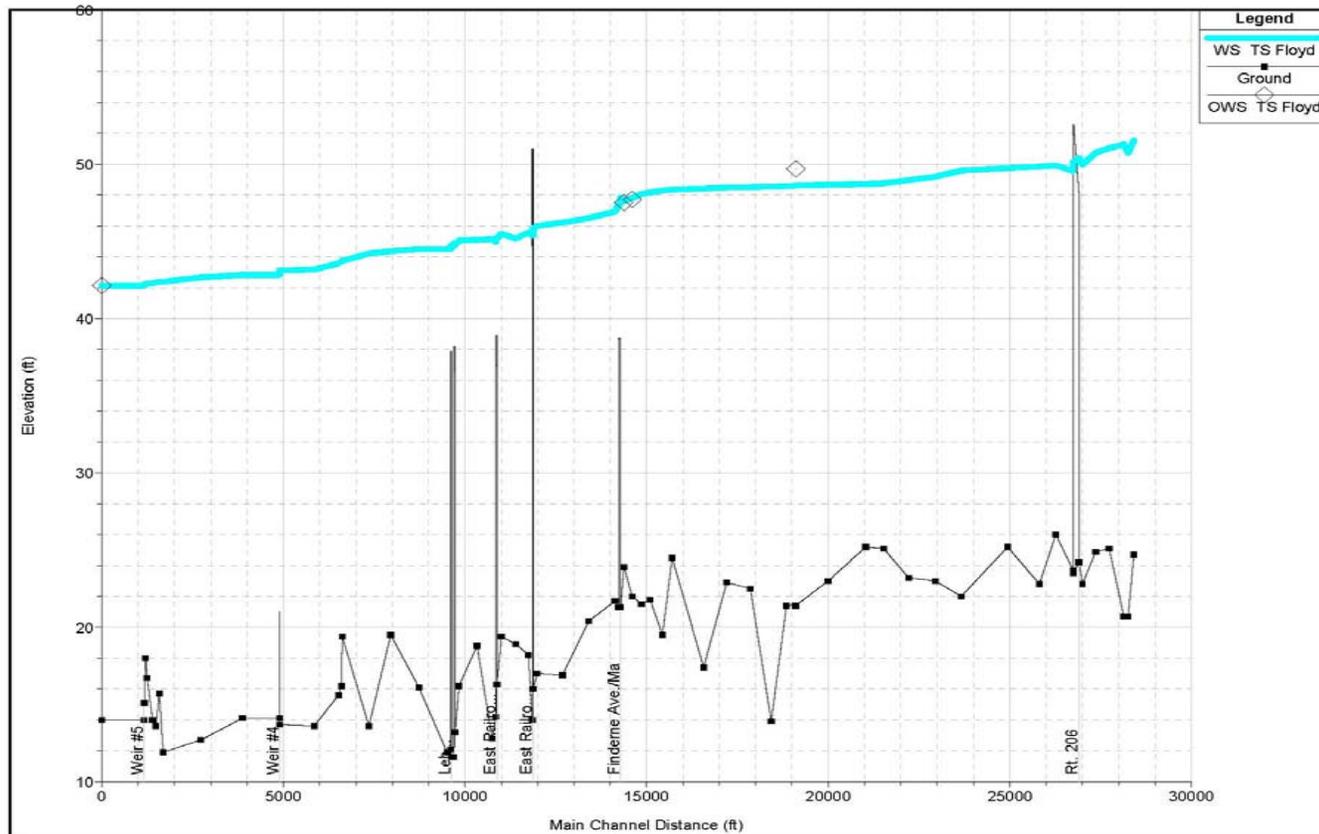


Sta. 774 on Raritan (Upper) River

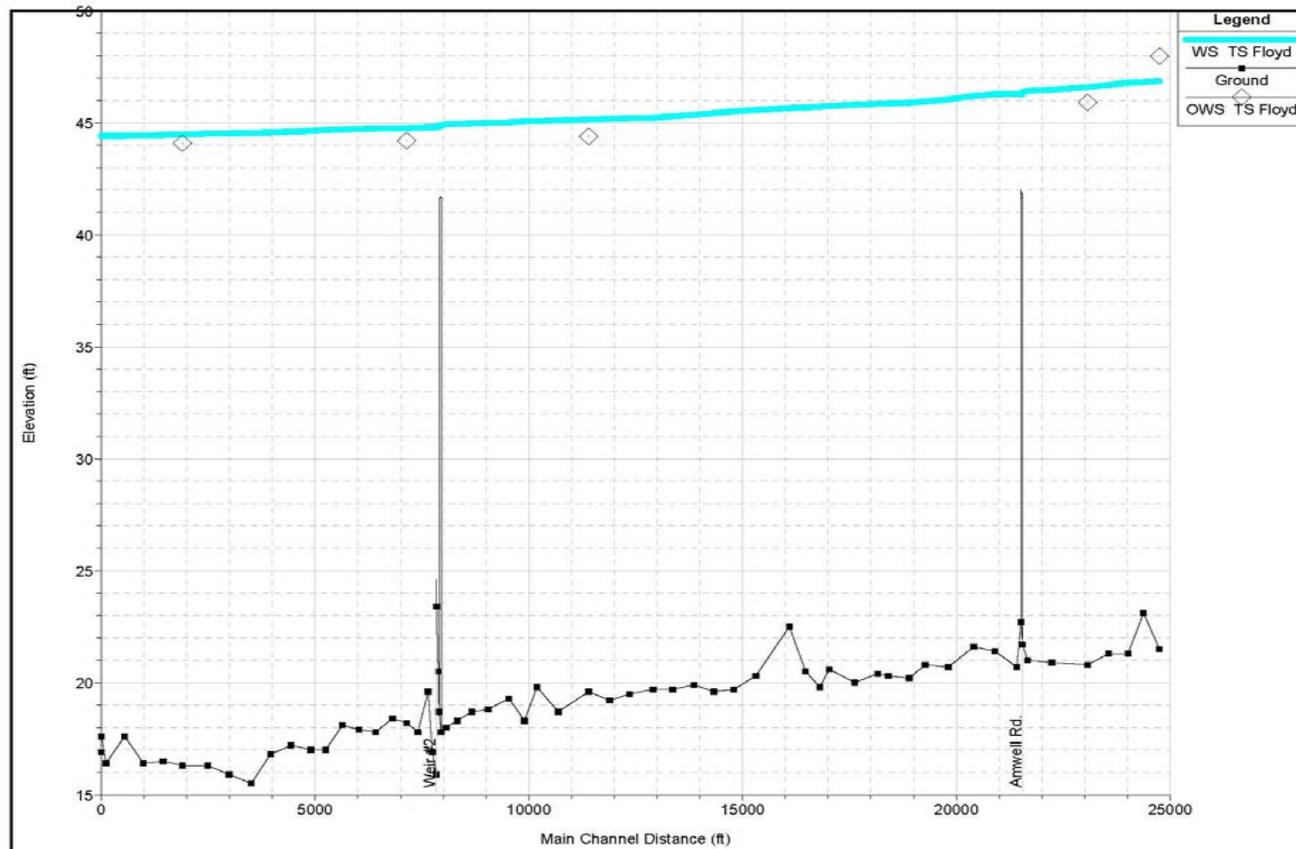


