TECHNICAL REPORT

HINESBURG CENTER PHASE II
PATRICK BROOK FLOODPLAIN ANALYSIS
HINESBURG, VERMONT

October 4, 2013

MMI #5253-01-1

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1.0   <u>INTRODUCTION</u>

Milone & MacBroom, Inc. (MMI) has been retained by Milot Real Estate to conduct a hydraulic study of Patrick Brook in the town of Hinesburg, Vermont. The Patrick Brook study reach extends from the outlet of an existing cross culvert under VT Route 116 to the confluence with the LaPlatte River. The current project is known as Phase II of the Hinesburg Center Project, which is proposed on the west side of VT Route 116 between Patrick Brook and Farmall Drive. Phase I of the development, including the Kinney Drug building, is currently under construction and consists of several mixed-use buildings and associated parking areas, access driveways, and infrastructure.

A hydraulic study of this reach of Patrick Brook was conducted as part of Phase I that is , the details are summarized in a Hydraulic Study Report prepared by MMI dated January 13, 2010. The outcome of that study was the establishment of a FEMA floodway boundary along Patrick Brook from the outlet of the VT Route 116 culvert to the confluence with the LaPlatte River. That study was conducted to determine conformance with state and local floodplain management regulations, specifically the Flood Hazard Area regulations as identified in Article 6 of the Hinesburg Zoning Regulations as well as Criterion 1(D) of the Vermont Act 250 Land Use Permit.

As part of the Phase II permitting process, the Town of Hinesburg and State River Management Program has requested additional information regarding the potential impacts on flood risks to areas adjacent to the proposed project site. In response to the requested information, additionally hydraulic analysis of Patrick Brook has been conducted to address the following:

- Potential impacts on flood risks due to the fill proposed for Phase II.
- Potential impacts on flood risks due to the future replacement (by others) of the VT Route 116 culvert.
- Potential impacts on flood risks derived from the recent construction of the new water and sewer lines for the Haystack Crossing subdivision (by others) that cross the subject property.
- Potential impacts on flood risks due to the future construction of a new stream crossing (by others) over Patrick Brook to the Haystack Crossing subdivision.
- Potential impacts on flood risks due to changes in hydrologic conditions in Patrick Brook based on recent hydrologic study of future conditions in Hinesburg.
- Potential impact of flood risks during a 500-year flood in addition to the 100-year flood.

Methods, results, and conclusions of the Phase II hydraulic study follow. Hydraulic modeling data are provided in the Appendix of this report.
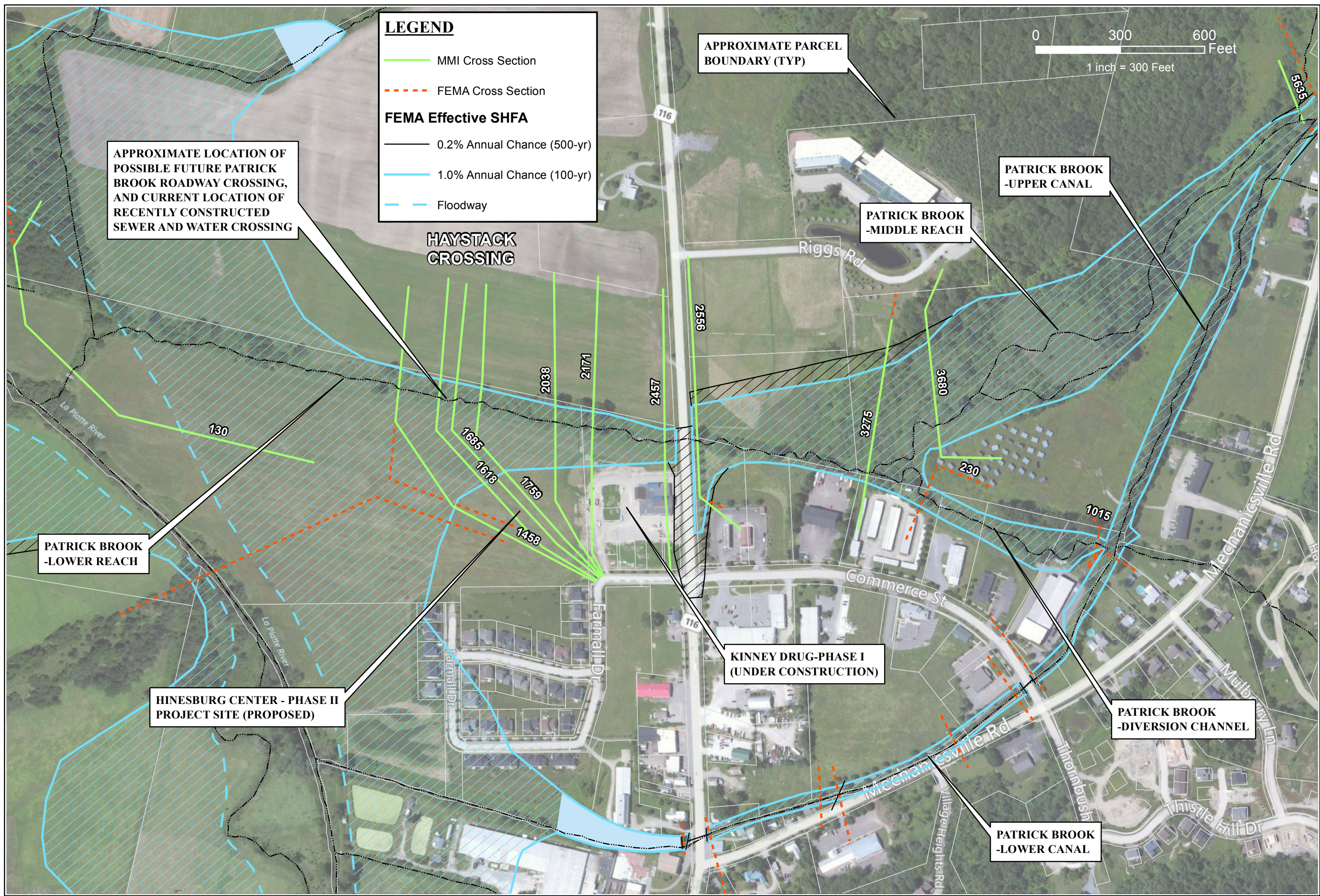
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2.0   EXISTING CONDITIONS

As shown on the effective Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) dated July 18, 2011, Patrick Brook is a detailed study stream. This indicates that a hydraulic analysis has been performed on the watercourse, with the results of that analysis mapped to designate Special Flood Hazard Areas (SFHA). The effective hydraulic computer model of both Patrick Brook and the LaPlatte River were obtained from the Vermont Department of Environmental Conservation (DEC) River Management Section. The effective model was used to develop the data as found on the current FEMA FIRM panels for the Town of Hinesburg and was also used as the primary basis for the Phase I analysis and this study. All hydraulic modeling referred to in the current study was conducted using the United States Army Corps of Engineers *Hydrologic Engineering Center – River Analysis System* (HEC-RAS) version 4.1.0 computer modeling software.

The hydraulic modeling used during Phase I was used as the starting point for the hydraulic analysis conducted under Phase II. The hydraulic model of Patrick Brook includes the lower, middle, and upper reaches of Patrick Brook, the Patrick Brook diversion channel, as well as the upper and lower Patrick Brook canal (Figure 1). However, this study focuses on the lower and middle reaches of Patrick Brook (Table 2.1). The existing conditions model used for the current Phase II study was created by incorporating the changes caused by the construction of Phase I of the overall development. In addition, several cross sections were added to the hydraulic analysis to facilitate making comparisons between existing, proposed, and future conditions.

TABLE 2.1
Patrick Brook Study Area

Section of Patrick Brook	From Cross Section Number (Downstream)	To Cross Section Number (Upstream)
Lower Reach	130	3275
Middle Reach	3680	5635
Phase I	2038	2457
Phase II	1458	2038
Sewer Crossing	1618	1685
Future Street Crossing	1618	1685
VT Route 116	2457	2556

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Figure 1

LEGEND

— MMI Cross Section

---- FEMA Cross Section

FEMA Effective SHFA

— 0.2% Annual Chance (500-yr)

— 1.0% Annual Chance (100-yr)

-- Floodway

APPROXIMATE PARCEL BOUNDARY (TYP)

APPROXIMATE LOCATION OF POSSIBLE FUTURE PATRICK BROOK ROADWAY CROSSING, AND CURRENT LOCATION OF RECENTLY CONSTRUCTED SEWER AND WATER CROSSING

HAYSTACK CROSSING

PATRICK BROOK -UPPER CANAL

PATRICK BROOK -MIDDLE REACH

PATRICK BROOK -LOWER REACH

HINESBURG CENTER - PHASE II PROJECT SITE (PROPOSED)

KINNEY DRUG-PHASE I (UNDER CONSTRUCTION)

PATRICK BROOK -DIVERSION CHANNEL

PATRICK BROOK -LOWER CANAL

OVERVIEW FLOODPLAIN MAP
HINESBURG CENTER - PHASE II
PATRICK BROOK
HINESBURG, VERMONT

0   300   600
Feet
1 inch = 300 Feet

The effective peak discharge rates published by FEMA were taken as the project design flows. The peak flood water surface elevations and velocities for the current existing conditions were used as the baseline flooding information for subsequent comparisons (Table 2.2).

TABLE 2.2
Existing Flood Elevation and Velocity

Cross Section	100-year Flood		500-year Flood	
	Water Surface Elev. (NAVD88)	Flow Velocity (ft/sec)	Water Surface Elev. (NAVD88)	Flow Velocity (ft/sec)
5635	360.06	5.9	360.27	6.2
3680	337.44	1.9	337.71	1.9
3275	334.71	7.6	334.99	8.0
2556	334.02	0.5	334.79	0.4
2457	330.98	2.7	331.20	2.8
2171	329.93	4.6	330.06	5.1
2038	329.34	2.6	329.45	2.7
1759	328.32	2.9	328.46	3.0
1685	328.05	2.4	328.16	2.6
1618	327.82	2.9	327.94	2.9
1458	326.85	4.4	326.96	4.7
130	324.60	0.9	325.00	0.7

Topography contours and proposed site design plans developed for Phase II of the Hinesburg Center project were provided by Ruggiano Engineering, Inc. of South Burlington, Vermont. The topographic data were used to develop new and extend existing cross sections. Data regarding the recently constructed utility crossing that traverses the project site was obtained from plan and profile sheets (Sheet P3 and P4, dated December 14, 2010 and revised to April 7, 2011) prepared by Trudell Consulting Engineers of Williston, Vermont. In areas located outside the project site, 2004 LIDAR-derived two-foot contour data available through the Vermont Center for Geographic Information (VCGI) were used to refine the cross sections.

3.0   PROPOSED CONDITIONS

The Phase II project is located to the west of the Phase I development along Patrick Brook. The project consists of a mixture of retail and commercial space, residential apartments, townhouses, and single-family building lots, along with associated access drives, street extensions, parking areas, and infrastructure.

The changes proposed by Phase II that primarily consist of fill in the floodplain area to the south of Patrick Brook were incorporated into the cross sectional geometry of the hydraulic model to create a proposed conditions model. The results indicate that a local increase in flood depth can be anticipated along with an increase in channel velocity during both the 100-year and 500-year storm events (Table 3.1).

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TABLE 3.1
Proposed Flood Elevation and Velocity

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Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing
3275	334.71	0	334.99	0	7.59	0	8.02	0
2556	334.09	0.07	334.79	0.01	0.47	-0.03	0.38	0
2457	331.05	0.07	331.20	0.09	2.53	-0.15	2.66	-0.18
2171	330.62	0.69	330.06	0.79	2.49	-2.12	2.66	-2.41
2038	330.21	0.87	329.45	0.99	3.21	0.57	3.33	0.59
1759	328.93	0.61	328.46	0.67	3.88	0.95	4.15	1.19
1685	328.40	0.35	328.16	0.44	4.01	1.57	4.11	1.47
1618	328.17	0.35	327.94	0.40	3.11	0.21	3.42	0.53
1458	326.78	-0.07	326.96	0.10	5.71	1.28	5.46	0.78
130	324.60	0	325.00	0	0.85	0	0.74	0

The maximum increase in flood depth is approximately 0.9 feet with an increase in channel velocity of 1.6 feet per second (fps) during the 100-year storm. Changes in the flood levels extend along the Phase I and Phase I project sites for approximately 950 linear feet. There were no changes in flood levels upstream of VT Route 116 indicated by the results of the hydraulic modeling. The results show a decrease in channel velocity adjacent to the Phase I development, primarily due to the back up of floodwaters downstream adjacent to Phase II. During the 500-year storm, similar changes occur. Flood depths increase by a maximum of one foot locally with a change in velocity of approximately 1.5 fps.

4.0   ADDITIONAL HYDRAULIC SCENARIOS

Each of the hydraulic scenarios was reviewed to explore changes to flood elevations and velocities. Identical changes were made to both the existing conditions model and the proposed Phase II conditions model to show the potential future conditions of these other activities with and without the proposed project.

4.1   VT Route 116 Culvert

Under this scenario, the existing culvert under VT Route 116 was changed in the hydraulic model based on likely future improvements. Currently the culvert is approximately 7 feet wide by 4 feet high. Under this scenario, the culvert has been enlarged to a 14-foot wide by 8-foot high culvert (buried 1-foot into channel providing a 7-foot high effective opening height). The culvert size selected was based on recommendations resulting from a study of numerous culverts along VT Route 116 conducted by Milone & MacBroom, Inc. completed in June, 2012. It should be noted that little to no channel geometry changes were made to the modeling under this scenario

so that the potential effects due to the culvert size increase could be explored exclusively. Additional hydraulic analysis would be required to detail the culvert design in the future. Table 4.1 and 4.2 provide a summary of the potential changes with the enlarge VT Route 116 culvert in place.

TABLE 4.1
Existing Conditions vs. Enlarged VT Route 116 Culvert

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.24	-0.2	337.52	-0.19	2.24	0.37	2.23	0.29
3275	336.12	1.41	336.23	1.24	3.35	-4.24	4.04	-3.98
2556	330.77	-3.25	331.46	-3.33	7.40	6.9	5.97	5.59
2457	330.98	0	331.20	0	2.68	0	2.84	0
2171	329.93	0	330.06	0	4.61	0	5.07	0
2038	329.34	0	329.45	0	2.64	0	2.74	0
1759	328.32	0	328.46	0	2.93	0	2.96	0
1685	328.05	0	328.16	0	2.44	0	2.64	0
1618	327.82	0	327.94	0	2.90	0	2.89	0
1458	326.85	0	326.96	0	4.43	0	4.68	0
130	324.60	0	325.00	0	0.85	0	0.74	0

TABLE 4.2
Proposed Conditions vs. VT Route 116 Scenario

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.24	-0.2	337.52	-0.19	2.24	0.37	2.23	0.29
3275	336.12	1.41	336.23	1.24	3.35	-4.24	4.04	-3.98
2556	330.77	-3.32	331.46	-3.34	7.4	6.93	5.97	5.59
2457	331.05	0	331.29	0	2.53	0	2.66	0
2171	330.62	0	330.85	0	2.49	0	2.66	0
2038	330.21	0	330.44	0	3.21	0	3.33	0
1759	328.93	0	329.13	0	3.88	0	4.15	0
1685	328.4	0	328.6	0	4.01	0	4.11	0
1618	328.17	0	328.34	0	3.11	0	3.42	0
1458	326.78	0	327.06	0	5.71	0	5.46	0
130	324.6	0	325	0	0.85	0	0.74	0

The results of the hydraulic model indicate that there will be no change in flood depth or velocity downstream of the culvert for the proposed project if the Patrick Brook culvert at Vermont Route 116 is upgraded to a larger structure. Changes in flood depth and velocity do take place upstream of the culvert crossing and extend approximately 900 linear feet upstream of the culvert inlet due to the change in culver size.

4.2   Constructed Utility Crossing

A sewer and water utility crossing was recently constructed that traverses the Hinesburg Center project site extending to the north across Patrick Brook to the Haystack Crossing subdivision. The utilities were placed within a right-of-way of a planned future street and have been covered with soil. Concerns have been raised over the effects of that material placed within the floodplain due to changes to flood depths and velocity. The fill material placed when the new utility crossing was constructed appears to encroach into the floodway boundary established during the Phase I hydraulic study. The hydraulic modeling was modified to include the fill material placed to cover the utilities under both existing and proposed conditions. The results are provided in Table 4.3 and 4.4 below.

TABLE 4.3
Existing Conditions vs. Utility Crossing Scenario

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.44	0	337.71	0	1.87	0	1.94	0
3275	334.71	0	334.99	0	7.59	0	8.02	0
2556	334.01	-0.01	334.78	-0.01	0.50	0	0.38	0
2457	330.97	-0.01	331.20	0	2.69	0.01	2.84	0
2171	329.96	0.03	330.06	0	4.48	-0.13	5.08	0.01
2038	329.30	-0.04	329.45	0	2.88	0.24	2.73	-0.01
1759	328.41	0.09	328.51	0.05	2.53	-0.4	2.84	-0.12
1685	328.27	0.22	328.36	0.2	1.69	-0.75	1.71	-0.93
1618	327.82	0	327.94	0	2.90	0	2.89	0
1458	326.85	0	326.96	0	4.43	0	4.68	0
130	324.60	0	325.00	0	0.85	0	0.74	0

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TABLE 4.4
Proposed Conditions vs. Utility Crossing Scenario

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.44	0	337.71	0	1.87	0	1.94	0
3275	334.71	0	334.99	0	7.59	0	8.02	0
2556	334.08	-0.01	334.80	0	0.47	0	0.38	0
2457	331.04	-0.01	331.28	-0.01	2.54	0.01	2.67	0.01
2171	330.61	-0.01	330.83	-0.02	2.51	0.02	2.69	0.03
2038	330.19	-0.02	330.39	-0.05	3.27	0.06	3.46	0.13
1759	329.03	0.1	329.35	0.22	3.59	-0.29	3.49	-0.66
1685	328.77	0.37	329.14	0.54	2.77	-1.24	2.59	-1.52
1618	328.17	0	328.34	0	3.11	0	3.42	0
1458	326.78	0	327.06	0	5.71	0	5.46	0
130	324.60	0	325.00	0	0.85	0	0.74	0

The results indicate that there is an increase in flood elevation during both the 100-year and 500-year storms with the utility crossing in place. The increase in flood depth is localized and extends approximately 350 feet upstream. Additionally, the channel velocity directly upstream of the utility crossing decreases during both the 100-year and 500-year storm. Both the increase in flood depth and decrease in channel velocity are expected given that the utility crossing restricts flow downstream.

Results are similar under proposed conditions (Phase II). The modeling shows that the placement of additional fill as part of Phase II creates an increase in flood water surface elevation of up to 0.5 feet and velocity of up to 0.1 fps over just the fill at the utility crossing alone.

4.3   Future Roadway Crossing

As previously mentioned, there is a right-of-way that extends northward from the existing terminus of Farmall Drive, traverses the Hinesburg Center project site, and crosses Patrick Brook accessing the Haystack Crossing subdivision to the north. The right-of-way was established such that a new street could eventually be constructed in the future connecting the two developments.

Two crossings types were explored under this hydraulic scenario. The first crossing type is a box culvert as shown on the plan and profile sheets prepared by Trudell Consulting Engineers indicates. The culvert proposed on the Trudell design is a 4-foot high by 7-foot wide concrete box culvert, however since a culvert size of 14-feet wide by 8-feet high (7-foot high effective opening) has been recommended for the future culvert under

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VT Route 116, a culvert with equal dimensions was used under this scenario as well. Results are summarized in Table 4.5 and 4.6 below.

TABLE 4.5
Existing Conditions vs. New Culvert Scenario

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.44	0	337.71	0	1.87	0	1.94	0
3275	334.71	0	334.99	0	7.59	0	8.02	0
2556	334.01	-0.01	334.78	-0.01	0.50	0	0.38	0
2457	330.97	-0.01	331.18	-0.02	2.69	0.01	2.88	0.04
2171	329.96	0.03	330.19	0.13	4.46	-0.15	4.48	-0.59
2038	329.29	-0.05	329.27	-0.18	2.91	0.27	3.86	1.12
1759	328.49	0.17	328.86	0.4	2.36	-0.57	1.51	-1.45
1685	328.41	0.36	328.83	0.67	1.23	-1.21	0.80	-1.84
1618	327.82	0	327.94	0	2.90	0	2.89	0
1458	326.85	0	326.96	0	4.43	0	4.68	0
130	324.60	0	325.00	0	0.85	0	0.74	0

Under existing conditions, the results indicate that there would be an increase in flood depths of up to 0.4 feet upstream of the new culvert during the 100-year and 0.7 feet during 500-year storm event. The increase in flood depths is primarily caused by the constriction with the new culvert in place as compared to the wide floodplain without the culvert. The results also indicate a reduction in channel velocity caused by the constriction. The changes in flood depth and velocity extend upstream for approximately 375 feet. The results indicate that the new culvert would not effect the performance of the VT Route 116 culvert.

TABLE 4.6
Proposed Conditions vs. New Culvert Scenario

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.44	0	337.71	0	1.87	0	1.94	0
3275	334.71	0	334.99	0	7.59	0	8.02	0
2556	334.09	0	334.81	0.01	0.47	0	0.38	0
2457	331.05	0	331.29	0	2.53	0	2.67	0.01
2171	330.62	0	330.84	-0.01	2.49	0	2.69	0.03
2038	330.21	0	330.41	-0.03	3.21	0	3.42	0.09
1759	328.95	0.02	329.25	0.12	3.84	-0.04	3.75	-0.4
1685	328.54	0.14	328.99	0.39	3.48	-0.53	2.91	-1.2
1618	328.17	0	328.34	0	3.11	0	3.42	0
1458	326.78	0	327.06	0	5.71	0	5.46	0
130	324.60	0	325.00	0	0.85	0	0.74	0

The effects of the new culvert on proposed conditions show similar results as described under existing conditions. The flood depths just upstream of the new culvert are predicted to increase, while the channel velocity would decrease during both the 100-year and 500-year storms. The results indicate that once beyond the influence of the new culvert or approximately 100 linear feet upstream, the flood depths and channel velocities would match the proposed conditions modeling results. The new culvert would encroach on the floodway boundary established during the Phase I hydraulic study. The results indicate that the new culvert would not effect the performance of the VT Route 116 culvert with Phase II in place.

In order to avoid the potential encroachment on the floodway caused by the installation of a cross culvert, a bridge crossing was also explored under this hydraulic scenario. The bridge abutments would be placed outside of the floodway boundary. To remain outside of the floodway, a span of approximately 76 feet would be required. Table 4.7 and 4.8 provided below summarizes the results of the hydraulic modeling with a new bridge crossing over Patrick Brook in place.

