Exelon Generation®

10 CFR 50.54(f)

RS-15-268

October 28, 2015

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Limerick Generating Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Subject: Response to NRC Audit Review Request for Additional Information Regarding Fukushima Lessons Learned - Flood Hazard Reevaluation Report

References:

1. Exelon Generation Company, LLC Letter to USNRC, Flood Hazard Reevaluation Report Pursuant to 10 CFR 50.54(f) Regarding the Fukushima Near-Term Task Force Recommendation 2.1: Flooding, dated March 12, 2015 (RS-15-064)
2. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 12, 2012

In Reference 1, Exelon Generation Company, LLC (EGC) provided the Flooding Hazard Reevaluation Report (FHRR) for the Limerick Generating Station, Units 1 and 2 in response to the March 12, 2012 Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, (Reference 2). The NRC conducted an audit/webinar review of the Limerick Generating Station, Units 1 and 2 FHRR on September 24, 2015. In support of the FHRR audit, the NRC provided audit information needs items. The information provided by EGC to address the audit information needs items was subsequently reviewed by the NRC during the audit. Based on the audit review, the NRC identified items that required additional information.

The purpose of this letter is to provide the responses to the NRC requested additional information items identified during the Limerick Generating Station, Units 1 and 2 FHRR audit review on September 24, 2015. The enclosure to this letter provides the individual responses to each of the items identified by the NRC during the audit.

This letter contains no new regulatory commitments.

If you have any questions regarding this report, please contact Ron Gaston at (630) 657-3359.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 28th day of October 2015.

Respectfully submitted,

James Barstow
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure: Limerick Generating Station, Units 1 and 2 Response to NRC Audit Review Request for Additional Information Regarding Fukushima Lessons Learned - Flood Hazard Reevaluation Report

cc: NRC Regional Administrator - Region I
NRC Project Manager, NRR - Limerick Generating Station
NRC Senior Resident Inspector – Limerick Generating Station
Ms. Tekia Govan, NRR/JLD/PPSD/HMB, NRC
Director, Bureau of Radiation Protection – Pennsylvania Department of Environmental Resources
R. R. Janati, Chief, Division of Nuclear Safety, Pennsylvania Department of Environmental Protection, Bureau of Radiation Protection

Enclosure

Limerick Generating Station, Units 1 and 2

Response to NRC Audit Review Request for Additional Information Regarding Fukushima Lessons Learned - Flood Hazard Reevaluation Report

(20 pages)

Information Need 2: Streams and Rivers – Watershed Delineation

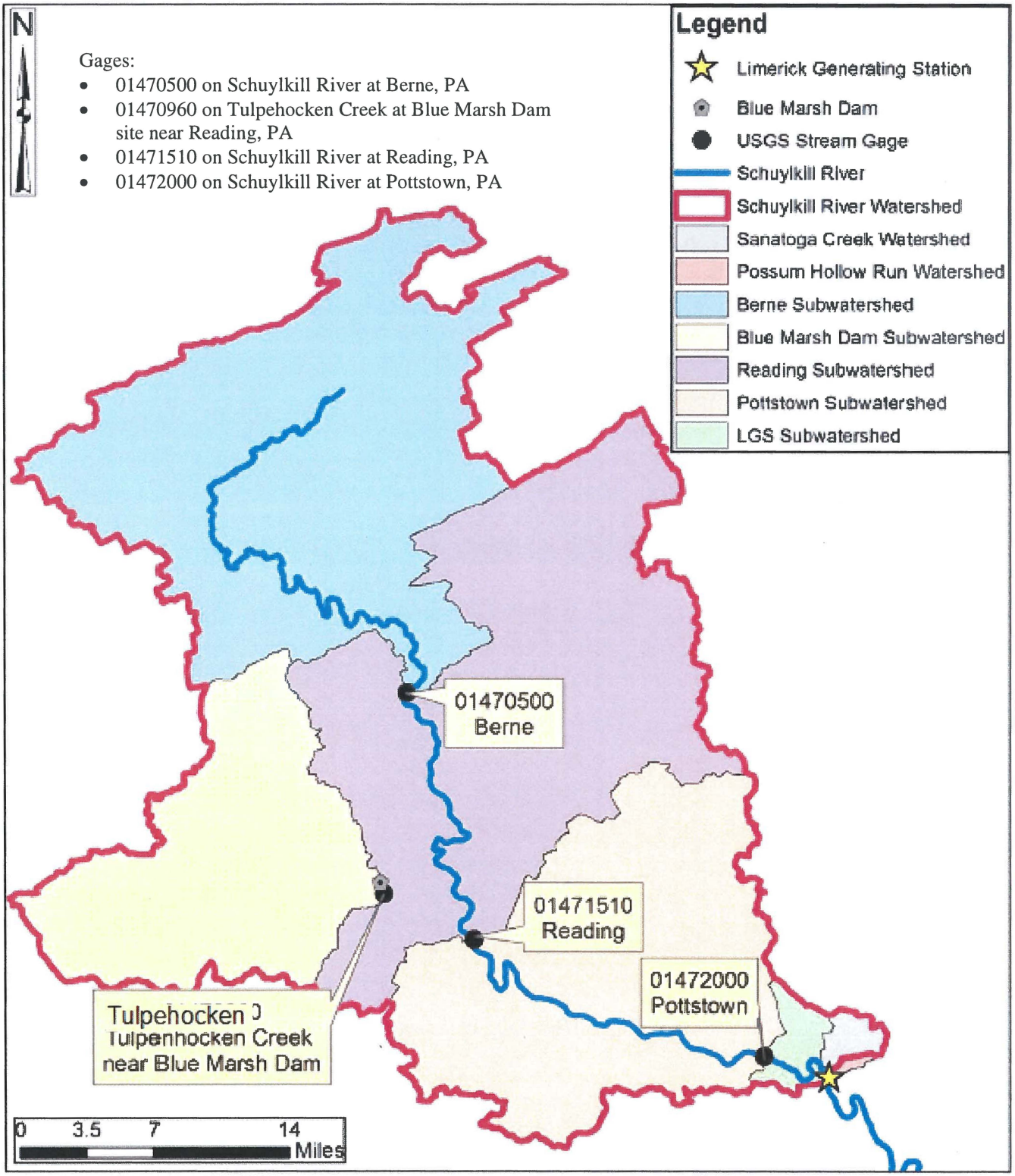
Background: Figure is needed for inclusion in staff's assessment. This information is in Figure 4 of Calculation FINAL_LM-0700_Limerick_PMF-Hydrology. The issue does not directly affect estimated water-surface elevations but is needed for staff to clearly describe the Schuylkill River watershed in the SA.

Request: The FHRR does not include a figure of the Schuylkill River drainage showing subwatersheds and alternative centroids. The staff request Figure 4 from Calculation FINAL_LM-0700_Limerick_PMF-Hydrology.