Sta. 0 on Raritan (Lower) River

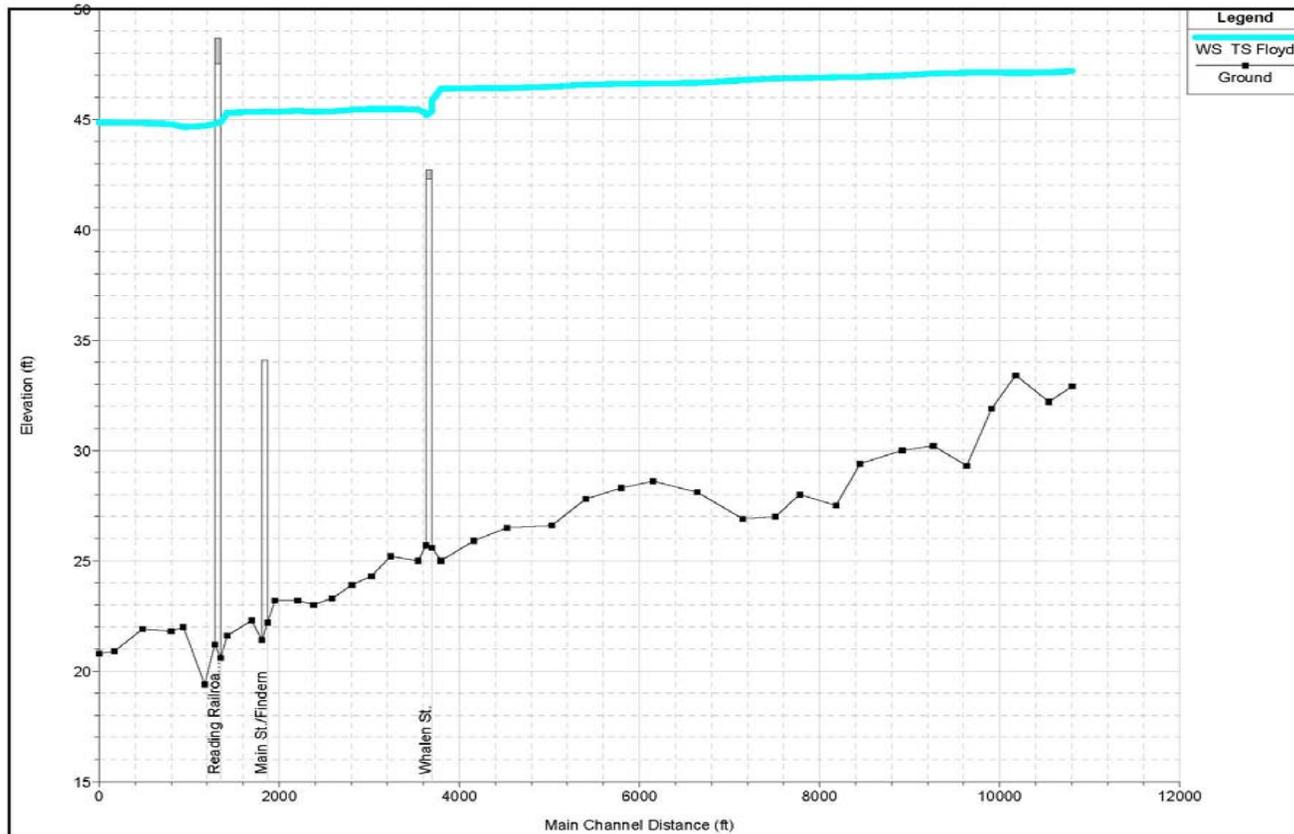
Water Surface Profiles from HEC-RAS: Raritan River - Floyd