TABLE 4.7
Existing Conditions vs. New Bridge Scenario

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.44	0	337.71	0	1.87	0	1.94	0
3275	334.71	0	334.99	0	7.59	0	8.02	0
2556	334.00	-0.02	334.82	0.03	0.50	0	0.37	-0.01
2457	330.96	-0.02	331.18	-0.02	2.72	0.04	2.88	0.04
2171	330.08	0.15	330.19	0.13	3.95	-0.66	4.50	-0.57
2038	329.15	-0.19	329.27	-0.18	4.03	1.39	3.82	1.08
1759	328.79	0.47	329.07	0.61	1.33	-1.6	1.12	-1.84
1685	328.77	0.72	329.05	0.89	0.69	-1.75	0.62	-2.02
1618	327.82	0	327.94	0	2.90	0	2.89	0
1458	326.85	0	326.96	0	4.43	0	4.68	0
130	324.60	0	325.00	0	0.85	0	0.74	0

TABLE 4.8
Proposed Conditions vs. New Bridge Scenario

Cross Section	Water Surface Elevation (NAVD 88)				Channel Velocity (ft/sec)			
	100-year		500-year		100-year		500-year	
	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.44	0	337.71	0	1.87	0	1.94	0
3275	334.71	0	334.99	0	7.59	0	8.02	0
2556	334.08	-0.01	334.81	0.01	0.47	0	0.38	0
2457	331.04	-0.01	331.28	-0.01	2.54	0.01	2.67	0.01
2171	330.61	-0.01	330.84	-0.01	2.51	0.02	2.69	0.03
2038	330.18	-0.03	330.40	-0.04	3.28	0.07	3.44	0.11
1759	329.04	0.11	329.29	0.16	3.55	-0.33	3.64	-0.51
1685	328.79	0.39	329.05	0.45	2.72	-1.29	2.76	-1.35
1618	328.17	0	328.34	0	3.11	0	3.42	0
1458	326.78	0	327.06	0	5.71	0	5.46	0
130	324.60	0	325.00	0	0.85	0	0.74	0

In general, the results with a new bridge in place are similar to the results assuming a new culvert is in place when compared to existing and proposed conditions without the bridge in place. The flood depths increase locally upstream of the new crossing, and channel velocities generally decrease. Additionally, the results under both existing and proposed

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indicate that the effects of the new bridge will not extend far enough upstream to effect the performance of the VT Route 116 culvert.

When compared to the results with the culvert in place, the hydraulic modeling results with a new bridge in place are counter-intuitive, as the change in flood depth under existing conditions increases more with the wider bridge in place than it does with the narrower culvert in place. The reason for this unexpected result is that the channel velocity decreases with the bridge leading to less conveyance downstream and a higher flood level. The hydraulic modeling indicates similar results under proposed conditions, with an increase in flood depths of approximately 0.4 feet upstream of the new bridge and a decrease of approximately 1.3 fps during the 100-year storm event. During the 500-year storm event, the flood depths would increase by approximately 0.5 feet and velocities decrease by 1.4 fps.

4.4   Future Hydrologic Conditions

The future hydrologic condition within the Patrick Brook watershed was explored to look at the potential for increased peak flow rates in Patrick Brook. The larger floods could be due to future development and changes within the watershed or due to higher precipitation rates in the region. The hydrology used for this hydraulic scenario is based on the results of a study conducted by Milone & MacBroom, Inc. The final report entitled *Growth Area Existing Conditions Hydrology Study* dated January 2012 prepared for the Town of Hinesburg details how the future conditions hydrology was developed. The future condition assumes a full-buildout condition of all land with development potential based on current zoning in Hinesburg located within the watershed. The previous hydrologic study looked at a range of storm events up to the 100-year storm, and thus for this hydraulic scenario only the 100-year storm event was analyzed.

Estimated peak discharge rates were taken from the hydrologic model for future conditions and inserted into the hydraulic model of Patrick Brook. The peak flow for the lower reach of Patrick Brook was estimated to be 713 cubic feet per second (cfs) for the 100-year storm. The current 100-year peak flow rate used in the FEMA FIS within the same segment of Patrick Brook is 271 cfs. It should be noted that there were no changes made to the cross sectional geometry to accommodate the increased flow rates, and therefore there may be some cross sections that do not fully capture the flow for this conservative modeling exercise. The results assuming future hydrology are summarized in Table 4.9.

TABLE 4.9
Existing and Proposed Conditions with Future 100-year Hydrology

Cross Section	Existing Conditions				Proposed Conditions			
	Water Surface Elevation (NAVD 88)		Channel Velocity (ft/sec)		Water Surface Elevation (NAVD 88)		Channel Velocity (ft/sec)	
	Value	Change from Existing	Value	Change from Existing	Value	Change from Proposed	Value	Change from Proposed
5635	360.47	0.41	6.60	0.73	360.47	0.41	6.60	0.73
3680	338.45	1.01	1.39	-0.48	338.45	1.01	1.39	-0.48
3275	335.99	1.28	9.42	1.83	335.99	1.28	9.42	1.83
2556	335.38	1.36	0.59	0.09	335.34	1.25	0.60	0.13
2457	332.08	1.1	3.48	0.8	332.23	1.18	3.26	0.73
2171	330.43	0.5	7.63	3.02	331.74	1.12	3.36	0.87
2038	329.85	0.51	2.82	0.18	331.27	1.06	4.01	0.8
1759	328.80	0.48	3.43	0.5	329.91	0.98	4.91	1.03
1685	328.49	0.44	2.80	0.36	329.38	0.98	4.63	0.62
1618	328.21	0.39	3.64	0.74	329.07	0.9	4.37	1.26
1458	327.60	0.75	3.11	-1.32	327.55	0.77	6.76	1.05
130	327.60	3	0.31	-0.54	327.60	3	0.31	-0.54

The results for existing conditions indicate that the water surface elevations can be expected to increase within the study reach. Additionally, channel velocities generally increase, most notably at the transition between Phase I and Phase II where there is an increase of approximately 3 fps.

The hydraulic modeling shows similar results under proposed conditions. Flood depths generally increase with the higher future flow rate for the 100-year storm event. The results show an increase in channel velocity; however the increase at the transition between Phase I and Phase II is approximately 0.9 fps. The results of the hydraulic model indicate that the effects of the Phase II proposed conditions extend approximately 900 linear feet along the project site, however the changes do not extend far enough upstream to effect the VT Route 116 culvert or areas upstream.

4.5   Combination of Future Conditions

The final hydraulic scenario explored includes a combination of multiple scenarios to estimate how flood depths and channel velocities could possibly change with several potential future changes implemented. The modeling explores the addition of the enlarged VT Route 116 culvert and the future street crossing over Patrick Brook. These two scenarios were added to both the existing conditions and proposed Phase II conditions model. Results of the hydraulic modeling assuming this scenario is provided in Table 4.10 and Table 4.11.

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TABLE 4.10
Existing Conditions vs. Culvert Combination Scenario

| Cross Section | Water Surface Elevation (NAVD 88) | | | | Channel Velocity (ft/sec) | | | |
| | 100-year | | 500-year | | 100-year | | 500-year | |
	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing	Value	Change from Existing
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.24	-0.2	337.52	-0.19	2.24	0.37	2.23	0.29
3275	336.12	1.41	336.23	1.24	3.35	-4.24	4.04	-3.98
2556	330.77	-3.25	331.46	-3.33	7.40	6.9	5.97	5.59
2457	330.97	-0.01	331.18	-0.02	2.69	0.01	2.88	0.04
2171	329.96	0.03	330.19	0.13	4.46	-0.15	4.48	-0.59
2038	329.29	-0.05	329.27	-0.18	2.91	0.27	3.86	1.12
1759	328.49	0.17	328.86	0.4	2.36	-0.57	1.51	-1.45
1685	328.41	0.36	328.83	0.67	1.23	-1.21	0.80	-1.84
1618	327.82	0	327.94	0	2.90	0	2.89	0
1458	326.85	0	326.96	0	4.43	0	4.68	0
130	324.60	0	325.00	0	0.85	0	0.74	0

The results of the hydraulic modeling under existing conditions indicate that similar changes that occurred when the addition of the culverts were explored individually would also occur when the future culverts are modeled together. There is an increase of approximately 0.4 feet just upstream of the new culvert over Patrick Brook with a decrease in velocity of approximately 1.2 fps during the 100-year storm. The changes in flood depth and channel velocity due to the new culvert extend approximately 500 linear feet upstream of the culvert inlet. Similar results are realized during a 500-year storm event, with an increase of 0.7 feet in flood depth upstream of the new culvert inlet and a decrease in channel velocity of approximately 1.8 fps.

Upstream of the enlarged VT Route 116 culvert, the flood depths would decrease by approximately 3.3 feet during a 100-year storm, however the exit velocity downstream of the enlarged culvert would increase by approximately 6.9 fps. Similar results occur during the 500-year, with a decrease of 3.3 feet in flood depth upstream of the enlarged culvert and an increase in channel velocity of approximately 5.6 fps downstream at the culvert outlet.

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TABLE 4.11
Proposed Conditions vs. Culvert Combination Scenario

| Cross Section | Water Surface Elevation (NAVD 88) | | | | Channel Velocity (ft/sec) | | | |
| | 100-year | | 500-year | | 100-year | | 500-year | |
	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed	Value	Change from Proposed
5635	360.06	0	360.27	0	5.87	0	6.21	0
3680	337.24	-0.2	337.52	-0.19	2.24	0.37	2.23	0.29
3275	336.12	1.41	336.23	1.24	3.35	-4.24	4.04	-3.98
2556	330.77	-3.32	331.46	-3.34	7.40	6.93	5.97	5.59
2457	331.05	0	331.29	0	2.53	0	2.67	0.01
2171	330.62	0	330.84	-0.01	2.49	0	2.69	0.03
2038	330.21	0	330.41	-0.03	3.21	0	3.42	0.09
1759	328.95	0.02	329.25	0.12	3.84	-0.04	3.75	-0.4
1685	328.54	0.14	328.99	0.39	3.48	-0.53	2.91	-1.2
1618	328.17	0	328.34	0	3.11	0	3.42	0
1458	326.78	0	327.06	0	5.71	0	5.46	0
130	324.60	0	325.00	0	0.85	0	0.74	0

The results of the hydraulic model under proposed conditions indicate that there would be a local increase in flood depth of approximately 0.1 feet and decrease of 0.5 fps in channel velocity during the 100-year storm event upstream of the new culvert crossing over Patrick Brook. During the 500-year storm, an increase in flood depth of 0.4 feet is estimated with a decrease in channel velocity of 1.2 fps.

Similar results occur upstream of the enlarged VT Route 116 culvert under proposed conditions as indicated by the results under existing conditions. A decrease in flood depth of approximately 3.3 feet is estimated upstream of the enlarge culvert during a 100-year storm event, while an increase in channel velocity of 6.9 fps in estimated downstream at the culvert outlet. Similar results occur during the 500-year, with a decrease of 3.3 feet in flood depth upstream of the enlarged culvert and an increase in channel velocity of approximately 5.6 fps downstream at the culvert outlet. Because the changes that occur upstream and downstream of the enlarged VT Route 116 culvert under proposed conditions are the same as the changes that occur under existing conditions, it can be said that the Phase II proposed conditions do not effect the performance of the enlarged VT Route 116 culvert or areas upstream.

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5.0   CONCLUSIONS

The following is a bulleted list of conclusions summarizing the hydraulic analyses conducted as part of this phase of the Patrick Brook study.

o   Under the proposed conditions, a maximum increase in the existing flood elevation of 0.9 feet and maximum increase in channel velocity of 1.6 feet per second occurs with the Phase II changes during the 100-year storm.

o   Channel velocities decrease slightly adjacent to Phase I under proposed conditions.

o   Changes under proposed conditions are isolated to the section of Patrick Brook adjacent to Phase I and Phase II (approximately 950 linear feet).

o   Changes under proposed conditions do not extend upstream of VT Route 116.

o   Changes due to the replacement of the VT Route 116 culvert occur upstream of culvert and at the exit of the culvert.

o   No change in flood depth or channel velocity occurs adjacent to Phase II if the Patrick Brook culvert at Vermont Route 116 is upgraded to a larger structure.

o   The placement of additional fill as part of Phase II creates an increase in flood water surface elevation of up to 0.5 feet and velocity of up to 0.1 fps in conjunction with the fill at the utility crossing previously performed by others.

o   The placement of additional fill as part of Phase II creates an increase in flood depth of up to 0.4 feet and velocity of up to 0.1 fps in conjunction with the addition of a new culvert crossing over Patrick Brook performed by others.

o   The placement of additional fill as part of Phase II creates an increase in flood depth of up to 0.5 feet and velocity of up to 0.1 fps in conjunction with the addition of a new bridge crossing over Patrick Brook performed by others.

o   A maximum increase in flood depth of 1.2 feet and maximum increase in channel velocity of 1.3 fps occurs adjacent to the Phase II project site under proposed conditions assuming higher future peak flow rates.

o   The placement of additional fill as part of Phase II creates an increase in flood depth of up to 0.4 feet and velocity of up to 0.1 fps in conjunction with the addition of a new culvert crossing over Patrick Brook and enlarged VT Route 116 culvert performed by others.

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APPENDIX A: EXISTING CONDITIONS

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HEC-RAS Plan: Ex Cnd Ph I

River	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)	
Unnamed diversio	diversion	4310	100-yr	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	500-yr	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2502		Culvert									
Patrick Brook	Lower reach	2457	100-yr	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	500-yr	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2171	100-yr	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	500-yr	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2038	100-yr	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	500-yr	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	1759	100-yr	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	500-yr	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1685	100-yr	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	500-yr	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1618	100-yr	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	500-yr	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1458	100-yr	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	500-yr	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	130	100-yr	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: Existing Conditions w Phase I   10/2/2013

Patrick Brook Lower reach

Legend

WS 500-yr
WS 100-yr
Crit 500-yr
Crit 100-yr
Ground
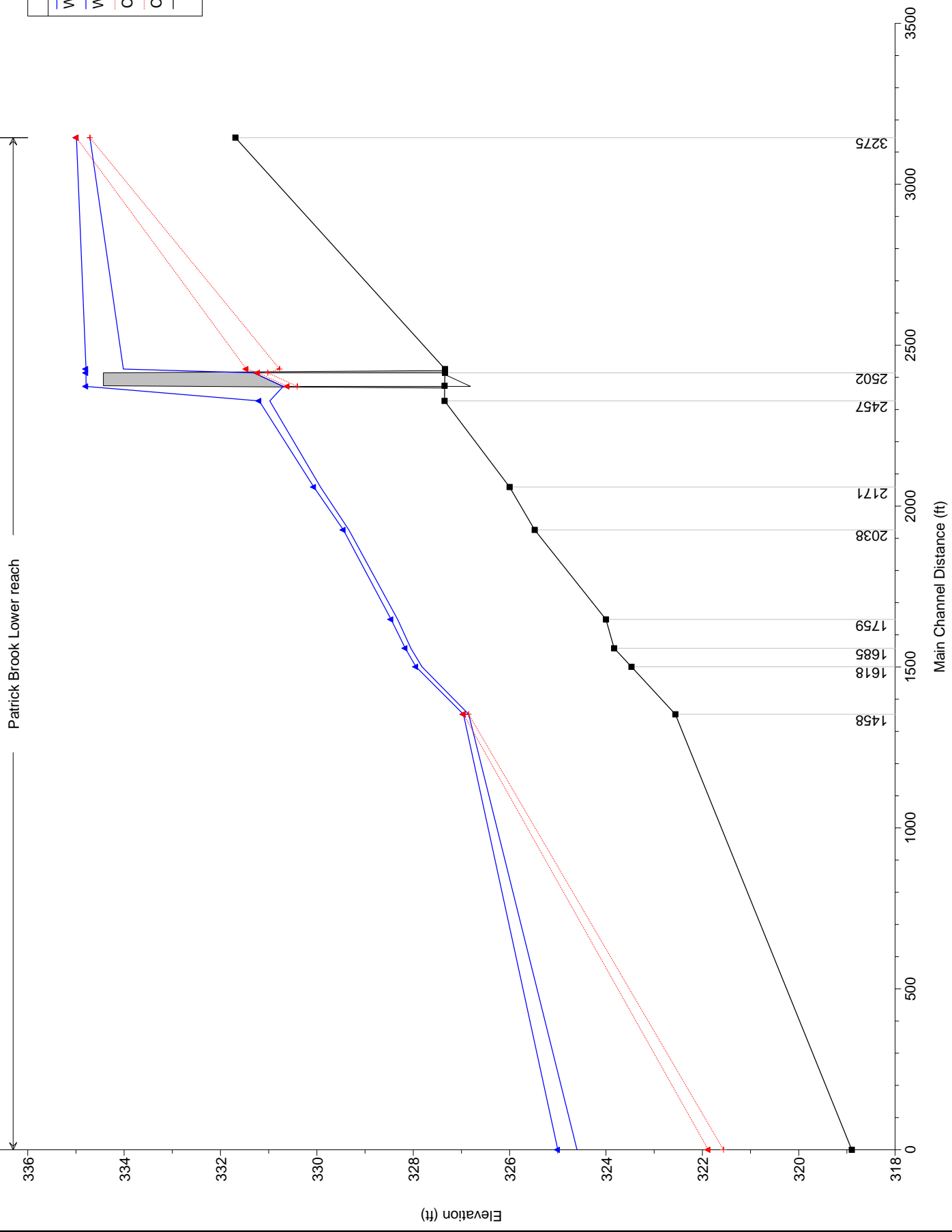
Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: Existing Conditions w Phase I   10/2/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

- Crit 500-yr
- Crit 100-yr
- WS 500-yr
- WS 100-yr
- Ground

Elevation (ft)
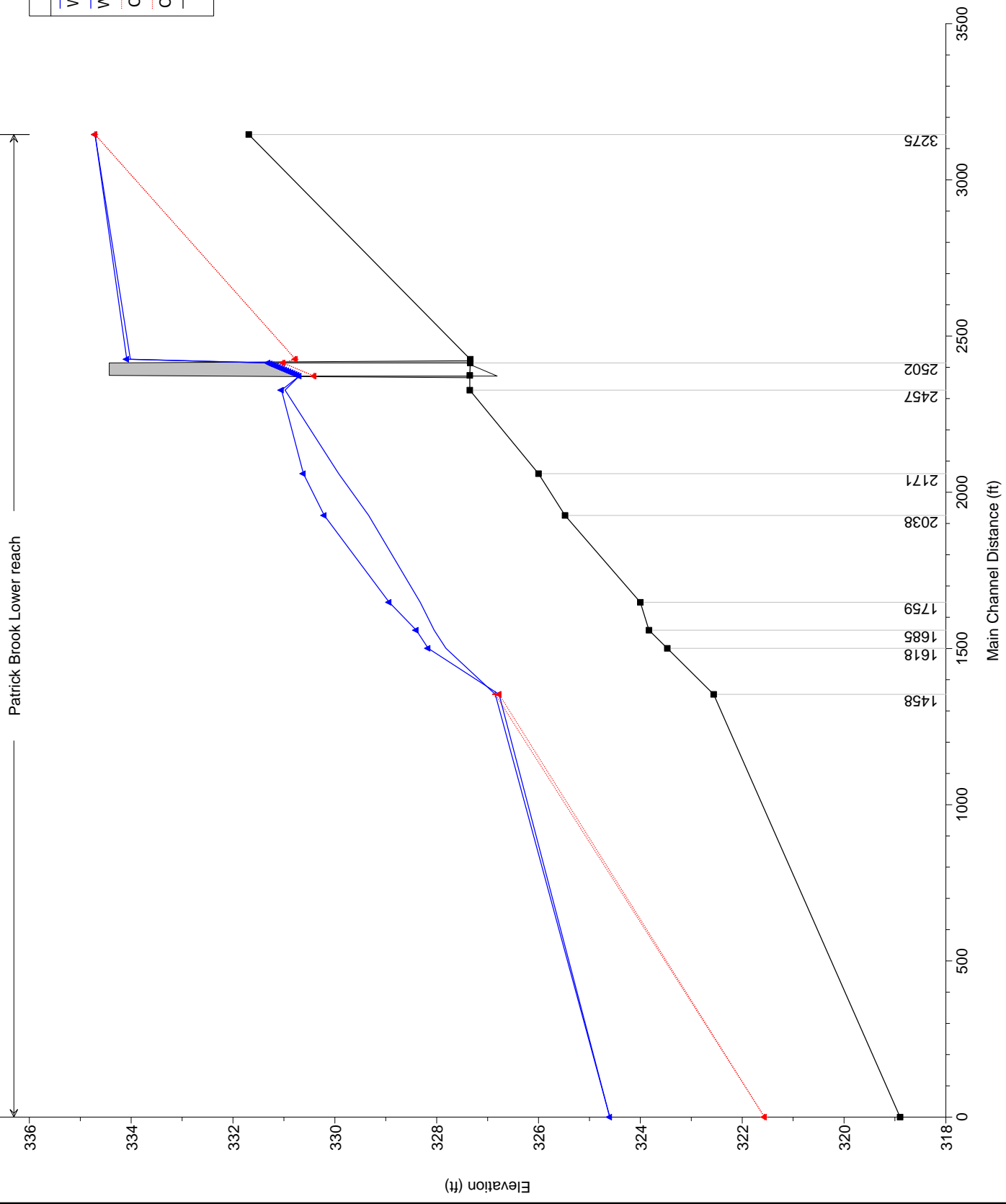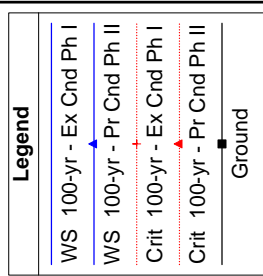
Main Channel Distance (ft)
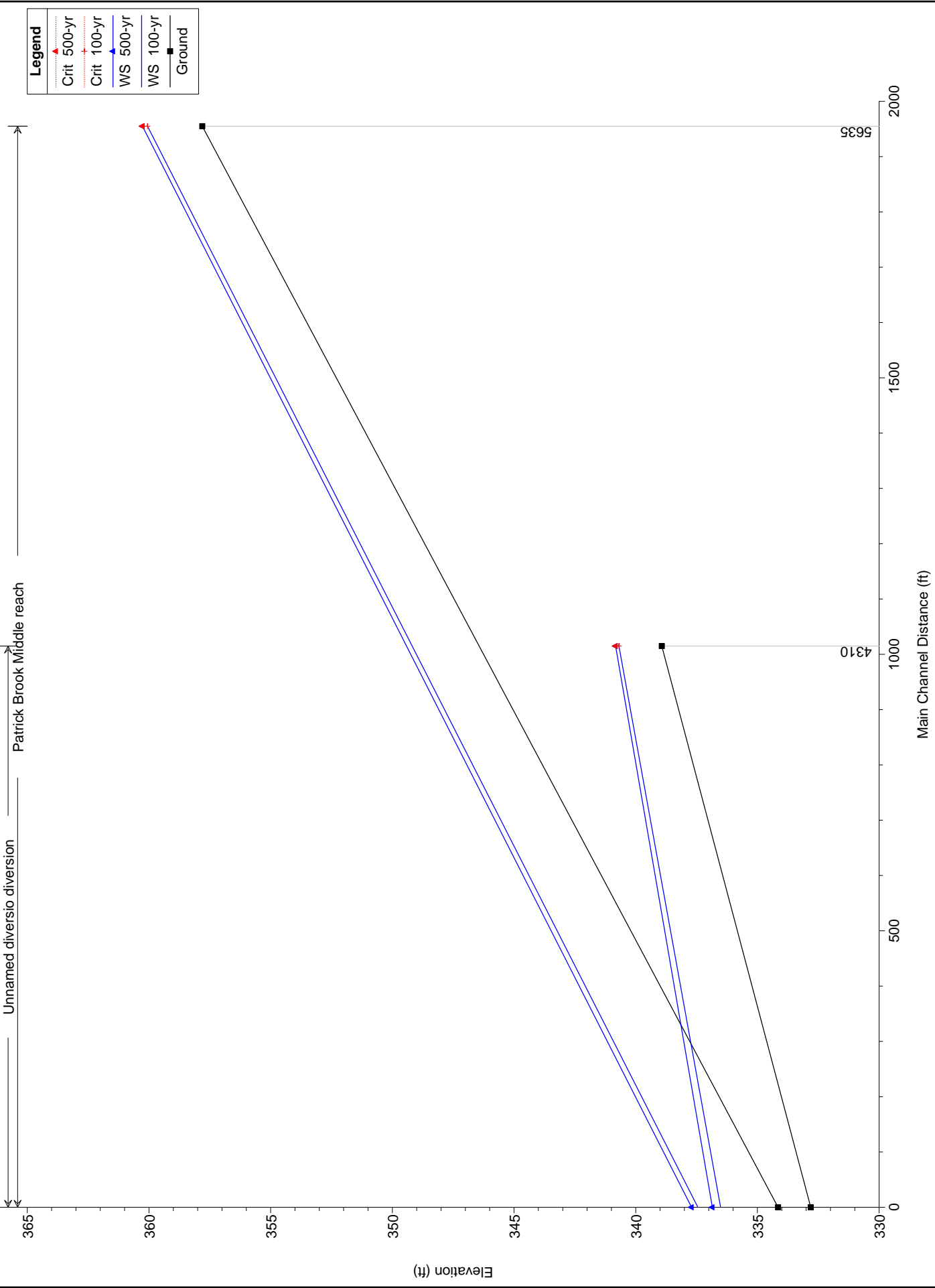
APPENDIX B: PROPOSED CONDITIONS