Response:

Figure 4 from calculation FINAL_LM-0700_Limerick_PMF-Hydrology is provided below.

Figure 4: USGS Stream Gage Locations and Gage Numbers



Information Need 3: Streams and Rivers – PMP Temporal Distribution

Background: It is not clear that the temporal distributions used by the licensee are typically used front, center, and end-loaded configurations. There are no plots included in the FHRR or the calculations. This information exists in Section 6.2 of Calculation FINAL-Limerick_PMP-LM-0698 and Section 6.9 of Calculation FINAL_LM-0700_Limerick_PMF-Hydrology. The temporal pattern of PMP can significantly affect the water-surface elevation near the LGS site.

Request: The FHRR states that four temporal distributions were used for the all-season PMP. However, no justification is provided for their derivation. The staff requests a detailed description of the four temporal distributions considered by the licensee including example hyetograph plots.

Response:

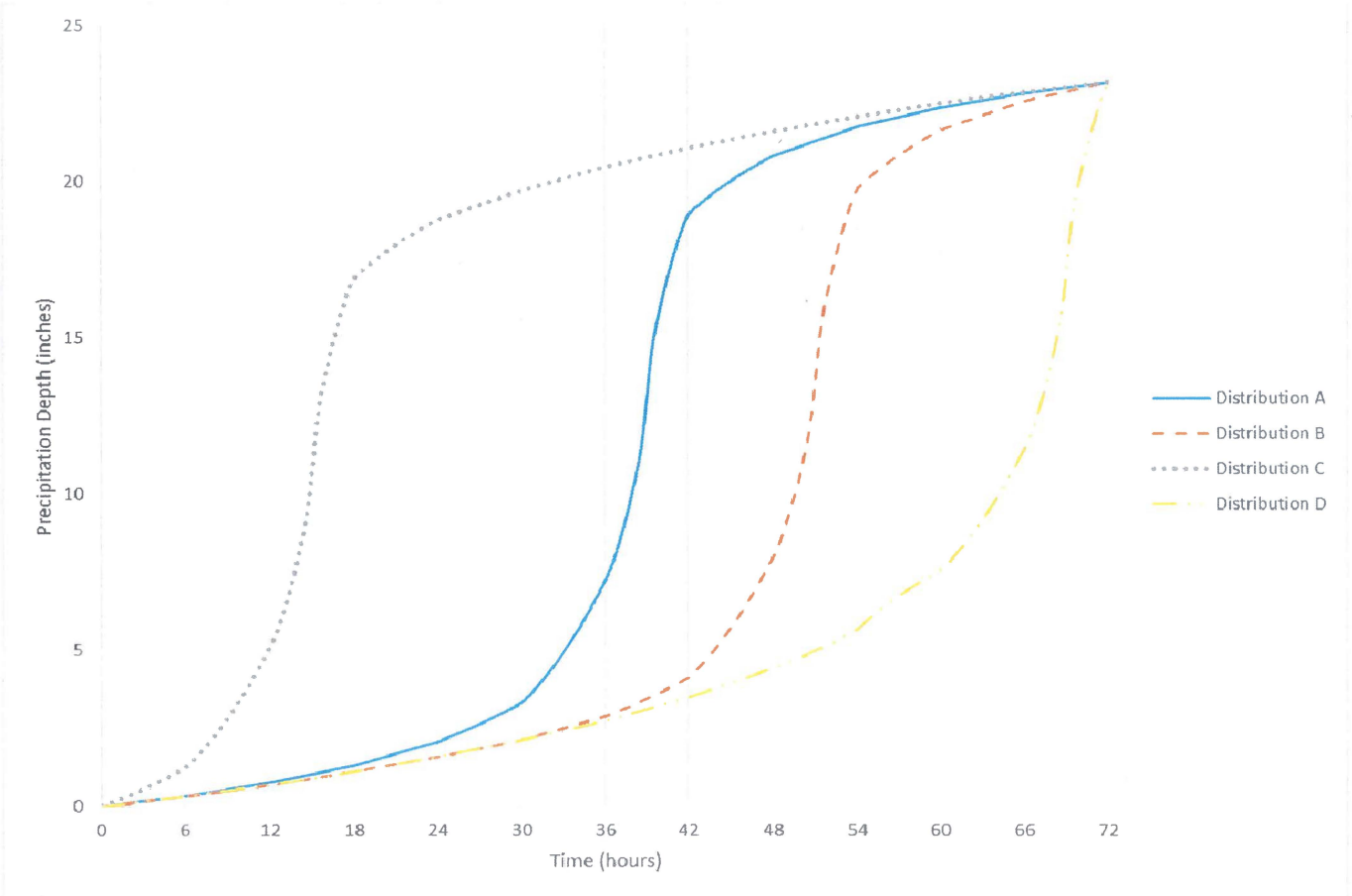
The following information was summarized from Item 7 of Section 6.2.1 of the Limerick PMP Calculation FINAL-Limerick_PMP-LM-0698:

Four Probable Maximum Precipitation (PMP) temporal distributions were analyzed for the all-season PMP. The PMP consists of twelve 6 hour increments of precipitation (i.e. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12) in which the values denote the order of rainfall intensity, with 1 being the maximum increment and 12 being the minimum increment. For each of the three watersheds- Schuylkill River, Possum Hollow Run and Sanatoga Creek- the temporal order was varied by manually arranging the temporal distributions to develop the all-season hyetographs with the following identification:

- Distribution A (BOSS HMR52 Default): 12, 10, 8, 6, 4, 2, 1, 3, 5, 7, 9, 11; with 1 being the maximum rainfall increment and 12 being the minimum rainfall increment;
- Distribution B: Substituting the maximum 6-hr at the 9th position (i.e., 12, 11, 10, 9, 8, 6, 4, 2, 1, 3, 5, 7);
- Distribution C: Shift the four maximum 6-hr increments to the first 24-hour period (i.e., 4, 2, 1, 3, 5, 6, 7, 8, 9, 10, 11, 12);
- Distribution D: Shift the four max 6-hr increments to the final 24-hour period (i.e., 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1).

The four analyzed all-season PMP distributions for the Schuylkill River overall watershed storm center scenario are displayed in Figure 3.1. Similar distributions were used for the Possum Hollow Run and Sanatoga Creek watersheds sensitivity analyses.