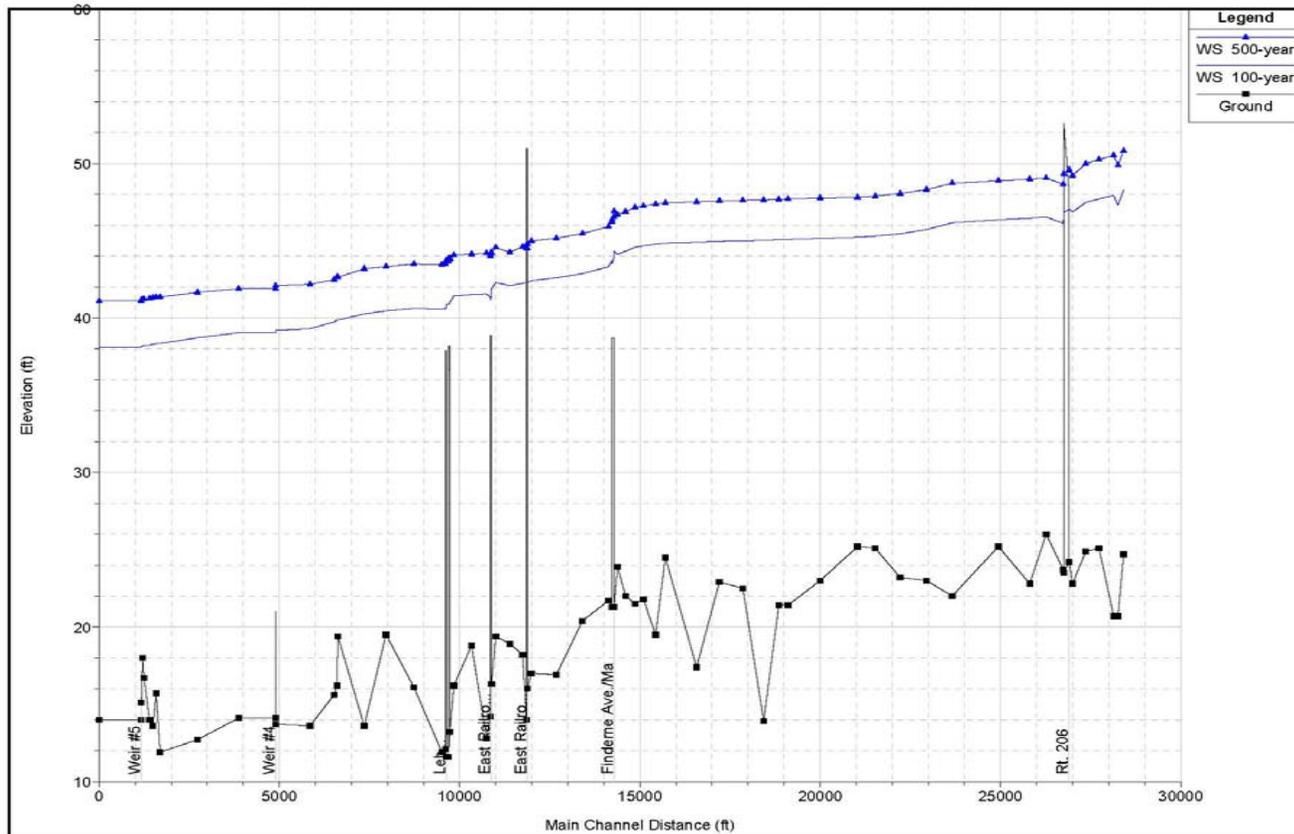
Water Surface Profiles from HEC-RAS: Millstone River - Floyd