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Cnd Ph II	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Cnd Ph II	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Cnd Ph II	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Cnd Ph II	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Cnd Ph II	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.40	695.76	0.04
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Cnd Ph II	342.00	327.34	334.80	331.46	334.80	0.000016	0.38	1645.18	768.19	0.03
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Pr Cnd Ph II	342.00	327.35	331.29		331.36	0.001619	2.66	191.84	125.97	0.25
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Pr Cnd Ph II	342.00	326.00	330.85		330.91	0.001741	2.66	238.09	156.33	0.25
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Pr Cnd Ph II	342.00	325.48	330.44		330.57	0.003912	3.33	160.81	139.37	0.37
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Pr Cnd Ph II	342.00	324.00	329.13		329.33	0.005020	4.15	139.75	132.09	0.42
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Pr Cnd Ph II	342.00	323.83	328.60		328.78	0.007377	4.11	133.52	129.96	0.49
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Pr Cnd Ph II	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Pr Cnd Ph II	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Cnd Ph II	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013

Patrick Brook Lower reach

Legend

WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Cnd Ph II
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Cnd Ph II
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Cnd Ph II
WS 100-yr - Pr Cnd Ph II
WS 100-yr - Ex Cnd Ph I
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013

Patrick Brook Lower reach

Elevation (ft)

Main Channel Distance (ft)

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Cnd Ph II
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr Cnd Ph II
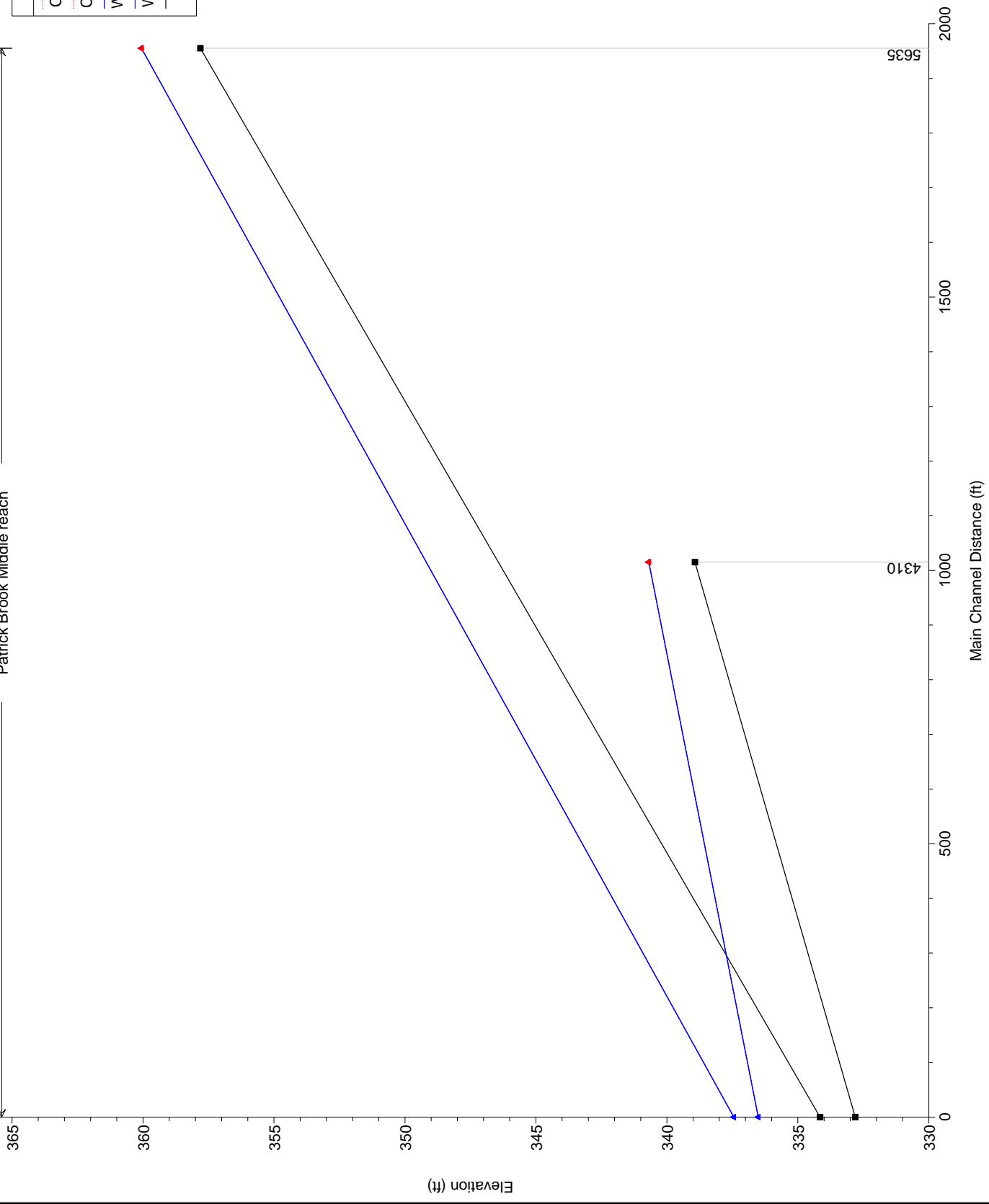Ground

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013
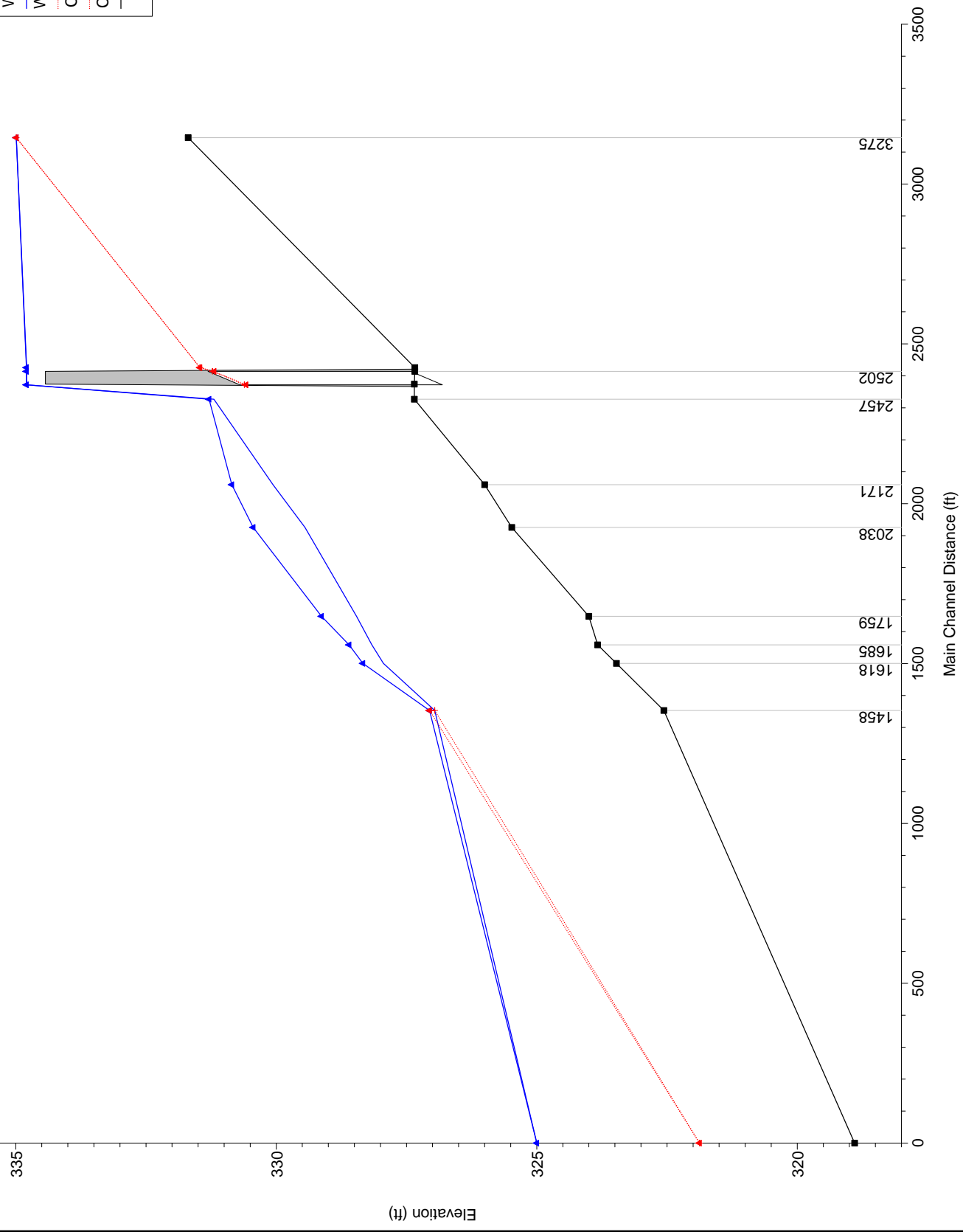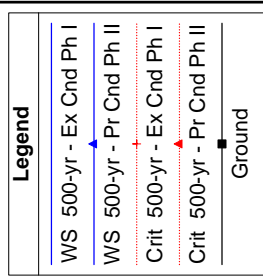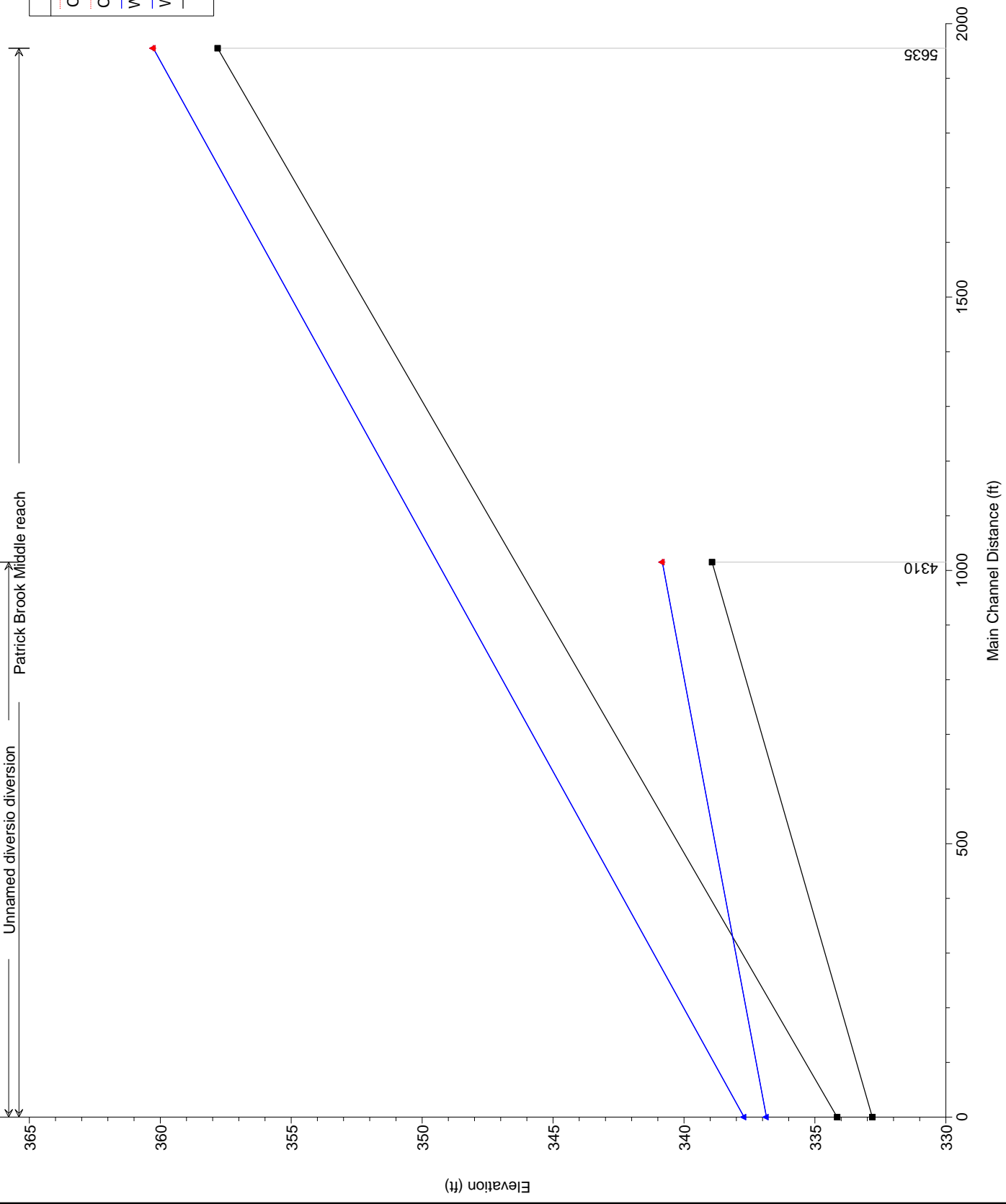
Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr Cnd Ph II
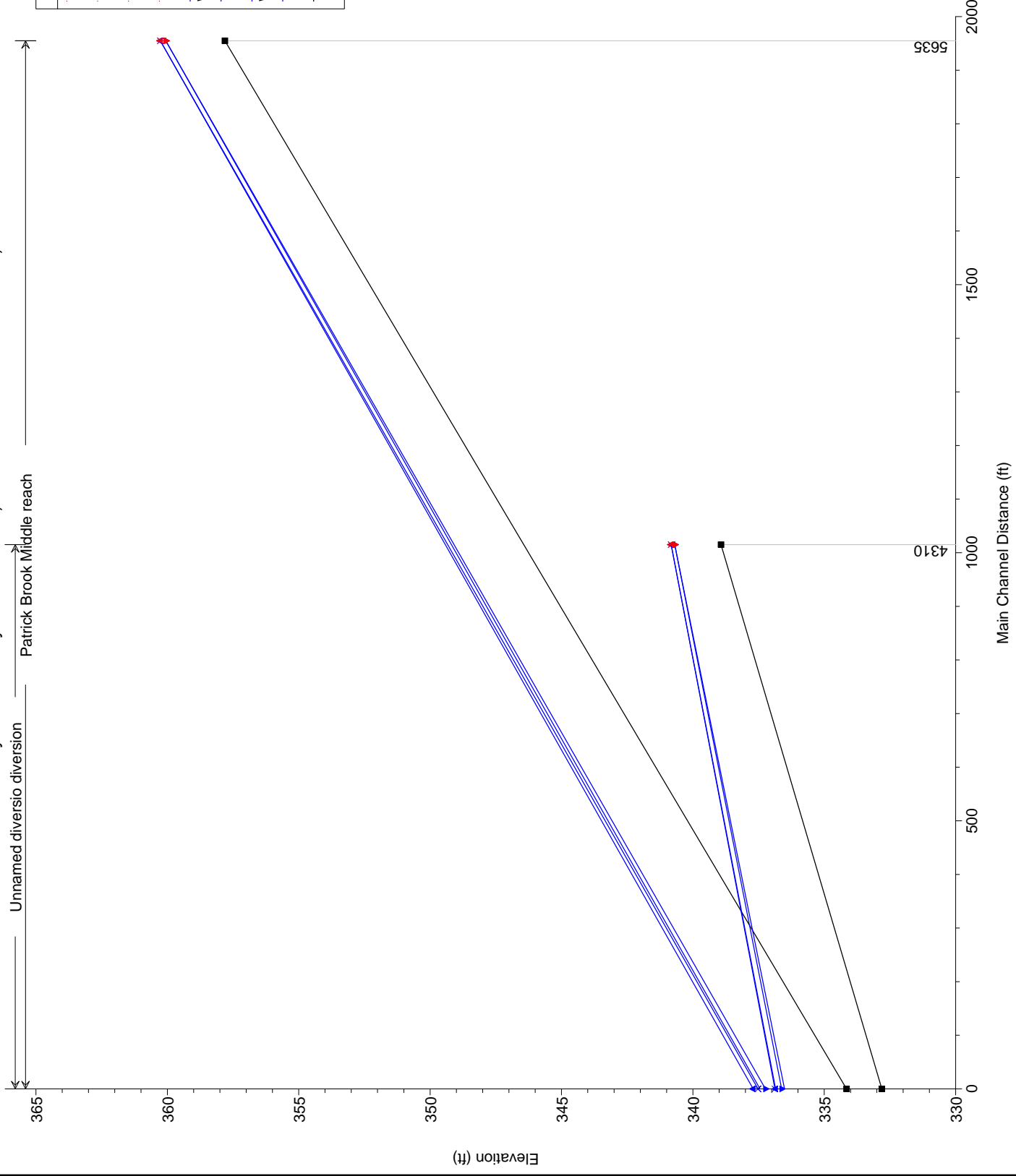WS 500-yr - Pr Cnd Ph II
WS 500-yr - Ex Cnd Ph I
Ground

Elevation (ft)

Main Channel Distance (ft)

5635

4310

APPENDIX C: VT ROUTE 116 SCENARIO

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Ex Ph I Rte 116	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Ex Ph I Rte 116	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Ex Ph I Rte 116	109.00	332.81	336.62		336.66	0.000651	1.54	70.92	71.50	0.18
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Ph I Rte 116	137.00	332.81	336.88		336.92	0.000725	1.72	79.62	75.88	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Ex Ph I Rte 116	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Ph I Rte 116	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Ex Ph I Rte 116	162.00	334.15	337.24		337.29	0.002166	2.24	105.71	492.54	0.25
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Ph I Rte 116	205.00	334.15	337.52		337.57	0.001864	2.23	132.58	496.60	0.23
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Ex Ph I Rte 116	271.00	331.69	336.12		336.24	0.002885	3.35	139.19	359.91	0.35
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Ex Ph I Rte 116	342.00	331.69	336.23		336.39	0.003998	4.04	145.71	366.65	0.42
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Ex Ph I Rte 116	271.00	327.34	330.77	330.77	331.61	0.023575	7.40	39.04	30.48	0.87
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Ex Ph I Rte 116	342.00	327.34	331.46	331.46	331.93	0.010725	5.97	85.51	121.30	0.61
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Ex Ph I Rte 116	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Ex Ph I Rte 116	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Ex Ph I Rte 116	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Ex Ph I Rte 116	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Ex Ph I Rte 116	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Ex Ph I Rte 116	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Ex Ph I Rte 116	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Ex Ph I Rte 116	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Ex Ph I Rte 116	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Ex Ph I Rte 116	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Ph I Rte 116	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Ph I Rte 116	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Ex Ph I Rte 116	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Ex Ph I Rte 116	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Ex Ph I Rte 116	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Ex Ph I Rte 116	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I Rte 116   10/2/2013

Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Ex Ph I Rte 116
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Ex Ph I Rte 116
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Ex Ph I Rte 116
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Ex Ph I Rte 116
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I Rte 116   10/2/2013

Patrick Brook Middle reach

Unnamed diversio diversion

Legend

▲	Crit 500-yr - Ex Cnd Ph I
✕	Crit 500-yr - Ex Ph I Rte 116
▶	Crit 100-yr - Ex Ph I Rte 116
+	Crit 100-yr - Ex Cnd Ph I
✕	WS 500-yr - Ex Ph I Rte 116
◀	WS 500-yr - Ex Cnd Ph I
▶	WS 100-yr - Ex Ph I Rte 116
	WS 100-yr - Ex Cnd Ph I
■	Ground

Elevation (ft)

Main Channel Distance (ft)

5635

4310

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr PhII Rte 116	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Cnd Ph II	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr PhII Rte 116	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr PhII Rte 116	109.00	332.81	336.62		336.66	0.000651	1.54	70.92	71.50	0.18
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Cnd Ph II	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr PhII Rte 116	137.00	332.81	336.88		336.92	0.000725	1.72	79.62	75.88	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr PhII Rte 116	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Cnd Ph II	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr PhII Rte 116	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr PhII Rte 116	162.00	334.15	337.24		337.29	0.002166	2.24	105.71	492.54	0.25
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Cnd Ph II	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr PhII Rte 116	205.00	334.15	337.52		337.57	0.001864	2.23	132.58	496.60	0.23
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr PhII Rte 116	271.00	331.69	336.12		336.24	0.002885	3.35	139.19	359.91	0.35
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Cnd Ph II	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr PhII Rte 116	342.00	331.69	336.23		336.39	0.003998	4.04	145.71	366.65	0.42
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.40	695.76	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr PhII Rte 116	271.00	327.34	330.77	330.77	331.61	0.023575	7.40	39.04	30.48	0.87
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Cnd Ph II	342.00	327.34	334.80	331.46	334.80	0.000016	0.38	1645.18	768.19	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr PhII Rte 116	342.00	327.34	331.46	331.46	331.93	0.010725	5.97	85.51	121.30	0.61
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	100-yr	Pr PhII Rte 116	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Pr Cnd Ph II	342.00	327.35	331.29		331.36	0.001619	2.66	191.84	125.97	0.25
Patrick Brook	Lower reach	2457	500-yr	Pr PhII Rte 116	342.00	327.35	331.29		331.36	0.001619	2.66	191.84	125.97	0.25
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	100-yr	Pr PhII Rte 116	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Pr Cnd Ph II	342.00	326.00	330.85		330.91	0.001741	2.66	238.09	156.33	0.25
Patrick Brook	Lower reach	2171	500-yr	Pr PhII Rte 116	342.00	326.00	330.85		330.91	0.001741	2.66	238.09	156.33	0.25
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	100-yr	Pr PhII Rte 116	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Pr Cnd Ph II	342.00	325.48	330.44		330.57	0.003912	3.33	160.81	139.37	0.37
Patrick Brook	Lower reach	2038	500-yr	Pr PhII Rte 116	342.00	325.48	330.44		330.57	0.003912	3.33	160.81	139.37	0.37
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	100-yr	Pr PhII Rte 116	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Pr Cnd Ph II	342.00	324.00	329.13		329.33	0.005020	4.15	139.75	132.09	0.42
Patrick Brook	Lower reach	1759	500-yr	Pr PhII Rte 116	342.00	324.00	329.13		329.33	0.005020	4.15	139.75	132.09	0.42
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	100-yr	Pr PhII Rte 116	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Pr Cnd Ph II	342.00	323.83	328.60		328.78	0.007377	4.11	133.52	129.96	0.49
Patrick Brook	Lower reach	1685	500-yr	Pr PhII Rte 116	342.00	323.83	328.60		328.78	0.007377	4.11	133.52	129.96	0.49
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	100-yr	Pr PhII Rte 116	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Pr Cnd Ph II	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1618	500-yr	Pr PhII Rte 116	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	100-yr	Pr PhII Rte 116	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Pr Cnd Ph II	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	1458	500-yr	Pr PhII Rte 116	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	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)	
Patrick Brook	Lower reach	130	100-yr	Pr PhII Rte 116	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Cnd Ph II	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr PhII Rte 116	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII Rte 116   10/3/2013

Patrick Brook Lower reach

Legend

WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Cnd Ph II
WS 100-yr - Pr PhII Rte 116
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr PhII Rte 116
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII Rte 116   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Pr PhII Rte 116
WS 100-yr - Pr PhII Rte 116
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Cnd Ph II
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII Rte 116   10/3/2013

Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Cnd Ph II
WS 500-yr - Pr PhII Rte 116
Crit 500-yr - Pr Cnd Ph II
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr PhII Rte 116
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII Rte 116   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr Cnd Ph II
Crit 500-yr - Pr PhII Rte 116
WS 500-yr - Pr PhII Rte 116
WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Cnd Ph II
Ground