Figure 3.1 – All-Season PMP Cumulative Temporal Distributions Plots



Information Need 4: Streams and Rivers – PMP Spatial Distribution for the Schuylkill River Drainage

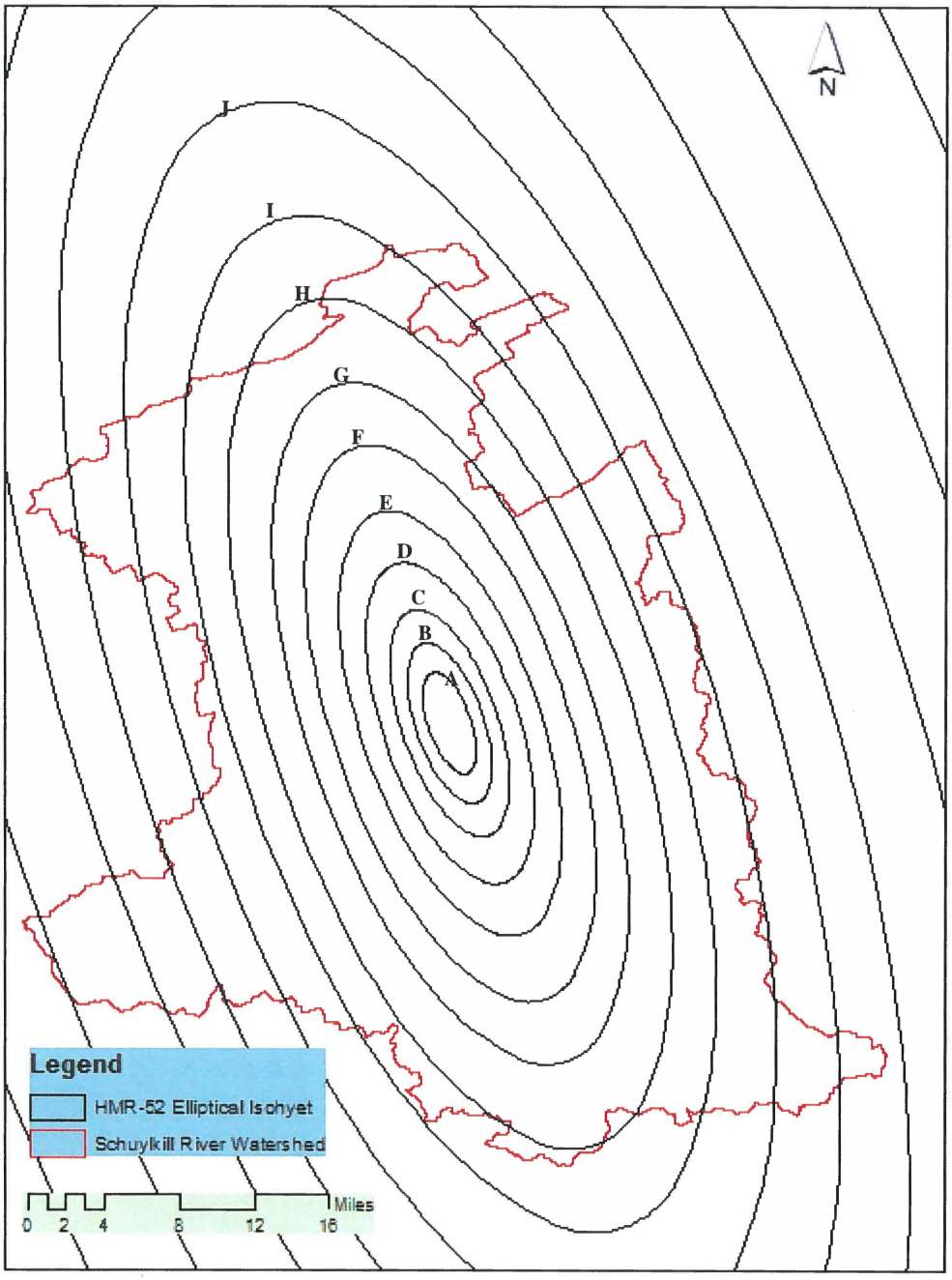
Background: The staff was unable to find isohyets for the Schuylkill River drainage. The isohyetal pattern and its orientation can significantly affect the water-surface elevation near the LGS site.

Request: The FHRR does not include a figure showing the isohyetal pattern of the PMP over the Schuylkill River drainage. The staff requests an isohyetal map and orientation for the storm estimated by BOSS HMR52.

Response:

The final BOSS HMR52 (computer program) storm orientation calculated by the HMR-52 computer program that maximizes the total precipitation depths for the Schuylkill River watershed is 160 degrees. An isohyetal map/spatial distribution with a storm orientation of 160 degrees for the PMP storm estimated by BOSS HMR52 for the Schuylkill River watershed is shown on Figure 4.2. Although this plot was not originally included, this storm center and isohyetal pattern is the basis for calculation FINAL-Limerick_PMP-LM-0698.

Figure 4.2: GIS Figure Showing Isohyetal Pattern/Spatial Distribution and Orientation of PMP Storm for Schuylkill River Watershed



Information Need 7: Streams and Rivers – Snow Water Equivalents for the 100-year Snowpack Depths

Background: The FHRR states that snowmelt for Alternative 3 is limited by the 100-year snowpack. This information is in Sections 6.2 and 7.2 of Calculation FINAL-Limerick_PMP-LM-0698. Initial snow water equivalent and snowmelt rates can significantly affect estimated water-surface elevations near the LGS site.

Request: The FHRR states that Alternative 3 precipitation scenario consists of a 72-hour cool-season PMP coincident with snowmelt from a 100-year snowpack. The calculation package describes the estimation of 100-year snowpack depth. A brief but clear description of how the snow water equivalents for the 100-year snowpack depths were estimated is needed for the staff's assessment. The staff requests a brief description of how snow water equivalents were determined for the 100-year snowpack depths. The staff also request clarification if the 100-year snowpack was spatially uniform over the Schuylkill River watershed and if it completely melted during the 72-hour cool-season PMP event.

Response:

Snow-water equivalent (SWE) data was not available for the LGS watersheds and surrounding regions. In lieu of site-specific data, the SWE (ratio) was conservatively assumed to be 0.5 of the 100-year snow depth for November to April (Cool-Season months). The 100-year snowpack is assumed to be spatially uniform over each of the five Schuylkill River sub-watersheds, and Possum Hollow Run and Sanatoga Creek watersheds. In other words, each sub-watershed has its own unique 100-year snowpack that is spatially uniform only over its own area. For the Schuylkill River, the entire watershed consists of five sub-watersheds with five different 100-year snowpack values, one for each sub-watershed.

The complete melt of the snowpack is variable depending on the month and sub-watershed considered. This is because the snowpack depths (or SWE) and energy budget input parameters are different for each month evaluated and for each sub-watershed. Tabulated below are the calculated theoretical snowmelt (M_1) using the energy budget equation, assuming there are no limitations on the amount of melt available, and the 100-year snowpack melt depth (or SWE) available (M_0). The lesser of the two is used in the calculation to determine the resulting flood effects. Therefore, if the calculated theoretical snowmelt (M_1) is less than the 100-year snowpack melt depth available (M_0), then the snowpack did not completely melt. Otherwise, the snowpack depleted during the course of the rainfall event.

