HYDROLOGIC ANALYSIS & EMERGENCY ACCESS RECOMMENDATIONS

FOR

ROOSEVELT ROAD

Town of Hyde Park
Dutchess County, NY

Prepared with funding provided by:

New England Interstate Water Pollution Control Commission

In partnership with the,

NYSDEC Hudson River Estuary Program
21 South Putt Corners Road
New Paltz, NY 12561

MA Project Number: 214701.29

Date Prepared: September 29, 2014

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1.0 INTRODUCTION

The Harbourd Hills/Roosevelt Road area is located in the south-central portion of the Town of Hyde Park and is bordered to the south by the Eleanor Roosevelt National Historic Site (NHS). The area is comprised primarily of single family residential dwellings constructed in and around State and Federal wetlands along the Fallkill Creek. Due to the low lying nature of this area and large upstream watershed, flooding has historically occurred in this area but with the increased frequency and severity of rain events in recent years, the flooding experienced along the Fallkill has also increased.

In the past the Town has evaluated various alternatives to help alleviate the flooding along the Fallkill Creek corridor from the Roosevelt Road area south to the Town of Poughkeepsie border. In these evaluations it has become evident that the change in elevation between the Southern Roosevelt Road crossing and the dam located near the Town of Poughkeepsie boundary is minimal and in some locations the creek bed is actually lower than the dam overflow. These factors all contribute the flooding experienced in this area.

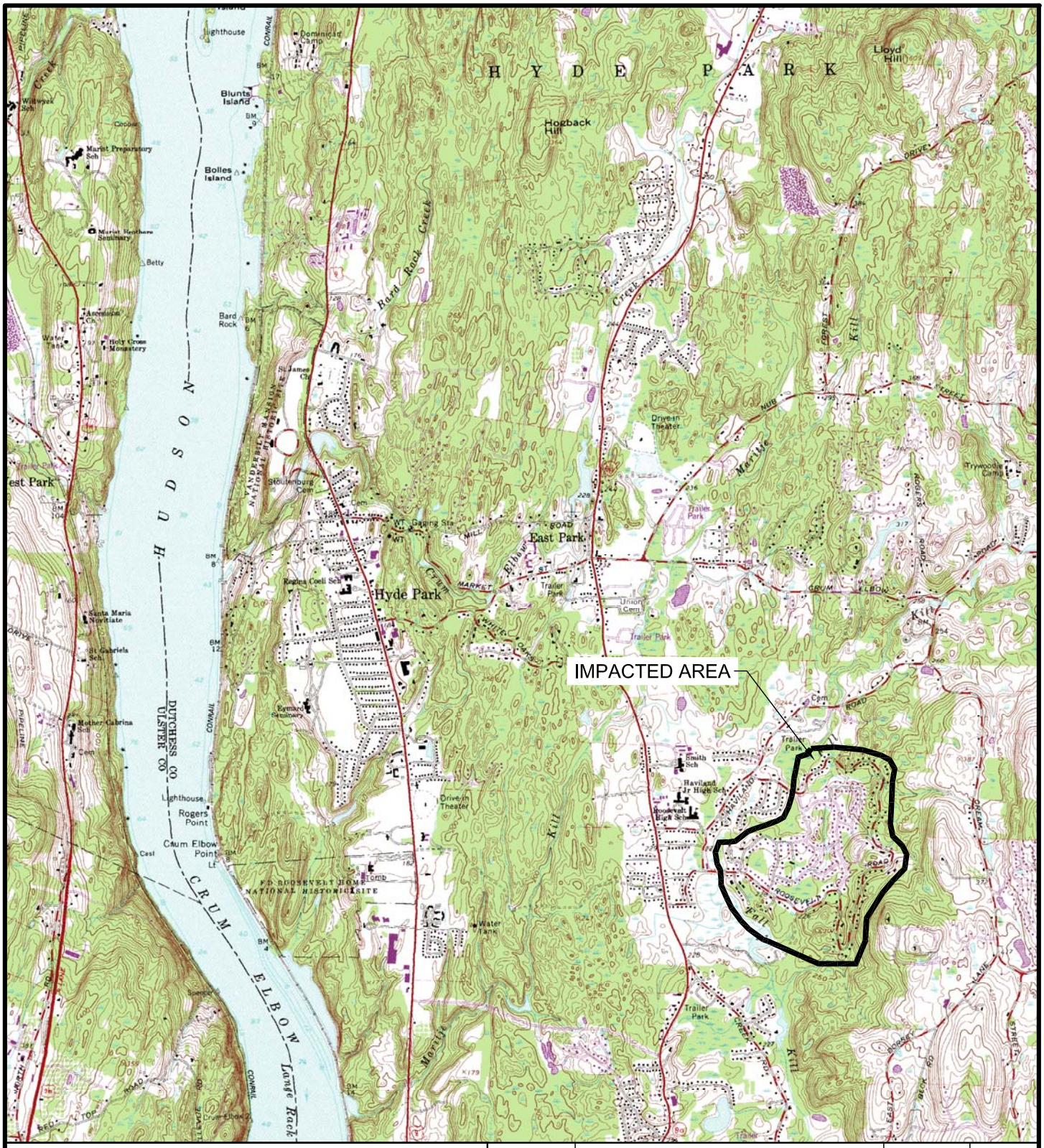
Roosevelt Road is a loop road, with a northerly and southerly crossing over the Fallkill Creek, and is the only means of access to 382 residences east of the Fallkill. When flooding occurs at one or both of the crossings access is limited or completely cut off to these residences. This was the situation that occurred in August 2011 when heavy rains from Hurricane Irene inundated both crossings for a period of approximately 48 hours. A location map indicating the area east of the Fallkill with limited access during flooding events is provided as Figure 1.

This analysis evaluates various alternatives that could be implemented to ensure emergency access to the residences east of the Fallkill without causing increased flooding upstream or downstream. The following is a summary of the potential alternatives:

- Improved South Roosevelt Road Crossing;
- Improved North Roosevelt Road Crossing;
- Improved Eleanor Roosevelt NHS Bridge;
- Cream Street Emergency Access Road;
- Norah Lane Emergency Access Bridge;
- Flood Mitigation Measures

The improvements noted above can be divided into two categories; Alternative Access Options and Flood Mitigation. The alternative access options would provide access to the isolated portion of Roosevelt Road based upon current Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) whereas Flood Mitigation measures would implement flood mitigation measures upstream of the impacted area to reduce or eliminate flooding of the existing Roosevelt Road Crossings. A map indicating the location of each proposed Alternative Access Option is provided as Figure 2.

The following sections evaluate each of the above alternatives based on required improvements, cost and feasibility.



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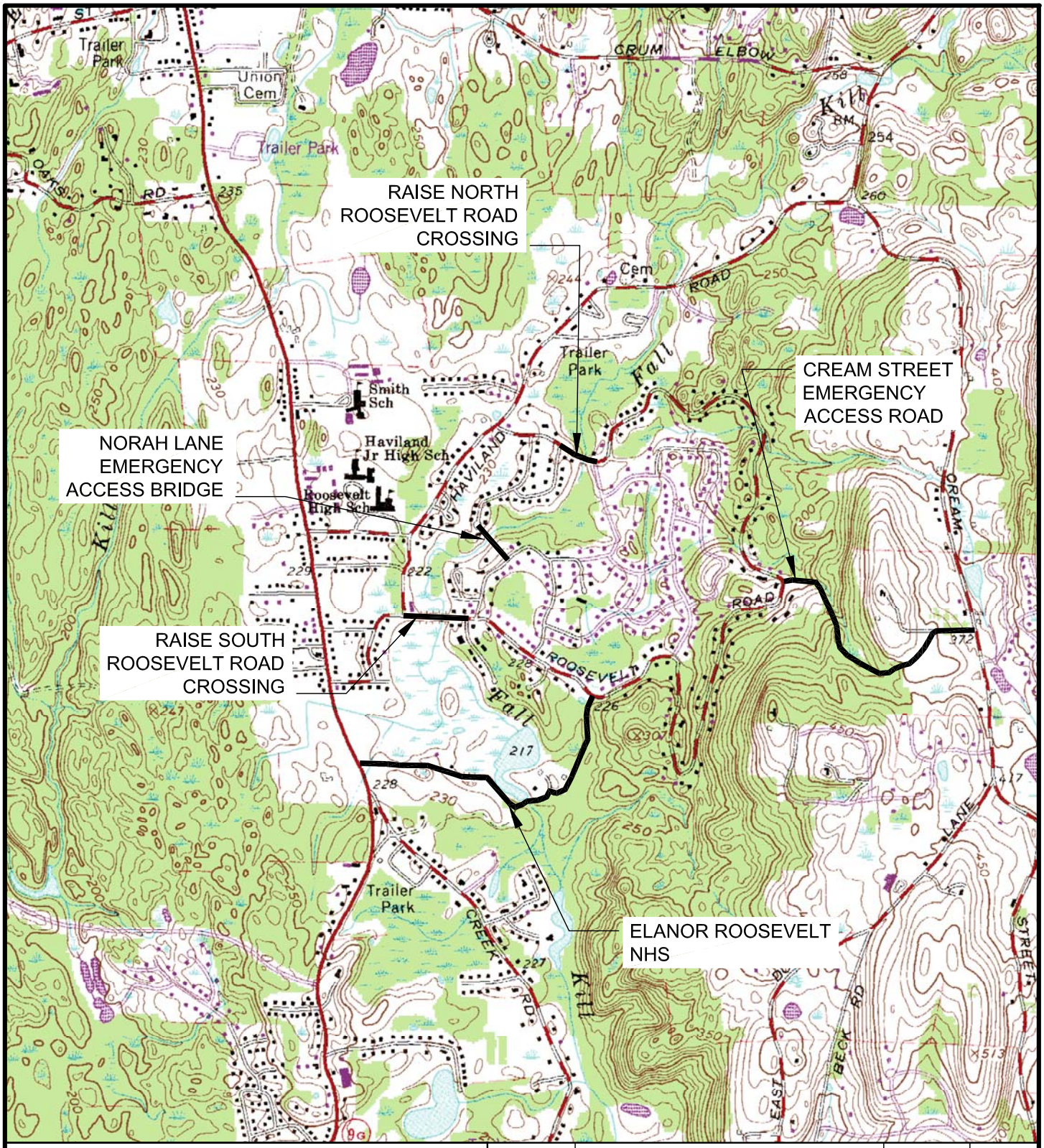
ROOSEVELT ROAD FLOOD MITIGATION

TOWN OF HYDE PARK — DUTCHESS COUNTY, NY

LOCATION MAP

HYDE PARK, NY QUADRANGLE — FIGURE 1

DATE	SCALE	DESIGNED BY:	FILE No.
9/11/2014	1"=1000'	AL	214701.29
		DRAWN BY: KS	
		CHECKED BY: PS	



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ROOSEVELT ROAD FLOOD MITIGATION

TOWN OF HYDE PARK — DUTCHESS COUNTY, NY

ALTERNATE ACCESS OPTIONS

HYDE PARK, NY QUADRANGLE — FIGURE 2

DATE	SCALE		FILE No.
9/11/2014	1"=500'	DESIGNED BY: AL DRAWN BY: KS CHECKED BY: PS	214701.29

2.0 ALTERNATIVE ACCESS OPTIONS

According to FEMA Flood Insurance Rate Map (FIRM) Number 36027C0269E which covers the Roosevelt Road area (See Appendix A), many of the local roads in and around the subject area will be flooded during the 100-Year Storm Event (1% Annual Chance Flood) which must be one of the primary considerations when evaluating the Alternative Access Options. Implementation of an alternative access option will be of no benefit if it is inaccessible or leads to another area isolated by flood waters.

2.1 IMPROVED SOUTH ROOSEVELT ROAD CROSSING

The southern crossing over the Fallkill consists of a concrete box culvert with an open area 15 feet wide and 4.7 feet high. According Dutchess County GeoAccess, a web based geographic information system (GIS), the road elevation at this crossing is approximately 220 feet above mean sea level (MSL). An approximately 400 feet long section of Roosevelt Road immediately west of the crossing is also within the flood plain, at an elevation less than 220 feet above MSL. Any improvements to the stream crossing must also incorporate modification to the section of Roosevelt Road west of the crossing. FEMA flood plain mapping indicates a 100-year flood elevation of 223 feet above MSL at this crossing. Any improvement to this crossing should raise the finished road surface a minimum of 2 feet above the calculated flood plain elevation to an elevation of approximately 225 feet above MSL.

The improvement envisioned for this crossing would involve raising the road surface to elevation 225 from west of Bill Reynolds Boulevard to a point near Douglass Rd, a distance of approximately 800 feet. In order to minimize changes in flow rate downstream, the open area of the box culvert would remain the same and multiple “Flood Plain Culverts” would be installed west of the crossing. Regardless of the number or size of the culverts, this plan is likely to result in an increase in the upstream water surface elevation as water backs up prior to flowing through the culverts rather than sheet flowing over the existing roadway.

Raising the road surface between 4-5 feet would impact 8 properties along that section of Roosevelt Road, requiring easements, modifications to driveways and/or other improvements to the properties to allow continued use after construction. Two of the impacted parcels are owned by the Roosevelt Fire District, the existing Roosevelt Fire Station #3 is located at the corner of Bill Reynolds Boulevard and Roosevelt Road. The new Roosevelt Fire Station #3, currently under construction, is located on the parcel west of the existing Fire Station, with frontage on both Bill Reynolds Boulevard and US Route 9G. Due to flooding impacts to the existing Fire Station, the new Fire Station is being constructed outside the flood plain with direct access to US Route 9G. No plans are yet known for the parcel on which the existing Fire Station is located. Another parcel impacted by this potential improvement option is owned by the National Parks Service (NPS) as part of the Eleanor Roosevelt National Historic Site (NHS).

The parcel owned by the NPS is located south of Roosevelt Road and contains wetlands under the jurisdiction of the NYS Department of Environmental Conservation (NYSDEC). Due to the proximity of the NYSDEC wetlands, the improvements described would require permits from the NYSDEC for wetland impacts as well as the approval of the NPS.

The estimated cost to design, permit and construct the improvements described in this section is $500,000.

2.2 IMPROVED NORTH ROOSEVELT ROAD CROSSING

The northerly crossing over the Fallkill consists of a concrete box culvert with an open area 18.7 feet wide and 5 feet high. According Dutchess County GeoAccess, the road elevation at this crossing is approximately 221 feet above mean sea level (MSL). FEMA flood plain mapping indicates a 100-year flood elevation of 227 feet above MSL at this crossing. Any improvement to this crossing should raise the finished road surface a minimum of 2 feet above the calculated flood plain elevation to an elevation of approximately 229 feet above MSL.

Raising the road surface up to 8 feet would impact at least 16 parcels over a distance of approximately 1,200 feet. Additionally, this section of Roosevelt Road intersects with Haviland Road which is also inundated during the 100-year flood event.

Based upon the flooded conditions predicted west of this crossing and the extent of the improvements required, it does not appear feasible to move forward with improvements to this crossing.

2.3 IMPROVED ELEANOR ROOSEVELT NHS BRIDGE

The Valkill Park Road within the Eleanor Roosevelt National Historic Site (NHS) is the primary means of access to the park from US Route 9G. Although this road is posted as “not a through road” there exists a bridge over the Fallkill and an unpaved road that connects to Roosevelt Road which functions as a secondary point of access to the park.

The existing bridge is wooden and has a 2 ton weight limit posted. The bridge deck elevation is approximately 220 feet above MSL according to Dutchess County GeoAccess and the 100-year flood elevation at this point is 223 feet above MSL.