Main Channel Distance (ft)

Elevation (ft)

5635

4310

APPENDIX D: UTILITY CROSSING SCENARIO

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Ex Ph I Sewer	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Ex Ph I Sewer	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Ex Ph I Sewer	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Ph I Sewer	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Ex Ph I Sewer	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Ph I Sewer	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Ex Ph I Sewer	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Ph I Sewer	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Ex Ph I Sewer	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Ex Ph I Sewer	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Ex Ph I Sewer	271.00	327.34	334.01	330.77	334.01	0.000032	0.50	1075.07	688.34	0.04
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Ex Ph I Sewer	342.00	327.34	334.78	331.46	334.78	0.000016	0.38	1630.50	766.24	0.03
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Ex Ph I Sewer	271.00	327.35	330.97		331.05	0.001872	2.69	152.39	123.33	0.26
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Ex Ph I Sewer	342.00	327.35	331.20		331.28	0.001915	2.84	180.23	125.03	0.27
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Ex Ph I Sewer	271.00	326.00	329.96		330.15	0.007353	4.48	112.51	123.61	0.49
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Ex Ph I Sewer	342.00	326.00	330.06		330.30	0.008991	5.08	125.75	127.60	0.55
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Ex Ph I Sewer	271.00	325.48	329.30		329.36	0.004519	2.88	230.18	514.94	0.37
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Ex Ph I Sewer	342.00	325.48	329.45		329.50	0.003816	2.73	317.93	598.71	0.35
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Ex Ph I Sewer	271.00	324.00	328.41		328.45	0.002425	2.53	284.44	620.39	0.28
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Ex Ph I Sewer	342.00	324.00	328.51		328.56	0.002930	2.84	353.43	697.54	0.31
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Ex Ph I Sewer	271.00	323.83	328.27	327.71	328.28	0.001438	1.69	434.70	825.52	0.21
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Ex Ph I Sewer	342.00	323.83	328.36	327.79	328.38	0.001417	1.71	514.97	829.21	0.21
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Ph I Sewer	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Ph I Sewer	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Ex Ph I Sewer	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Ex Ph I Sewer	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Ex Ph I Sewer	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Ex Ph I Sewer	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I Sewer   10/2/2013

Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Ex Ph I Sewer
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Ex Ph I Sewer
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Ex Ph I Sewer
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Ex Ph I Sewer
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I Sewer   10/2/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Ex Ph I Sewer
Crit 100-yr - Ex Ph I Sewer
Crit 100-yr - Ex Cnd Ph I
WS 500-yr - Ex Cnd Ph I
WS 500-yr - Ex Ph I Sewer
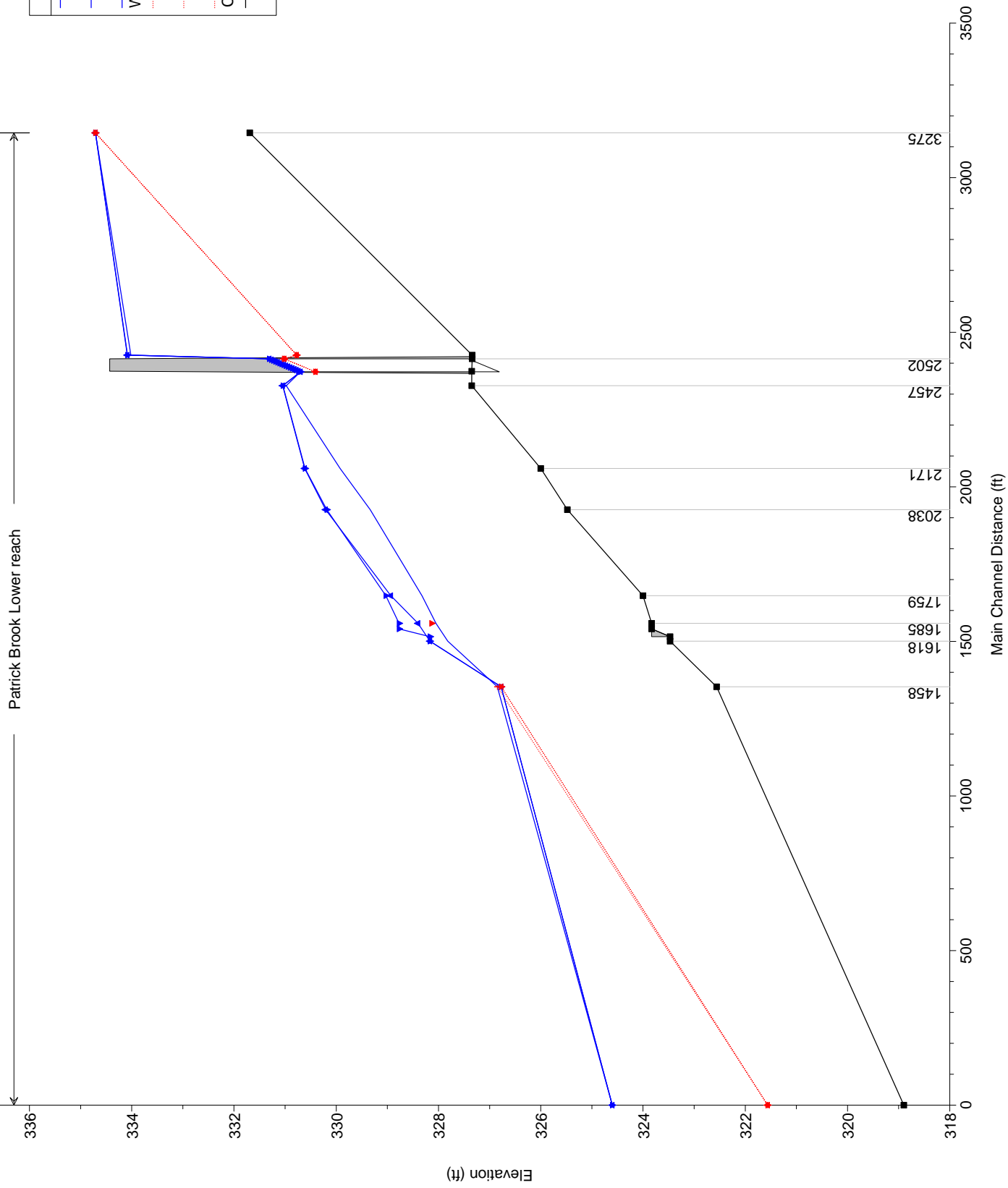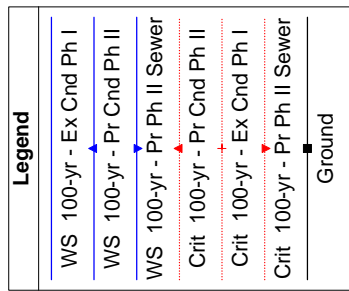WS 100-yr - Ex Ph I Sewer
WS 100-yr - Ex Cnd Ph I
Ground

Elevation (ft)

Main Channel Distance (ft)

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Ph II Sewer	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Cnd Ph II	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Ph II Sewer	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Ph II Sewer	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Cnd Ph II	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Ph II Sewer	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Ph II Sewer	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Cnd Ph II	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Ph II Sewer	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Ph II Sewer	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Cnd Ph II	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Ph II Sewer	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Ph II Sewer	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Cnd Ph II	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Ph II Sewer	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.40	695.76	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Ph II Sewer	271.00	327.34	334.08	330.77	334.08	0.000029	0.47	1123.49	695.48	0.04
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Cnd Ph II	342.00	327.34	334.80	331.46	334.80	0.000016	0.38	1645.18	768.19	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Ph II Sewer	342.00	327.34	334.80	331.46	334.81	0.000015	0.38	1651.70	769.06	0.03
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	100-yr	Pr Ph II Sewer	271.00	327.35	331.04		331.11	0.001624	2.54	161.04	124.09	0.25
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Pr Cnd Ph II	342.00	327.35	331.29		331.36	0.001619	2.66	191.84	125.97	0.25
Patrick Brook	Lower reach	2457	500-yr	Pr Ph II Sewer	342.00	327.35	331.28		331.35	0.001639	2.67	190.95	125.90	0.25
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	100-yr	Pr Ph II Sewer	271.00	326.00	330.61		330.66	0.001698	2.51	201.50	147.59	0.25
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Pr Cnd Ph II	342.00	326.00	330.85		330.91	0.001741	2.66	238.09	156.33	0.25
Patrick Brook	Lower reach	2171	500-yr	Pr Ph II Sewer	342.00	326.00	330.83		330.89	0.001794	2.69	235.42	155.70	0.26
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	100-yr	Pr Ph II Sewer	271.00	325.48	330.19		330.31	0.004238	3.27	126.50	127.07	0.38
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Pr Cnd Ph II	342.00	325.48	330.44		330.57	0.003912	3.33	160.81	139.37	0.37
Patrick Brook	Lower reach	2038	500-yr	Pr Ph II Sewer	342.00	325.48	330.39		330.53	0.004338	3.46	154.06	137.26	0.38
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	100-yr	Pr Ph II Sewer	271.00	324.00	329.03		329.19	0.003884	3.59	126.24	131.63	0.36
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Pr Cnd Ph II	342.00	324.00	329.13		329.33	0.005020	4.15	139.75	132.09	0.42
Patrick Brook	Lower reach	1759	500-yr	Pr Ph II Sewer	342.00	324.00	329.35		329.48	0.003323	3.49	168.01	133.02	0.34
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	100-yr	Pr Ph II Sewer	271.00	323.83	328.77	328.14	328.85	0.003155	2.77	155.66	131.55	0.32
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Pr Cnd Ph II	342.00	323.83	328.60		328.78	0.007377	4.11	133.52	129.96	0.49
Patrick Brook	Lower reach	1685	500-yr	Pr Ph II Sewer	342.00	323.83	329.14	328.33	329.21	0.002367	2.59	205.87	145.50	0.28
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	100-yr	Pr Ph II Sewer	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Pr Cnd Ph II	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1618	500-yr	Pr Ph II Sewer	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	100-yr	Pr Ph II Sewer	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Pr Cnd Ph II	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	1458	500-yr	Pr Ph II Sewer	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	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)	
Patrick Brook	Lower reach	130	100-yr	Pr Ph II Sewer	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Cnd Ph II	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Ph II Sewer	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Ph II Sewer   10/3/2013

Patrick Brook Lower reach

Legend

WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Cnd Ph II
WS 100-yr - Pr Ph II Sewer
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Ph II Sewer
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Ph II Sewer   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Pr Ph II Sewer
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Ph II Sewer
WS 100-yr - Pr Cnd Ph II
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Ph II Sewer   10/3/2013

Patrick Brook Lower reach

Legend

—▲—	WS 500-yr - Ex Cnd Ph I
—▲—	WS 500-yr - Pr Cnd Ph II
—▲—	WS 500-yr - Pr Ph II Sewer
◀ ◀ ◀	Crit 500-yr - Pr Cnd Ph II
+ + +	Crit 500-yr - Ex Cnd Ph I
▶ ▶ ▶	Crit 500-yr - Pr Ph II Sewer
—■—	Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Ph II Sewer   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr Cnd Ph II
Crit 500-yr - Pr Ph II Sewer
WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Ph II Sewer
WS 500-yr - Pr Cnd Ph II
Ground

Elevation (ft)

Main Channel Distance (ft)

5635

4310

APPENDIX E: NEW CULVERT CROSSING SCENARIO

MILONE & MACBROOM®

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Ex Ph I New Culv	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Ex Ph I New Culv	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Ex Ph I New Culv	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Ph I New Culv	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Ex Ph I New Culv	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Ph I New Culv	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Ex Ph I New Culv	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Ph I New Culv	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Ex Ph I New Culv	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Ex Ph I New Culv	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Ex Ph I New Culv	271.00	327.34	334.01	330.77	334.01	0.000032	0.50	1074.84	688.31	0.04
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Ex Ph I New Culv	342.00	327.34	334.78	331.46	334.79	0.000016	0.38	1636.09	766.98	0.03
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Ex Ph I New Culv	271.00	327.35	330.97		331.05	0.001874	2.69	152.35	123.32	0.26
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Ex Ph I New Culv	342.00	327.35	331.18		331.26	0.001978	2.88	178.07	124.85	0.27
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Ex Ph I New Culv	271.00	326.00	329.96		330.15	0.007302	4.46	112.86	123.72	0.49
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Ex Ph I New Culv	342.00	326.00	330.19	329.42	330.37	0.006554	4.48	142.87	132.38	0.47
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Ex Ph I New Culv	271.00	325.48	329.29		329.35	0.004621	2.91	227.82	511.85	0.38
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Ex Ph I New Culv	342.00	325.48	329.27		329.38	0.008204	3.86	216.56	496.91	0.50
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Ex Ph I New Culv	271.00	324.00	328.49		328.53	0.002041	2.36	338.18	692.51	0.26
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Ex Ph I New Culv	342.00	324.00	328.86		328.87	0.000734	1.51	608.15	776.74	0.16
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Ex Ph I New Culv	271.00	323.83	328.41	327.71	328.42	0.000718	1.23	554.44	831.02	0.15
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Ex Ph I New Culv	342.00	323.83	328.83	327.79	328.83	0.000260	0.80	903.58	846.87	0.09
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Ph I New Culv	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Ph I New Culv	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Ex Ph I New Culv	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Ex Ph I New Culv	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Ex Ph I New Culv	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Ex Ph I New Culv	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I New Culv   10/2/2013

Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Ex Ph I New Culv
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Ex Ph I New Culv
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Ex Ph I New Culv
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Ex Ph I New Culv
Ground

Elevation (ft)

Main Channel Distance (ft)
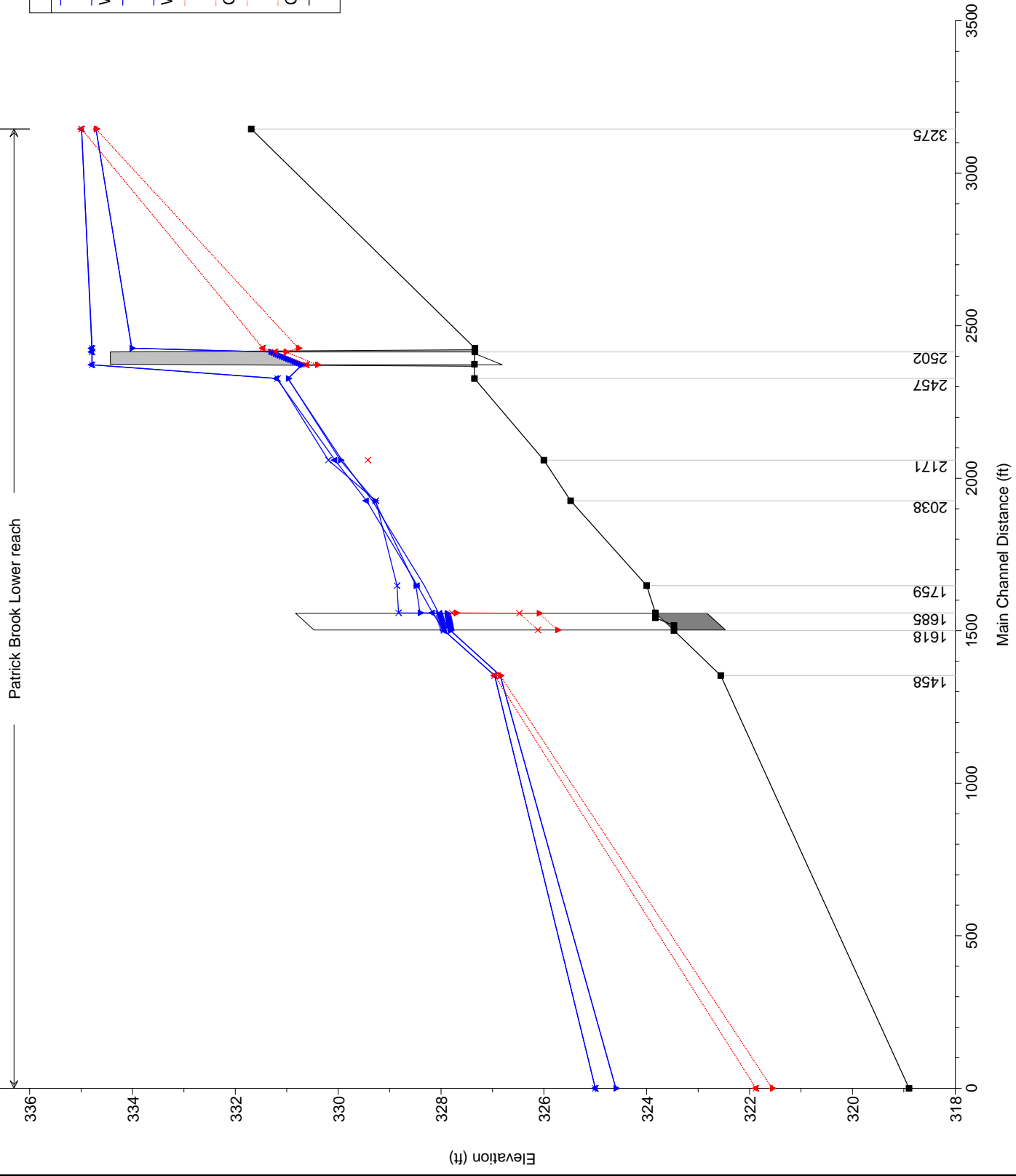
Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I New Culv   10/2/2013

Unnamed diversio diversion

Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I

Crit 500-yr - Ex Ph I New Culv

Crit 100-yr - Ex Ph I New Culv

Crit 100-yr - Ex Cnd Ph I

WS 500-yr - Ex Cnd Ph I

WS 500-yr - Ex Ph I New Culv

WS 100-yr - Ex Ph I New Culv

WS 100-yr - Ex Cnd Ph I

Ground

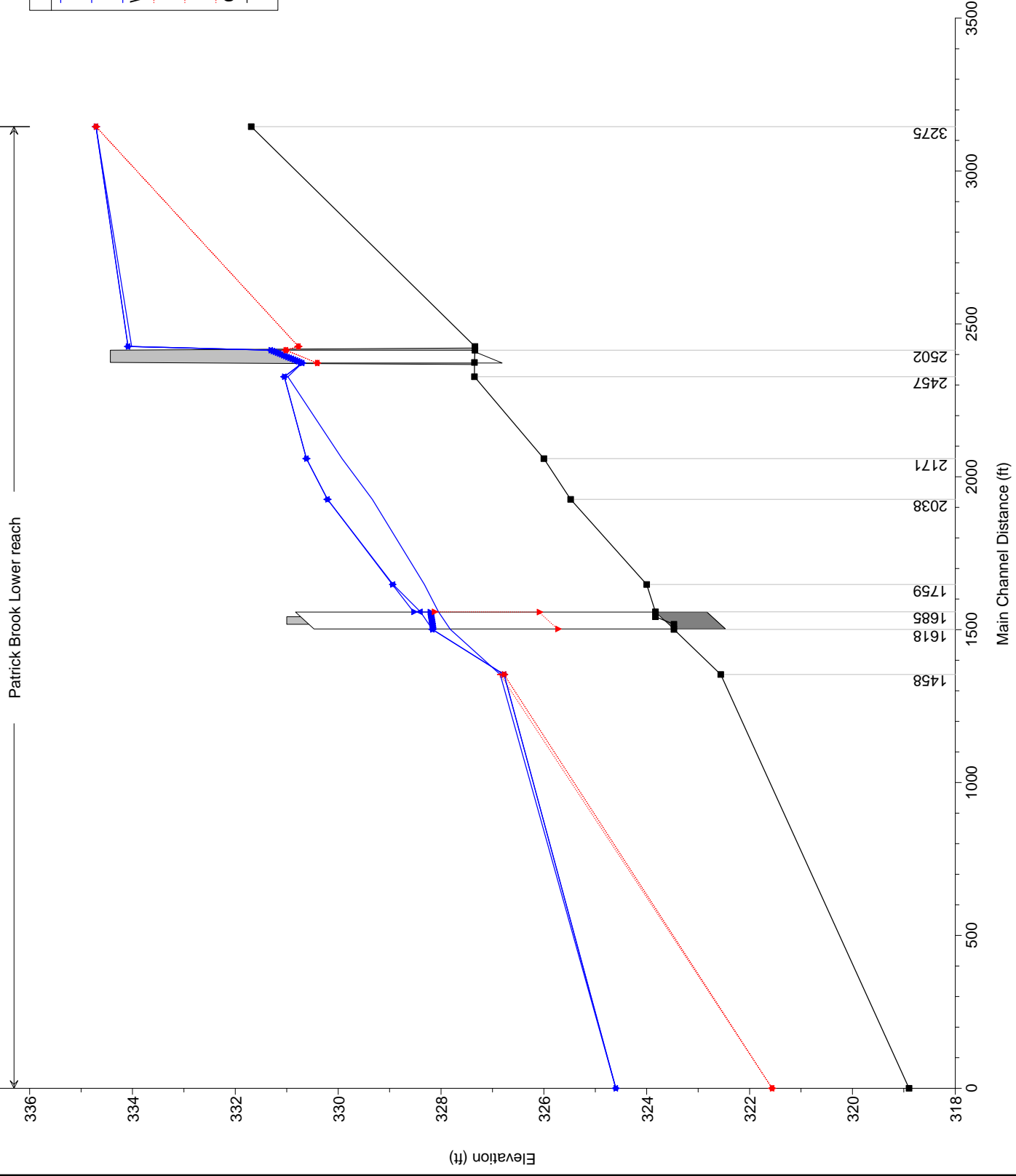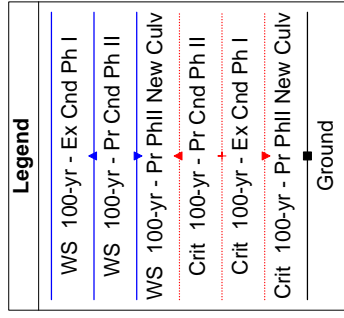Elevation (ft)

Main Channel Distance (ft)

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr PhII New Culv	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Cnd Ph II	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr PhII New Culv	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr PhII New Culv	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Cnd Ph II	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr PhII New Culv	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr PhII New Culv	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Cnd Ph II	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr PhII New Culv	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr PhII New Culv	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Cnd Ph II	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr PhII New Culv	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr PhII New Culv	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Cnd Ph II	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr PhII New Culv	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.40	695.76	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr PhII New Culv	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.42	695.76	0.04
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Cnd Ph II	342.00	327.34	334.80	331.46	334.80	0.000016	0.38	1645.18	768.19	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr PhII New Culv	342.00	327.34	334.81	331.46	334.81	0.000015	0.38	1652.90	769.22	0.03
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	100-yr	Pr PhII New Culv	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Pr Cnd Ph II	342.00	327.35	331.29		331.36	0.001619	2.66	191.84	125.97	0.25
Patrick Brook	Lower reach	2457	500-yr	Pr PhII New Culv	342.00	327.35	331.29		331.36	0.001634	2.67	191.19	125.92	0.25
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	100-yr	Pr PhII New Culv	271.00	326.00	330.62		330.67	0.001675	2.49	202.57	147.85	0.25
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Pr Cnd Ph II	342.00	326.00	330.85		330.91	0.001741	2.66	238.09	156.33	0.25
Patrick Brook	Lower reach	2171	500-yr	Pr PhII New Culv	342.00	326.00	330.84		330.90	0.001780	2.69	236.14	155.87	0.26
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	100-yr	Pr PhII New Culv	271.00	325.48	330.21		330.33	0.004050	3.21	129.24	128.23	0.37
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Pr Cnd Ph II	342.00	325.48	330.44		330.57	0.003912	3.33	160.81	139.37	0.37
Patrick Brook	Lower reach	2038	500-yr	Pr PhII New Culv	342.00	325.48	330.41		330.54	0.004214	3.42	155.92	137.85	0.38
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	100-yr	Pr PhII New Culv	271.00	324.00	328.95		329.13	0.004571	3.84	115.29	126.79	0.39
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Pr Cnd Ph II	342.00	324.00	329.13		329.33	0.005020	4.15	139.75	132.09	0.42
Patrick Brook	Lower reach	1759	500-yr	Pr PhII New Culv	342.00	324.00	329.25		329.41	0.003950	3.75	155.88	132.62	0.37
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	100-yr	Pr PhII New Culv	271.00	323.83	328.54	328.14	328.67	0.005435	3.48	124.90	129.33	0.42
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Pr Cnd Ph II	342.00	323.83	328.60		328.78	0.007377	4.11	133.52	129.96	0.49
Patrick Brook	Lower reach	1685	500-yr	Pr PhII New Culv	342.00	323.83	328.99	328.33	329.07	0.003225	2.91	184.16	133.57	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	100-yr	Pr PhII New Culv	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Pr Cnd Ph II	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1618	500-yr	Pr PhII New Culv	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	100-yr	Pr PhII New Culv	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Pr Cnd Ph II	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	1458	500-yr	Pr PhII New Culv	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	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)	
Patrick Brook	Lower reach	130	100-yr	Pr PhII New Culv	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Cnd Ph II	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr PhII New Culv	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Culv   10/3/2013