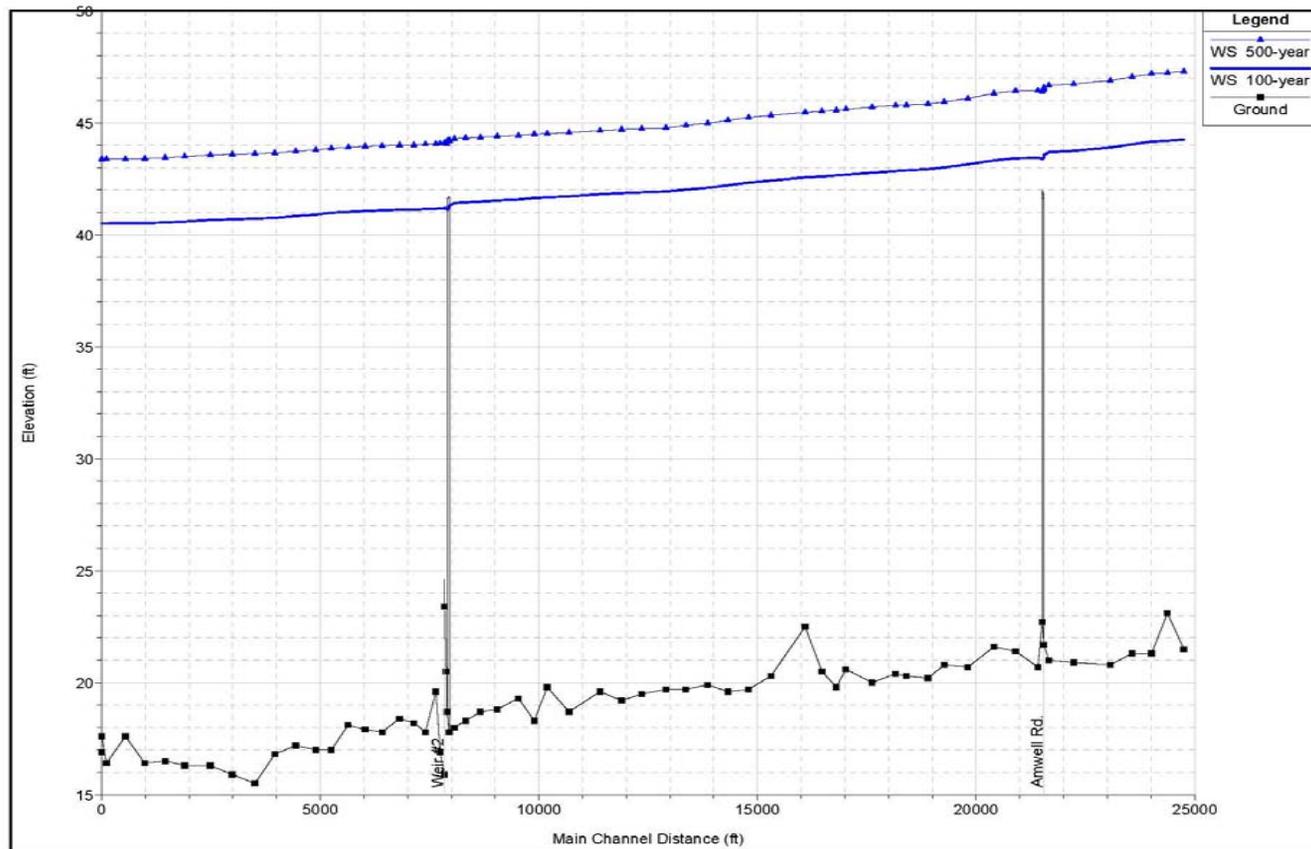
Water Surface Profiles from HEC-RAS: Royce Brook - Floyd



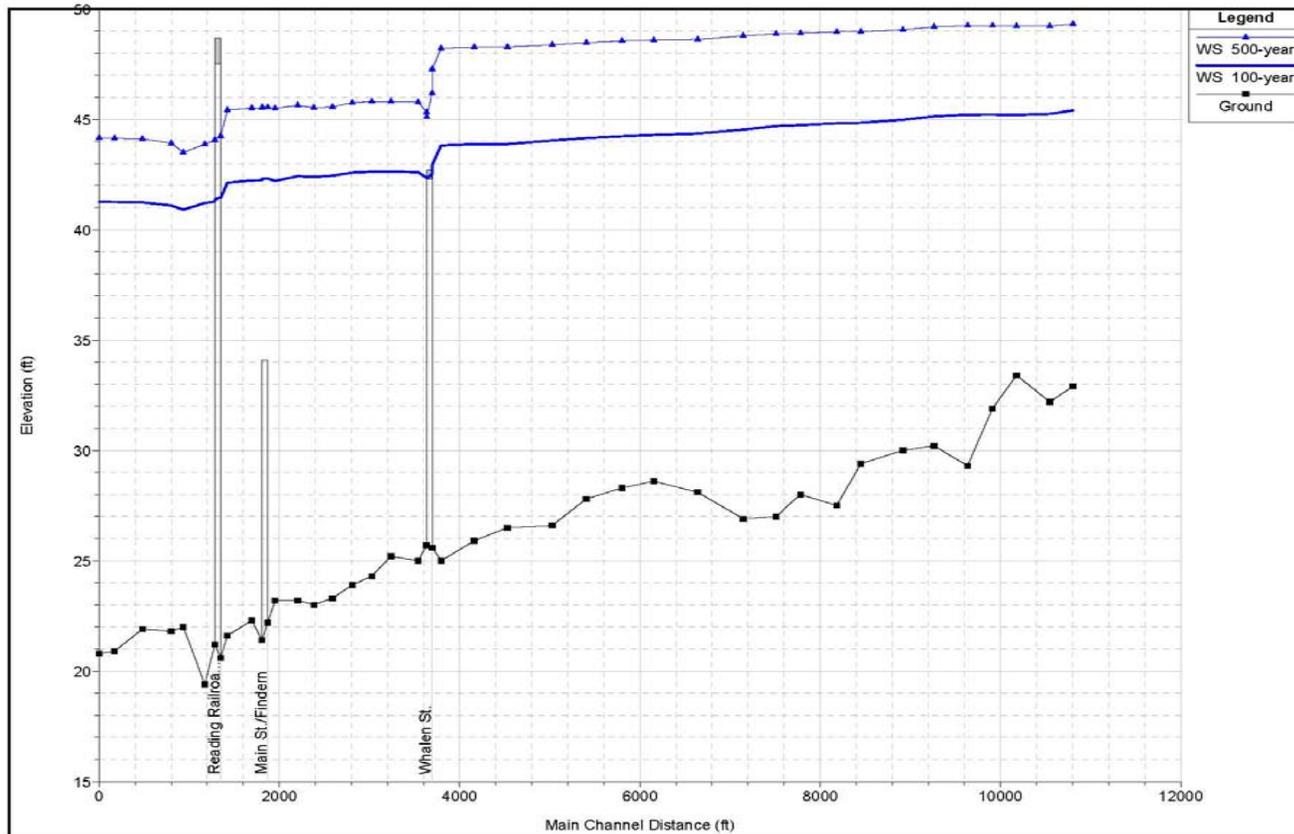
Water Surface Profiles from HEC-RAS: Raritan River - Hypo.