With the cooperation of the NPS, it would be possible to upgrade the existing bridge to accommodate emergency vehicles and raise the bridge deck elevation to 225 feet above MSL. However, the bridge is bounded by low lying areas to the east and west that will be inundated during the 100-year flood, requiring over 2,000 feet of roadway to be modified.

Based upon the flooded conditions predicted on both sides of this crossing and the extent of the improvements required, it does not appear feasible to move forward with improvements to this crossing.

2.4 CREAM STREET EMERGENCY ACCESS ROAD

At the most easterly point on Roosevelt Road the elevation rises significantly to a point approximately 285 feet above MSL. At this point there is also an existing privately owned parcel (Tax ID Number 133200-6264-03-240428-0000) with frontage on both Roosevelt Road and Cream Street. Cream Street is the next road east of Roosevelt. Based upon discussions with the Chief of the Roosevelt Fire Station #3, in the past an access road existed over this property between Roosevelt Road and Cream Street. A review of the historic photographs available on the Dutchess County GIS seems to confirm this statement.

Considering the relatively high elevation at this point on Roosevelt and the lack of any mapped FEMA flood plains along Cream Street, re-establishment of an emergency access to Cream Street appears to be a logical alternative to modifying or creating new crossings over the Fallkill. This would require the Town to work with the property owner and the Roosevelt Fire District to establish easements and design standards for the emergency access lane.

An emergency access lane between Roosevelt Road and Cream Street would be approximately 3,300 feet in length taking into account the circuitous route required to avoid steep slopes and wetlands. The access lane would be between 20-24 feet in width with a gravel surface and gates on both ends to prevent unauthorized use. The cost to design, permit and construct an emergency access lane as described is estimated to be approximately $425,000.

2.5 NORAH LANE EMERGENCY ACCESS BRIDGE

Another alternative to consider is construction of an emergency access bridge between the end of Norah Lane and Lawrence Road. Norah Lane is a cul-de-sac on the west side of the Fallkill, the end of which is at an elevation of approximately 230 feet above MSL and Lawrence Road connects the two ends of Roosevelt Road, running roughly parallel to the easterly side of the Fallkill. There is an existing drainage easement on the east side of the Fallkill, between two parcels (Tax IDs 133200-6164-02-787535-0000 & 133200-6164-02-793543-0000) that roughly aligns with the cul-de-sac at the end of Norah Lane that could be utilized for construction of an emergency access bridge over the Fallkill. The flood plain elevation in this area is between 224-225 feet above MSL.

The crossing is envisioned as a small one lane bridge between Lawrence Road & Norah Lane for use by emergency vehicles only. Construction of such a bridge would likely require modification of the existing drainage easement and establishment of a new easement over at least one other parcel.

Construction of such a bridge would be costly (at least $500,000) and would lead to the same part of Haviland Road which is flooded during 100-year event as described in Section 2.2 above.

Based upon the flooded conditions predicted on the westerly side of this crossing and the cost of the improvements required, it does not appear feasible to move forward with this alternative.

3.0 FLOOD MITIGATION MEASURES

An alternative to improving or creating new access routes to the portion of Roosevelt Road isolated by flood waters is to implement programs that would alleviate the flooding experienced at the Roosevelt Road crossings. The advantage to this approach is that most flood mitigation strategies would reduce flood plain elevations and thereby minimize damage to buildings prone to flooding as well as ensuring continuous access to the flood isolated portions of Roosevelt Road.

The most effective means of flood mitigation involves construction of water storage facilities that function similarly to stormwater management basins or natural wetlands by expanding the flood plain in undeveloped areas and providing additional volume for flood waters to fill during flood events, detaining the water, slowing stream velocities and reducing flood elevations downstream. When these water storage practices are constructed along a stream they are called On-Stream Storage facilities.

The size and number of On-Stream storage facilities required is a function of the capacity of the stream channel versus the flow rate of the design storm. In this case, the stream channel capacity is limited by the size of the opening at each point at which Roosevelt Road crosses the Fallkill Creek. The culvert dimensions, elevations and capacities at each crossing are summarized in the table below.

Roosevelt Rd Crossing Over Fallkill Creek	Culvert Width	Culvert Height	Road Height Above Streambed	Culvert Capacity
Northern (DP-4)	18.5 ft.	60 in	84 in	900 CFS
Southern (DP-3)	15 ft.	56 in	82 in	630 CFS

Table 1: Culvert Dimensions & Capacity

Culvert dimensions are based upon field measurements. Culvert capacity was calculated using HydroCAD ® stormwater modeling software using the measured culvert dimensions assuming the maximum inlet water surface elevation that will not result in flow overtopping the road. Culvert capacity calculations from HydroCAD are provided in Appendix C.

It is an unexpected finding for the Southern (downstream) crossing to have a smaller cross section and capacity than the Northern crossing. This is most like the result of filling activities that took place in the area west of the Southern crossing, now part of the Roosevelt Fire District Station #3 property. According to historic photographs available through the Dutchess County GIS Aerial Access, filling of the flood plain adjacent to the Fallkill took place sometime between 1936 and the 1940's.

The flow rate at each of the Roosevelt Road Crossing's has been calculated using the USGS StreamStats Program. StreamStats is a web-based geographic information system (GIS) that provides users with access to an assortment of analytical tools that are useful for water-resources planning and management, and for engineering design applications, such as the design of bridges. StreamStats quickly provides watershed information for a selected point on a stream and calculates the flow rates for various storm events using Regression Equations developed by the USGS and the NYSDOT. The following table summarizes the data generated by StreamStats for each crossing.

Roosevelt Rd Crossing Over Fallkill Creek	Watershed Area	Watershed Storage	Peak Flow Rate		
			10-Year Storm	25-Year Storm	100-Year Storm
Northern (DP-4)	10.4 sq. mi. 6,600 acres	4.31% (284 acres)	586 CFS	801 CFS	1,200 CFS
Southern (DP-3)	10.7 sq. mi 6,900 acres	4.50 % (310 acres)	579 CFS	790 CFS	1,180 CFS

Table 2: Existing Watershed Data

Based upon the culvert capacities noted in Table 1, the Southern crossing will flood during the 25-year storm event, whereas the Northern crossing will not flood until the 100-year event. This result corresponds with the observations noted by the Roosevelt Fire Chief during Super Storm Sandy in which the flooding over the Northern crossing receded nearly 24 hours prior to the Southern crossing. It is not feasible to simply increase the size of the Southern crossing to match the size of the Northern crossing to improve emergency access to the portion of Roosevelt Road east of the Fallkill because of the impacts this change would have on areas downstream. Increasing the Southern crossing culvert size would eliminate the detention effect

provided by the smaller culvert and would likely result in increased flow rates and flood elevations downstream.

It should also be noted that the peak flow rates at the Southern crossing are slightly less than those at the Northern crossing, despite a slightly larger watershed area at the Southern crossing. This result can be attributed to the effect of natural On-Stream storage provided by low lying wetlands between the two crossings which equates to approximately 26 acres according to the data provided by StreamStats.

As evidenced by the difference in peak flow rates between the Northern and Southern crossings, On-Stream storage requires large, relatively level land located upstream of the area of interest and adjacent to the stream. Based upon NRCS Technical Release 55 (TR-55) Urban Hydrology for Small Watersheds detention basin storage calculations, the volume of storage required to reduce the Northerly crossing watershed peak flow rate sufficiently to maintain access during the 100-year storm event is approximately 1,100 acre-feet (See Appendix C for detention calculations). This is equivalent to 1,100 acres of water 1 foot deep. Due to the significant difference between the culvert capacity and 100-year peak flow rate at the Southern crossing, similar detention volume calculations would result in a significantly larger volume required. Based upon the detention volumes required, it would not be feasible to pursue On-Stream storage alone to ensure emergency access to the easterly portion of Roosevelt Road.

Upon review of the Dutchess County Parcel Access mapper, there are between 7-8 tracts of land that would lend themselves to On-Stream storage, although they are unlikely to yield the entire volume required to fully mitigate the flooding experienced at the Roosevelt Road crossings. If the Town wishes to pursue this form of flood mitigation some or all of these parcels must be purchased or easements must be negotiated with the owners for the purpose of construction and long term maintenance. The full market value of these parcels ranges from approximately $250,000 to $750,000. Assuming the parcels must be purchased, the total estimated cost of obtaining the required land alone would be over $2 million.

4.0 HEC-RAS MODEL

The US Army Corps of Engineers River Analysis System (HEC-RAS) is software that can be used to determine the hydraulic characteristics of a stream based upon hydraulic flow rate and stream cross sectional data at various points along the stream. HEC-RAS is used to determine the flood plain elevations noted on FEMA flood plain mapping.

A HEC-RAS model of the Fallkill Creek has been developed as part of this analysis for the design of future projects within the corridor upstream and downstream of the Roosevelt Road crossings. The model has been developed to match the water surface elevations indicated on the FEMA Flood Insurance Rate Maps so that the impact of a project on flood elevations can be evaluated. The locations of the stream cross sections used in the model as well as Design Point (DP) locations at which flow rates were calculated using the StreamStats website are indicated on Figure 3 in Appendix A. The stream cross sections have been selected to match as closely as possible with those indicated in the Flood Insurance Study for Dutchess County. Stream cross section elevations were based upon USGS Topographic mapping (Hyde Park & Poughkeepsie Quadrangles). Model output as well as a CD-ROM containing the HEC-RAS file has been provided in Appendix D.

5.0 RECOMMENDATIONS

In conclusion, the flooding experienced along the Fallkill Creek is a regional issue that is too vast and costly for the Town of Hyde Park to resolve independently. As such, the Town should partner with the County and other Watershed wide organizations to develop regional flood control strategies that could include on stream storage and flood plain protection. The Town should also participate in programs that would assist home owners to relocate or demolish structures within the flood plain. Other strategies that could help with flooding issues would include public preparedness campaigns and the purchase of water rescue equipment for local emergency responders.

The most logical short term solution to the flooding of the Roosevelt Road crossings is the construction of the Cream Street Emergency Access Lane. This alternate appears to be the least expensive and most practical option to ensure emergency access that will not be impacted by flood water.

APPENDIX A - Maps

- FEMA Flood Insurance Map No. 36027C0269E
- Figure 3 – Stream Cross Sections & Drainage Design Points

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 18. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3182
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from digital orthophotography provided by the New York State Office of Cyber Security & Critical Infrastructure Coordination. This information was produced as one-foot and two-foot resolution natural color orthoimagery from photography dated April 2006.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

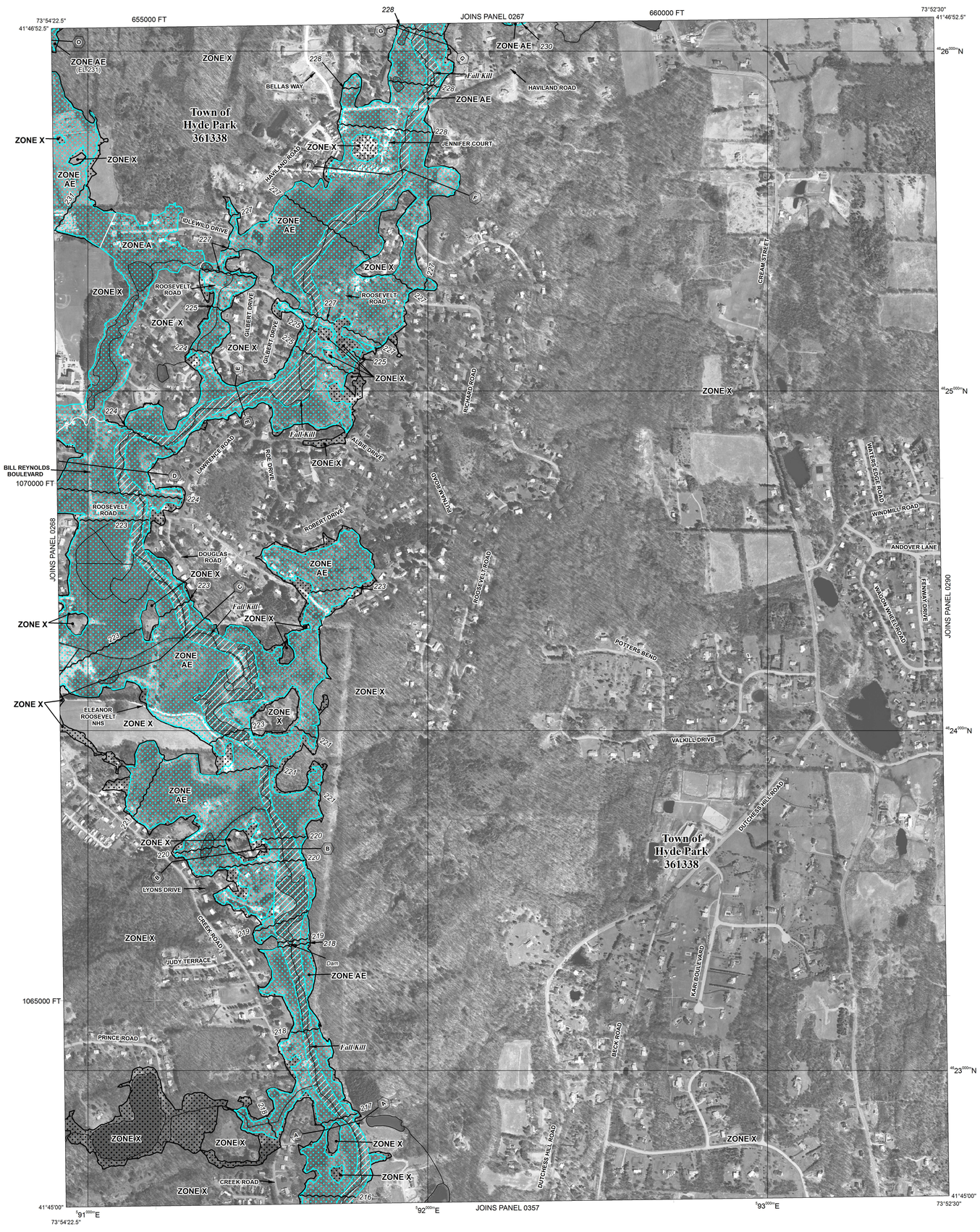
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM, visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange (FMIX) at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

CTP Cooperating Technical Partners

This digital FIRM was produced through a unique cooperative partnership between the New York State Department of Environmental Conservation (NYSDEC) and FEMA. As part of the effort, NYSDEC has joined in a Cooperative Technical Partnership agreement to produce and maintain FEMA's digital FIRM.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL. 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
3 — 3	Limited detail cross section line
23 — 23	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{21}76^{000m}$N	1000-meter Universal Transverse Mercator grid values, zone 18
600000 FT	5000-foot grid values: New York State Plane coordinate system, East zone (FIPSZONE 3101), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
May 2, 2012

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0269E

FIRM

FLOOD INSURANCE RATE MAP

for DUTCHESS COUNTY, NEW YORK
(ALL JURISDICTIONS)

CONTAINS:

COMMUNITY	NUMBER
HYDE PARK, TOWN OF	361338

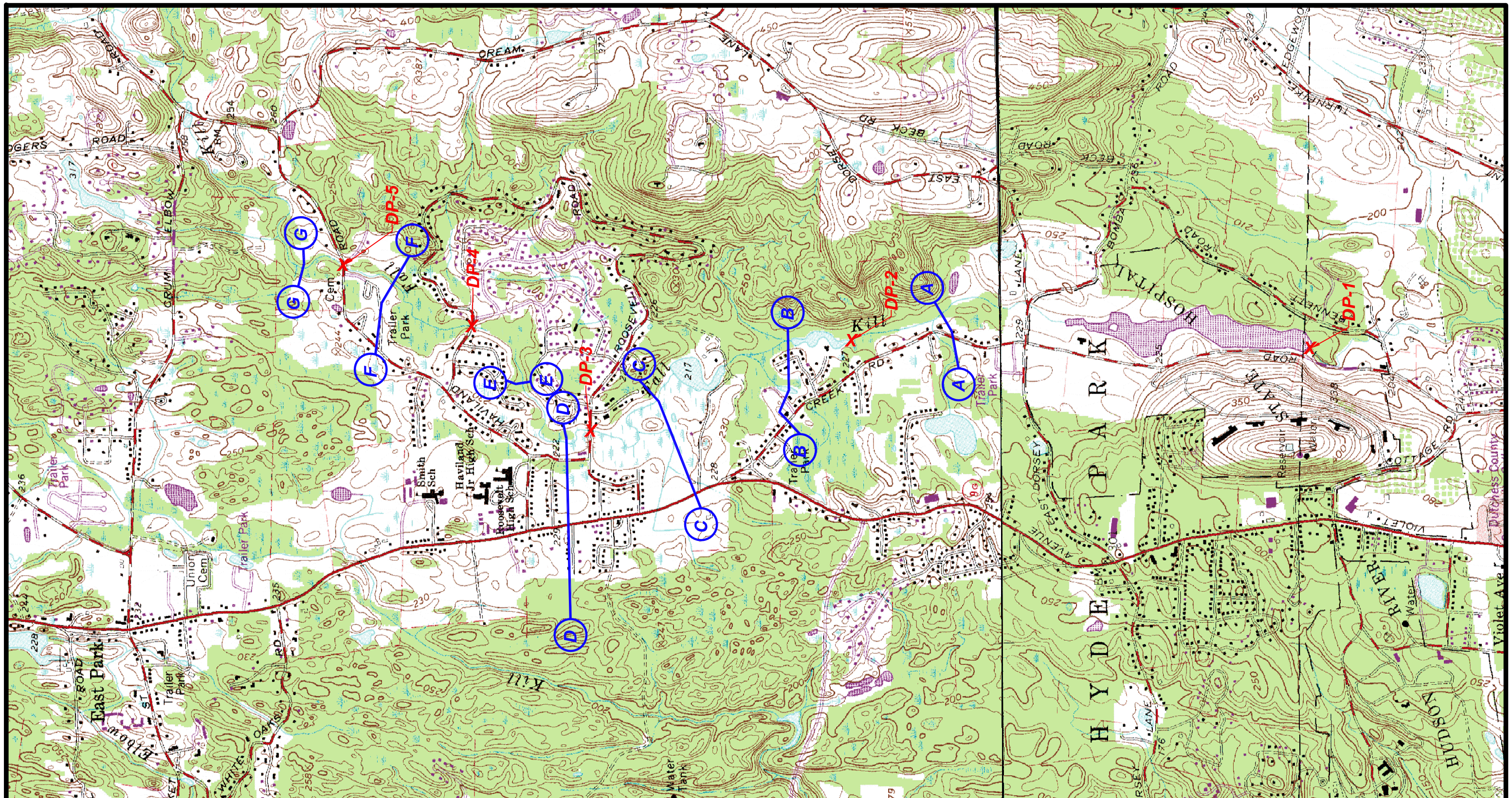
PANEL 269 OF 602
MAP SUFFIX: E
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
36027C0269E

EFFECTIVE DATE
MAY 2, 2012

Federal Emergency Management Agency



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64 Green Street, Hudson, New York 12534
Phone No. (518) 828-2300 Fax No. (518) 828-3963

REV. No.	DESCRIPTION	DATE	BY

ROOSEVELT ROAD FLOOD MITIGATION

TOWN OF HYDE PARK — DUTCHESS COUNTY, NY

STREAM CROSS SECTIONS & DRAINAGE DESIGN POINTS

HYDE PARK/POUGHKEEPSIE, NY QUADRANGLE — FIGURE 3

DATE	SCALE	DESIGNED BY:	FILE No.
9/18/2014	1"=1500'	AL	214701.29
		DRAWN BY: KS	
		CHECKED BY: PS	

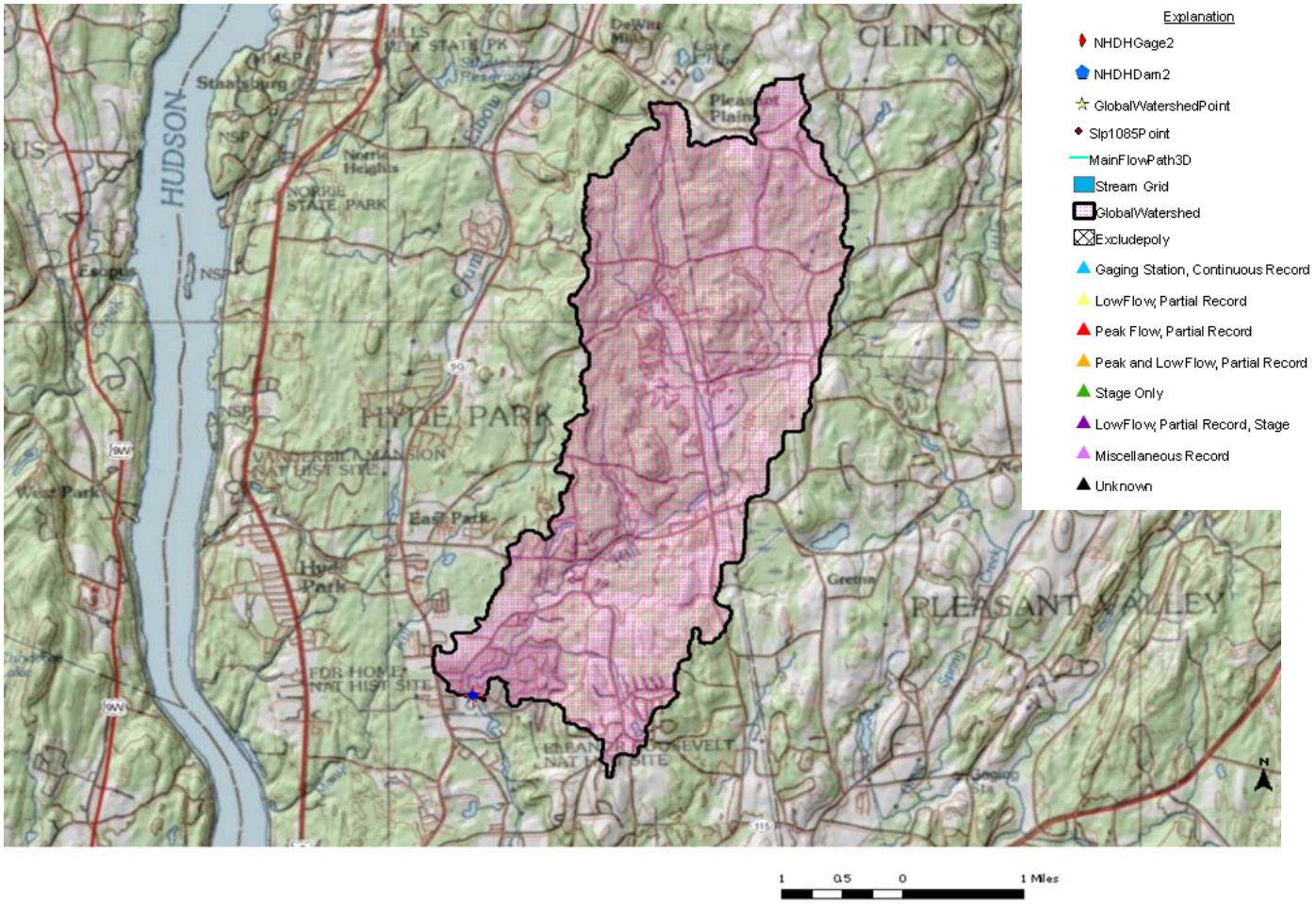
APPENDIX B – Watershed Data

- Roosevelt Road South Crossing
- Roosevelt Road North Crossing

USGS New York StreamStats

Design Point 3

Fallkill Flood Mit



3/25/2014 10:57:23 AM

USGS New York StreamStats

Basin Characteristics Report

Date: Sun Sep 28 2014 20:19:03 Mountain Daylight Time
NAD27 Latitude: 41.7681 (41 46 05)
NAD27 Longitude: -73.9037 (-73 54 13)
NAD83 Latitude: 41.7682 (41 46 06)
NAD83 Longitude: -73.9033 (-73 54 12)
ReachCode: 02020008000660
Measure: 49.89

Parameter	Value
Area that drains to a point on a stream in square miles.	10.7
Main-channel 10-85 slope, in feet per mile	24.1
Main-channel stream length, in miles	9
10-85 slope of lower half of main channel in feet per mile.	19.9
10-85 slope of upper half of main channel in feet per mile.	46.3
Total length of all elevation contours in drainage area in miles	35.82749516
Average basin slope, in feet per mile.	335
Slope ratio. Ratio of main channel slope to basin slope	0.0719
Basin Lag factor.	0.29
Percentage of basin at or above 1200 ft elevation	0
Basin storage. Percentage of total drainage area shown as lakes, ponds and swamps	4.5
Percent of area covered by forest	71.6
Mean annual runoff in inches.	17.6
Seasonal maximum snow depth, 50th percentile, in inches	15.1
Mean annual precipitation in inches.	38.6
Urban Land Use percentage (1992)	4.55

USGS New York StreamStats

Streamstats Ungaged Site Report

Date: Tue Mar 25 2014 10:58:29 Mountain Daylight Time
Site Location: New_York
NAD27 Latitude: 41.7681 (41 46 05)
NAD27 Longitude: -73.9037 (-73 54 13)
NAD83 Latitude: 41.7682 (41 46 06)
NAD83 Longitude: -73.9033 (-73 54 12)
ReachCode: 02020008000660
Measure: 49.64
Drainage Area: 10.7 mi2
Percent Urban: 4.55 %

Peak Flows Region Grid Basin Characteristics

100% 2006 Full Region 2 (10.7 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	10.7	1.93	996
Lag Factor (dimensionless)	0.29	0.014	6.997
Percent Storage (percent)	4.5	0	11.88
Mean Annual Runoff in inches (inches)	17.6	16.03	33.95

Bank Full Region Grid Basin Characteristics

100% Bankfull Region 3 SIR2009 5144 (10.7 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	10.7	0.42	329

Peak Flows Region Grid Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK1_25	180	26	4.8		
PK1_5	218	26	4.3		
PK2	271	26	4.4		
PK5	437	27	7.3		
PK10	579	28	10		
PK25	790	30	14		
PK50	973	31	16		
PK100	1180	33	18		
PK200	1410	35	19		
PK500	1760	38	20		

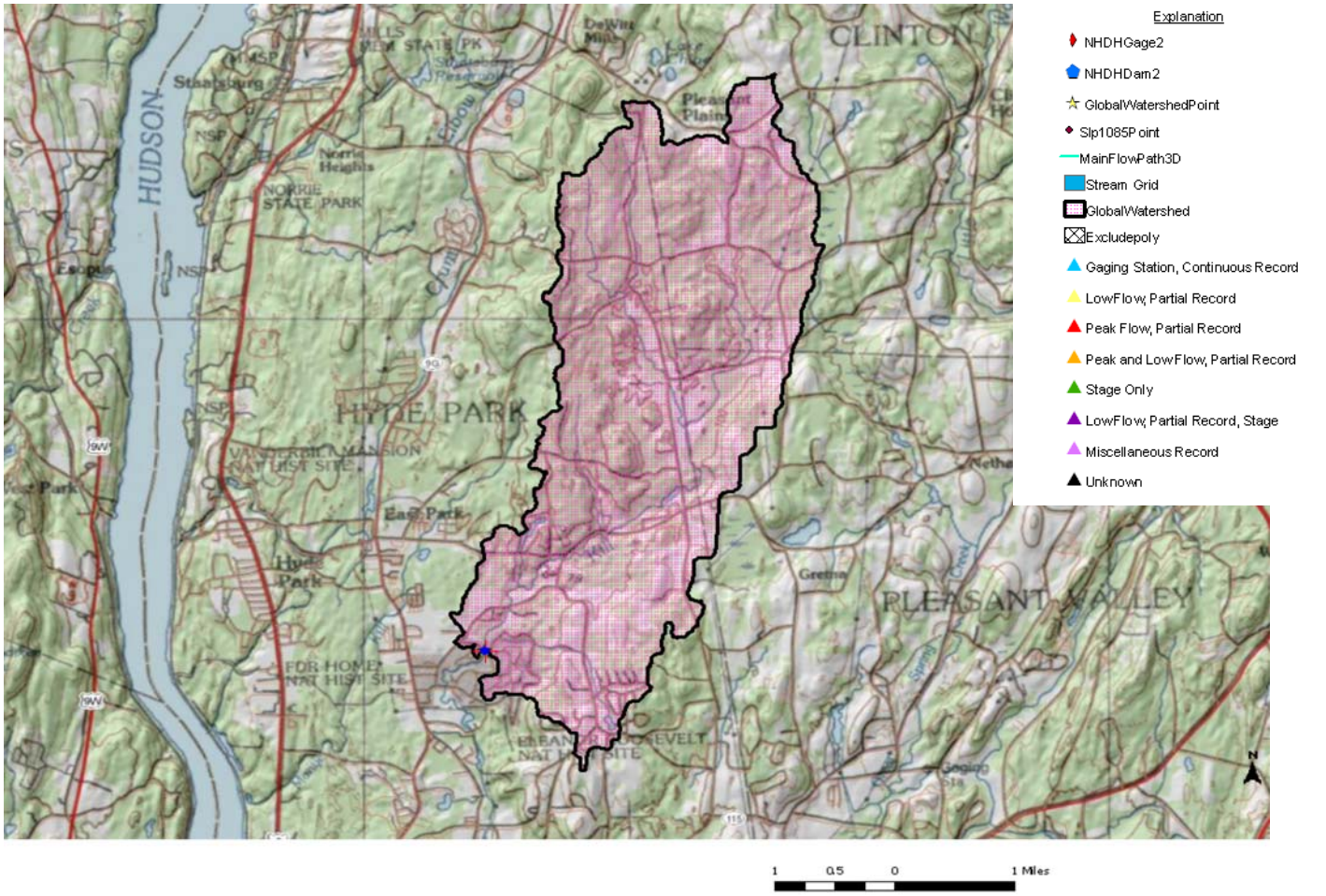
Bank Full Region Grid Streamflow Statistics

Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
BFAREA	131	27		61	282
BFDPTH	2.73	21		1.34	5.57
BFFLOW	419	40		101	1730
BFWDTH	48	23		23.1	99.5

USGS New York StreamStats

Design Point 4

Fallkill Flood Mit



3/25/2014 11:00:17 AM

USGS New York StreamStats

Basin Characteristics Report

Date: Sun Sep 28 2014 20:24:12 Mountain Daylight Time
NAD27 Latitude: 41.7733 (41 46 24)
NAD27 Longitude: -73.8975 (-73 53 51)
NAD83 Latitude: 41.7734 (41 46 24)
NAD83 Longitude: -73.8971 (-73 53 49)
ReachCode: 02020008000660
Measure: 72.74

Parameter	Value
Area that drains to a point on a stream in square miles.	10.4
Main-channel 10-85 slope, in feet per mile	27.3
Main-channel stream length, in miles	8.3
10-85 slope of lower half of main channel in feet per mile.	24.5
10-85 slope of upper half of main channel in feet per mile.	48.8
Total length of all elevation contours in drainage area in miles	35.82749516
Average basin slope, in feet per mile.	344
Slope ratio. Ratio of main channel slope to basin slope	0.0795
Basin Lag factor.	0.23
Percentage of basin at or above 1200 ft elevation	0
Basin storage. Percentage of total drainage area shown as lakes, ponds and swamps	4.31
Percent of area covered by forest	73
Mean annual runoff in inches.	17.6
Seasonal maximum snow depth, 50th percentile, in inches	15.1
Mean annual precipitation in inches.	38.6
Urban Land Use percentage (1992)	3.81