Patrick Brook Lower reach

Legend

WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Cnd Ph II
WS 100-yr - Pr PhII New Culv
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr PhII New Culv
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Culv   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Elevation (ft)

Main Channel Distance (ft)

Legend

Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Pr PhII New Culv
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr PhII New Culv
WS 100-yr - Pr Cnd Ph II
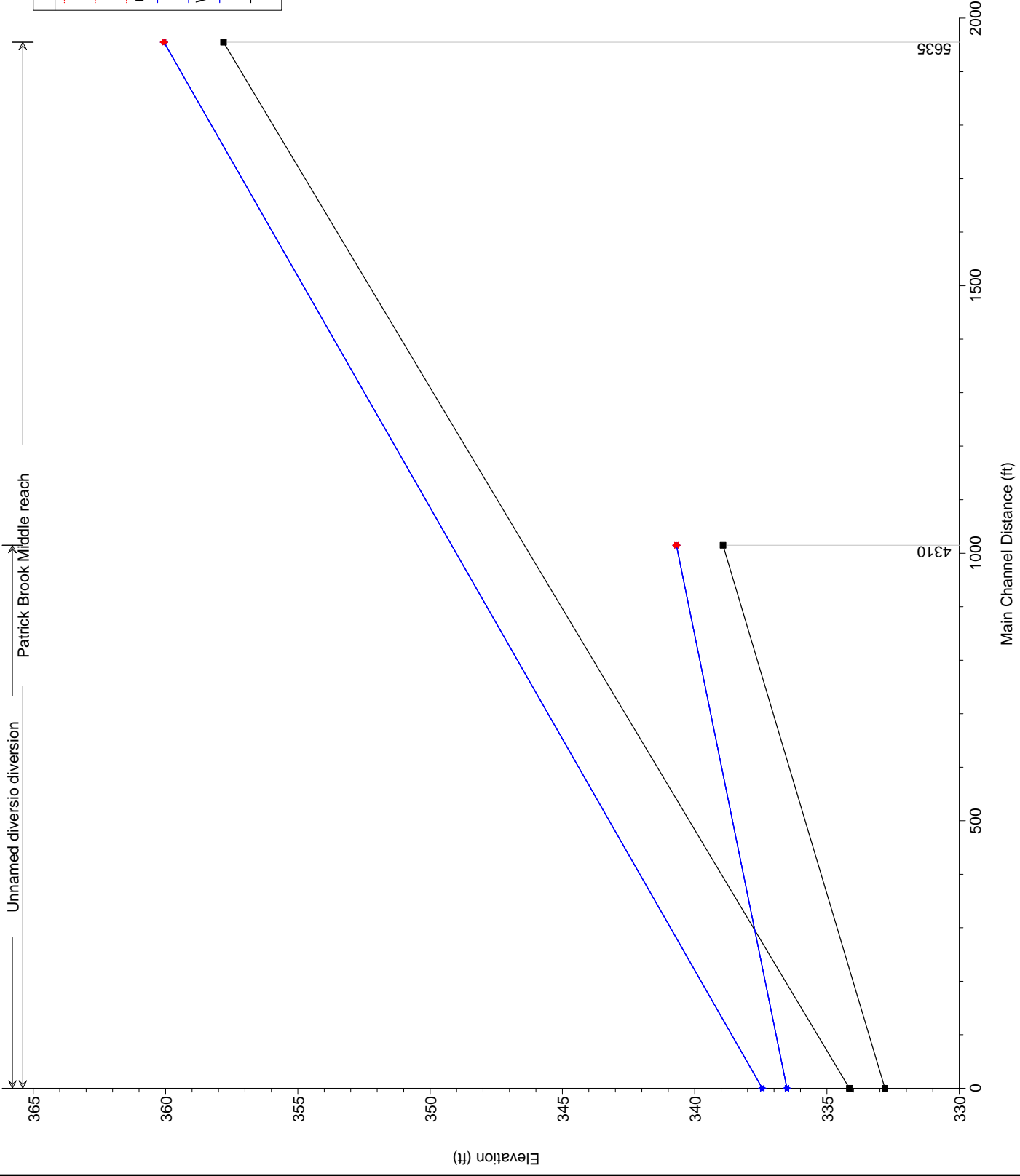Ground

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Culv   10/3/2013

Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Cnd Ph II
WS 500-yr - Pr PhII New Culv
Crit 500-yr - Pr Cnd Ph II
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr PhII New Culv
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Culv   10/3/2013
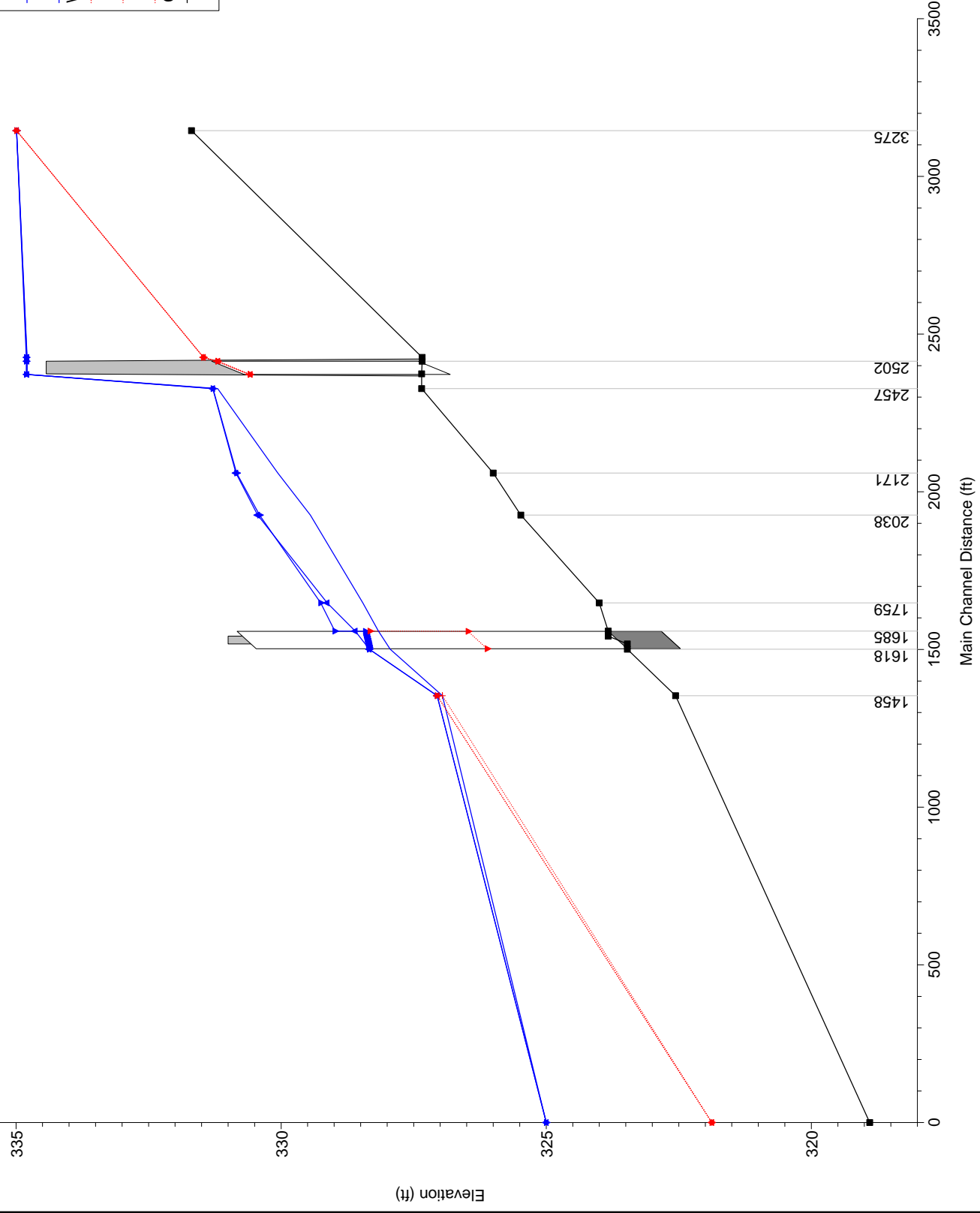
Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I

Crit 500-yr - Pr Cnd Ph II

Crit 500-yr - Pr PhII New Culv

WS 500-yr - Ex Cnd Ph I

WS 500-yr - Pr PhII New Culv

WS 500-yr - Pr Cnd Ph II

Ground

Elevation (ft)

Main Channel Distance (ft)
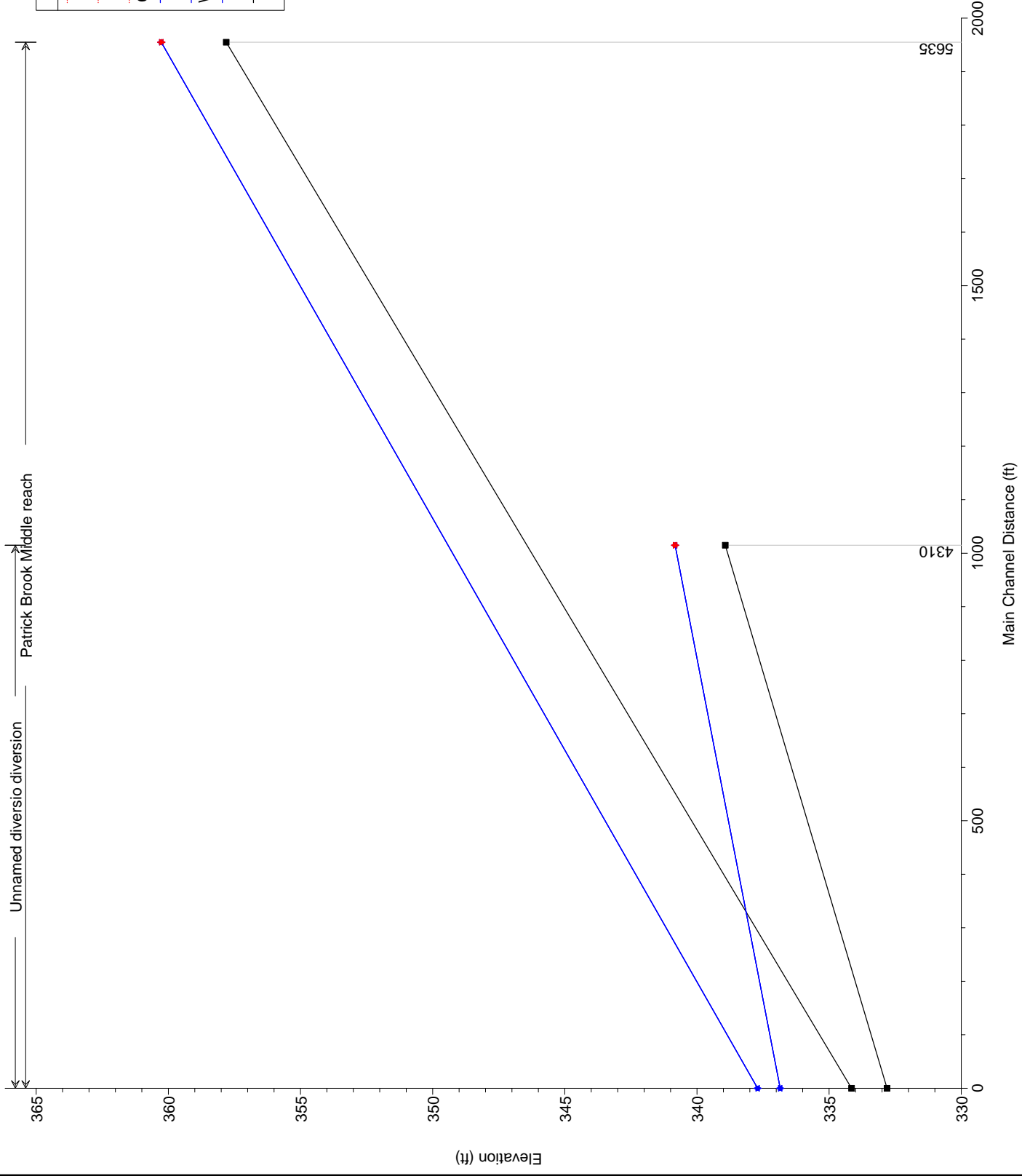
APPENDIX F: NEW BRIDGE CROSSING SCENARIO

MILONE & MACBROOM®

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Ex Ph I New Brdg	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Ex Ph I New Brdg	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Ex Ph I New Brdg	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Ph I New Brdg	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Ex Ph I New Brdg	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Ph I New Brdg	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Ex Ph I New Brdg	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Ph I New Brdg	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Ex Ph I New Brdg	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Ex Ph I New Brdg	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Ex Ph I New Brdg	271.00	327.34	334.00	330.77	334.00	0.000033	0.50	1066.15	687.02	0.04
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Ex Ph I New Brdg	342.00	327.34	334.82	331.46	334.82	0.000015	0.37	1660.02	770.16	0.03
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Ex Ph I New Brdg	271.00	327.35	330.96		331.04	0.001922	2.72	150.79	123.04	0.27
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Ex Ph I New Brdg	342.00	327.35	331.18		331.26	0.001976	2.88	178.11	124.85	0.27
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Ex Ph I New Brdg	271.00	326.00	330.08	329.37	330.23	0.005370	3.95	128.35	128.34	0.43
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Ex Ph I New Brdg	342.00	326.00	330.19	329.42	330.37	0.006623	4.50	142.28	132.22	0.48
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Ex Ph I New Brdg	271.00	325.48	329.15	329.15	329.30	0.009379	4.03	162.54	423.04	0.53
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Ex Ph I New Brdg	342.00	325.48	329.27		329.38	0.007994	3.82	219.21	500.46	0.50
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Ex Ph I New Brdg	271.00	324.00	328.79		328.80	0.000583	1.33	556.84	761.45	0.14
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Ex Ph I New Brdg	342.00	324.00	329.07		329.07	0.000372	1.12	773.69	797.22	0.11
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Ex Ph I New Brdg	271.00	323.83	328.77	327.71	328.77	0.000195	0.69	853.64	844.62	0.08
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Ex Ph I New Brdg	342.00	323.83	329.05	327.79	329.05	0.000143	0.62	1093.61	857.72	0.07
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Ph I New Brdg	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Ph I New Brdg	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Ex Ph I New Brdg	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Ex Ph I New Brdg	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Ex Ph I New Brdg	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Ex Ph I New Brdg	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I New Brdg   10/2/2013

Patrick Brook Lower reach

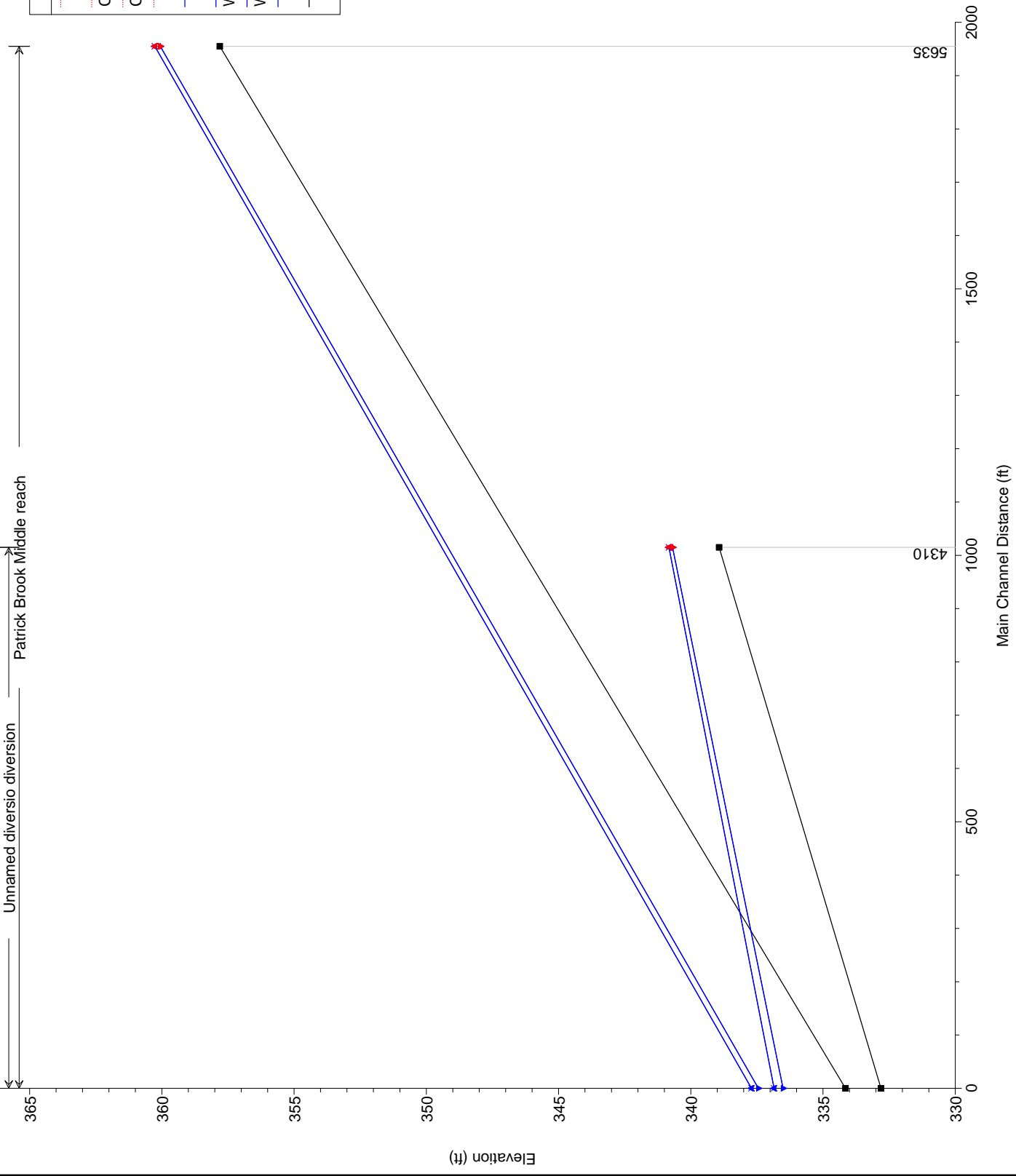Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Ex Ph I New Brdg
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Ex Ph I New Brdg
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Ex Ph I New Brdg
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Ex Ph I New Brdg
Ground

Main Channel Distance (ft)

Elevation (ft)
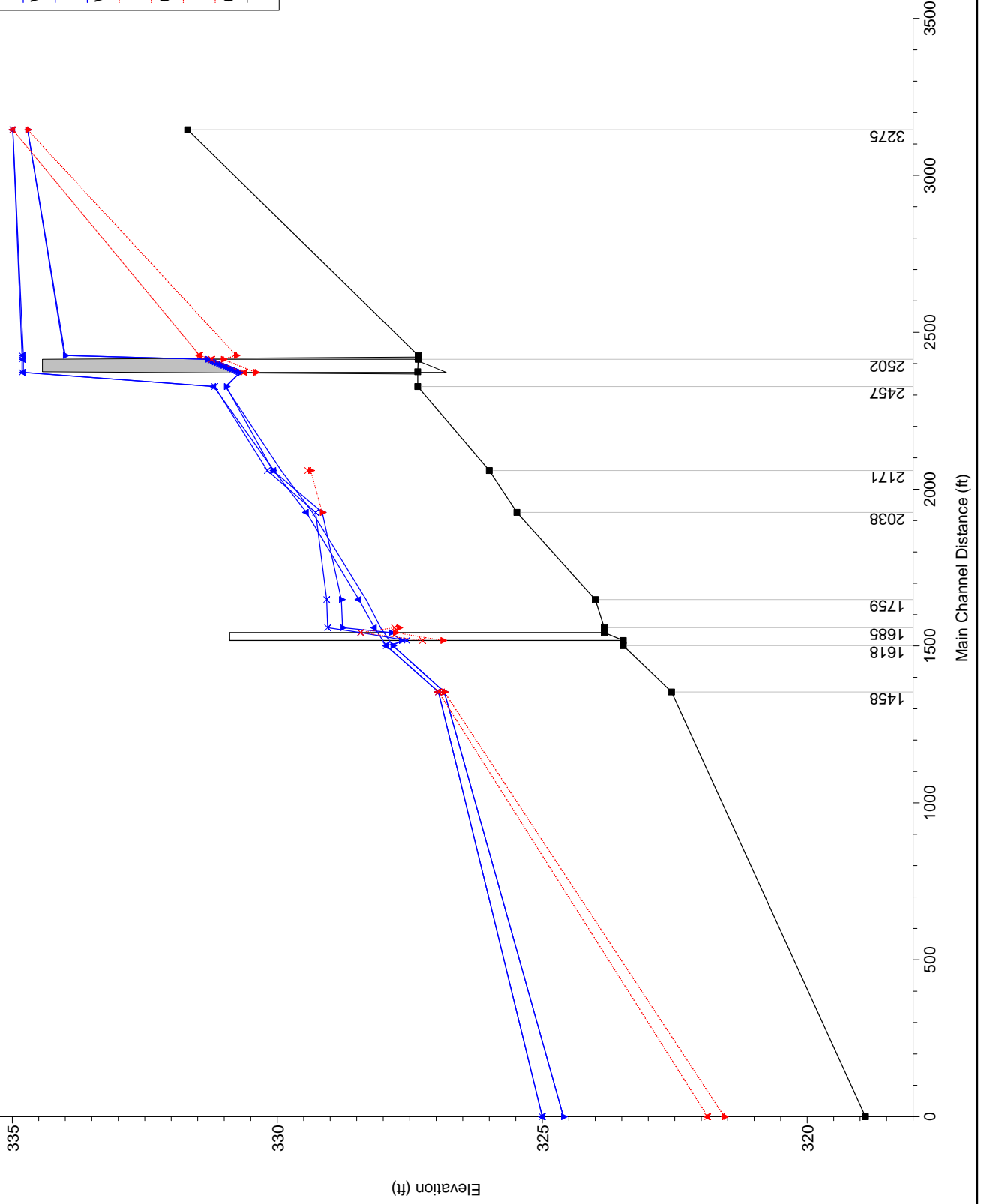
Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I New Brdg   10/2/2013

Unnamed diversio diversion

Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I

Crit 500-yr - Ex Ph I New Brdg

Crit 100-yr - Ex Ph I New Brdg

Crit 100-yr - Ex Cnd Ph I

WS 500-yr - Ex Cnd Ph I

WS 500-yr - Ex Ph I New Brdg

WS 100-yr - Ex Ph I New Brdg

WS 100-yr - Ex Cnd Ph I

Ground

Elevation (ft)