For the controlling month (March), the bolded values in the Schuylkill River sub-watersheds in Table 7.1 show that the snowpack will completely melt (M_0-M_1<0) before the end of the 72-hr period in all the Schuylkill River sub-watersheds except for the Berne sub-watershed (M_0-M_1>0). Table 7.2 for the Nearby Streams watersheds (Possum and Sanatoga watersheds) also shows that the snowpack will completely melt in March before the end of the 72-hr period.

Table 7.1 - Schuylkill River Watershed Snow Melt Calculation Comparison (Alternative 3 – Cool Season PMP on a 100-Year Snowpack)

Basin	Month	*72-hr Snowmelt M_1	**Snowpack Melt M_0=SWE*Ds	M_0-M_1	Snowpack melts 100% in 72-hr
		[inches]	[inches]	[Inches]	Yes/No
Berne Watershed	Jan	7.0	16.5	9.5	No
	Feb	5.6	18.0	12.4	No
	Mar	**9.3**	**12.4**	**3.1**	**No**
	Apr	11.6	7.0	-4.6	Yes
	Nov	13.2	5.0	-8.2	Yes
	Dec	8.7	12.0	3.3	No
Blue Marsh Watershed	Jan	7.7	19.0	11.3	No
	Feb	6.2	14.7	8.5	No
	Mar	**10.3**	**8.5**	**-1.8**	**Yes**
	Apr	12.5	2.5	-10.0	Yes
	Nov	13.5	2.2	-11.3	Yes
	Dec	9.3	5.9	-3.4	Yes
Reading Watershed	Jan	8.4	12.5	4.1	No
	Feb	6.7	12.0	5.3	No
	Mar	**11.2**	**8.0**	**-3.2**	**Yes**
	Apr	13.9	3.0	-10.9	Yes
	Nov	15.4	2.5	-12.9	Yes
	Dec	10.3	8.0	-2.3	Yes
Pottstown Watershed	Jan	7.7	17.5	9.8	No
	Feb	6.2	12.6	6.4	No
	Mar	**10.31**	**8.0**	**-2.31**	**Yes**
	Apr	12.7	5.5	-7.2	Yes
	Nov	14.1	3.5	-10.6	Yes
	Dec	9.5	6.5	-3.0	Yes
LGS Watershed	Jan	6.9	17.5	10.6	No
	Feb	5.6	12.6	7.0	No
	Mar	**9.2**	**8.0**	**-1.2**	**Yes**
	Apr	11.1	5.5	-5.6	Yes
	Nov	11.7	3.5	-8.2	Yes
	Dec	8.2	6.5	-1.7	Yes

* From Calculation FINAL-Limerick_PMP-LM-0698, Table 34
** From Calculation FINAL-Limerick_PMP-LM-0698, Table 37

Table 7.2 - Nearby Streams Watersheds Snow Melt Calculation Comparison (Alternative 3 – Cool Season PMP on a 100-Year Snowpack)

Basin	Month	*72-hr Snowmelt M_1	**Snowpack Melt M_0=SWE*Ds	M_0-M_1	Snowpack melts 100% in 72-hr
		[inches]	[inches]	[Inches]	Yes/No
Possum Watershed	Jan	10.9	17.5	6.6	No
	Feb	8.7	12.6	3.9	No
	Mar	**14.6**	**8.0**	**-6.6**	**Yes**
	Apr	18.3	5.5	-12.8	Yes
	Nov	21.2	3.5	-17.7	Yes
	Dec	13.7	6.5	-7.2	Yes
Sanatoga Watershed	Jan	10.3	17.5	7.2	No
	Feb	8.2	12.6	4.4	No
	Mar	**13.7**	**8.0**	**-5.7**	**Yes**
	Apr	17.3	5.5	-11.8	Yes
	Nov	20.2	3.5	-16.7	Yes
	Dec	13.0	6.5	-6.5	Yes

* From Calculation FINAL-Limerick_PMP-LM-0698, Table 35
** From Calculation FINAL-Limerick_PMP-LM-0698, Table 38

Information Need 8: Streams and Rivers – HEC-HMS Model Calibration

Background: The description of dams and how they affect the calibration and validation of HEC-HMS model parameters is not clear in the FHRR. Some of this information exists in Section 6.7 of Calculation FINAL_LM-0700_Limerick_PMF-Hydrology. Parameter values used in the estimate of PMF can significantly affect the water-surface elevation near the LGS site.

Request: The FHRR states that dams were not incorporated into the HEC-HMS model used to estimate the PMF. The calculation package (LM-0700) states that the Blue Marsh dam was not modeled in HEC-HMS but the discharges measured at the USGS gauge downstream of the dam were used for calibration of downstream basins with the exception of the 1972 flood. The staff requests a list of storms/floods for each calibrated subbasin indicating whether those storms/floods were used in calibration or validation.

Response:

Multiple storm events were used for both calibration and validation of the HEC-HMS hydrologic model. Calibration was performed using multiple events to identify a bounding range of parameters. The selection of parameters from within the calibrated bounding range was then verified using multiple events. As noted in the request, observed USGS streamflow data downstream of the Blue Marsh Dam is used for calibration and validation of the downstream Reading and Pottstown sub-watersheds, with the exception of the 1972 flood. Due to the lack of available data, the Blue Marsh Dam sub-watershed was conservatively calibrated so the modeled peak flow of the 1972 flood exceeded the observed peak flow.

The calibration events are tabulated below with the corresponding sub-watersheds that used the storm event for calibration.

Table 8.1 – Calibration Events

Storm Event	Sub-watersheds Calibrated with Storm Event
June 1972	Berne, Blue Marsh Dam, and Pottstown
October 1996	Berne, Reading, and Pottstown
September 1999	Berne, Reading, and Pottstown
September 2011	Berne, Reading, and Pottstown

Reference: Calculation FINAL_LM-0700_Limerick_PMF-Hydrology

The validation events are tabulated below with the corresponding subbasins that used the storm event for validation.

Table 8.2 – Validation Events

Storm Event	Sub-watersheds Verified with Storm Event
June 2003	Berne and Reading
August 2004	Berne
September 2004	Berne, Reading, and Pottstown
June 2006	Reading and Pottstown
August 2011	Pottstown

Reference: Calculation FINAL_LM-0700_Limerick_PMF-Hydrology

Information Need 10: Streams and Rivers – HEC-RAS Model Setup

Background: The FHRR does not present figures that show the extents and details of the HEC-RAS modeled reaches for the Schuylkill River, Possum Hollow Run, and Sanatoga Creek. The staff were unable to find this information in the ERR. The issue does not directly affect estimated water-surface elevations but is needed for staff to clearly describe the HEC-RAS model setup for the Schuylkill River, Possum Hollow Run, and Sanatoga Creek in the SA.