USGS New York StreamStats

Streamstats Ungaged Site Report

Date: Tue Mar 25 2014 11:01:14 Mountain Daylight Time
Site Location: New_York
NAD27 Latitude: 41.7733 (41 46 24)
NAD27 Longitude: -73.8975 (-73 53 51)
NAD83 Latitude: 41.7734 (41 46 24)
NAD83 Longitude: -73.8971 (-73 53 49)
ReachCode: 02020008000660
Measure: 72.88
Drainage Area: 10.4 mi2
Percent Urban: 3.81 %

Peak Flows Region Grid Basin Characteristics

100% 2006 Full Region 2 (10.4 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	10.4	1.93	996
Lag Factor (dimensionless)	0.23	0.014	6.997
Percent Storage (percent)	4.31	0	11.88
Mean Annual Runoff in inches (inches)	17.6	16.03	33.95

Bank Full Region Grid Basin Characteristics

100% Bankfull Region 3 SIR2009 5144 (10.4 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	10.4	0.42	329

Peak Flows Region Grid Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK1_25	182	25	4.8		
PK1_5	219	26	4.3		
PK2	274	26	4.4		
PK5	442	27	7.3		
PK10	586	28	10		
PK25	801	30	14		
PK50	987	32	16		
PK100	1200	33	18		
PK200	1430	35	19		
PK500	1790	38	20		

Bank Full Region Grid Streamflow Statistics

Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
BFAREA	129	27		60.1	278
BFDPTH	2.71	21		1.33	5.54
BFFLOW	411	40		99.1	1700
BFWDTH	47.6	23		22.9	98.7

APPENDIX C - Calculations

- Culvert Capacity
- Detention Volume Estimates

Summary for Pond DP-3: DP-3

Inflow	=	630.00 cfs @	6.00 hrs,	Volume=	777.994 af
Outflow	=	630.00 cfs @	6.00 hrs,	Volume=	777.994 af, Atten= 0%, Lag= 0.0 min
Primary	=	630.00 cfs @	6.00 hrs,	Volume=	777.994 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 219.97' @ 5.95 hrs
Flood Elev= 220.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	213.17'	**15.00' W x 4.67' H x 24.0' long Culvert DP-3** Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 213.05' S= 0.0050 '/' Cc= 0.900 n= 0.030 Stream, clean & straight

Primary OutFlow Max=630.02 cfs @ 6.00 hrs HW=219.97' (Free Discharge)
↑**1=Culvert DP-3** (Barrel Controls 630.02 cfs @ 8.99 fps)

Summary for Pond DP-4: DP-4

Inflow	=	900.00 cfs @	6.00 hrs, Volume=	1,111.787 af
Outflow	=	900.00 cfs @	6.00 hrs, Volume=	1,111.787 af, Atten= 0%, Lag= 0.0 min
Primary	=	900.00 cfs @	6.00 hrs, Volume=	1,111.787 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 220.98' @ 6.00 hrs
Flood Elev= 221.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	214.00'	**18.66' W x 5.00' H x 24.0' long Culvert DP-4** Box, headwall w/3 rounded edges, Ke= 0.200 Outlet Invert= 213.88' S= 0.0050 '/' Cc= 0.900 n= 0.030 Stream, clean & straight

Primary OutFlow Max=900.02 cfs @ 6.00 hrs HW=220.98' (Free Discharge)
↑**1=Culvert DP-4** (Barrel Controls 900.02 cfs @ 9.65 fps)

Project:	214701.29
Project Name:	Roosevelt Rd Flood Mitigation
Location:	T/Hyde Park
County:	Dutchess
State:	NY
State:	9/28/2014

Extreme Flood Protection Volume, (Q_f)

Design Point 4: **Northern Crossing**

Qp_{v100} = post-development total storm runoff volume of a 100-year event

q_{i100} (cfs), (post-developed)	q_{o100} (cfs), (pre developed)	$(q_{o100})/(q_{i100})$	CN, (post development)	Vs/Vr, (see figure 8.6)	Qp_{v100} (ft^3)	Vs (acre-feet)	Vs (ft^3)
1200	900	0.750	73	0.535	88905960	1091.935	47564689

Storage Required to Mitigate 100-year event	**$Q_{p\text{-}100}$ (acre-ft) =**	**1100.000**
	$Q_{p\text{-}100}$ (ft^3) =	**47916000**

Summary for Subcatchment 1S: Northern Crossing Watershed

Runoff = 1,201.91 cfs @ 36.28 hrs, Volume= 2,041.424 af, Depth> 3.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=8.00"

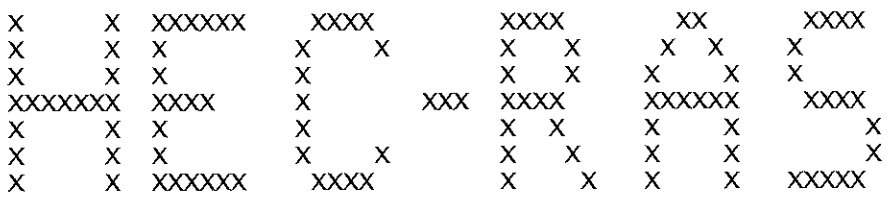
Area (ac)	CN	Description
4,752.000	70	Woods, Good, HSG C
251.000	98	Paved parking & roofs
1,597.000	79	1 acre lots, 20% imp, HSG C
6,600.000	73	Weighted Average
6,029.600		Pervious Area
570.400		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1,720.0					**Direct Entry,**

APPENDIX D – HEC-RAS Output

RooseveltRoadFloo.rep

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California



PROJECT DATA
Project Title: Roosevelt Road Flood Mitigation Base
Project File : RooseveltRoadFloo.prj
Run Date and Time: 5/9/2014 4:30:44 PM

Project in English units

PLAN DATA

Plan Title: Plan 01
Plan File : e:\documents\Hyde Park\2014\214701.29 Roosevelt Rd Drainage\Design\RooseveltRoadFloo.p01

Geometry Title: Roosevelt Road Flood Mitigation Base
Geometry File : e:\documents\Hyde Park\2014\214701.29 Roosevelt Rd Drainage\Design\RooseveltRoadFloo.g01

Flow Title : Flow 01
Flow File : e:\documents\Hyde Park\2014\214701.29 Roosevelt Rd Drainage\Design\RooseveltRoadFloo.f01

Plan Summary Information:

Number of:	Cross Sections	= 11	Multiple Openings	=	0
	Culverts	= 3	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.3
Flow tolerance factor	= 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Flow 01
Flow File : e:\documents\Hyde Park\2014\214701.29 Roosevelt Rd Drainage\Design\RooseveltRoadFloo.f01

Flow Data (cfs)

River	Reach	RS	PF 1
Fallkill	1	15065	1300
Fallkill	1	13373	1440
Fallkill	1	0	1660

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Fallkill	1	PF 1	Normal S = 0.0005	Normal S = 0.0005

GEOMETRY DATA

Geometry Title: Roosevelt Road Flood Mitigation Base
Geometry File : e:\documents\Hyde Park\2014\214701.29 Roosevelt Rd Drainage\Design\RooseveltRoadFloo.g01

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 15065

INPUT
Description: X-Sect. G
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	235	100	230	133	218	139	225	159	220
382	220	415	221	503	225	618	230		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	100	.02	139	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
100	139	2103	1692	1949	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	222.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.05	Wt. n-Val.		0.020	0.020
W.S. Elev (ft)	222.64	Reach Len. (ft)	2103.00	1692.00	1949.00

Crit W.S. (ft) 701.63		Flow Area (sq ft)		38.76
E.G. Slope (ft/ft) 701.63	0.000184	Area (sq ft)		38.76
Q Total (cfs) 1238.57	1300.00	Flow (cfs)		61.43
Top Width (ft) 302.53	319.26	Top Width (ft)		16.72
Vel Total (ft/s) 1.77	1.76	Avg. Vel. (ft/s)		1.58
Max Chl Dpth (ft) 2.32	4.64	Hydr. Depth (ft)		2.32
Conv. Total (cfs) 91258.0	95784.3	Conv. (cfs)		4526.4
Length Wtd. (ft) 302.91	1808.17	Wetted Per. (ft)		19.67
Min Ch El (ft) 0.03	218.00	Shear (lb/sq ft)		0.02
Alpha 0.00	1.00	Stream Power (lb/ft s)	618.00	0.00
Frctn Loss (ft) 30.35	0.64	Cum Volume (acre-ft)	173.28	208.46
C & E Loss (ft) 14.80	0.01	Cum SA (acres)	113.87	100.36

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 13373

INPUT
Description: X-sect. F
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	230	506.5	231	586	230	968	225	1058	218
1099	220	1218	221	1247	220	1435	225	1670	230
1706	235								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	968	.02	1435	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
968	1435	1865	1964 1820.5	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	222.04	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.13	Wt. n-Val.		0.020
W.S. Elev (ft)	221.91	Reach Len. (ft)	2204.00	3278.00
3574.50				
Crit W.S. (ft)		Flow Area (sq ft)		493.41

E.G. Slope (ft/ft)	0.000834	Area (sq ft)		493.41
Q Total (cfs)	1440.00	Flow (cfs)		1440.00
Top Width (ft)	310.85	Top Width (ft)		310.85
Vel Total (ft/s)	2.92	Avg. Vel. (ft/s)		2.92
Max Chl Dpth (ft)	3.91	Hydr. Depth (ft)		1.59
Conv. Total (cfs)	49855.2	Conv. (cfs)		49855.2
Length Wtd. (ft)	3246.54	Wetted Per. (ft)		311.10
Min Ch El (ft)	218.00	Shear (lb/sq ft)		0.08
Alpha	1.00	Stream Power (lb/ft s)	1706.00	0.00
0.00				
Frctn Loss (ft)	0.71	Cum Volume (acre-ft)	173.28	198.12
14.66				
C & E Loss (ft)	0.02	Cum SA (acres)	113.87	93.99
8.03				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 11424

INPUT
Description: Upstream X-Section of Northern Crossing
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	232	80	230	136	221	182	230	226	225
229	224	255	220	256	221	382	220	408	225
440	230								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	80	.02	182	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
80	182	56	30	.1	.3

CULVERT

RIVER: Fallkill
REACH: 1 RS: 11409

INPUT
Description: Box culvert on Roosevelt Road
Distance from Upstream XS = 20
Deck/Roadway Width = 21.3
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates

num= 0

Upstream Bridge Cross Section Data
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	232	80	230	136	221	182	230	226	225
229	224	255	220	256	221	382	220	408	225
440	230								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	80	.02	182	.02

Bank Sta: Left Right Coeff Contr. Expan.
80 182 .1 .3

Downstream Deck/Roadway Coordinates
num= 0

Downstream Bridge Cross Section Data
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	229	92	221	138	230	178	225	184	224
201	220	210	221	338	220	364	225	395	230

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.02	138	.02

Bank Sta: Left Right Coeff Contr. Expan.
0 138 .1 .3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span
Culvert #1 Box 4.17 18.6
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	Top n	Bottom n	Depth Blocked	Entrance Loss Coef	Exit Loss Coef
	30	10.65	.011	.011	0	.4	.6

Upstream Elevation = 221
Centerline Station = 136
Downstream Elevation = 220.9
Centerline Station = 92

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 11394

INPUT
Description: Down Stream X-Section of Northern Crossing
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	229	92	221	138	230	178	225	184	224
201	220	210	221	338	220	364	225	395	230

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	0	.02	138	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	138	731	1284	2062	.1	.3

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 10095

INPUT
Description: X-sect. E
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	230	59	225	118	220	169	218	180	216
260	216	270	218	341	220	367.5	225	408	230

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	169	.02	270	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
169	270	4209.5	1805.5	959	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	221.30	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.06	Wt. n-Val.	0.020	0.020
0.020				
W.S. Elev (ft)	221.24	Reach Len. (ft)	4209.50	1805.50
959.00				
Crit W.S. (ft)		Flow Area (sq ft)	123.51	508.55
163.35				
E.G. Slope (ft/ft)	0.000099	Area (sq ft)	123.51	508.55
163.35				
Q Total (cfs)	1440.00	Flow (cfs)	139.12	1102.59
198.29				
Top Width (ft)	244.26	Top Width (ft)	65.67	101.00
77.59				
Vel Total (ft/s)	1.81	Avg. Vel. (ft/s)	1.13	2.17
1.21				
Max Chl Dpth (ft)	5.24	Hydr. Depth (ft)	1.88	5.04
2.11				
Conv. Total (cfs)	144601.8	Conv. (cfs)	13969.7	110720.2
19911.9				
Length Wtd. (ft)	1872.31	Wetted Per. (ft)	65.76	101.38
77.73				
Min Ch El (ft)	216.00	Shear (lb/sq ft)	0.01	0.03
0.01				
Alpha	1.20	Stream Power (lb/ft s)	408.00	0.00

0.00				
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)	170.15	160.42
7.95				
C & E Loss (ft)	0.00	Cum SA (acres)	112.21	78.50
4.85				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 8289.5

INPUT
Description: X-sect. D
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	230	1260	229	1300	229	2074	227.5	2372	225
2600.5	221	2632.5	220	2710	219	2720	218	2730	218
2740	219	3057	220	3091	225	3141.5	230		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	2632.5	.02	3057	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
2632.5	3057	761	498	607	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	220.92	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.09	Wt. n-Val.	0.020	0.020
0.020				
W.S. Elev (ft)	220.83	Reach Len. (ft)	3160.00	2645.50
1996.00				
Crit W.S. (ft)		Flow Area (sq ft)	11.04	599.93
2.35				
E.G. Slope (ft/ft)	0.000646	Area (sq ft)	11.04	599.93
2.35				
Q Total (cfs)	1440.00	Flow (cfs)	11.60	1425.95
2.45				
Top Width (ft)	456.74	Top Width (ft)	26.59	424.50
5.65				
Vel Total (ft/s)	2.35	Avg. Vel. (ft/s)	1.05	2.38
1.04				
Max Chl Dpth (ft)	2.83	Hydr. Depth (ft)	0.42	1.41
0.42				
Conv. Total (cfs)	56675.9	Conv. (cfs)	456.7	56122.9
96.4				
Length Wtd. (ft)	2775.86	Wetted Per. (ft)	26.60	424.61
5.71				
Min Ch El (ft)	218.00	Shear (lb/sq ft)	0.02	0.06
0.02				
Alpha	1.02	Stream Power (lb/ft s)	3141.50	0.00
0.00				
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	163.65	137.45

6.13
C & E Loss (ft) 0.03 Cum SA (acres) 107.75 67.61
3.93

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 7792

INPUT
Description: Upstream X-Section of Southern Crossing
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	230	1360	226	1586	225	2146	216	2246	220
2287	218	2355	218	2415	220	2522	225		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	1586	.02	2246	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1586	2246	30	30	36	.1	.3

CULVERT

RIVER: Fallkill
REACH: 1 RS: 7777

INPUT
Description:
Distance from Upstream XS = 5
Deck/Roadway Width = 10
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 0

Upstream Bridge Cross Section Data
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	230	1360	226	1586	225	2146	216	2246	220
2287	218	2355	218	2415	220	2522	225		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	1586	.02	2246	.02