Main Channel Distance (ft)

5635

4310

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr PhII New Brdg	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Cnd Ph II	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr PhII New Brdg	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr PhII New Brdg	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Cnd Ph II	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr PhII New Brdg	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr PhII New Brdg	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Cnd Ph II	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr PhII New Brdg	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr PhII New Brdg	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Cnd Ph II	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr PhII New Brdg	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr PhII New Brdg	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Cnd Ph II	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr PhII New Brdg	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.40	695.76	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr PhII New Brdg	271.00	327.34	334.08	330.77	334.08	0.000029	0.47	1123.21	695.44	0.04
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Cnd Ph II	342.00	327.34	334.80	331.46	334.80	0.000016	0.38	1645.18	768.19	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr PhII New Brdg	342.00	327.34	334.81	331.46	334.81	0.000015	0.38	1654.92	769.48	0.03
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	100-yr	Pr PhII New Brdg	271.00	327.35	331.04		331.11	0.001625	2.54	160.99	124.09	0.25
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Pr Cnd Ph II	342.00	327.35	331.29		331.36	0.001619	2.66	191.84	125.97	0.25
Patrick Brook	Lower reach	2457	500-yr	Pr PhII New Brdg	342.00	327.35	331.28		331.35	0.001636	2.67	191.10	125.91	0.25
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	100-yr	Pr PhII New Brdg	271.00	326.00	330.61		330.66	0.001702	2.51	201.32	147.54	0.25
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Pr Cnd Ph II	342.00	326.00	330.85		330.91	0.001741	2.66	238.09	156.33	0.25
Patrick Brook	Lower reach	2171	500-yr	Pr PhII New Brdg	342.00	326.00	330.84		330.89	0.001785	2.69	235.89	155.81	0.26
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	100-yr	Pr PhII New Brdg	271.00	325.48	330.18		330.31	0.004272	3.28	126.00	126.86	0.38
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Pr Cnd Ph II	342.00	325.48	330.44		330.57	0.003912	3.33	160.81	139.37	0.37
Patrick Brook	Lower reach	2038	500-yr	Pr PhII New Brdg	342.00	325.48	330.40		330.54	0.004256	3.44	155.29	137.65	0.38
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	100-yr	Pr PhII New Brdg	271.00	324.00	329.04		329.19	0.003797	3.55	127.69	131.68	0.36
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Pr Cnd Ph II	342.00	324.00	329.13		329.33	0.005020	4.15	139.75	132.09	0.42
Patrick Brook	Lower reach	1759	500-yr	Pr PhII New Brdg	342.00	324.00	329.29		329.44	0.003676	3.64	160.88	132.79	0.36
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	100-yr	Pr PhII New Brdg	271.00	323.83	328.79	328.14	328.87	0.003010	2.72	158.53	131.75	0.31
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Pr Cnd Ph II	342.00	323.83	328.60		328.78	0.007377	4.11	133.52	129.96	0.49
Patrick Brook	Lower reach	1685	500-yr	Pr PhII New Brdg	342.00	323.83	329.05	328.33	329.13	0.002810	2.76	193.43	138.22	0.31
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	100-yr	Pr PhII New Brdg	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Pr Cnd Ph II	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1618	500-yr	Pr PhII New Brdg	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	100-yr	Pr PhII New Brdg	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Pr Cnd Ph II	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	1458	500-yr	Pr PhII New Brdg	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	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)	
Patrick Brook	Lower reach	130	100-yr	Pr PhII New Brdg	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Cnd Ph II	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr PhII New Brdg	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Brdg   10/3/2013

Patrick Brook Lower reach

Legend

WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Cnd Ph II
WS 100-yr - Pr PhII New Brdg
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr PhII New Brdg
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Brdg   10/3/2013
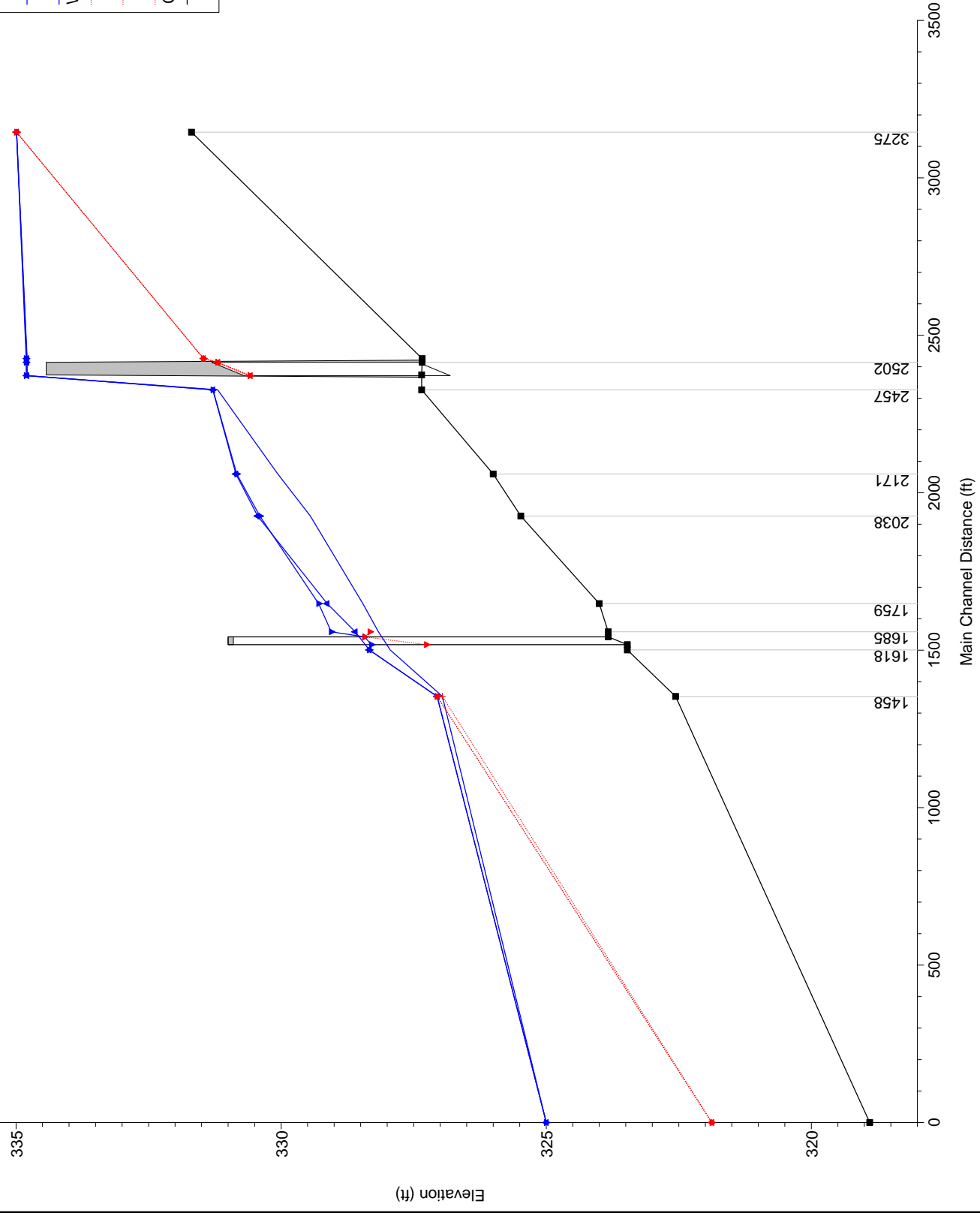
Unnamed diversio diversion

Patrick Brook Middle reach

Legend

Crit 100-yr - Ex Cnd Ph I

Crit 100-yr - Pr Cnd Ph II

Crit 100-yr - Pr PhII New Brdg

WS 100-yr - Ex Cnd Ph I

WS 100-yr - Pr PhII New Brdg

WS 100-yr - Pr Cnd Ph II
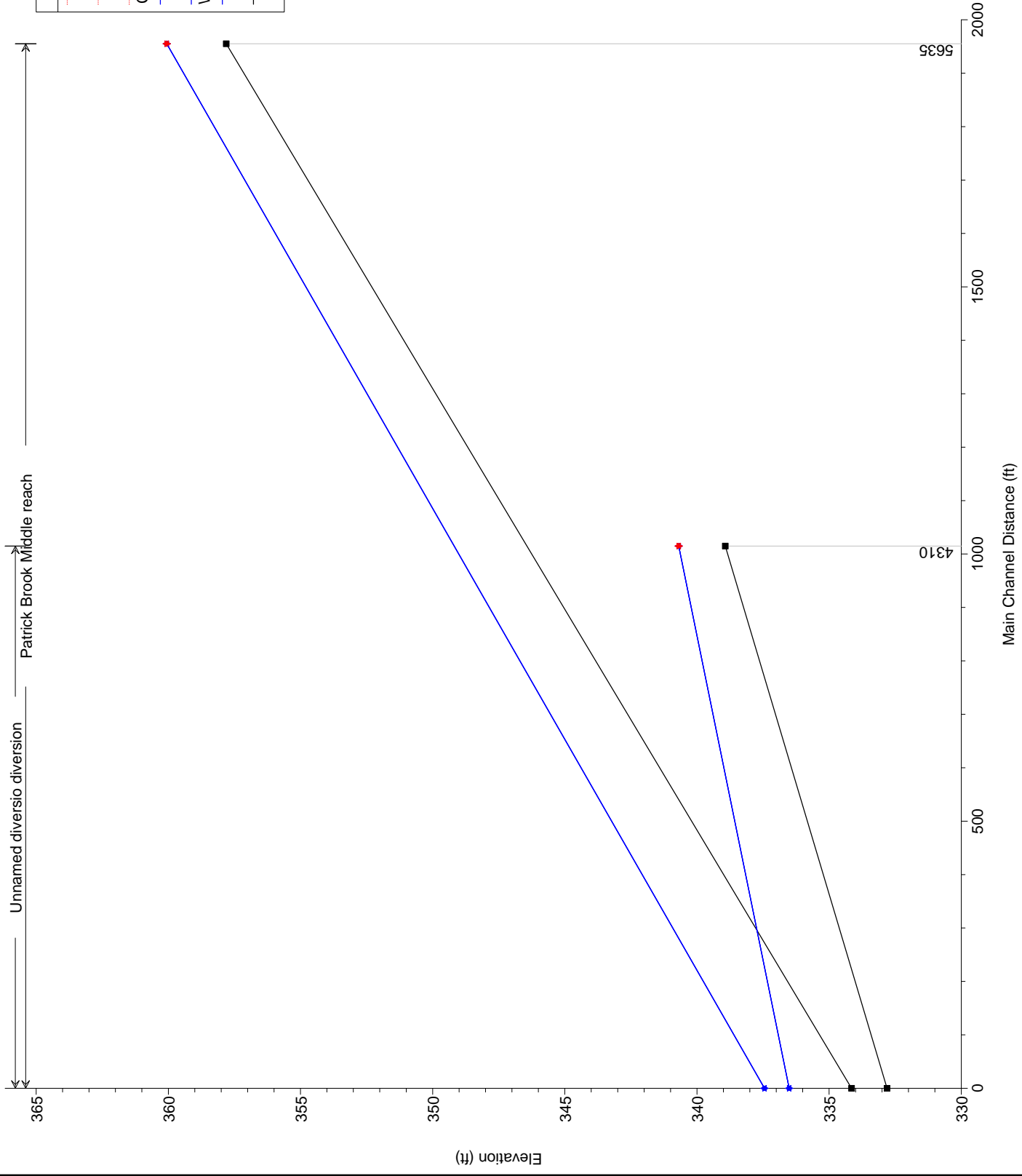
Ground

Elevation (ft)

Main Channel Distance (ft)

5635

4310

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Brdg   10/3/2013

Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Cnd Ph II
WS 500-yr - Pr PhII New Brdg
Crit 500-yr - Pr Cnd Ph II
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr PhII New Brdg
Ground

Elevation (ft)

Main Channel Distance (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII New Brdg   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I

Crit 500-yr - Pr Cnd Ph II

Crit 500-yr - Pr PhII New Brdg

WS 500-yr - Ex Cnd Ph I

WS 500-yr - Pr PhII New Brdg

WS 500-yr - Pr Cnd Ph II

Ground

Elevation (ft)

Main Channel Distance (ft)

5635

4310
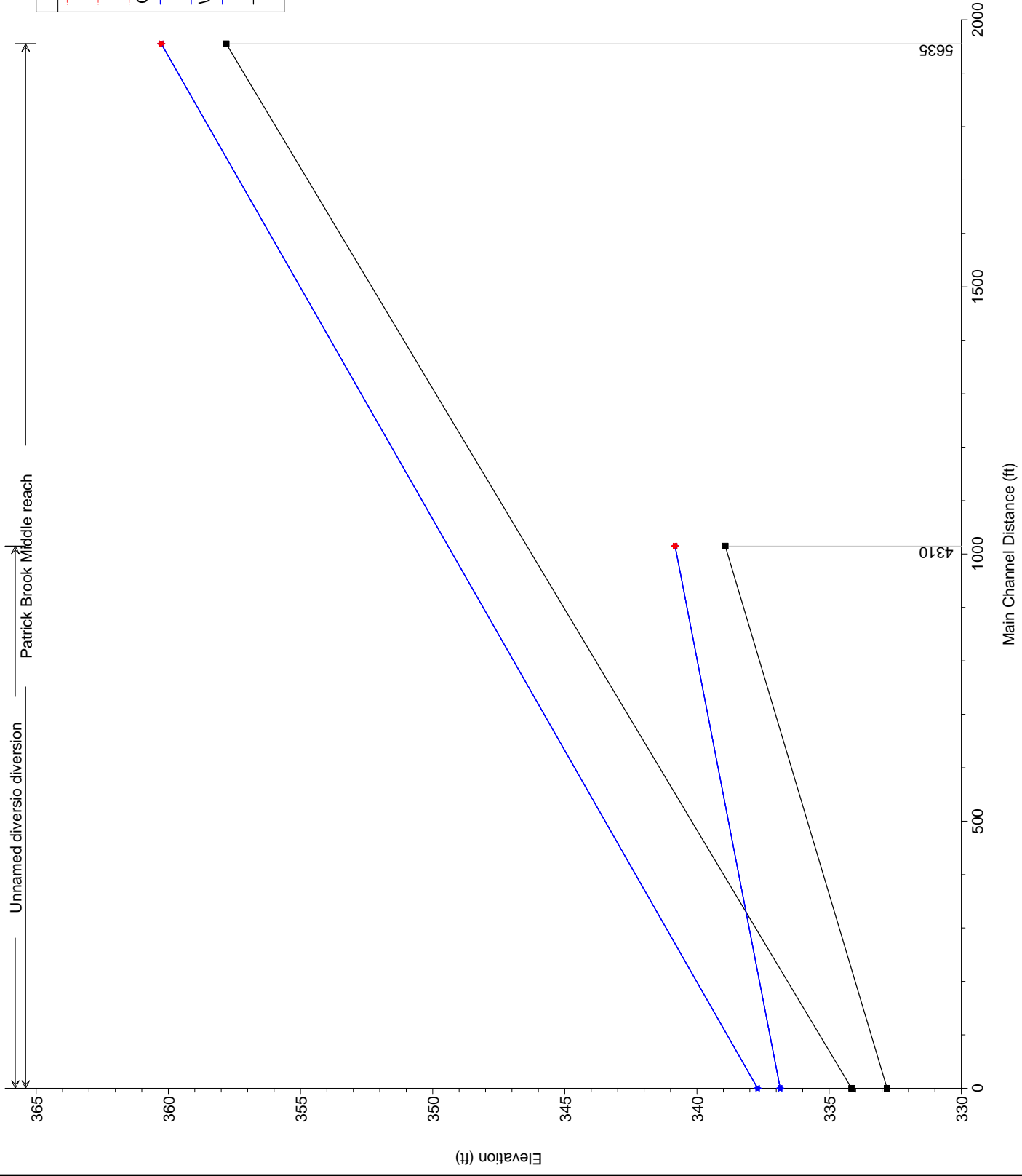
APPENDIX G: FUTURE HYDROLOGY SCENARIO

HEC-RAS   Profile: 100-yr

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Ex Ph I Fut Q100	594.70	338.93	342.42		342.84	0.012219	5.16	115.20	57.41	0.64
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Ex Ph I Fut Q100	594.70	332.81	338.21		338.40	0.002178	3.84	231.57	254.42	0.37
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Ex Ph I Fut Q100	256.30	357.81	360.47	360.47	361.06	0.024723	6.60	50.50	46.98	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Ex Ph I Fut Q100	256.30	334.15	338.45		338.47	0.000499	1.39	410.12	509.91	0.13
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Ex Ph I Fut Q100	713.30	331.69	335.99	335.99	336.91	0.023562	9.42	131.11	352.09	1.01
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Ex Ph I Fut Q100	713.30	327.34	335.38	332.07	335.38	0.000034	0.59	2109.93	827.60	0.04
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Ex Ph I Fut Q100	713.30	327.35	332.08		332.19	0.002124	3.48	294.30	136.26	0.29
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Ex Ph I Fut Q100	713.30	326.00	330.43	330.38	330.91	0.017068	7.63	174.70	140.84	0.77
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Ex Ph I Fut Q100	713.30	325.48	329.85		329.89	0.003529	2.82	565.52	653.67	0.34
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Ex Ph I Fut Q100	713.30	324.00	328.80		328.86	0.003839	3.43	567.51	764.65	0.36
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Ex Ph I Fut Q100	713.30	323.83	328.49		328.52	0.003576	2.80	619.71	834.01	0.34
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Ph I Fut Q100	713.30	323.47	328.21		328.29	0.004700	3.64	519.03	760.06	0.40
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Ex Ph I Fut Q100	713.30	322.56	327.60		327.66	0.003807	3.11	546.97	727.08	0.35
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Ex Ph I Fut Q100	713.30	318.90	327.60	323.72	327.60	0.000009	0.31	5352.52	1642.00	0.02

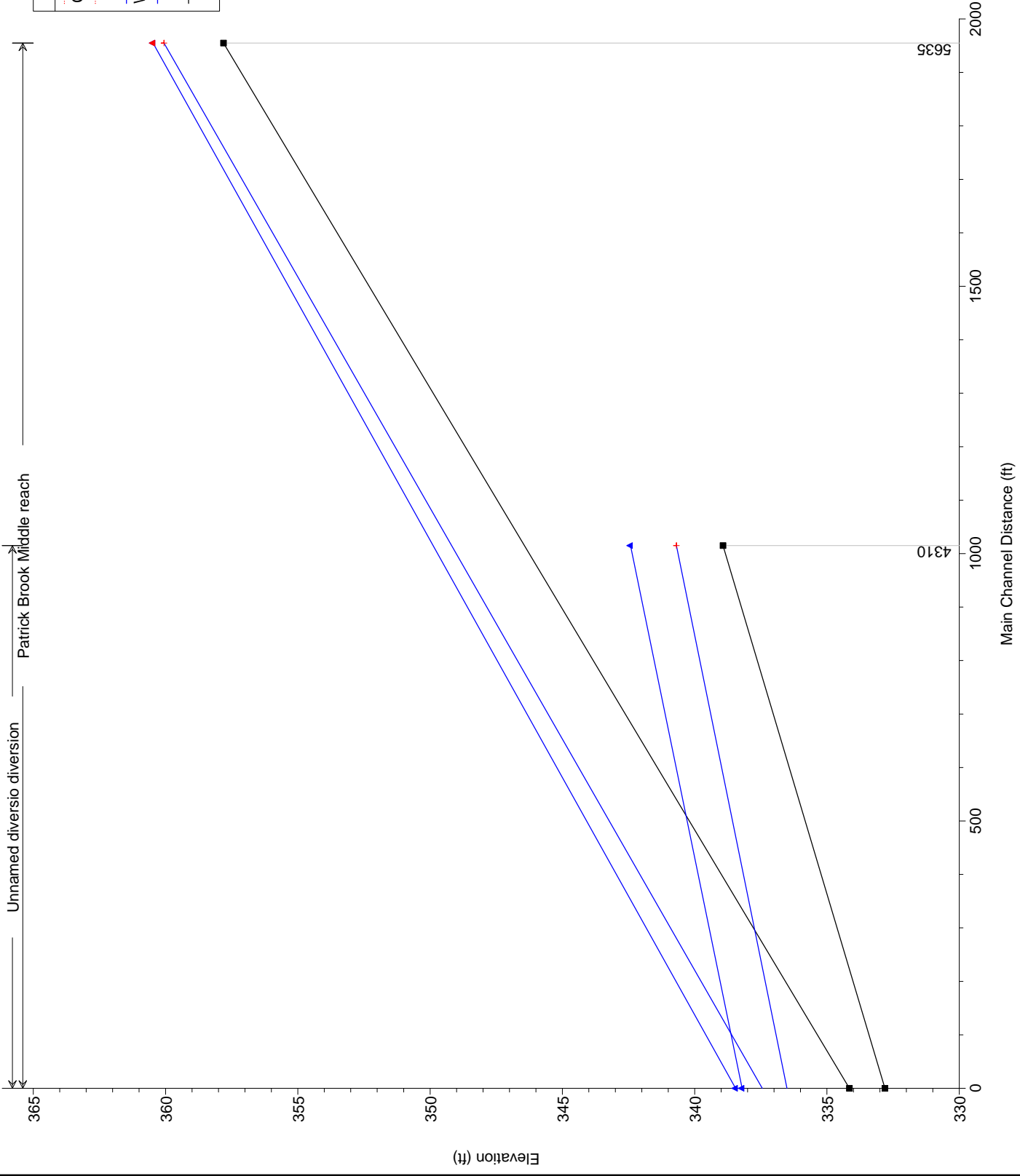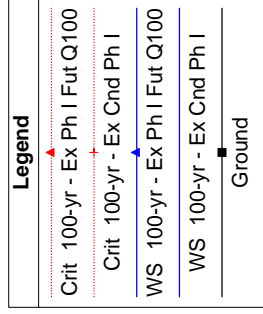Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I Fut Q100   10/3/2013

