NRR-DMPSPEm Resource

From:	Hon, Andrew
Sent:	Friday, February 23, 2018 3:20 PM
To:	Thompson, Russell R
Subject:	Request For Additional Information Related to TVA Fleet Topical Report TVA-NPG-AWA16 – EPIC: L-2016-TOP-0011)
Attachments:	TVA ssPMP TR RAIs_02222018_final.docx

By a letter dated September 20, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML16264A454), the Tennessee Valley Authority (TVA) submitted the a fleet topical report (TR) TVA-NPG-AWA16 "Overall Basin probable Maximum Precipitation and Local Intense Precipitation Analysis." This TR will be used for future licensing actions for Browns Ferry Units 1,2 and 3, Sequoyah Units 1 and 2 and Watts Bar Units 1 and 2.

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing your submittal and has determined that additional information is required to complete the review. The specific information requested is attached to this email. The proposed questions were emailed in draft form and a clarification call was held on January 22, 2018. Your staff confirmed that these draft questions did not include proprietary or security-related information and agreed to provide a response April 20, 2018 to this request for additional information (RAI).

The NRC staff considers that timely responses to RAIs help ensure sufficient time is available for staff review and contribute toward the NRC's goal of efficient and effective use of staff resources. Please note that if you do not respond to this request by the agreed-upon date or provide an acceptable alternate date, we may deny your application for amendment under the provisions of Title 10 of the *Code of Federal Regulations*, Section 2.108. If circumstances result in the need to revise the agreed upon response date, please contact me at (301) 415-8480 or via e-mail Andrew.Hon@nrc.gov.

Docket Nos. 50-259, 50-260, 50-296, 50-327, 50-328, 50-390, and 50-391

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Hearing Identifier: NRR_DMPS
Email Number: 209

Mail Envelope Properties (Andrew.Hon@nrc.gov20180223151900)

Subject: Request For Additional Information Related to TVA Fleet Topical Report TVA-NPG-AWA16 – EPIC: L-2016-TOP-0011)
Sent Date: 2/23/2018 3:19:44 PM
Received Date: 2/23/2018 3:19:00 PM
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Tracking Status: None

Post Office:

Files	**Size**	**Date & Time**
MESSAGE	2116	2/23/2018 3:19:00 PM
TVA ssPMP TR RAIs_02222018_final.docx		5815025

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information

Issue Date: 02/22/2018

Topical Report TVA-NPG-AWA16, “TVA Overall Basin Probable Maximum Precipitation and Local Intense Precipitation Analysis, Calculation CDQ0000002016000041”

Operating Company: Tennessee Valley Authority

Docket Nos. 50-259, 50-260, and 50-296, Browns Ferry Nuclear Plant, Units 1, 2, and 3
50-327 and 50-328, Sequoyah Nuclear Plant, Units 1 and 2
50-390 and 50-391, Watts Bar Nuclear Plant, Units 1 and 2

Regulatory Basis

10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, states, in part, that structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as floods without loss of capability to perform their safety functions. The design bases for these structures, systems, and components shall reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition, Section 2.4.3, “Probable Maximum Flood (PMF) On Streams and Rivers,” states that to meet the requirements of GDC 2 with regards to design bases for flooding in streams and rivers, the probable maximum precipitation (PMP) on the drainage area that contributes to runoff on the stream network adjacent to the plant site should be determined. Similarly, NUREG-0800 Section 2.4.2, “Floods,” states that estimates of potential local flooding on the site and drainage design should be based on estimates of local intense precipitation or local PMP.

RAI #1: Complete Storm Analysis Information for All Short List Storms

Technical Deficiency: Information in the Topical Report is incomplete; additional information is necessary for the staff to make its regulatory finding.

Request:

Provide the analysis information for all short list storms that were used for PMP calculation. The detailed storm analysis information should include:

- Storm calculation spreadsheet
- Depth-area-duration values and chart
- Storm cumulative mass curve chart
- Total storm isohyetal analysis map
- HYSPLIT moisture trajectory map
- In-place storm representative dew point (or sea surface temperature) analysis map

RAI #2: TVA Observed Hourly Dew Point Data Sheet for All Short List Storms

Technical Deficiency: Information in the Topical Report is incomplete; additional information is necessary for the staff to make its regulatory finding.