Bank Sta: Left	Right	Coeff Contr.	Expan.
1586	2246	.1	.3

Downstream Deck/Roadway Coordinates
num= 0

Downstream Bridge Cross Section Data

```
Station Elevation Data    num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     230    1385     226    1578     225    2146     216    2238     220
    2282     218    2361     218    2412     220    2502     225

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .02    1578     .02    2238     .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
          1578    2238             .1       .3

Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins           =
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Culverts =  1

Culvert Name      Shape      Rise    Span
Culvert #1            Box     2.3      16
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
                30   10.65     .011     .011        0                    .4
     .6
Upstream   Elevation =  216
           Centerline Station =  2146
Downstream Elevation =  215.9
           Centerline Station =  2146

CROSS SECTION


RIVER: Fallkill
REACH: 1                  RS: 7762

INPUT
Description: Down Stream X-Section of Southern Crossing
Station Elevation Data    num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     230    1385     226    1578     225    2146     216    2238     220
    2282     218    2361     218    2412     220    2502     225

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .02    1578     .02    2238     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1578    2238             2540    2118    1469             .1       .3

CULVERT


RIVER: Fallkill
REACH: 1                  RS: 6500

INPUT
```

```
Description: test
Distance from Upstream XS =       20
Deck/Roadway Width        =       22
Weir Coefficient          =      2.6
Upstream  Deck/Roadway Coordinates
    num=        0


Upstream Bridge Cross Section Data
Station Elevation Data    num=        9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     230    1385     226    1578     225    2146     216    2238     220
    2282     218    2361     218    2412     220    2502     225

Manning's n Values        num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .02    1578     .02    2238     .02

Bank Sta: Left   Right    Coeff Contr.    Expan.
          1578    2238             .1        .3

Downstream  Deck/Roadway Coordinates
    num=        0


Downstream Bridge Cross Section Data
Station Elevation Data    num=       15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     230      55   227.5   226.5     225     412     220    1650     218
  1736.5     216    1844     216    1900     218    1956     220    2016     225
    2075     230    2161     235    2231     240  2273.5     245  2307.5     250

Manning's n Values        num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .02    1650     .02    1900     .02

Bank Sta: Left   Right    Coeff Contr.    Expan.
          1650    1900             .1        .3

Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins           =
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Culverts =  1

Culvert Name      Shape      Rise    Span
Culvert #1            Box       6      12
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
              1262      20     .011     .011        0                  .04
      1
Upstream   Elevation =  216
           Centerline Station =  2000
Downstream Elevation =  215
           Centerline Station =  1800
```

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 5644

INPUT
Description: X-sect. C
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	230	55	227.5	226.5	225	412	220	1650	218
1736.5	216	1844	216	1900	218	1956	220	2016	225
2075	230	2161	235	2231	240	2273.5	245	2307.5	250

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	1650	.02	1900	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1650	1900	2188.5	2743	3053	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	220.81	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.00	Wt. n-Val.	0.020	0.020
0.020				
W.S. Elev (ft)	220.80	Reach Len. (ft)	2188.50	2743.00
3053.00				
Crit W.S. (ft)		Flow Area (sq ft)	2244.09	1058.25
104.84				
E.G. Slope (ft/ft)	0.000010	Area (sq ft)	2244.09	1058.25
104.84				
Q Total (cfs)	1440.00	Flow (cfs)	763.21	643.52
33.27				
Top Width (ft)	1583.43	Top Width (ft)	1267.79	250.00
65.64				
Vel Total (ft/s)	0.42	Avg. Vel. (ft/s)	0.34	0.61
0.32				
Max Chl Dpth (ft)	4.80	Hydr. Depth (ft)	1.77	4.23
1.60				
Conv. Total (cfs)	460310.3	Conv. (cfs)	243966.3	205708.5
10635.5				
Length Wtd. (ft)	2485.99	Wetted Per. (ft)	1267.80	250.06
65.71				
Min Ch El (ft)	216.00	Shear (lb/sq ft)	0.00	0.00
0.00				
Alpha	1.28	Stream Power (lb/ft s)	2307.50	0.00
0.00				
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	81.86	87.10
3.67				
C & E Loss (ft)	0.00	Cum SA (acres)	60.80	47.13
2.30				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 2901

INPUT
Description: X-sect. B
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	225	150	225	195	224	240	224	262	225
356	230	537	230	607.5	226	641	225	728.5	220
871	219	1029	220	1264.5	221	1517	220	1631	218
1779.5	220	1790	221	1826	225	1858.5	230		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	1264.5	.02	1790	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1264.5	1790	3117	2901	2655 .1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	537	230	F
1858.5	1858.5	230	F

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	220.73	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.04	Wt. n-Val.	0.020	0.020
W.S. Elev (ft)	220.69	Reach Len. (ft)	3117.00	2901.00
2655.00				
Crit W.S. (ft)	219.85	Flow Area (sq ft)	418.45	506.82
E.G. Slope (ft/ft)	0.000427	Area (sq ft)	418.45	506.82
Q Total (cfs)	1440.00	Flow (cfs)	590.26	849.74
Top Width (ft)	919.72	Top Width (ft)	475.40	444.32
Vel Total (ft/s)	1.56	Avg. Vel. (ft/s)	1.41	1.68
Max Chl Dpth (ft)	2.69	Hydr. Depth (ft)	0.88	1.14
Conv. Total (cfs)	69655.7	Conv. (cfs)	28552.3	41103.5
Length Wtd. (ft)	2942.13	Wetted Per. (ft)	475.43	444.38
Min Ch El (ft)	218.00	Shear (lb/sq ft)	0.02	0.03
Alpha	1.02	Stream Power (lb/ft s)	1858.50	0.00
0.00				
Frctn Loss (ft)	1.37	Cum Volume (acre-ft)	14.97	37.82
C & E Loss (ft)	0.01	Cum SA (acres)	17.01	25.26

Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the

need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Fallkill
REACH: 1 RS: 0

INPUT
Description: X-sect. A
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	230	35	225	70.5	220	524	220	555	225
580	230	592	232	620	230	687.5	225	715.5	223
761	220	824.5	217	1070	217	1098.5	220	1124	225
1151	230								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	761	.02	1098.5	.02

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
761	1098.5	2000	2000	2000	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	620	230	F
1151	1151	230	F

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	219.36	Element	Left OB	Channel
Right OB				
Vel Head (ft)	0.11	Wt. n-Val.		0.020
W.S. Elev (ft)	219.25	Reach Len. (ft)		
Crit W.S. (ft)	218.10	Flow Area (sq ft)		629.03
E.G. Slope (ft/ft)	0.000501	Area (sq ft)		629.03
Q Total (cfs)	1660.00	Flow (cfs)		1660.00
Top Width (ft)	314.41	Top Width (ft)		314.41
Vel Total (ft/s)	2.64	Avg. Vel. (ft/s)		2.64
Max Chl Dpth (ft)	2.25	Hydr. Depth (ft)		2.00
Conv. Total (cfs)	74175.8	Conv. (cfs)		74175.8
Length Wtd. (ft)		Wetted Per. (ft)		314.58
Min Ch El (ft)	217.00	Shear (lb/sq ft)		0.06
Alpha	1.00	Stream Power (lb/ft s)	1151.00	0.00
0.00				
Frctn Loss (ft)		Cum Volume (acre-ft)		
C & E Loss (ft)		Cum SA (acres)		

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

SUMMARY OF MANNING'S N VALUES

River:Fallkill

Reach	River Sta.	n1	n2	n3
1	15065	.02	.02	.02
1	13373	.02	.02	.02
1	11424	.02	.02	.02
1	11409	Culvert		
1	11394	.02	.02	.02
1	10095	.02	.02	.02
1	8289.5	.02	.02	.02
1	7792	.02	.02	.02
1	7777	Culvert		
1	7762	.02	.02	.02
1	6500	Culvert		
1	5644	.02	.02	.02
1	2901	.02	.02	.02
1	0	.02	.02	.02

SUMMARY OF REACH LENGTHS

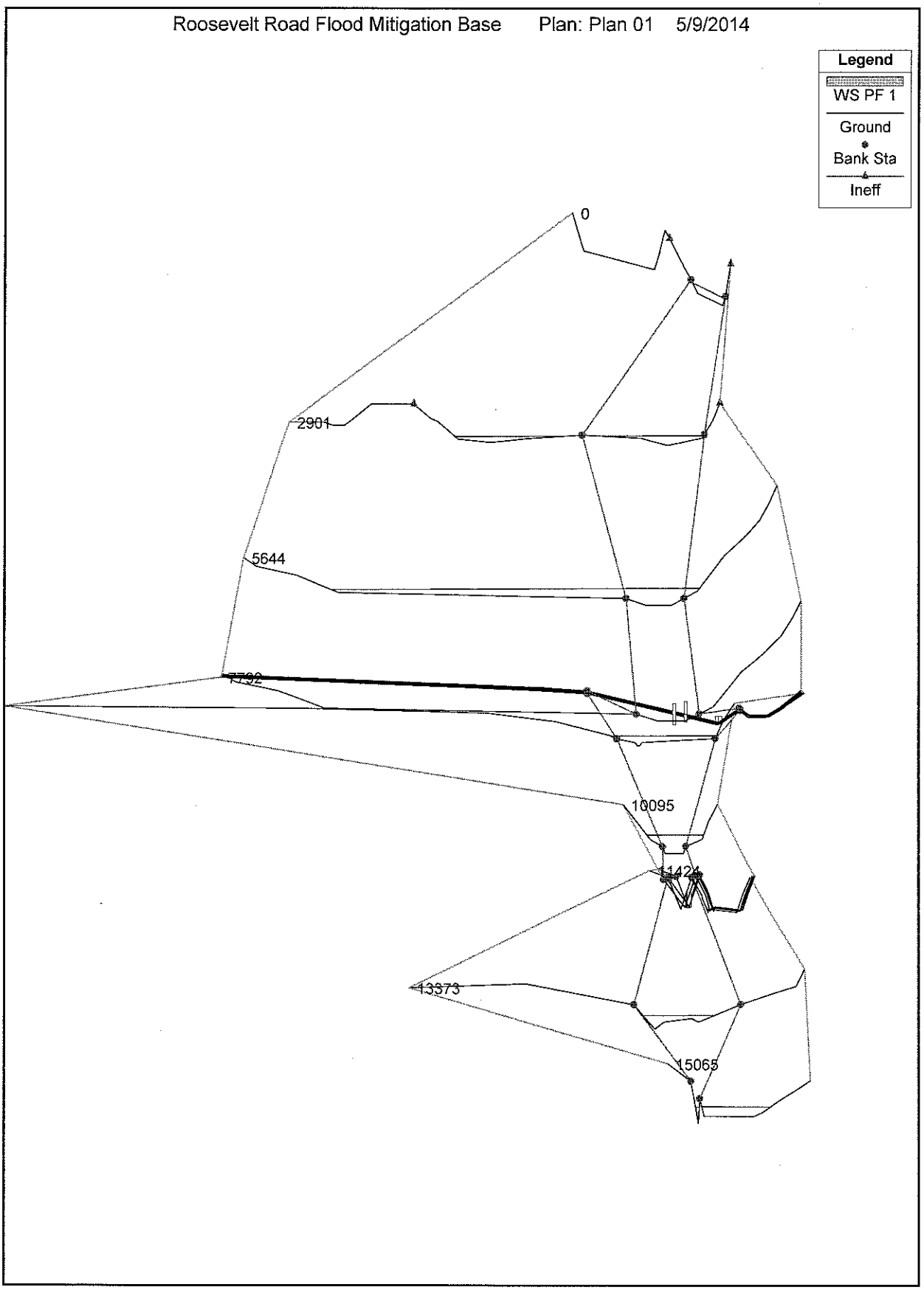
River: Fallkill

Reach	River Sta.	Left	Channel	Right
1	15065	2103	1692	1949
1	13373	1865	1964	1820.5
1	11424	56	30	30
1	11409	Culvert		
1	11394	731	1284	2062
1	10095	4209.5	1805.5	959
1	8289.5	761	498	607
1	7792	30	30	36
1	7777	Culvert		
1	7762	2540	2118	1469
1	6500	Culvert		
1	5644	2188.5	2743	3053
1	2901	3117	2901	2655
1	0	2000	2000	2000

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Fallkill

Reach	River Sta.	Contr.	Expan.
1	15065	.1	.3

1	13373		.1	.3
1	11424		.1	.3
1	11409	Culvert		
1	11394		.1	.3
1	10095		.1	.3
1	8289.5		.1	.3
1	7792		.1	.3
1	7777	Culvert		
1	7762		.1	.3
1	6500	Culvert		
1	5644		.1	.3
1	2901		.1	.3
1	0		.1	.3


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
Legend
WS PF 1
Ground
Bank Sta
Ineff
0
2901
5644
7792
10095
11424
13373
15065

HEC-RAS Plan: Plan 01 River: Fallkill Reach: 1 Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	15065	PF 1	1300.00	218.00	222.64		222.68	0.000184	1.58	740.39	319.26	0.18
1	13373	PF 1	1440.00	218.00	221.91		222.04	0.000834	2.92	493.41	310.85	0.41
1	10095	PF 1	1440.00	216.00	221.24		221.30	0.000099	2.17	795.42	244.26	0.17
1	8289.5	PF 1	1440.00	218.00	220.83		220.92	0.000646	2.38	613.32	456.74	0.35
1	5644	PF 1	1440.00	216.00	220.80		220.81	0.000010	0.61	3407.18	1583.43	0.05
1	2901	PF 1	1440.00	218.00	220.69	219.85	220.73	0.000427	1.68	925.26	919.72	0.28
1	0	PF 1	1660.00	217.00	219.25	218.10	219.36	0.000501	2.64	629.03	314.41	0.33

Plan: Plan 01 Fallkill 1 RS: 15065 Profile: PF 1

E.G. Elev (ft)	222.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.05	Wt. n-Val.		0.020	0.020
W.S. Elev (ft)	222.64	Reach Len. (ft)	2103.00	1692.00	1949.00
Crit W.S. (ft)		Flow Area (sq ft)		38.76	701.63
E.G. Slope (ft/ft)	0.000184	Area (sq ft)		38.76	701.63
Q Total (cfs)	1300.00	Flow (cfs)		61.43	1238.57
Top Width (ft)	319.26	Top Width (ft)		16.72	302.53
Vel Total (ft/s)	1.76	Avg. Vel. (ft/s)		1.58	1.77
Max Chl Dpth (ft)	4.64	Hydr. Depth (ft)		2.32	2.32
Conv. Total (cfs)	95784.3	Conv. (cfs)		4526.4	91258.0
Length Wtd. (ft)	1808.17	Wetted Per. (ft)		19.67	302.91
Min Ch El (ft)	218.00	Shear (lb/sq ft)		0.02	0.03
Alpha	1.00	Stream Power (lb/ft s)	618.00	0.00	0.00
Frctn Loss (ft)	0.64	Cum Volume (acre-ft)	173.28	208.46	30.35
C & E Loss (ft)	0.01	Cum SA (acres)	113.87	100.36	14.80

Plan: Plan 01 Fallkill 1 RS: 13373 Profile: PF 1

E.G. Elev (ft)	222.04	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.		0.020	
W.S. Elev (ft)	221.91	Reach Len. (ft)	2204.00	3278.00	3574.50
Crit W.S. (ft)		Flow Area (sq ft)		493.41	
E.G. Slope (ft/ft)	0.000834	Area (sq ft)		493.41	
Q Total (cfs)	1440.00	Flow (cfs)		1440.00	
Top Width (ft)	310.85	Top Width (ft)		310.85	
Vel Total (ft/s)	2.92	Avg. Vel. (ft/s)		2.92	
Max Chl Dpth (ft)	3.91	Hydr. Depth (ft)		1.59	
Conv. Total (cfs)	49855.2	Conv. (cfs)		49855.2	
Length Wtd. (ft)	3246.54	Wetted Per. (ft)		311.10	
Min Ch El (ft)	218.00	Shear (lb/sq ft)		0.08	
Alpha	1.00	Stream Power (lb/ft s)	1706.00	0.00	0.00
Frctn Loss (ft)	0.71	Cum Volume (acre-ft)	173.28	198.12	14.66
C & E Loss (ft)	0.02	Cum SA (acres)	113.87	93.99	8.03