Patrick Brook Lower reach
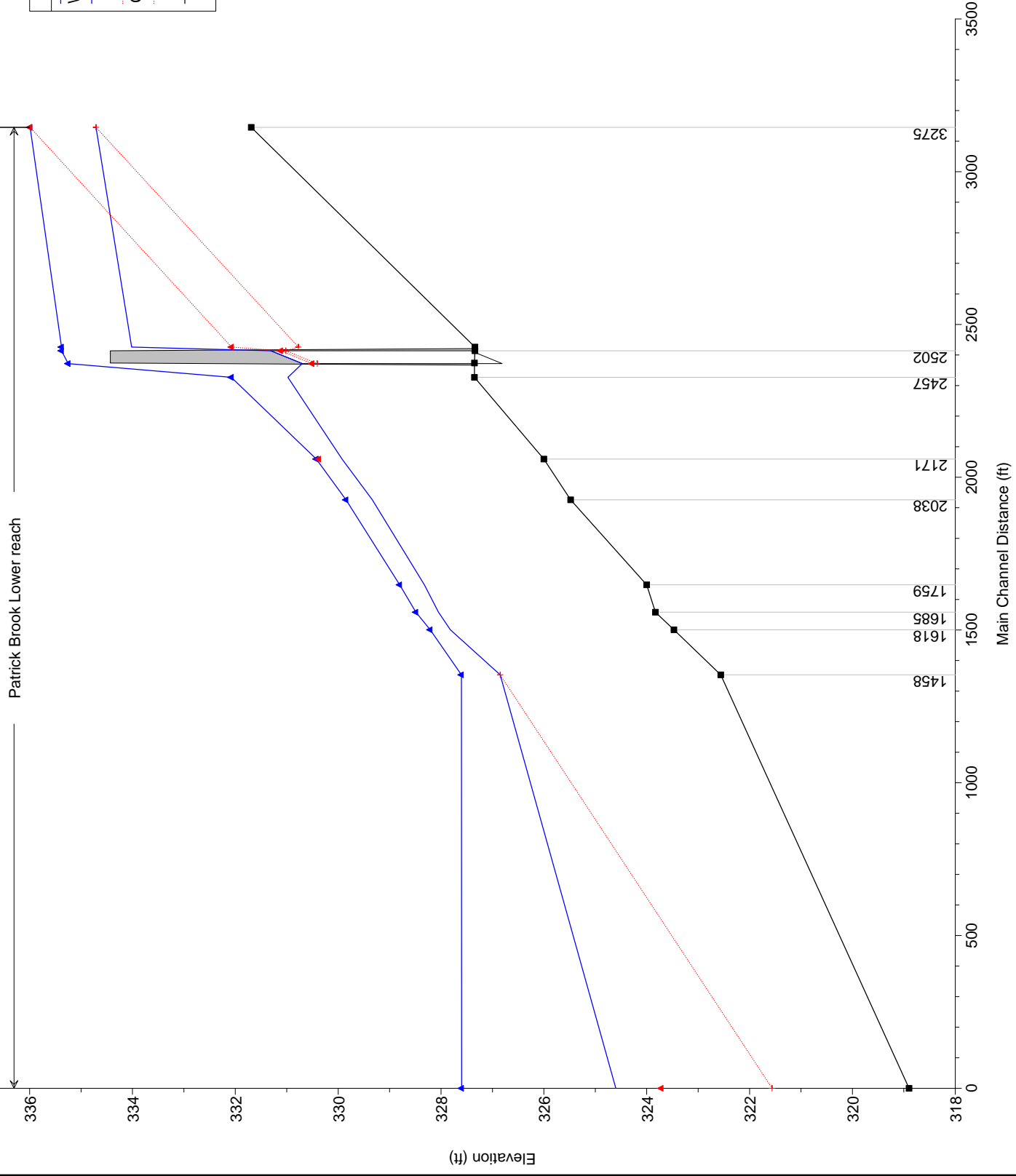
Legend

WS 100-yr - Ex Ph I Fut Q100
WS 100-yr - Ex Cnd Ph I
Crit 100-yr - Ex Ph I Fut Q100
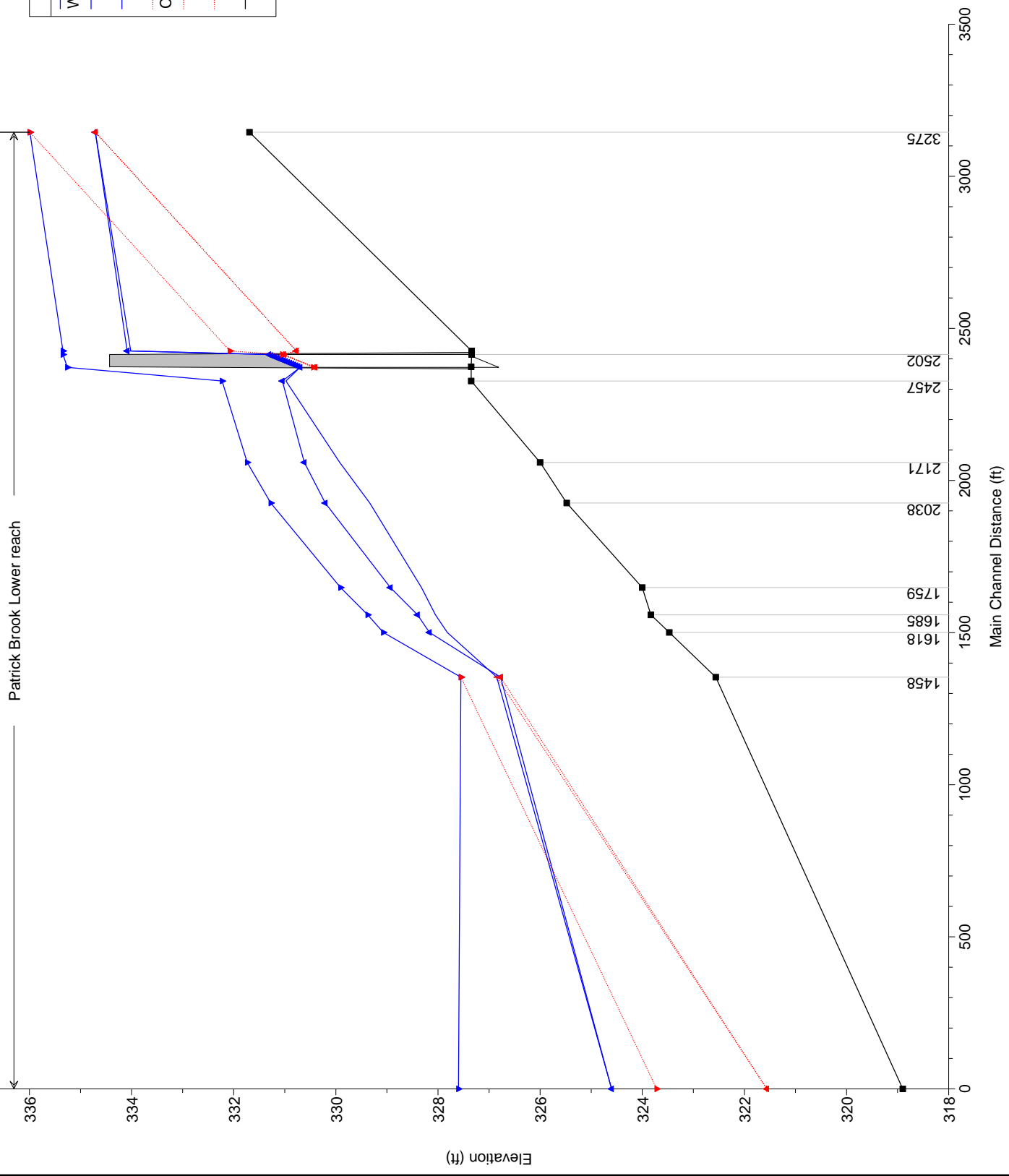Crit 100-yr - Ex Cnd Ph I
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Ph I Fut Q100   10/3/2013

Patrick Brook Middle reach

Legend

Crit 100-yr - Ex Ph I Fut Q100

Crit 100-yr - Ex Cnd Ph I

WS 100-yr - Ex Ph I Fut Q100

WS 100-yr - Ex Cnd Ph I

Ground

Elevation (ft)

Main Channel Distance (ft)

Unnamed diversio diversion

HEC-RAS   Profile: 100-yr

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr PhII Fut Q100	594.70	338.93	342.42		342.84	0.012219	5.16	115.20	57.41	0.64
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr PhII Fut Q100	594.70	332.81	338.21		338.40	0.002178	3.84	231.57	254.42	0.37
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr PhII Fut Q100	256.30	357.81	360.47	360.47	361.06	0.024723	6.60	50.50	46.98	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr PhII Fut Q100	256.30	334.15	338.45		338.47	0.000499	1.39	410.12	509.91	0.13
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr PhII Fut Q100	713.30	331.69	335.99	335.99	336.91	0.023562	9.42	131.11	352.09	1.01
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.40	695.76	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr PhII Fut Q100	713.30	327.34	335.34	332.07	335.35	0.000035	0.60	2081.22	824.06	0.04
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	100-yr	Pr PhII Fut Q100	713.30	327.35	332.23		332.32	0.001780	3.26	314.93	142.02	0.27
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	100-yr	Pr PhII Fut Q100	713.30	326.00	331.74		331.80	0.002044	3.36	507.52	414.57	0.28
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	100-yr	Pr PhII Fut Q100	713.30	325.48	331.27		331.43	0.003904	4.01	304.84	272.79	0.38
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	100-yr	Pr PhII Fut Q100	713.30	324.00	329.91		330.13	0.005609	4.91	246.80	165.35	0.45
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	100-yr	Pr PhII Fut Q100	713.30	323.83	329.38		329.58	0.006714	4.63	242.11	164.88	0.48
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	100-yr	Pr PhII Fut Q100	713.30	323.47	329.07		329.25	0.004600	4.37	271.25	187.48	0.42
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	100-yr	Pr PhII Fut Q100	713.30	322.56	327.55	327.55	328.02	0.018417	6.76	174.00	156.92	0.76
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr PhII Fut Q100	713.30	318.90	327.60	323.72	327.60	0.000009	0.31	5352.52	1642.00	0.02

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII Fut Q100   10/3/2013

Patrick Brook Lower reach

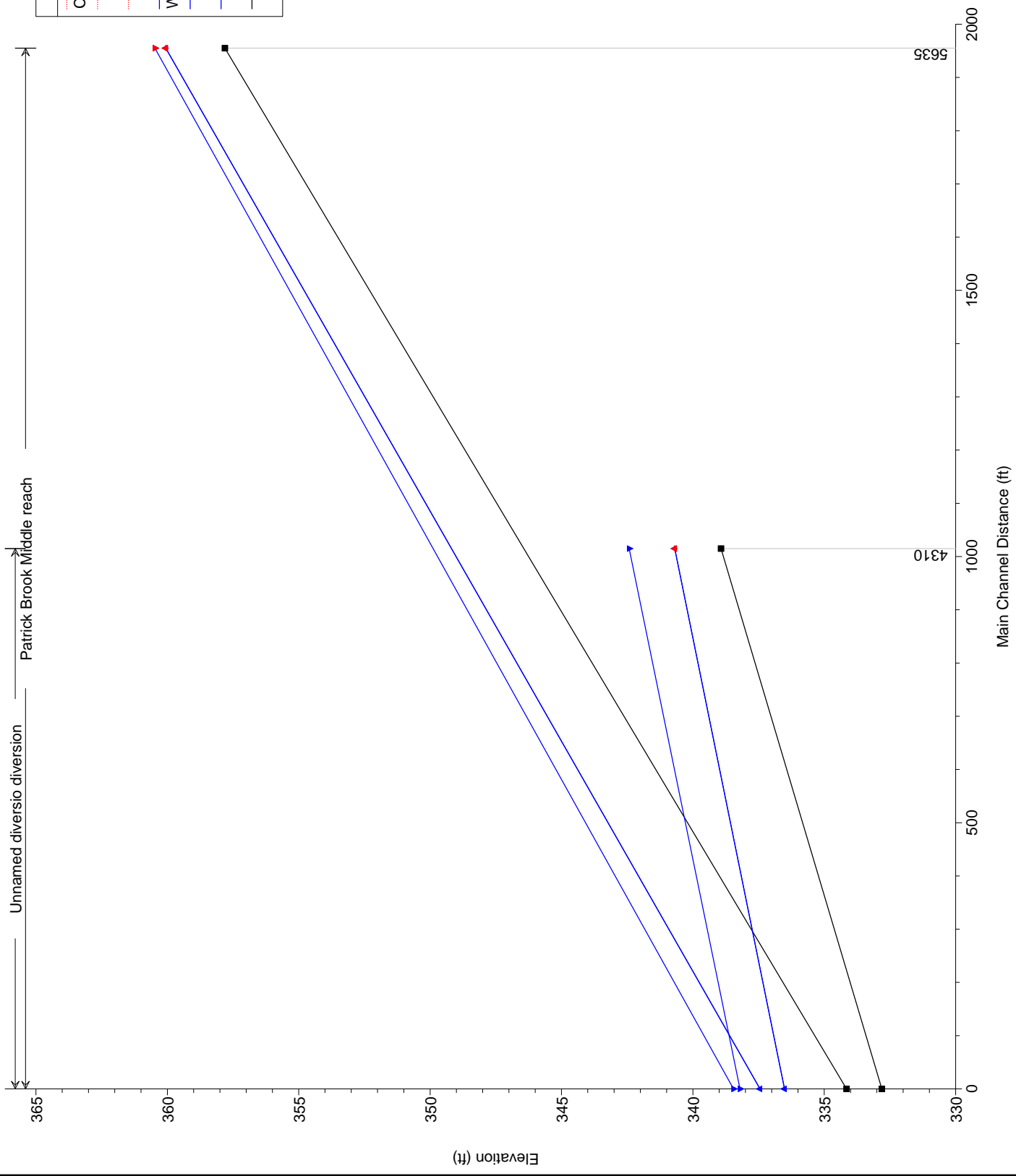**Legend**

WS 100-yr - Pr PhII Fut Q100
WS 100-yr - Pr Cnd Ph II
WS 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr PhII Fut Q100
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Cnd Ph II
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr PhII Fut Q100   10/3/2013

Unnamed diversio diversion

Patrick Brook Middle reach

Legend

| Crit 100-yr - Pr PhII Fut Q100 |
| Crit 100-yr - Ex Cnd Ph I |
| Crit 100-yr - Pr Cnd Ph II |
| WS 100-yr - Pr PhII Fut Q100 |
| WS 100-yr - Pr Cnd Ph II |
| WS 100-yr - Ex Cnd Ph I |
| Ground |

Elevation (ft)

Main Channel Distance (ft)

APPENDIX H: CULVERT COMBINATION SCENARIO

MILONE & MACBROOM®

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I ALL	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I ALL	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I ALL	109.00	332.81	336.62		336.66	0.000651	1.54	70.92	71.50	0.18
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I ALL	137.00	332.81	336.88		336.92	0.000725	1.72	79.62	75.88	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I ALL	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I ALL	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I ALL	162.00	334.15	337.24		337.29	0.002166	2.24	105.71	492.54	0.25
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I ALL	205.00	334.15	337.52		337.57	0.001864	2.23	132.58	496.60	0.23
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I ALL	271.00	331.69	336.12		336.24	0.002885	3.35	139.19	359.91	0.35
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I ALL	342.00	331.69	336.23		336.39	0.003998	4.04	145.71	366.65	0.42
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I ALL	271.00	327.34	330.77	330.77	331.61	0.023575	7.40	39.04	30.48	0.87
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I ALL	342.00	327.34	331.46	331.46	331.93	0.010725	5.97	85.51	121.30	0.61
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I ALL	271.00	327.35	330.97		331.05	0.001874	2.69	152.35	123.32	0.26
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I ALL	342.00	327.35	331.18		331.26	0.001978	2.88	178.07	124.85	0.27
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I ALL	271.00	326.00	329.96		330.15	0.007302	4.46	112.86	123.72	0.49
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I ALL	342.00	326.00	330.19	329.42	330.37	0.006554	4.48	142.87	132.38	0.47
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I ALL	271.00	325.48	329.29		329.35	0.004621	2.91	227.82	511.85	0.38
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I ALL	342.00	325.48	329.27		329.38	0.008204	3.86	216.56	496.91	0.50
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I ALL	271.00	324.00	328.49		328.53	0.002041	2.36	338.18	692.51	0.26
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I ALL	342.00	324.00	328.86		328.87	0.000734	1.51	608.15	776.74	0.16
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I ALL	271.00	323.83	328.41	327.71	328.42	0.000718	1.23	554.44	831.02	0.15
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I ALL	342.00	323.83	328.83	327.79	328.83	0.000260	0.80	903.58	846.87	0.09
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I ALL	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I ALL	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I ALL	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I ALL	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I ALL	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I ALL	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Cnd Ph I ALL   10/3/2013
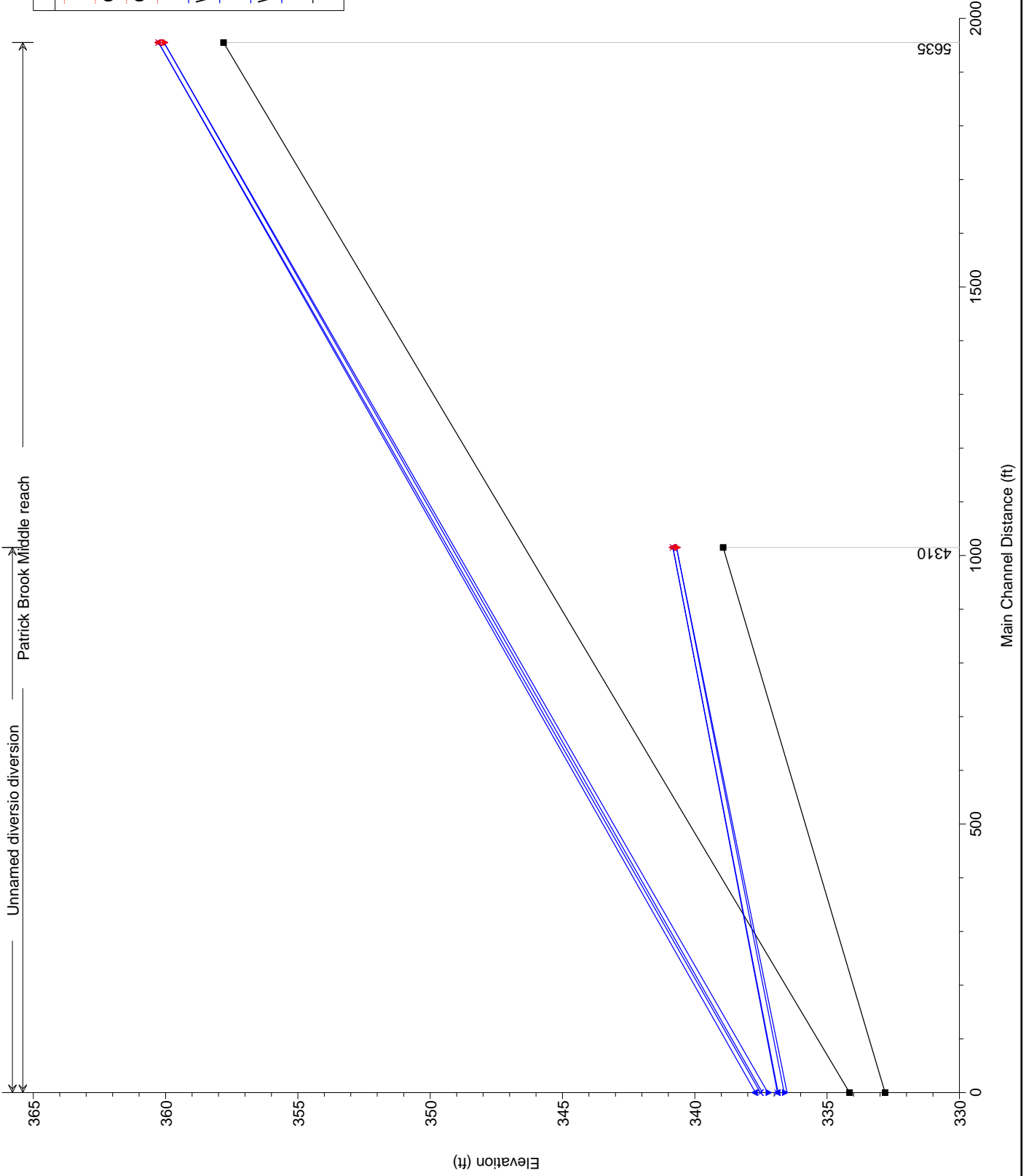
Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Ex Cnd Ph I ALL
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Ex Cnd Ph I ALL
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Ex Cnd Ph I ALL
Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Ex Cnd Ph I ALL
Ground

Elevation (ft)

Main Channel Distance (ft)
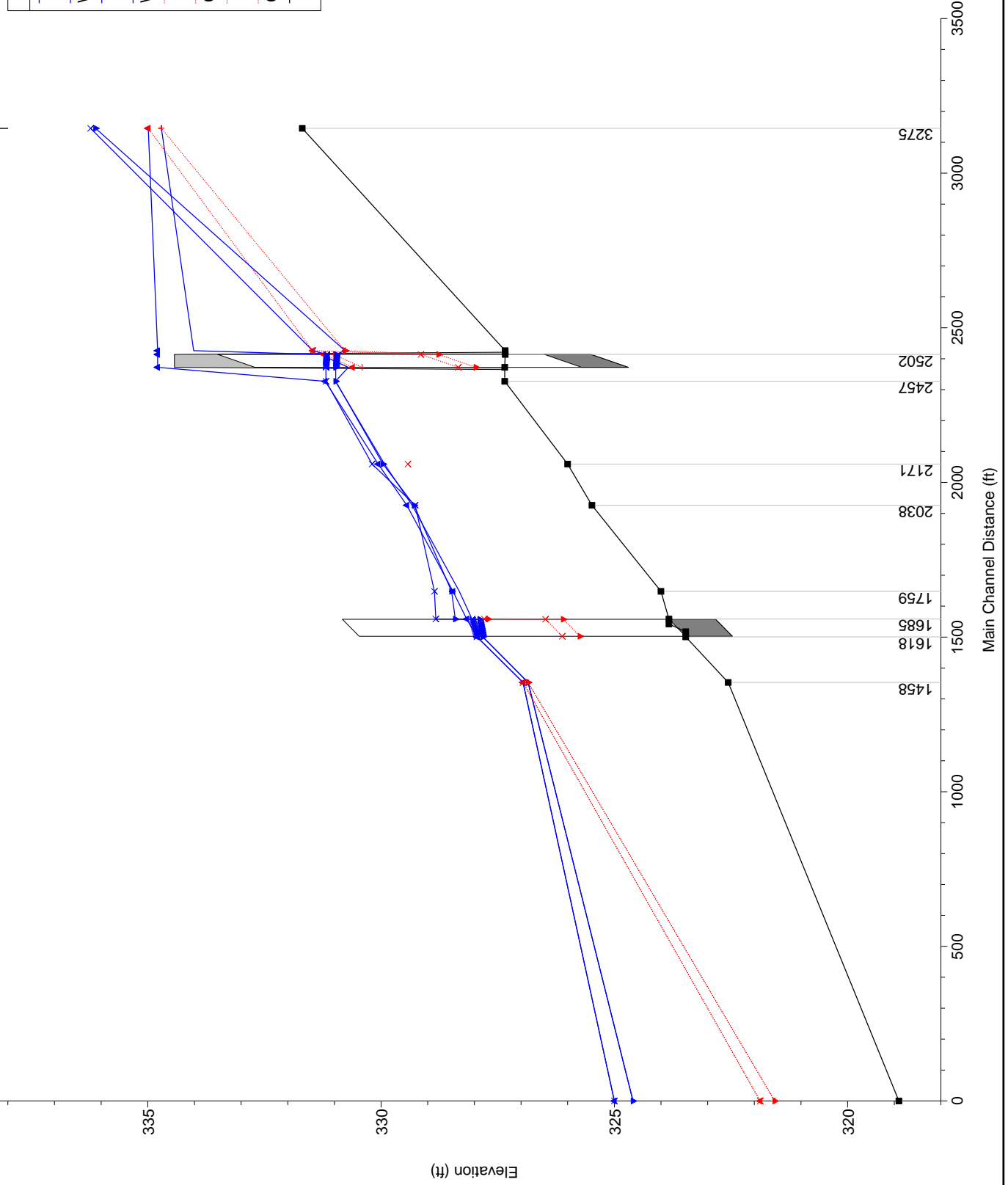
Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Ex Cnd Ph I ALL   10/3/2013