Water Surface Profiles from HEC-RAS: Millstone River - Hypo.



Water Surface Profiles from HEC-RAS: Royce Brook - Hypo.



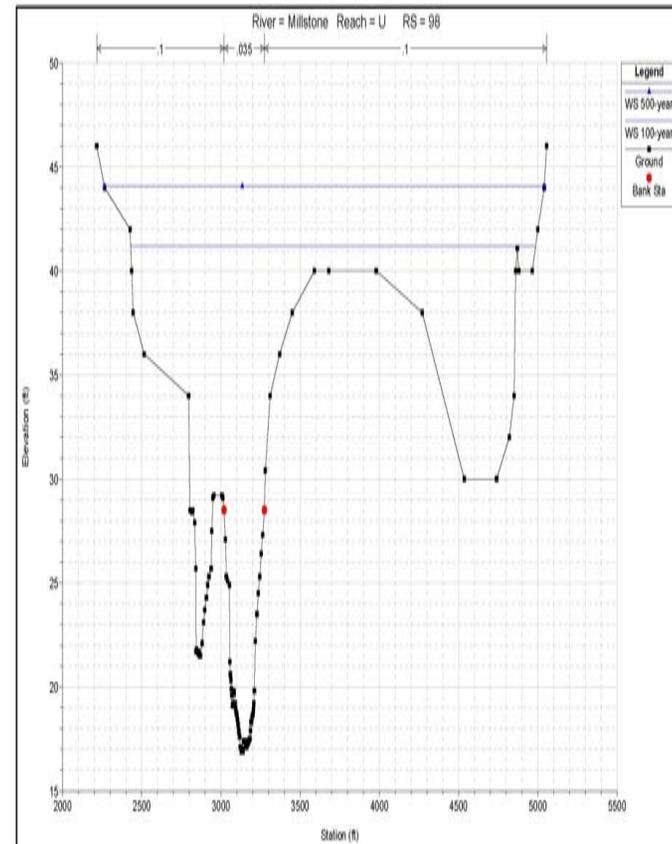
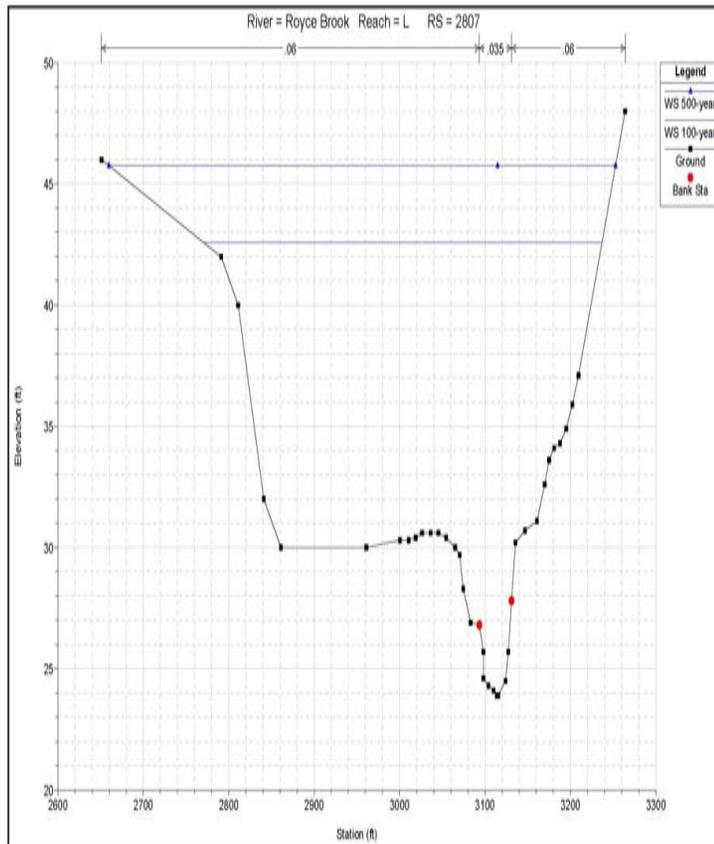
100-year Inundation Mapping