Plan: Plan 01 Fallkill 1 RS: 10095 Profile: PF 1

E.G. Elev (ft)	221.30	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.06	Wt. n-Val.	0.020	0.020	0.020
W.S. Elev (ft)	221.24	Reach Len. (ft)	4209.50	1805.50	959.00
Crit W.S. (ft)		Flow Area (sq ft)	123.51	508.55	163.35
E.G. Slope (ft/ft)	0.000099	Area (sq ft)	123.51	508.55	163.35
Q Total (cfs)	1440.00	Flow (cfs)	139.12	1102.59	198.29
Top Width (ft)	244.26	Top Width (ft)	65.67	101.00	77.59
Vel Total (ft/s)	1.81	Avg. Vel. (ft/s)	1.13	2.17	1.21
Max Chl Dpth (ft)	5.24	Hydr. Depth (ft)	1.88	5.04	2.11
Conv. Total (cfs)	144601.8	Conv. (cfs)	13969.7	110720.2	19911.9
Length Wtd. (ft)	1872.31	Wetted Per. (ft)	65.76	101.38	77.73
Min Ch El (ft)	216.00	Shear (lb/sq ft)	0.01	0.03	0.01
Alpha	1.20	Stream Power (lb/ft s)	408.00	0.00	0.00
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)	170.15	160.42	7.95
C & E Loss (ft)	0.00	Cum SA (acres)	112.21	78.50	4.85

Plan: Plan 01 Fallkill 1 RS: 8289.5 Profile: PF 1

E.G. Elev (ft)	220.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.020	0.020	0.020
W.S. Elev (ft)	220.83	Reach Len. (ft)	3160.00	2645.50	1996.00
Crit W.S. (ft)		Flow Area (sq ft)	11.04	599.93	2.35
E.G. Slope (ft/ft)	0.000646	Area (sq ft)	11.04	599.93	2.35
Q Total (cfs)	1440.00	Flow (cfs)	11.60	1425.95	2.45
Top Width (ft)	456.74	Top Width (ft)	26.59	424.50	5.65
Vel Total (ft/s)	2.35	Avg. Vel. (ft/s)	1.05	2.38	1.04
Max Chl Dpth (ft)	2.83	Hydr. Depth (ft)	0.42	1.41	0.42
Conv. Total (cfs)	56675.9	Conv. (cfs)	456.7	56122.9	96.4
Length Wtd. (ft)	2775.86	Wetted Per. (ft)	26.60	424.61	5.71
Min Ch El (ft)	218.00	Shear (lb/sq ft)	0.02	0.06	0.02
Alpha	1.02	Stream Power (lb/ft s)	3141.50	0.00	0.00
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	163.65	137.45	6.13
C & E Loss (ft)	0.03	Cum SA (acres)	107.75	67.61	3.93

Plan: Plan 01 Fallkill 1 RS: 5644 Profile: PF 1

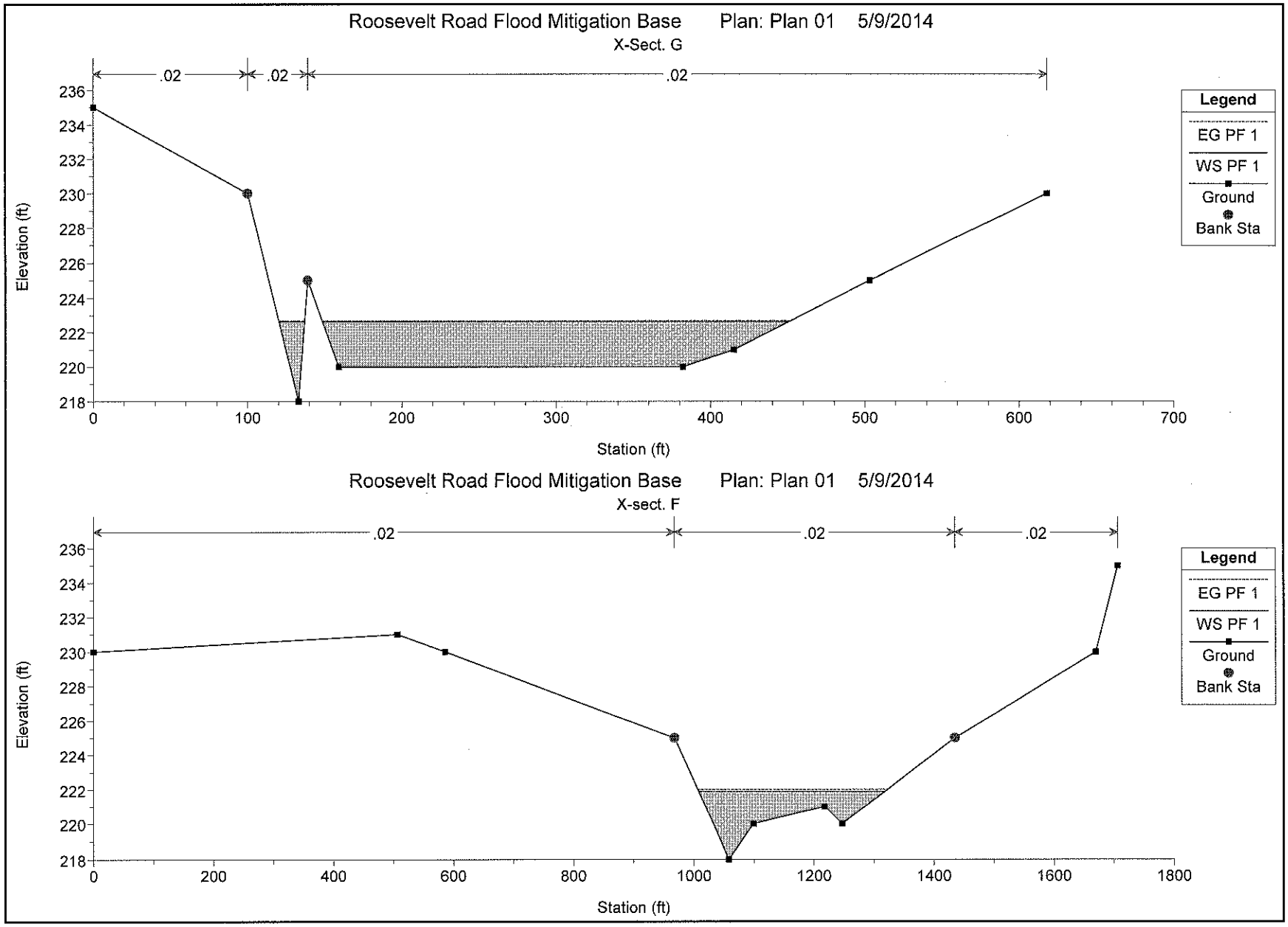
E.G. Elev (ft)	220.81	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.020	0.020	0.020
W.S. Elev (ft)	220.80	Reach Len. (ft)	2188.50	2743.00	3053.00
Crit W.S. (ft)		Flow Area (sq ft)	2244.09	1058.25	104.84
E.G. Slope (ft/ft)	0.000010	Area (sq ft)	2244.09	1058.25	104.84
Q Total (cfs)	1440.00	Flow (cfs)	763.21	643.52	33.27
Top Width (ft)	1583.43	Top Width (ft)	1267.79	250.00	65.64
Vel Total (ft/s)	0.42	Avg. Vel. (ft/s)	0.34	0.61	0.32
Max Chl Dpth (ft)	4.80	Hydr. Depth (ft)	1.77	4.23	1.60
Conv. Total (cfs)	460310.3	Conv. (cfs)	243966.3	205708.5	10635.5
Length Wtd. (ft)	2485.99	Wetted Per. (ft)	1267.80	250.06	65.71
Min Ch El (ft)	216.00	Shear (lb/sq ft)	0.00	0.00	0.00
Alpha	1.28	Stream Power (lb/ft s)	2307.50	0.00	0.00
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	81.86	87.10	3.67
C & E Loss (ft)	0.00	Cum SA (acres)	60.80	47.13	2.30

Plan: Plan 01 Fallkill 1 RS: 2901 Profile: PF 1

E.G. Elev (ft)	220.73	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.04	Wt. n-Val.	0.020	0.020	
W.S. Elev (ft)	220.69	Reach Len. (ft)	3117.00	2901.00	2655.00
Crit W.S. (ft)	219.85	Flow Area (sq ft)	418.45	506.82	
E.G. Slope (ft/ft)	0.000427	Area (sq ft)	418.45	506.82	
Q Total (cfs)	1440.00	Flow (cfs)	590.26	849.74	
Top Width (ft)	919.72	Top Width (ft)	475.40	444.32	
Vel Total (ft/s)	1.56	Avg. Vel. (ft/s)	1.41	1.68	
Max Chl Dpth (ft)	2.69	Hydr. Depth (ft)	0.88	1.14	
Conv. Total (cfs)	69655.7	Conv. (cfs)	28552.3	41103.5	
Length Wtd. (ft)	2942.13	Wetted Per. (ft)	475.43	444.38	
Min Ch El (ft)	218.00	Shear (lb/sq ft)	0.02	0.03	
Alpha	1.02	Stream Power (lb/ft s)	1858.50	0.00	0.00
Frctn Loss (ft)	1.37	Cum Volume (acre-ft)	14.97	37.82	
C & E Loss (ft)	0.01	Cum SA (acres)	17.01	25.26	

Plan: Plan 01 Fallkill 1 RS: 0 Profile: PF 1

E.G. Elev (ft)	219.36	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.		0.020	
W.S. Elev (ft)	219.25	Reach Len. (ft)			
Crit W.S. (ft)	218.10	Flow Area (sq ft)		629.03	
E.G. Slope (ft/ft)	0.000501	Area (sq ft)		629.03	
Q Total (cfs)	1660.00	Flow (cfs)		1660.00	
Top Width (ft)	314.41	Top Width (ft)		314.41	
Vel Total (ft/s)	2.64	Avg. Vel. (ft/s)		2.64	
Max Chl Dpth (ft)	2.25	Hydr. Depth (ft)		2.00	
Conv. Total (cfs)	74175.8	Conv. (cfs)		74175.8	
Length Wtd. (ft)		Wetted Per. (ft)		314.58	
Min Ch El (ft)	217.00	Shear (lb/sq ft)		0.06	
Alpha	1.00	Stream Power (lb/ft s)	1151.00	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-Sect. G
.02
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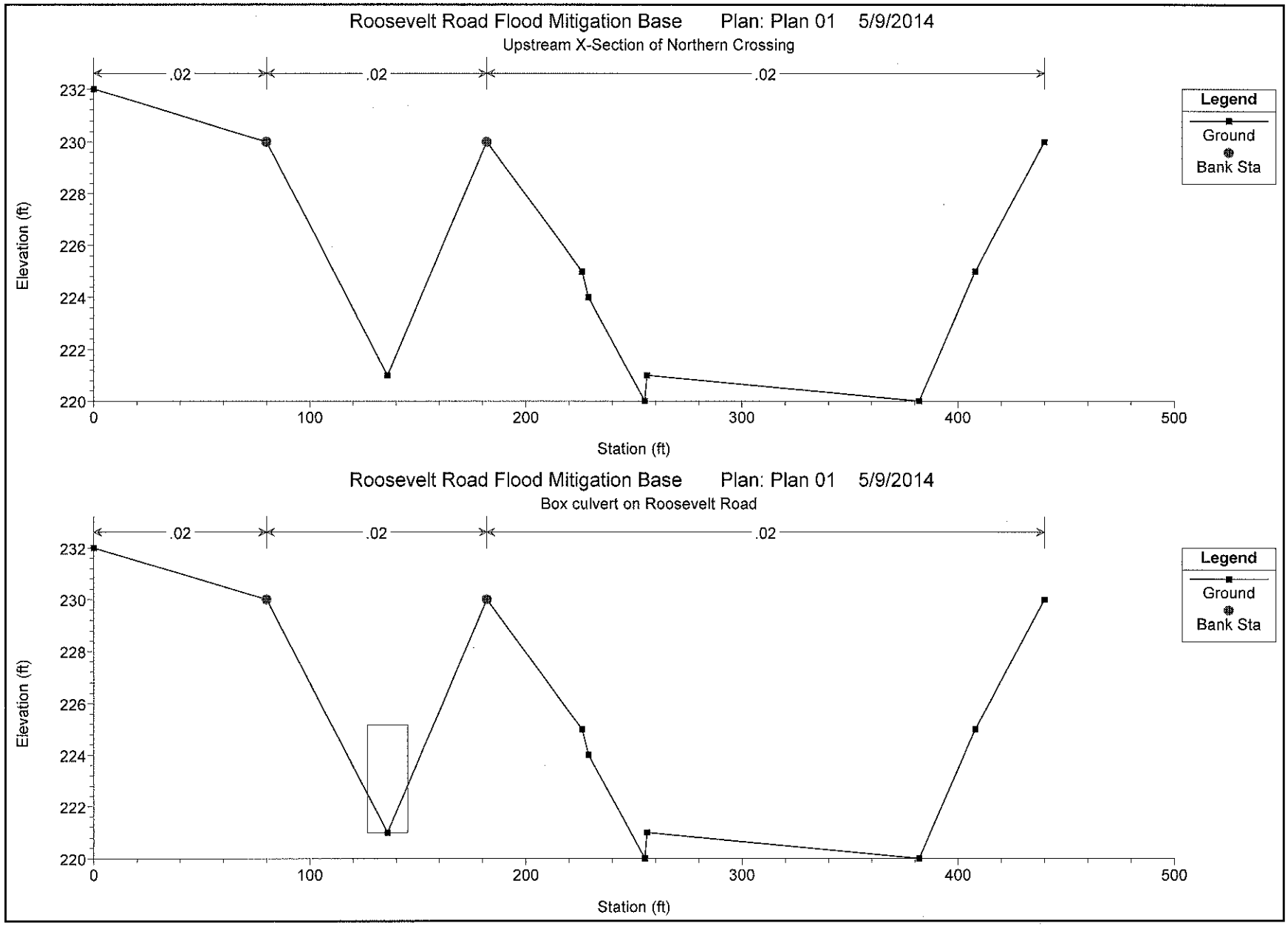
Elevation (ft)
236
234
232
230
228
226
224
222
220
218
0
100
200
300
400
500
600
700
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-sect. F
.02
.02
.02
Elevation (ft)
236
234
232
230
228
226
224
222
220
218
0
200
400
600
800
1000
1200
1400
1600
1800
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
Upstream X-Section of Northern Crossing
.02
.02
.02
Legend
Ground
Bank Sta
Elevation (ft)
232
230
228
226
224
222
220
0
100
200
300
400
500
Station (ft)
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
Box culvert on Roosevelt Road
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.02
.02
Legend
Ground
Bank Sta
Elevation (ft)
232
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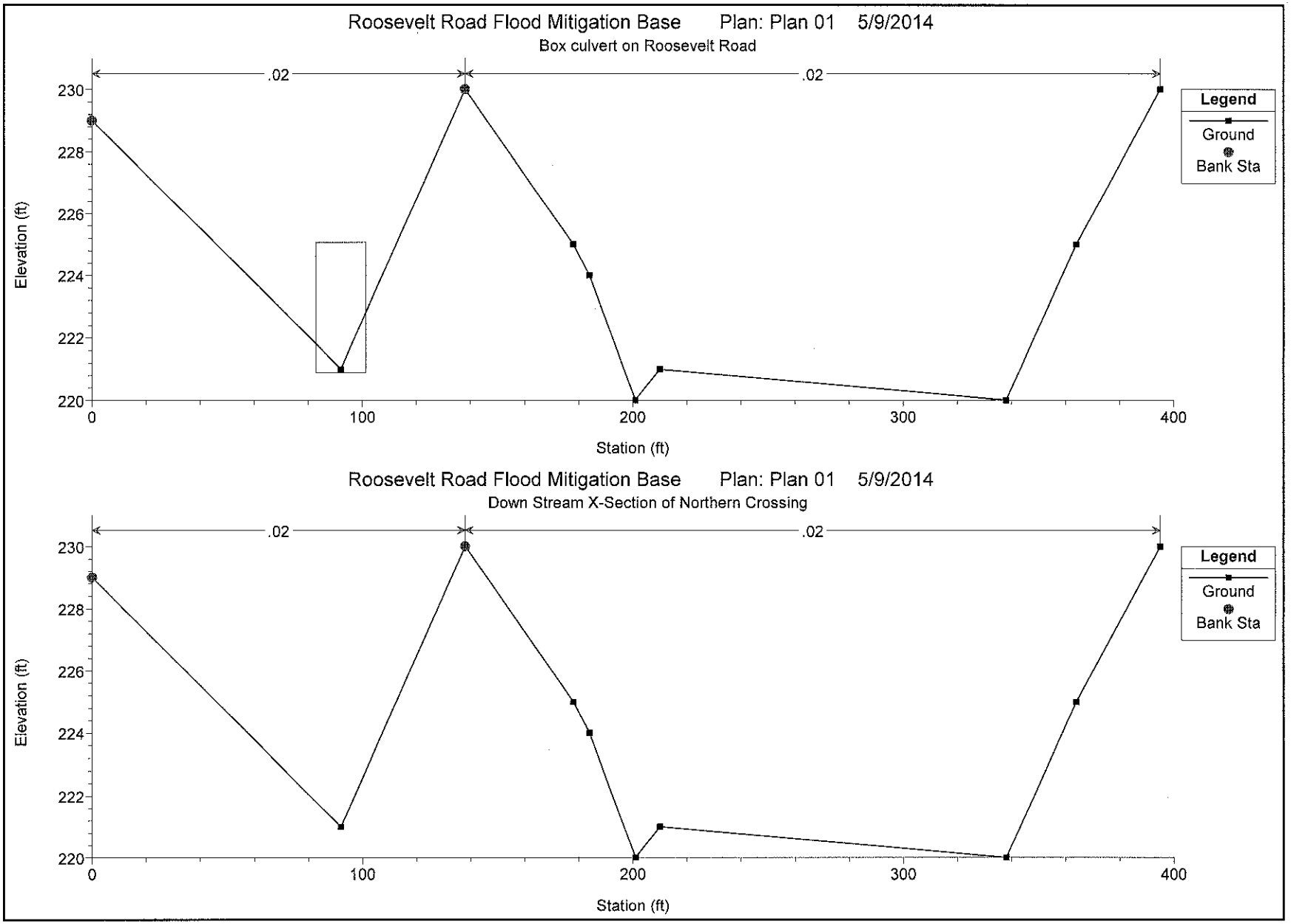
Station (ft)