Request: The FHRR does not present figures that show the extents of the HEC-RAS modeled reaches for the Schuylkill River, Possum Hollow Run, and Sanatoga Creek. The staff request clear, good quality, appropriately labeled figures that show the extent of the HEC-RAS modeled reaches for the Schuylkill River, Possum Hollow Run, and Sanatoga Creek. These figures should clearly show where boundary conditions (upstream, downstream, and lateral) are applied, where modeled structures within the reaches are located (dams, bridges), and where ineffective areas are located.

Response:

The hydraulic modeling is performed using the USACE Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 4.1.0 steady state model. The upstream boundary location of the Schuylkill River is at River Mile (RM) 74.00 located at Reading, PA, which is located about 27 river miles upstream of Limerick Generating Station (LGS). The downstream limit of the Schuylkill River HEC-RAS model is at RM 7.12, which is located about 40 river miles downstream of LGS and approximately 7 river miles upstream the confluence of the Schuylkill River with the Delaware River. Average cross sections spacing of 472 feet is used including interpolated cross-sections. Interpolated cross-sections were used to capture more rapidly changing flow characteristics near structures such as bridges. LGS is located approximately 0.8 miles south of Sanatoga Creek and 0.1 miles north of Possum Hollow Run.

The Possum Hollow Run watershed (1.4 square-miles) is located directly downstream of the Schuylkill River watershed at LGS. The Possum Hollow Run is included as a tributary to the Schuylkill River HEC-RAS hydraulic model at cross-section 48.41 to simulate potential backwater effects at LGS from Possum Hollow Run.

Figures showing where boundary conditions are applied are provided on Figures 10.22 through 10.24. The HEC-RAS hydraulic model included all bridges within approximately 10 river miles downstream of LGS and most upstream bridges that had the potential to significantly influence the water surface elevation at LGS. Some upstream bridges were not modeled in the HEC-RAS model, as omitting these bridges would not increase flood stage at the LGS.

Locations of ineffective flow areas along the Schuylkill River and Possum Hollow Run reaches are provided on Figure 10.24. The bridge, inline structure, and upstream inflow boundary locations on the Possum Hollow Run River are shown on Figure 10.22. Detail of the Sanatoga Creek HEC-RAS cross-sections is shown on Figure 10.23.