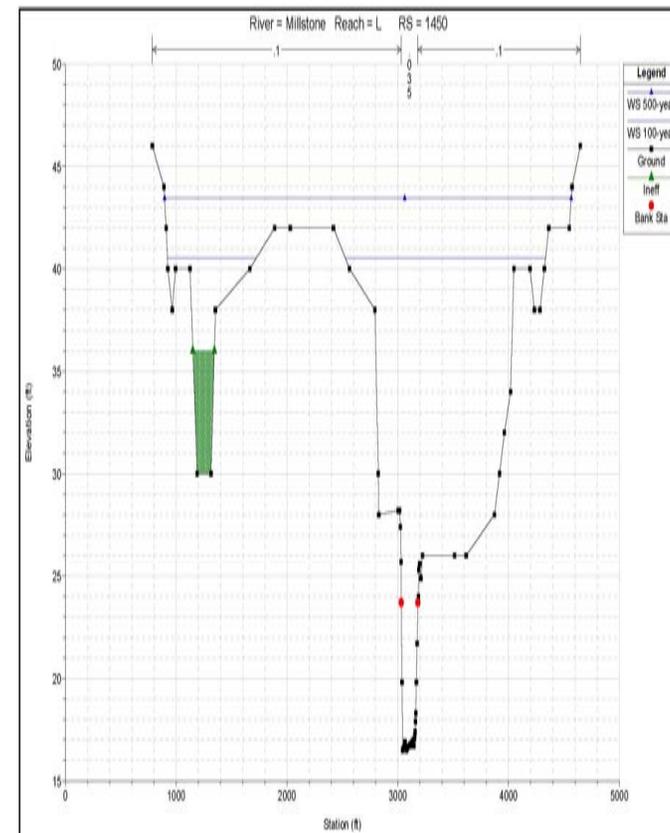
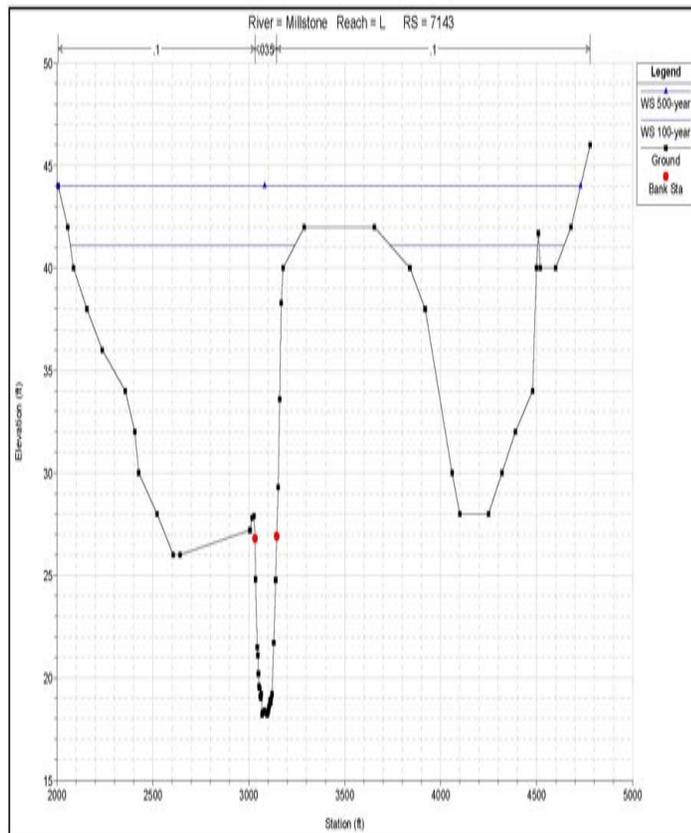
Conclusions of Hydraulic Analysis

- The results of the hydraulic analysis show that flooding does occur at define locations in the project area. These define locations will be represented by selected cross-sections (same ones as the stage-frequency curves).
- For these locations, flood control improvement alternatives can be considered to reduce or eliminate the flooding.