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
Box culvert on Roosevelt Road
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230
228
226
224
222
220
Elevation (ft)
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200
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400
Station (ft)
Legend
Ground
Bank Sta
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
Down Stream X-Section of Northern Crossing
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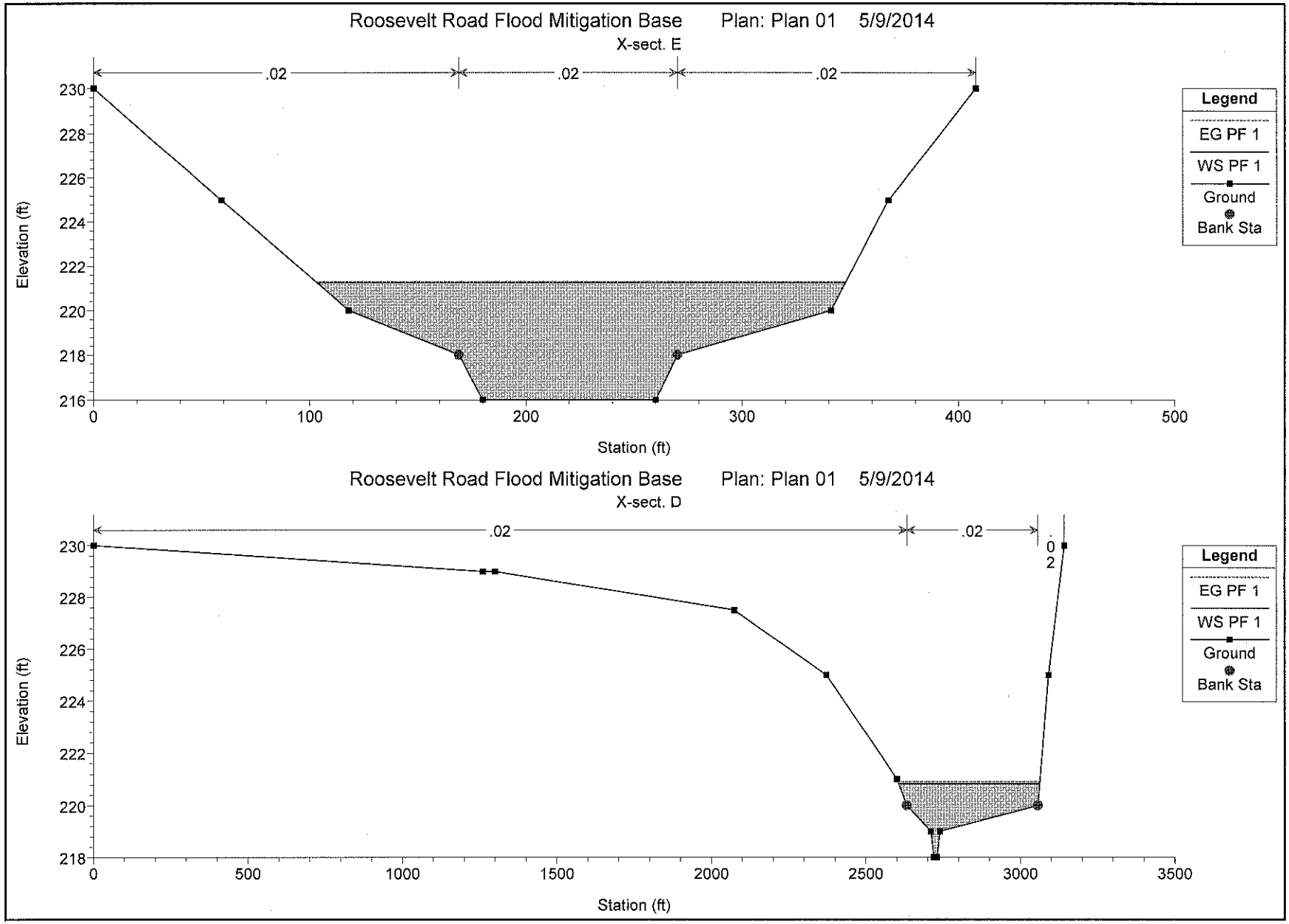
.02
230
228
226
224
222
220
Elevation (ft)
0
100
200
300
400
Station (ft)
Legend
Ground
Bank Sta


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-sect. E
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230
228
226
224
222
220
218
216
Elevation (ft)
0
100
200
300
400
500
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-sect. D
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228
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220
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Elevation (ft)
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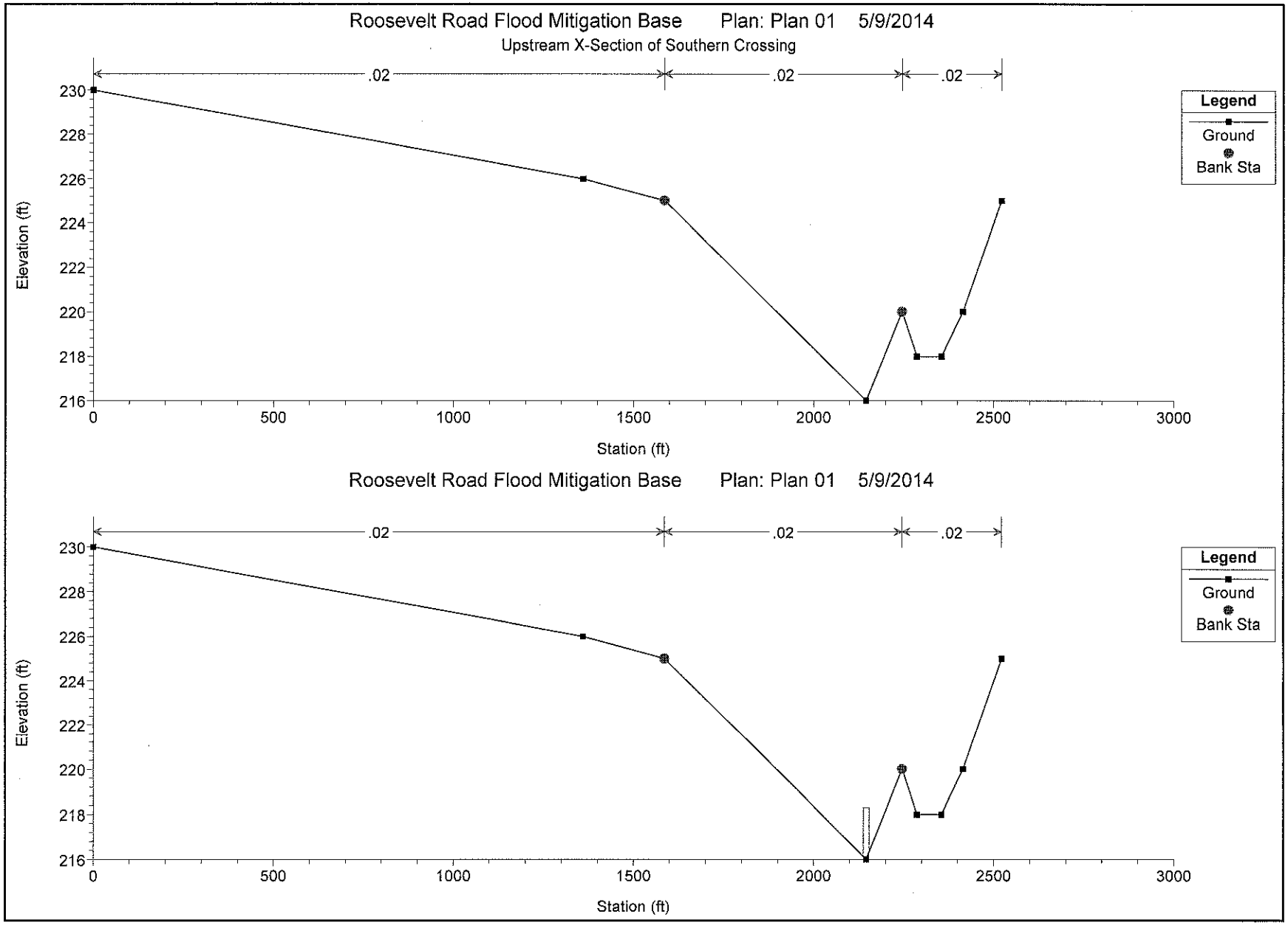
3500
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
Upstream X-Section of Southern Crossing
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Legend
Ground
Bank Sta
Elevation (ft)
230
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226
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Station (ft)
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
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Legend
Ground
Bank Sta
Elevation (ft)
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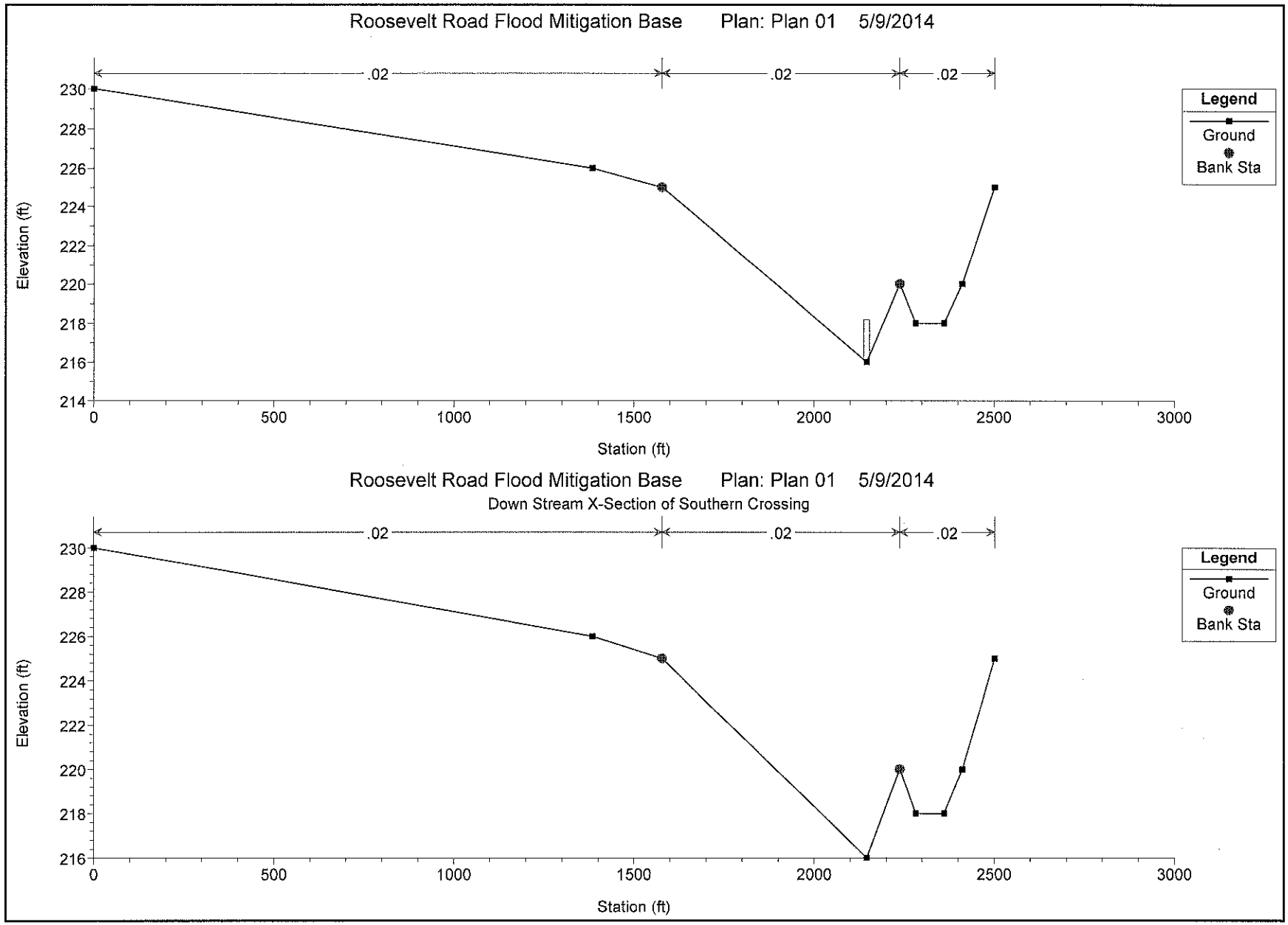
Station (ft)