Unnamed diversio diversion

Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Ex Cnd Ph I ALL
Crit 100-yr - Ex Cnd Ph I ALL
Crit 100-yr - Ex Cnd Ph I
WS 500-yr - Ex Cnd Ph I ALL
WS 500-yr - Ex Cnd Ph I
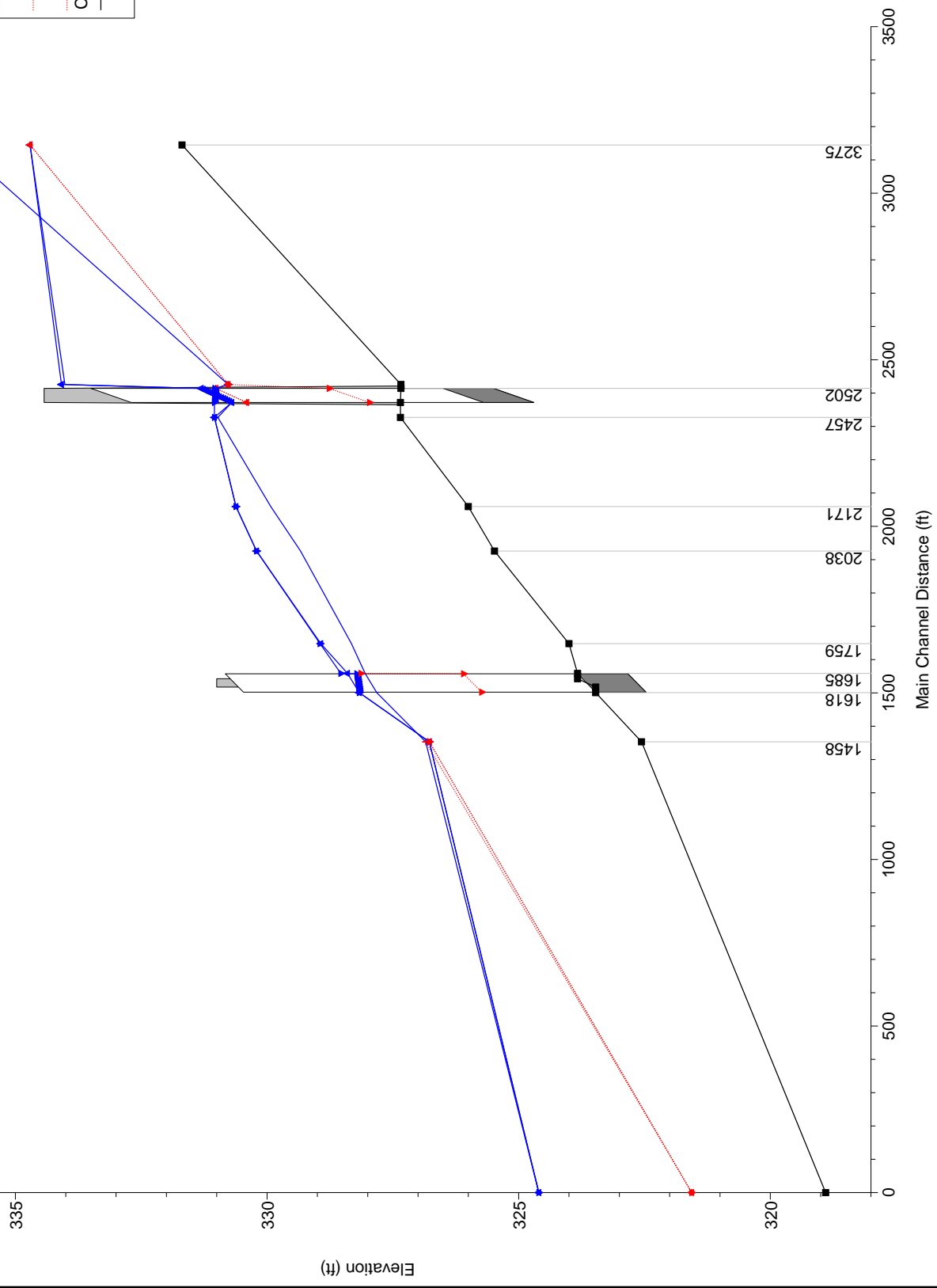WS 100-yr - Ex Cnd Ph I ALL
WS 100-yr - Ex Cnd Ph I
Ground

Elevation (ft)

Main Channel Distance (ft)

5635

4310

HEC-RAS

River	Reach	River Sta	Profile	Plan	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)	
Unnamed diversio	diversion	4310	100-yr	Ex Cnd Ph I	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	100-yr	Pr Cnd Ph II ALL	109.00	338.93	340.69	340.69	341.00	0.047007	4.46	24.45	42.05	1.03
Unnamed diversio	diversion	4310	500-yr	Ex Cnd Ph I	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Cnd Ph II	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	4310	500-yr	Pr Cnd Ph II ALL	137.00	338.93	340.83	340.83	341.14	0.041959	4.50	30.45	47.44	0.99
Unnamed diversio	diversion	3525	100-yr	Ex Cnd Ph I	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II	109.00	332.81	336.51		336.55	0.000751	1.62	67.34	69.95	0.20
Unnamed diversio	diversion	3525	100-yr	Pr Cnd Ph II ALL	109.00	332.81	336.62		336.66	0.000651	1.54	70.92	71.50	0.18
Unnamed diversio	diversion	3525	500-yr	Ex Cnd Ph I	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Cnd Ph II	137.00	332.81	336.85		336.90	0.000751	1.74	78.69	75.39	0.20
Unnamed diversio	diversion	3525	500-yr	Pr Cnd Ph II ALL	137.00	332.81	336.88		336.92	0.000725	1.72	79.62	75.88	0.20
Patrick Brook	Middle reach	5635	100-yr	Ex Cnd Ph I	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	100-yr	Pr Cnd Ph II ALL	162.00	357.81	360.06	360.06	360.57	0.026497	5.87	32.20	40.93	0.81
Patrick Brook	Middle reach	5635	500-yr	Ex Cnd Ph I	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Cnd Ph II	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	5635	500-yr	Pr Cnd Ph II ALL	205.00	357.81	360.27	360.27	360.81	0.025251	6.21	41.11	44.00	0.81
Patrick Brook	Middle reach	3680	100-yr	Ex Cnd Ph I	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II	162.00	334.15	337.44		337.48	0.001366	1.87	125.13	495.49	0.20
Patrick Brook	Middle reach	3680	100-yr	Pr Cnd Ph II ALL	162.00	334.15	337.24		337.29	0.002166	2.24	105.71	492.54	0.25
Patrick Brook	Middle reach	3680	500-yr	Ex Cnd Ph I	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Cnd Ph II	205.00	334.15	337.71		337.74	0.001303	1.94	150.65	499.23	0.20
Patrick Brook	Middle reach	3680	500-yr	Pr Cnd Ph II ALL	205.00	334.15	337.52		337.57	0.001864	2.23	132.58	496.60	0.23
Patrick Brook	Lower reach	3275	100-yr	Ex Cnd Ph I	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II	271.00	331.69	334.71	334.71	335.41	0.022774	7.59	58.78	201.56	0.94
Patrick Brook	Lower reach	3275	100-yr	Pr Cnd Ph II ALL	271.00	331.69	336.12		336.24	0.002885	3.35	139.19	359.91	0.35
Patrick Brook	Lower reach	3275	500-yr	Ex Cnd Ph I	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Cnd Ph II	342.00	331.69	334.99	334.99	335.75	0.023010	8.02	72.47	248.72	0.96
Patrick Brook	Lower reach	3275	500-yr	Pr Cnd Ph II ALL	342.00	331.69	336.23		336.39	0.003998	4.04	145.71	366.65	0.42
Patrick Brook	Lower reach	2556	100-yr	Ex Cnd Ph I	271.00	327.34	334.02	330.77	334.02	0.000032	0.50	1077.93	688.77	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II	271.00	327.34	334.09	330.77	334.09	0.000028	0.47	1125.40	695.76	0.04
Patrick Brook	Lower reach	2556	100-yr	Pr Cnd Ph II ALL	271.00	327.34	330.77	330.77	331.61	0.023575	7.40	39.04	30.48	0.87
Patrick Brook	Lower reach	2556	500-yr	Ex Cnd Ph I	342.00	327.34	334.79	331.46	334.79	0.000016	0.38	1640.99	767.63	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Cnd Ph II	342.00	327.34	334.80	331.46	334.80	0.000016	0.38	1645.18	768.19	0.03
Patrick Brook	Lower reach	2556	500-yr	Pr Cnd Ph II ALL	342.00	327.34	331.46	331.46	331.93	0.010725	5.97	85.51	121.30	0.61
Patrick Brook	Lower reach	2502			Culvert									
Patrick Brook	Lower reach	2457	100-yr	Ex Cnd Ph I	271.00	327.35	330.98		331.05	0.001857	2.68	152.90	123.42	0.26
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	100-yr	Pr Cnd Ph II ALL	271.00	327.35	331.05		331.11	0.001615	2.53	161.39	124.10	0.24
Patrick Brook	Lower reach	2457	500-yr	Ex Cnd Ph I	342.00	327.35	331.20		331.28	0.001917	2.84	180.18	125.02	0.27
Patrick Brook	Lower reach	2457	500-yr	Pr Cnd Ph II	342.00	327.35	331.29		331.36	0.001619	2.66	191.84	125.97	0.25
Patrick Brook	Lower reach	2457	500-yr	Pr Cnd Ph II ALL	342.00	327.35	331.29		331.36	0.001634	2.67	191.19	125.92	0.25
Patrick Brook	Lower reach	2171	100-yr	Ex Cnd Ph I	271.00	326.00	329.93		330.14	0.007939	4.61	108.82	122.40	0.51
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II	271.00	326.00	330.62		330.67	0.001675	2.49	202.56	147.85	0.25
Patrick Brook	Lower reach	2171	100-yr	Pr Cnd Ph II ALL	271.00	326.00	330.62		330.67	0.001675	2.49	202.57	147.85	0.25
Patrick Brook	Lower reach	2171	500-yr	Ex Cnd Ph I	342.00	326.00	330.06		330.30	0.008943	5.07	126.03	127.68	0.55
Patrick Brook	Lower reach	2171	500-yr	Pr Cnd Ph II	342.00	326.00	330.85		330.91	0.001741	2.66	238.09	156.33	0.25
Patrick Brook	Lower reach	2171	500-yr	Pr Cnd Ph II ALL	342.00	326.00	330.84		330.90	0.001780	2.69	236.14	155.87	0.26
Patrick Brook	Lower reach	2038	100-yr	Ex Cnd Ph I	271.00	325.48	329.34		329.38	0.003740	2.64	251.19	541.59	0.34
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II	271.00	325.48	330.21		330.33	0.004051	3.21	129.22	128.22	0.37
Patrick Brook	Lower reach	2038	100-yr	Pr Cnd Ph II ALL	271.00	325.48	330.21		330.33	0.004050	3.21	129.24	128.23	0.37
Patrick Brook	Lower reach	2038	500-yr	Ex Cnd Ph I	342.00	325.48	329.45		329.50	0.003855	2.74	316.66	598.25	0.35
Patrick Brook	Lower reach	2038	500-yr	Pr Cnd Ph II	342.00	325.48	330.44		330.57	0.003912	3.33	160.81	139.37	0.37
Patrick Brook	Lower reach	2038	500-yr	Pr Cnd Ph II ALL	342.00	325.48	330.41		330.54	0.004214	3.42	155.92	137.85	0.38
Patrick Brook	Lower reach	1759	100-yr	Ex Cnd Ph I	271.00	324.00	328.32		328.39	0.003373	2.93	235.87	532.87	0.33
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II	271.00	324.00	328.93		329.12	0.004693	3.88	113.49	125.53	0.40
Patrick Brook	Lower reach	1759	100-yr	Pr Cnd Ph II ALL	271.00	324.00	328.95		329.13	0.004571	3.84	115.29	126.79	0.39
Patrick Brook	Lower reach	1759	500-yr	Ex Cnd Ph I	342.00	324.00	328.46		328.52	0.003248	2.96	318.31	671.19	0.32
Patrick Brook	Lower reach	1759	500-yr	Pr Cnd Ph II	342.00	324.00	329.13		329.33	0.005020	4.15	139.75	132.09	0.42
Patrick Brook	Lower reach	1759	500-yr	Pr Cnd Ph II ALL	342.00	324.00	329.25		329.41	0.003950	3.75	155.88	132.62	0.37
Patrick Brook	Lower reach	1685	100-yr	Ex Cnd Ph I	271.00	323.83	328.05		328.09	0.003192	2.44	274.58	583.30	0.31
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II	271.00	323.83	328.40		328.59	0.007615	4.01	107.66	128.07	0.49
Patrick Brook	Lower reach	1685	100-yr	Pr Cnd Ph II ALL	271.00	323.83	328.54	328.14	328.67	0.005435	3.48	124.90	129.33	0.42
Patrick Brook	Lower reach	1685	500-yr	Ex Cnd Ph I	342.00	323.83	328.16		328.21	0.003648	2.64	353.26	777.38	0.33
Patrick Brook	Lower reach	1685	500-yr	Pr Cnd Ph II	342.00	323.83	328.60		328.78	0.007377	4.11	133.52	129.96	0.49
Patrick Brook	Lower reach	1685	500-yr	Pr Cnd Ph II ALL	342.00	323.83	328.99	328.33	329.07	0.003225	2.91	184.16	133.57	0.33
Patrick Brook	Lower reach	1618	100-yr	Ex Cnd Ph I	271.00	323.47	327.82		327.90	0.003385	2.90	245.83	603.37	0.33
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	100-yr	Pr Cnd Ph II ALL	271.00	323.47	328.17		328.28	0.003528	3.11	136.80	125.29	0.35
Patrick Brook	Lower reach	1618	500-yr	Ex Cnd Ph I	342.00	323.47	327.94		328.01	0.003198	2.89	324.89	675.38	0.33
Patrick Brook	Lower reach	1618	500-yr	Pr Cnd Ph II	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1618	500-yr	Pr Cnd Ph II ALL	342.00	323.47	328.34		328.47	0.003904	3.42	158.94	133.86	0.37
Patrick Brook	Lower reach	1458	100-yr	Ex Cnd Ph I	271.00	322.56	326.85	326.85	327.08	0.010279	4.43	118.16	290.95	0.55
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	100-yr	Pr Cnd Ph II ALL	271.00	322.56	326.78	326.78	327.25	0.017565	5.71	61.81	104.57	0.72
Patrick Brook	Lower reach	1458	500-yr	Ex Cnd Ph I	342.00	322.56	326.96	326.96	327.19	0.011062	4.68	153.03	380.96	0.57
Patrick Brook	Lower reach	1458	500-yr	Pr Cnd Ph II	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	1458	500-yr	Pr Cnd Ph II ALL	342.00	322.56	327.06	327.06	327.44	0.014574	5.46	97.94	146.69	0.66
Patrick Brook	Lower reach	130	100-yr	Ex Cnd Ph I	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08

HEC-RAS (Continued)

River	Reach	River Sta	Profile	Plan	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)	
Patrick Brook	Lower reach	130	100-yr	Pr Cnd Ph II ALL	271.00	318.90	324.60	321.56	324.61	0.000155	0.85	861.75	967.32	0.08
Patrick Brook	Lower reach	130	500-yr	Ex Cnd Ph I	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Cnd Ph II	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07
Patrick Brook	Lower reach	130	500-yr	Pr Cnd Ph II ALL	342.00	318.90	325.00	321.88	325.00	0.000102	0.74	1297.81	1213.00	0.07

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Cnd Ph II ALL   10/3/2013

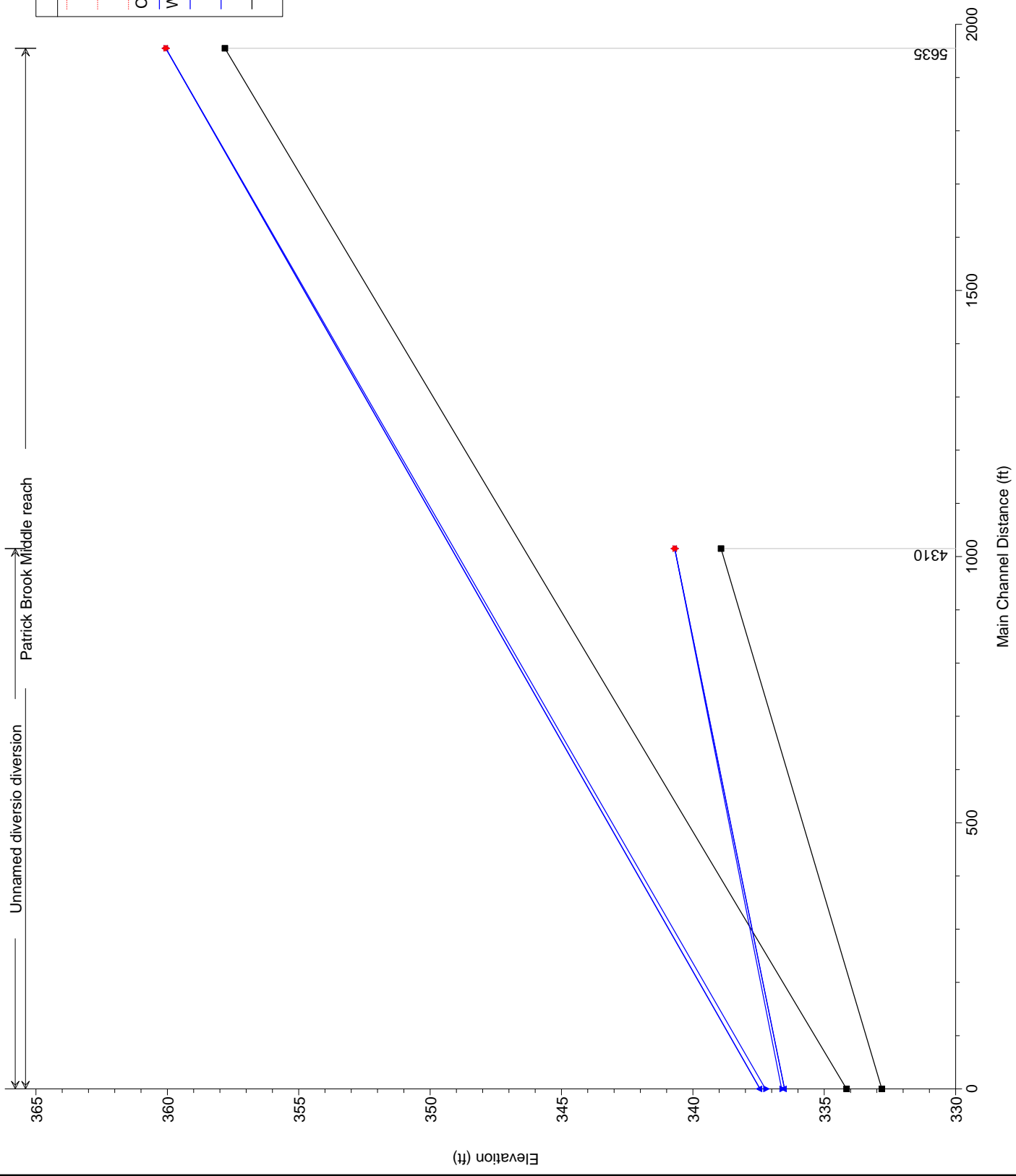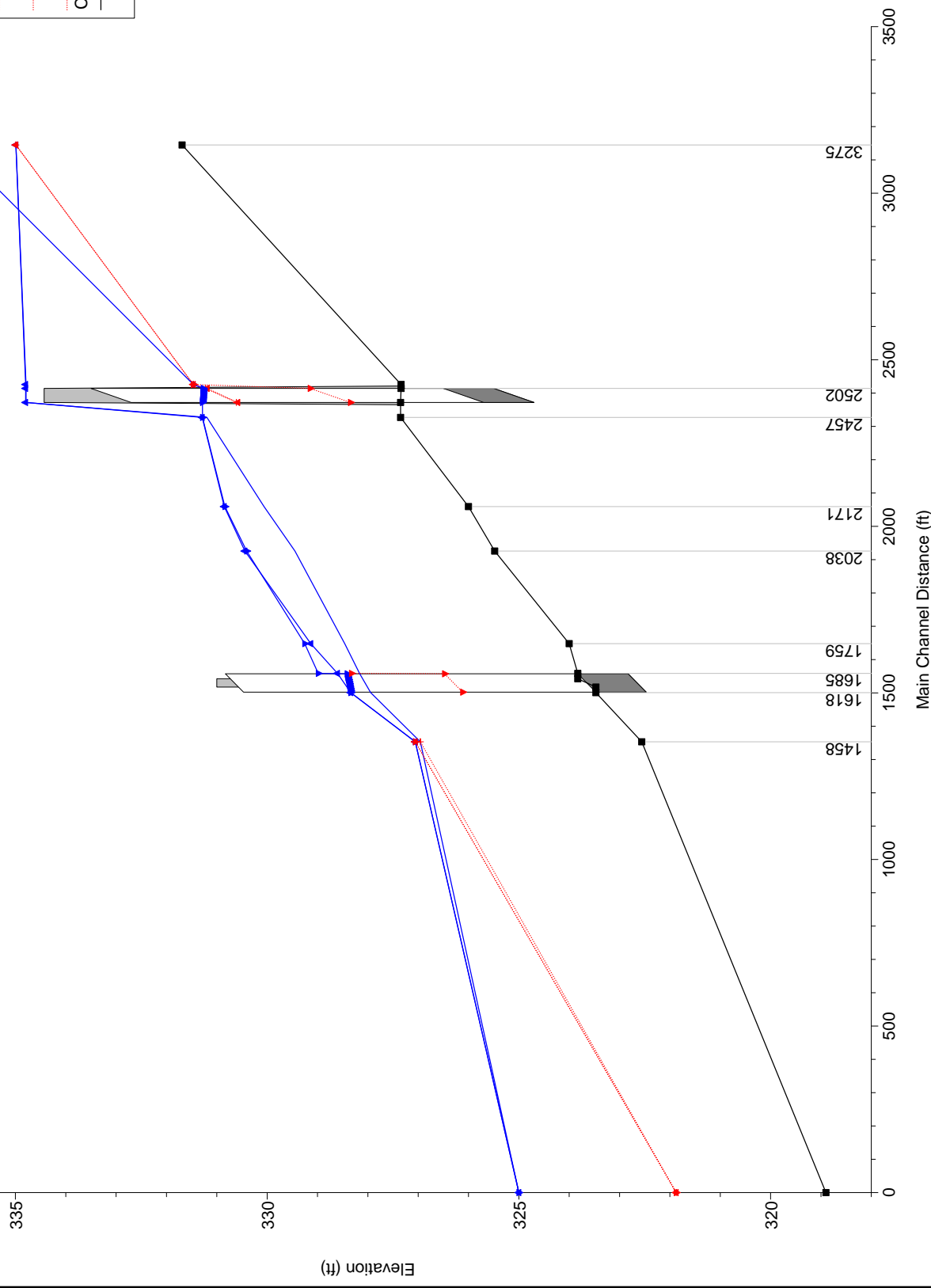Patrick Brook Lower reach

Legend

WS 100-yr - Ex Cnd Ph I

WS 100-yr - Pr Cnd Ph II

WS 100-yr - Pr Cnd Ph II ALL

Crit 100-yr - Pr Cnd Ph II

Crit 100-yr - Ex Cnd Ph I

Crit 100-yr - Pr Cnd Ph II ALL

Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Cnd Ph II ALL   10/3/2013

Legend

Crit 100-yr - Ex Cnd Ph I
Crit 100-yr - Pr Cnd Ph II
Crit 100-yr - Pr Cnd Ph II ALL
WS 100-yr - Pr Cnd Ph II ALL
WS 100-yr - Ex Cnd Ph I
WS 100-yr - Pr Cnd Ph II
Ground

Elevation (ft)

Main Channel Distance (ft)

Unnamed diversio diversion

Patrick Brook Middle reach

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Cnd Ph II ALL   10/3/2013

Patrick Brook Lower reach

Legend

WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Cnd Ph II
WS 500-yr - Pr Cnd Ph II ALL
Crit 500-yr - Pr Cnd Ph II
Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr Cnd Ph II ALL
Ground

Main Channel Distance (ft)

Elevation (ft)

Patrick Brook - Phase II Hydraulic Study   Plan: 1) Ex Cnd Ph I   10/2/2013   2) Pr Cnd Ph II   10/3/2013   3) Pr Cnd Ph II ALL   10/3/2013

Unnamed diversio diversion   Patrick Brook Middle reach

Legend

Crit 500-yr - Ex Cnd Ph I
Crit 500-yr - Pr Cnd Ph II
Crit 500-yr - Pr Cnd Ph II ALL
WS 500-yr - Pr Cnd Ph II ALL
WS 500-yr - Ex Cnd Ph I
WS 500-yr - Pr Cnd Ph II
Ground

Elevation (ft)

Main Channel Distance (ft)