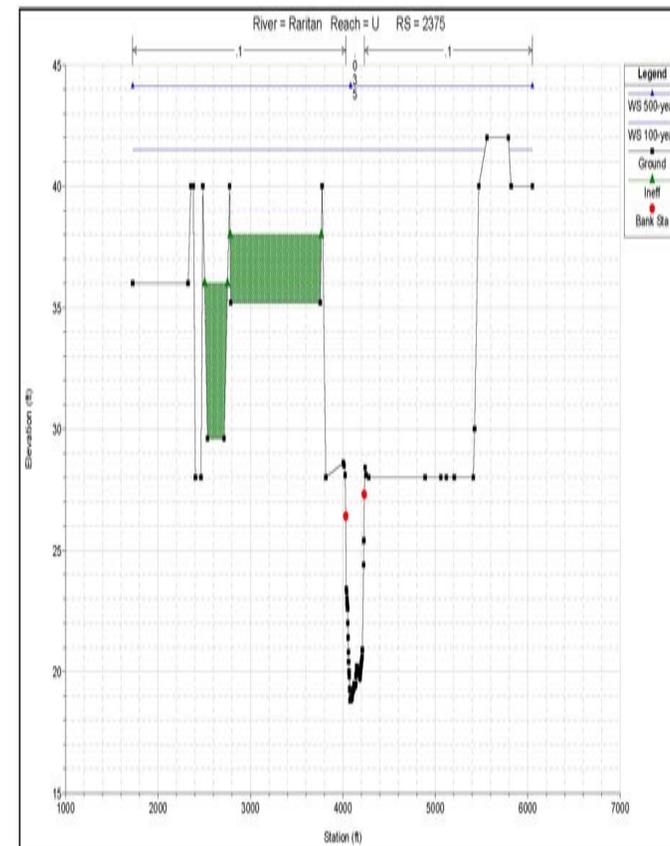
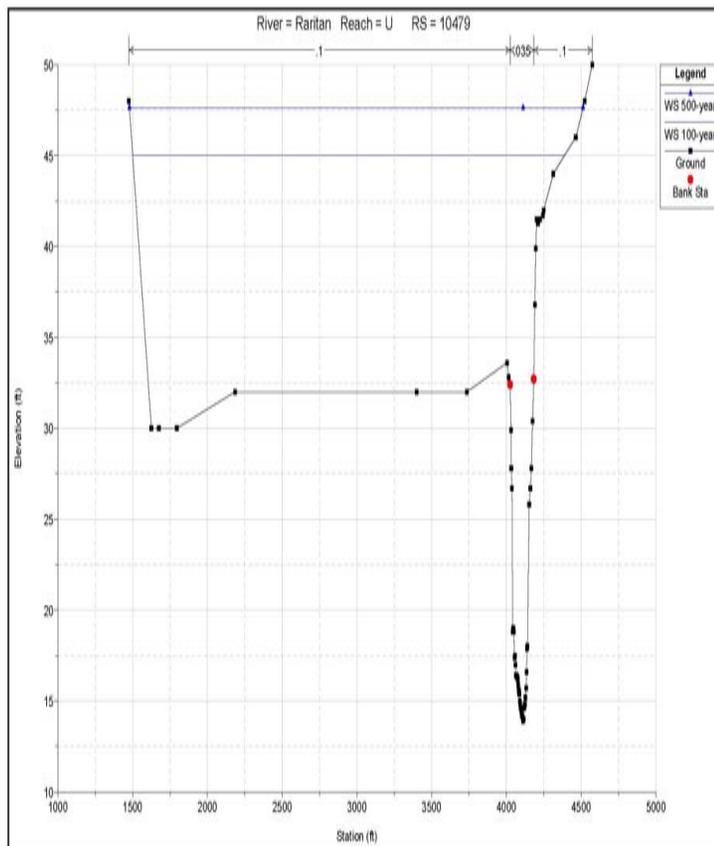
Selected cross-sections for Damage Locations



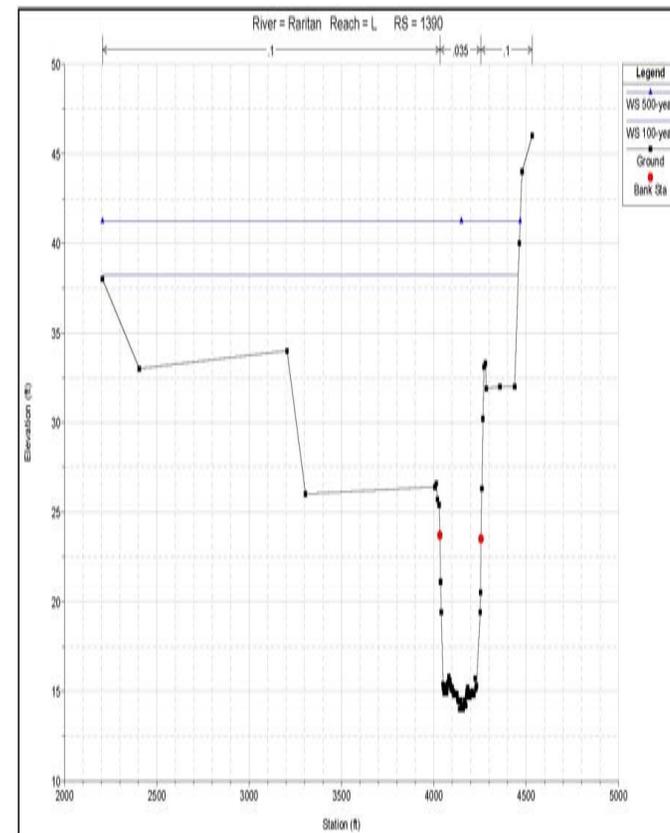
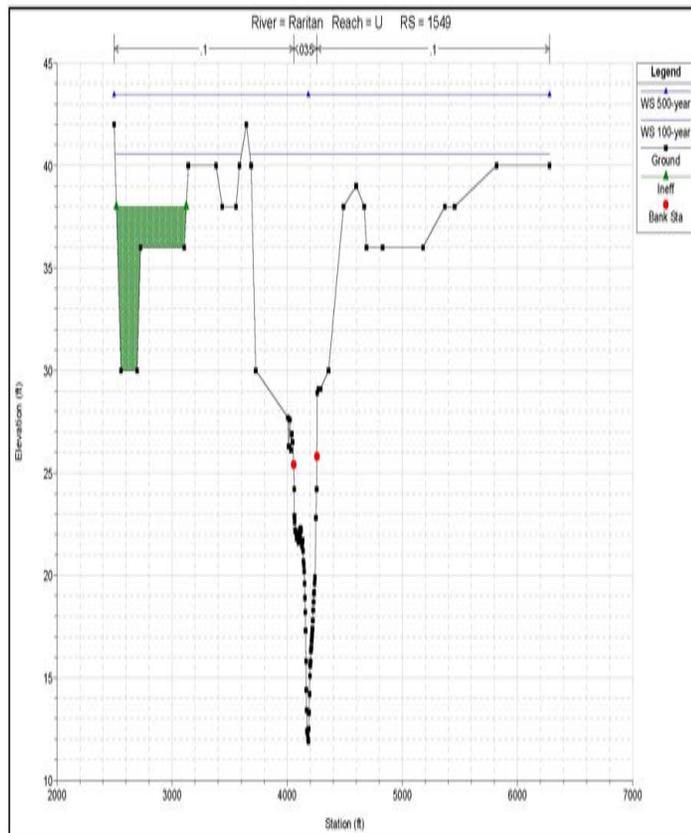
Selected cross-sections for Damage Locations