Figure 10.22: Possum Hollow Run HEC-RAS Sections 1.144 to 0.07

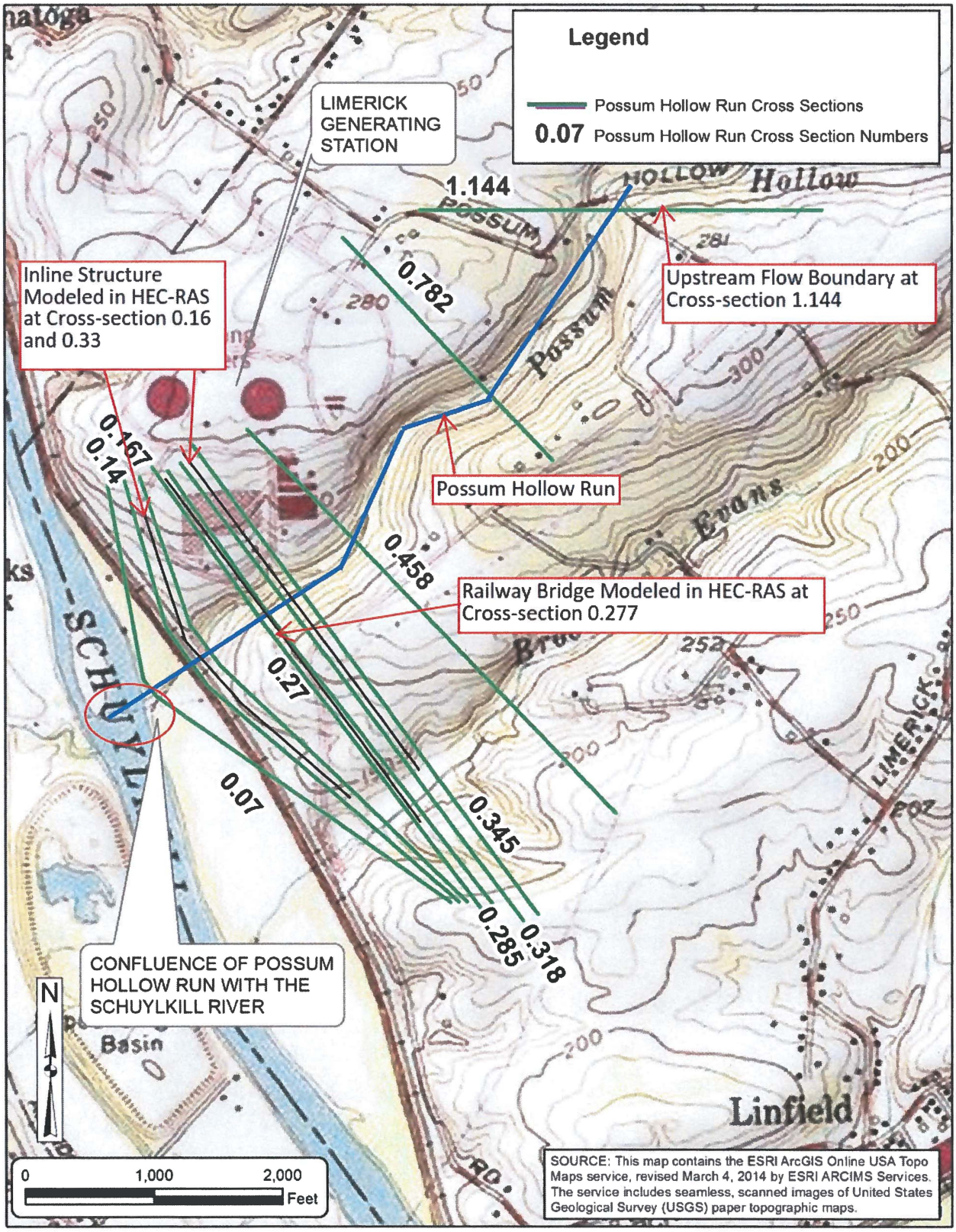


Figure 10.23: Sanatogo Creek HEC-RAS Sections 1.42 to 0.0

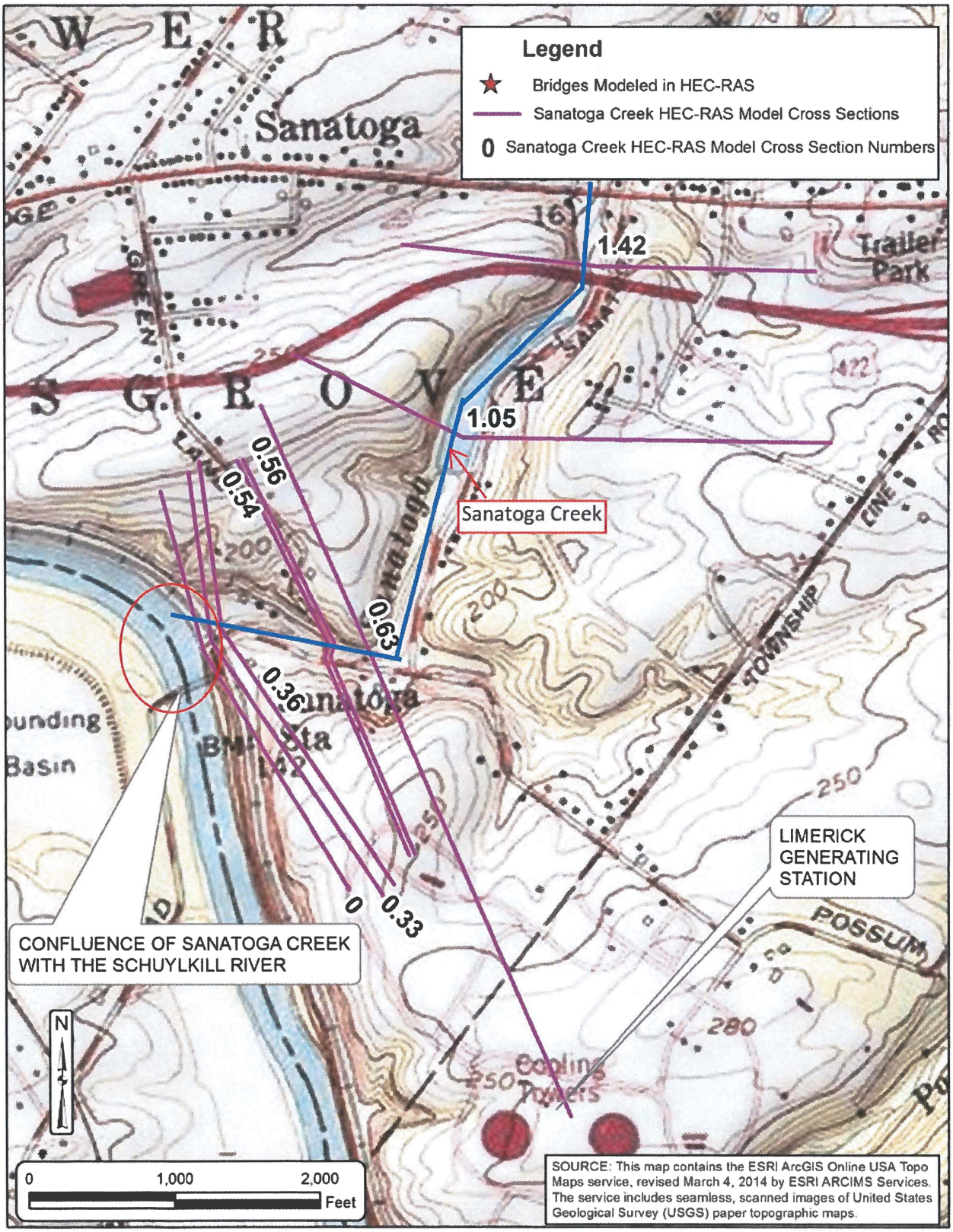
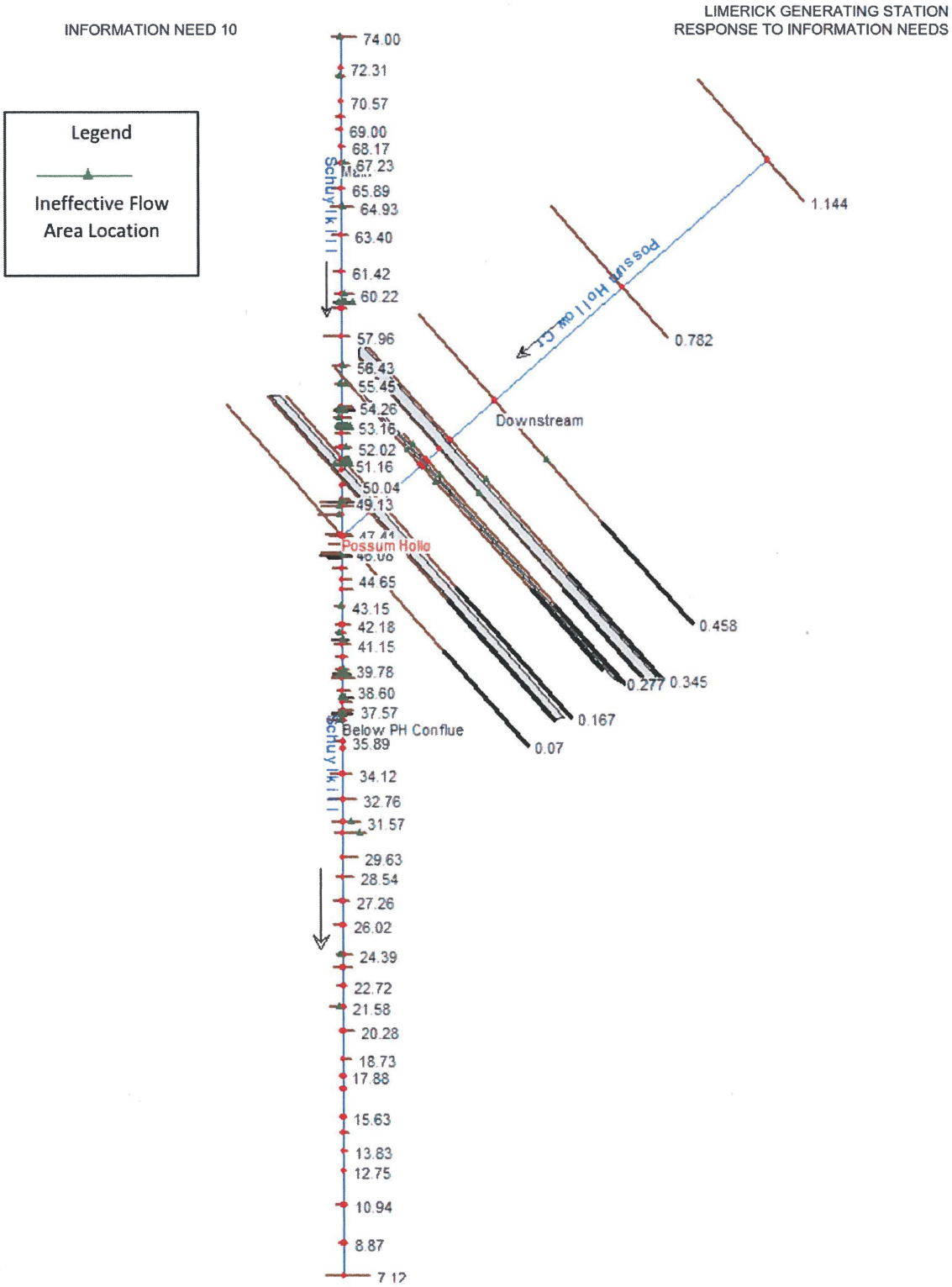


Figure 10.24: Location of Ineffective Flow Area along the Schuylkill River and Possum Hollow Run



Information Need 11: Streams and Rivers – HEC-RAS Model Calibration

Background: The FHRR does not present values of Manning's roughness coefficients for any of the modeled HEC-RAS reaches. This information is in Sections 7.3 and 7.4 of Calculation FINAL_LM-701_Limerick_PMF-Hydraulics. Manning's roughness values can significantly affect estimated water-surface elevations near the LGS site.