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
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Legend
Ground
Bank Sta
Elevation (ft)
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3000
Station (ft)
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
Down Stream X-Section of Southern Crossing
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.02
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Legend
Ground
Bank Sta
Elevation (ft)
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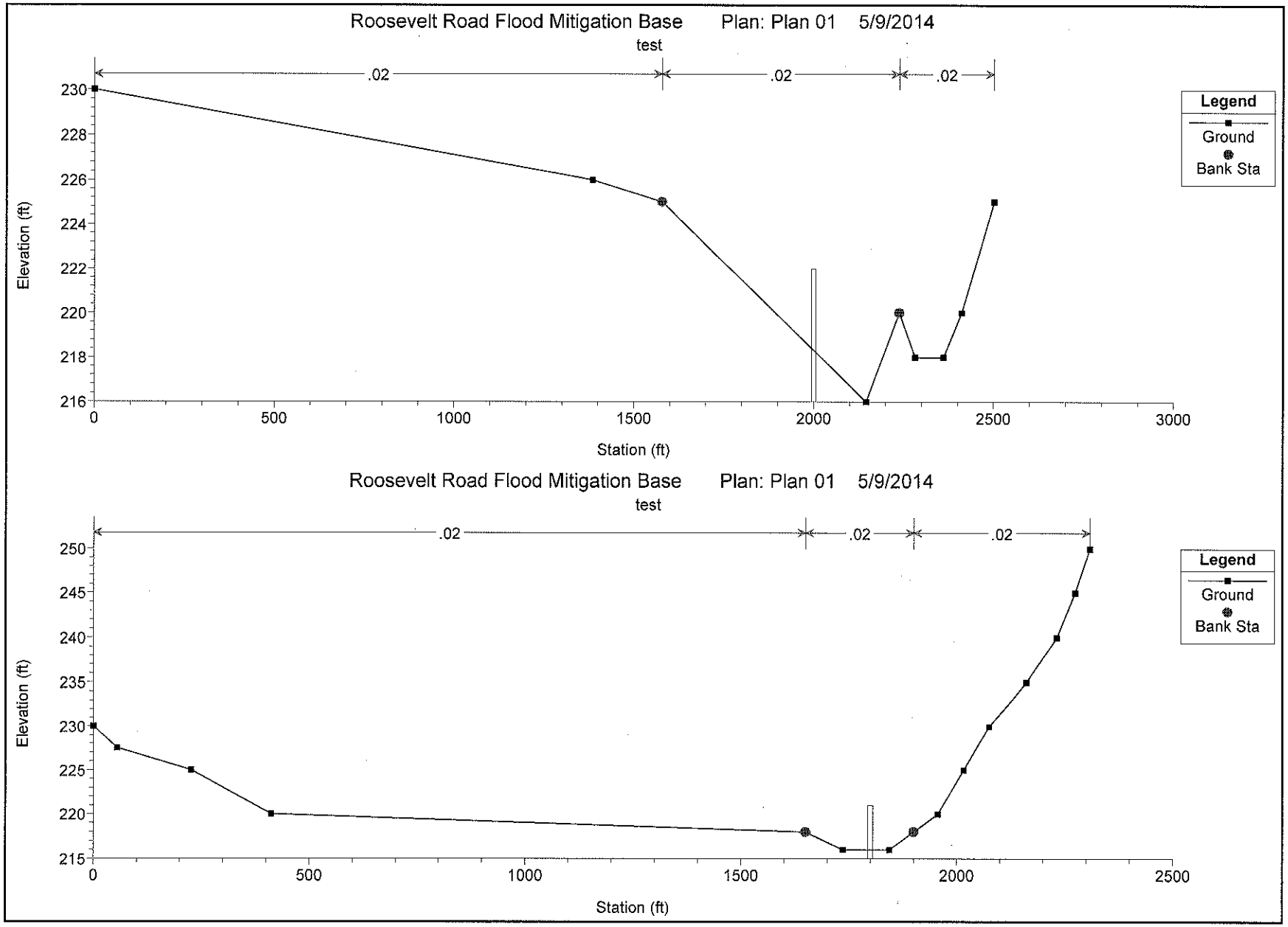
Station (ft)


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
test
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Legend
Ground
Bank Sta
Elevation (ft)
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Station (ft)
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
test
.02
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Legend
Ground
Bank Sta
Elevation (ft)
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240
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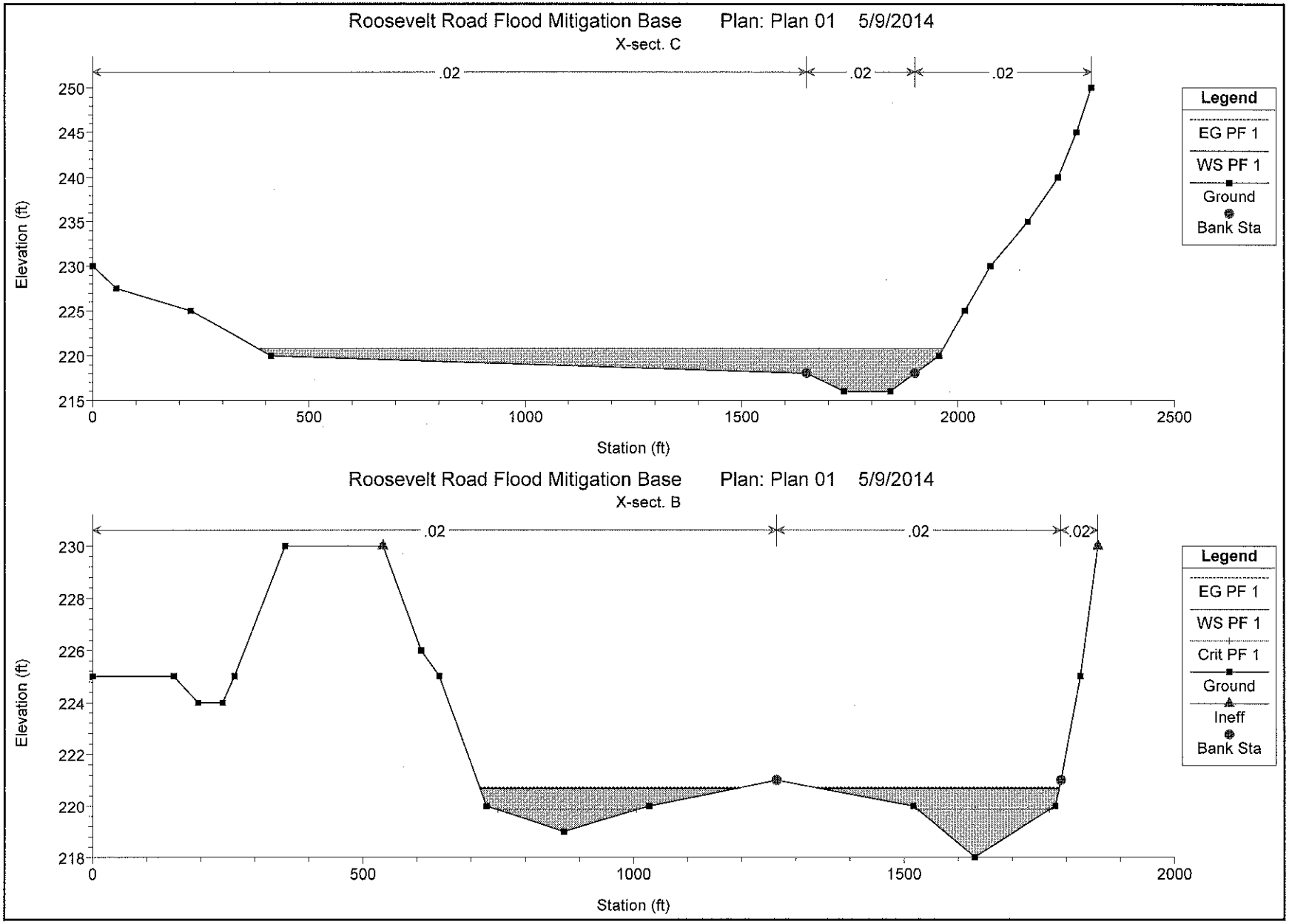
Station (ft)


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-sect. C
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Elevation (ft)
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Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-sect. B
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Elevation (ft)
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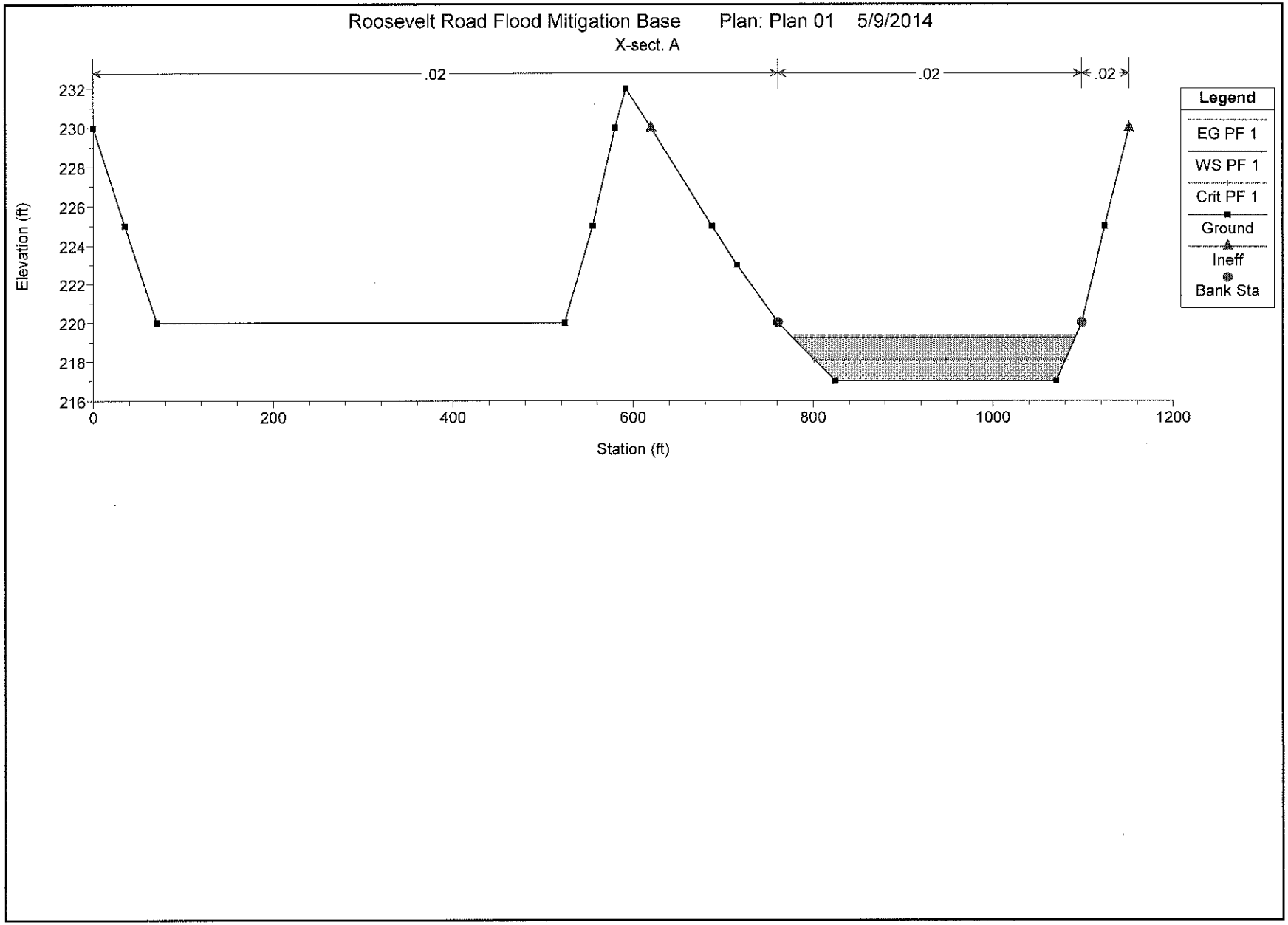
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-sect. A
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Elevation (ft)
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Station (ft)
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Crit PF 1
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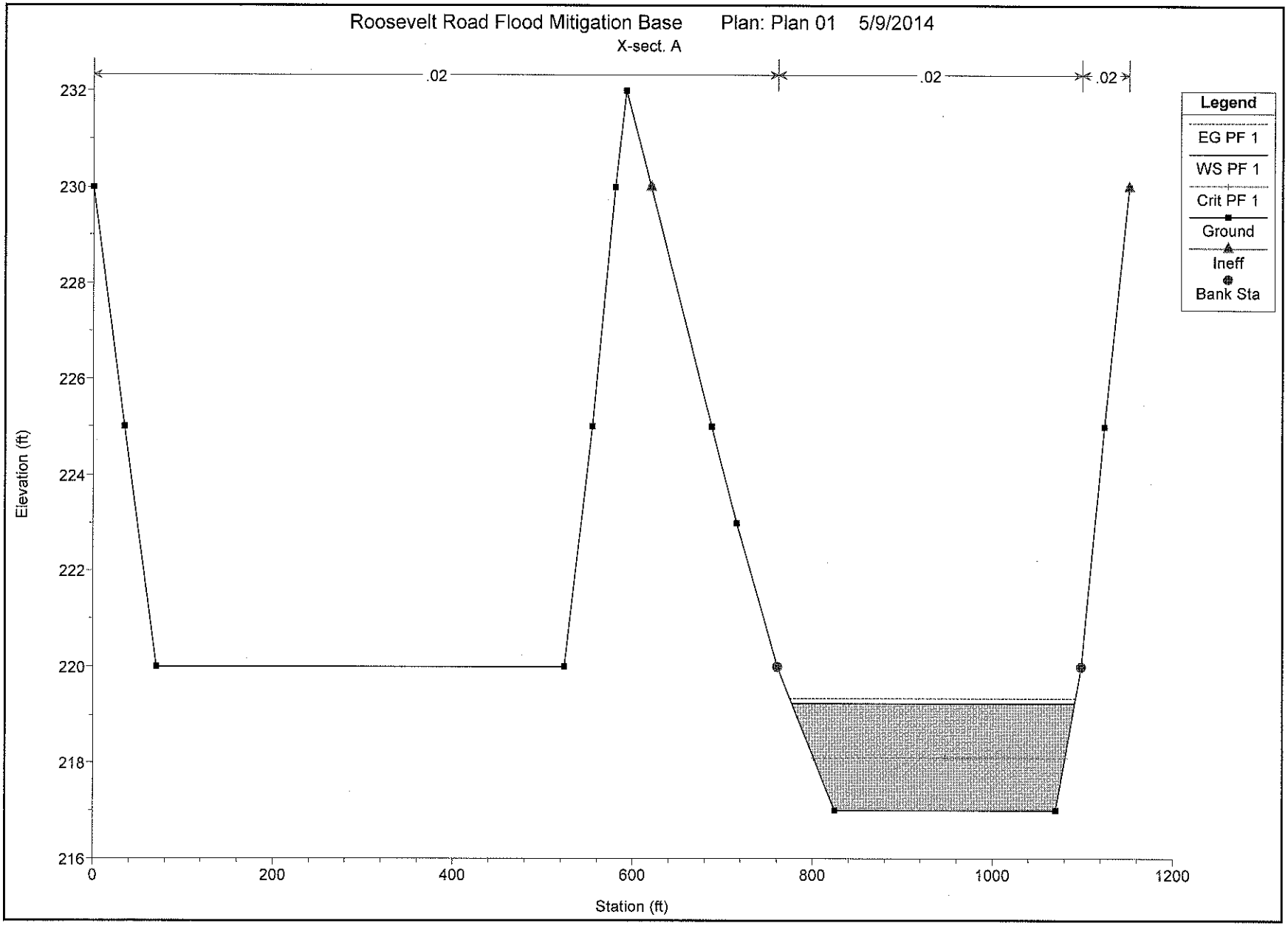
Bank Sta


Roosevelt Road Flood Mitigation Base Plan: Plan 01 5/9/2014
X-sect. A
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WS PF 1
Crit PF 1
Ground
Ineff
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Elevation (ft)
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Station (ft)