Selected cross-sections for Damage Locations



Selected cross-sections for Damage Locations

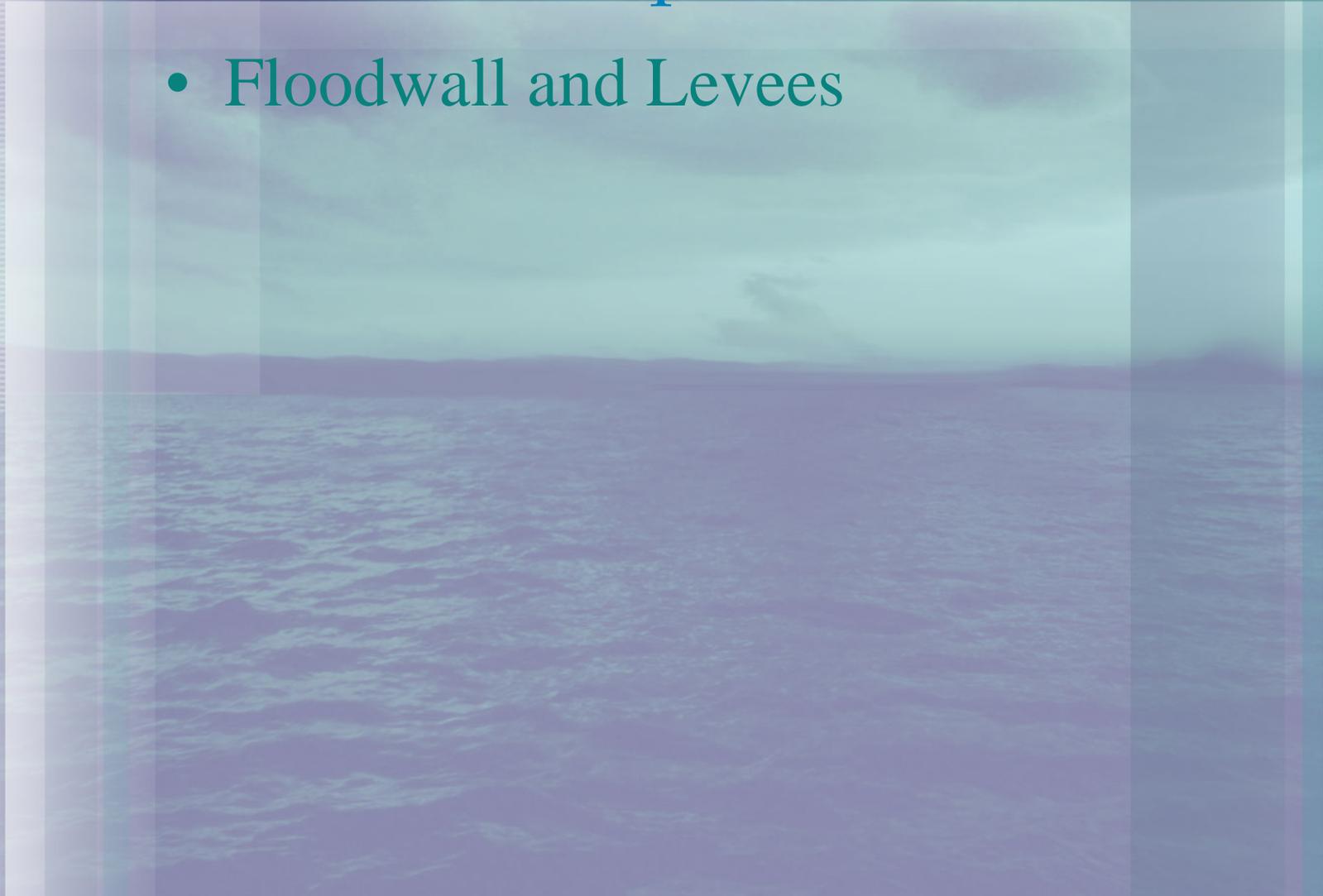


Potential Preliminary Improvements Alternatives

- Floodwall and Levees
- Detention of Floodwaters
- Flood Diversion Culvert
- Channel Modifications, Dredging and Streambank Clearing
- Modifications to existing Somerset County Flood Warning System
- Non-Structural Flood Measures (Flood-proofing, Buyouts, Flood-raising, etc.)

Preliminary Alternatives that will be studied under “Improved Conditions”

- Floodwall and Levees





Questions?