Request: The FHRR does not present values of Manning's roughness coefficients for any of the modeled HEC-RAS reaches. The staff request the following for the Schuylkill River reach: (1) initial Manning's roughness coefficients, (2) a brief description of how Manning's roughness coefficients were calibrated, (3) final calibrated values of the Manning's roughness coefficients. The staff also request Manning's roughness coefficients used for the Possum Hollow Run and Sanatoga Creek reaches.

Response:

The following information was summarized from Sections 6.3.4 and 7.3.4 (for item 1 below), 6.4 (for item 2 below), and 7.4 (for item 3 below) of calculation FINAL_LM-701_Limerick_PMF-Hydraulics:

(1) *Initial Manning's roughness coefficients*: The initial Manning's n values for the Schuylkill River, before the calibration process, were set to 0.03 for the channel and 0.10 for the overbank areas. The FEMA Flood Insurance Study was used as the basis for setting the initial values and these values were confirmed as being appropriate based on the ranges presented in Chow (Chow, 1959). The initial Manning's n values for Possum Hollow Run and Sanatoga Creek were set to 0.06 for the channel [this value is conservatively at the high end of range values for "minor streams with some weeds, stones, winding and some pools" according to Chow (Chow, 1959)], and 0.12 for the overbank areas [this value is conservatively at the high end of range of values for "flood plains – trees with heavy stand of timber, a few down trees and little undergrowth" according to Chow (Chow, 1959)].

(2) *A brief description of how Manning's roughness coefficients were calibrated*: The three largest floods of record that resulted in the three highest peak water surface elevations at the USGS stream gage station on the Schuylkill River at Pottstown, PA (USGS 01472000) were used as calibration floods. The gage is located about 5.6 miles upstream of LGS. These peak discharges were input into the Schuylkill River HEC-RAS steady-state model for calibration. The calibration process included the following steps:

1) Run each of the selected calibration floods in steady state mode in HEC-RAS using the initial Manning's n values.
2) Compare HEC-RAS simulation results to observed historical water surface elevation data at USGS stream gages on the Schuylkill River at Pottstown, PA (USGS 01472000) and Schuylkill River at Norristown (USGS 01473500).
    a. If the resultant modeled peak water surface elevations are no greater than 3.0 feet above the observed historical data, then no further action is taken (i.e. modeling of that calibration storm is completed).
    b. If the modeled peak water surface elevations are significantly higher (i.e., greater than 3.0 feet) than the observed historical data, decrease the Manning's n values.

c. In the event that the resultant peak water surface elevations at USGS Gage 01472000 corresponding to the calibration floods simulated in HEC-RAS are lower than the observed historical data, increase the Manning's n values.

d. Repeat the process of adjusting the cross section Manning's n values until the HEC-RAS peak water surface elevations corresponding to the calibration floods are higher than observed levels but no greater than three feet above the observed levels.

The calibration results for the Schuylkill River HEC-RAS model are summarized in Table 8 of Attachment 1 in calculation FINAL_LM-701_Limerick_PMF-Hydraulics and reproduced in Table 11.1 herein. Note that the Sanatoga Creek HEC-RAS model and the Possum Hollow Run reach within the Schuylkill River HEC-RAS model were not calibrated due to the unavailability of calibration data (i.e., no stream flow gage available) therefore conservative (i.e. high) Manning's values were selected.

(3) *Final calibrated values of the Manning's roughness coefficients*: The calibrated Manning's n values for the Schuylkill River were 0.036 for the channel and 0.12 for the overbank areas for the reach of Schuylkill River downstream of River Mile (RM) 37.00. For the reach of the Schuylkill River from RM 37.00 up to the upstream boundary of the model, the Manning's n values were calibrated to be 0.041 for the channel and 0.135 for the overbank areas. Note that all final Manning's values for the Schuylkill River are greater than the initial values. The channel of the Schuylkill River is essentially straight and clean with few to no rifts or deep pools. Chow (Chow, 1959) indicates Manning's n values for such channels range between 0.025 and 0.033. The overbanks of the Schuylkill River include areas of cultivated fields, light brush, and timber. For heavy stands of timber with flood stage generally below the branches, Chow (Chow, 1959) indicates Manning's n values for such flood plains range between 0.080 and 0.120. Manning's n values used in the calculation are therefore judged to be conservative.

General concerns regarding issues of uncertainty in assigning Manning's n values are addressed in the USACE engineering manual on "Risk-Based Analysis for Flood Damage Reduction Studies", (USACE, 1996). Table 5-2 of USACE, 1996 provides discussion of minimum standard deviation of error in stage based on the reliability of Manning's n values. Even when Manning's n reliability is judged to be "poor" due to poor model adjustment / validation or essentially no data for model adjustment / validation, the standard deviation of error in stage (equivalent to an 84 percent upper confidence limit) is 1.5 feet. Available margin for river flooding in each of the three streams exceeds this value.

References:

Chow, 1959. Ven Te Chow, "Open Channel Hydraulics," McGraw Hill Book Company, Inc., Copyright 1959.

USACE, 1996 "Risk-Based Analysis for Flood Damage Reduction Studies", EM 1110-2-1619. 1 Aug. 1996.

Table 11.1: Summary of Results of the Schuylkill River HEC-RAS Model Calibration

Flood	Stream Gage at Pottstown (Cross Section 52.79)					Stream Gage at Norristown (Cross Section 23.67)			
	Modeled Height	Observed Peak Flow [cfs]	Observed Stage	Modeled Stage	Difference [feet]	Modeled Height	Observed Stage	Modeled Stage	Difference [feet]
June 23, 1972	146.5	95,900	30.0	30.5	0.5	75.3	N/A	22.3	-
May 23, 1942	138.8	50,800	20.2	22.8	2.7	67.2	N/A	14.2	-
June 29, 2006	138.7	50,300	20.8	22.7	1.9	72.4	19.1	19.4	0.2

Information Need 12: Dam Failures – Locations of Dams Upstream of the LGS Site

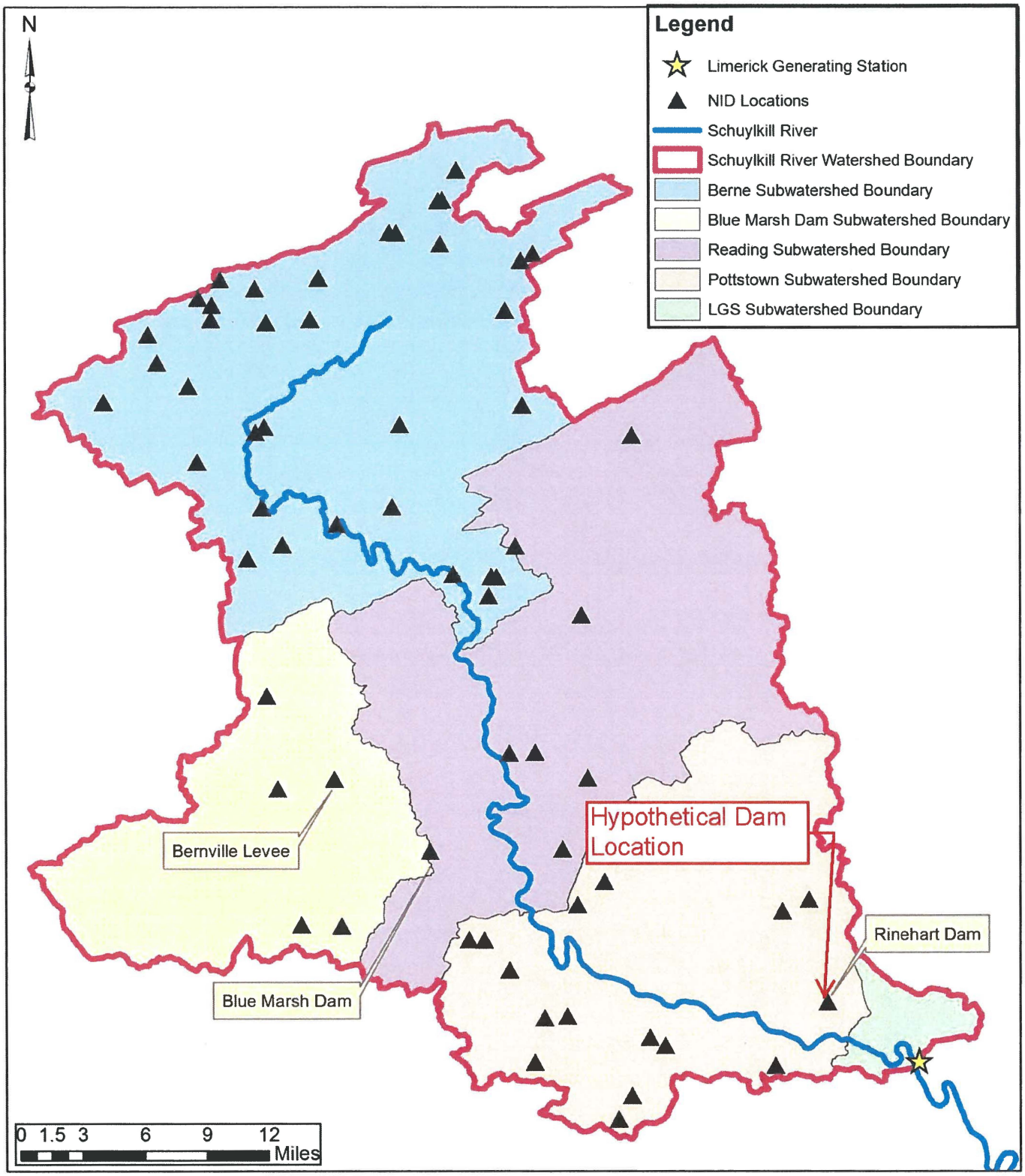
Background: The FHRR does not include a figure showing the locations of NID dams upstream of the LGS site. The locations of NID dams are shown in Figure 2 of Calculation FINAL_LM-702_Limerick_DamFailure. The locations of NID dams do not directly affect estimated water-surface elevations but are needed for staff to clearly describe the dam breach analysis for the Schuylkill River watershed in the SA. The selected location of the hypothetical dam directly affects the estimated water-surface elevation near the LGS site.

Request: The FHRR states that the locations of all dams upstream of the LGS site were obtained from the National Inventory of Dams (NID). The FHRR does not include a figure showing the locations of these dams. The staff request the licensee to provide a clear, good quality figure showing: (1) the locations of NID dams in relation to the LGS site and (2) the location of the hypothetical dam.

Response:

The locations of NID dams in relation to the LGS site are shown in Figure 12.1. A single hypothetical dam was modeled at the nearest dam upstream of the site, Reinhart Dam. The location of the hypothetical dam is identified in Figure 12.1.

Figure 12.1 – Location of NID and Hypothetical Dams



Information Need 15: All Flood Causing Mechanisms – Comparison of Reevaluated Flood Hazard with Current Design Basis

Background: Recommendation 2.1 of the 50.54(f) letter provides instructions for the Flood Hazard Reevaluation Report (FHRR). Under Section 1, Hazard Reevaluation Report, Items c and d, licensees are requested to perform:

> c. Comparison of current and reevaluated flood causing mechanisms at the site. Provide an assessment of the current design basis flood elevation to the reevaluated flood elevation for each flood causing mechanism. Include how the findings from Enclosure 4 of this letter (i.e., Recommendation 2.3 flooding walkdowns) support this determination. If the current design basis flood bounds the reevaluated hazard for all flood causing mechanisms, include how this finding was determined.
>
> d. Interim evaluation and actions taken or planned to address any higher flooding hazards relative to the design basis, prior to completion of the integrated assessment described below, if necessary.

The Limerick FHRR provides a comparison of the reevaluated flood hazards with the current licensing basis (CLB) instead of comparing with the current design basis for each flood hazard mechanism. FHRR Section 3.0 and Table 4.0.1 summarize this comparison.

Request: Clarify and where necessary correct the comparison of the reevaluated flood hazard to the current design basis for each flood hazard mechanism throughout the report.

Response:

Discussions in the Limerick FHRR, which include the terminology "design basis," provides information developed to determine the design basis flood, as indicated in Section 2.4 of the UFSAR. By definition, Current Licensing Basis (CLB) (per 10CFR54.3(a)) includes any NRC requirements, current and effective licensee commitments, operation, and any design basis information for the site as documented in the most recent final safety analysis report. For the purposes of the Limerick FHRR, the two terms, current design basis (CDB) and CLB, can be considered to have the same meaning. Additionally, Table 4.0.1 of the FHRR provides a comparison between the UFSAR and the FHRR, for parameters/methodology corresponding to each flood causing mechanism applicable at LGS. Note that Section 4 and Tables 4.0.2 (Local Intense Precipitation) and 4.0.3 (Combinations in Section H.1 of NUREG/CR-7046 for Possum Hollow Run including Dam Failure) in the FHRR use the term "current design basis" when comparing flood hazard parameters.

References:

Limerick Updated Safety Analysis Report (UFSAR), Revision 17.