Request:

For each short list storm, provide an individual spreadsheet documenting the hourly dew point data that were used for storm representative dew point selection. If publicly-accessible dew point data were used (e.g., NCDC ISD), the unique station identifier (e.g., USAF, WBAN, and/or ICAO) and the starting/ending dew point date and hour (used for the calculation of average 6-, 12-, or 24-hour dew points) should be clearly specified. Provide detailed meteorological reasoning if the selection of storm representative dew point location deviated significantly from the HYSPLIT trajectories. If sea surface temperature is used as a surrogate of surface dew point observation, the sea surface temperature observation should be provided. Provide the relevant data or source information used to determine the storm representative dew point for short list storms for which hourly dew point data were unavailable or not used.

RAI #3: TVA Storm Adjustment Factor Feature Class Table for All Short List Storms

Technical Deficiency: Information in the Topical Report is incomplete; additional information is necessary for the staff to make its regulatory finding.

Request:

For each short list storm, provide the storm adjustment factor feature class table developed for the TVA PMP study (as documented in Figure 24 of Calculation No. CDQ0000002016000041). The data layers should be in a common GIS data format that can be processed by ESRI ArcGIS, and should cover all of the information shown in Figure 24 including STORM, LON, LAT, ZONE_, ELEV, IPMF, MTF, OTF, TAF, and TRANS.

RAI #4: TVA Dew Point Climatology Data and GIS Layers

Technical Deficiency: Information in the Topical Report is incomplete; additional information is necessary for the staff to make its regulatory finding.

Request:

Provide the digital dew point climatology GIS data layers used for PMP development. The digital dew point climatology GIS data layers should be provided for the monthly 6-, 12-, and 24-hour, 100-year recurrence interval dew point maps provided in Appendix C of Calculation No. CDQ0000002016000041. In addition, provide the corresponding monthly dew point climatology values at each gauge that was used to develop the maps provided in Appendix C of Calculation No. CDQ0000002016000041.

RAI #5: TVA Probable Maximum Precipitation Data and GIS Layers

Technical Deficiency: Information in the Topical Report is incomplete; additional information is necessary for the staff to make its regulatory finding.

Request:

Provide the final digital PMP GIS data layers (across all durations and areas) developed for the TVA Overall Basin Probable Maximum Precipitation and Local Intense Precipitation Analysis. The digital PMP GIS data layer should cover the full TVA Basin for which PMP values have been determined.

RAI #6: Reasonableness of OTF Values

Technical Deficiency: Staff's review of Orographic Transposition Factor (OTF) application examples demonstrates discrepancies between expected OTF values and OTF values used by the licensee for selected storms.

The OTF is applied after an observed precipitation event is 1) moisture maximized using the in-place maximization factor (IPMF) and 2) geographically transpositioned (on a Lat-Lon plane) using a moisture transposition factor (MTF). The MTF captures geographic differences in moisture availability through comparison of dew point climatology. While it captures spatial variation in moisture, the MTF may not adequately capture the effects of terrain, hence the need for a terrain adjustment (e.g., the OTF, Barrier Adjustment Factor, or Storm Separation Method).

Staff interprets from the licensee's descriptions in the Technical Report that the OTF is intended to capture the impact that terrain will have on rainfall depths when transpositioning a storm from the original location to a new location. Therefore, staff believes that the OTF should be independent of geographical moisture influence (which is captured through use of the MTF). Consequently, staff believes that the OTF should not be significant when moving storms between regions with similar orographic characteristics (i.e., such regions should have a calculated OTF close to 1.00).

To assess whether the OTF calculation process produces OTF values close to 1.00 in cases where the original and transpositioned storm paths have similar orographic characteristics, staff evaluated the OTF for a series of case studies using data supplied by the licensee for TVA short list storms. Table 1 includes a summary of the rationale for evaluating these case studies and the subsequent observations.

Table 1. OTF case studies evaluated by staff

Storm	Rationale	Observations
Warner, OK (Example 1)	The storm center location and TVA Zone 1 share similar orographic characteristics (e.g., both locations exhibit minimal barriers, are of similar elevation, and are located at a similar distance-to-coast).	Avg. Zone 1 OTF: 0.80
Fall River, KS (Example 2)	The storm center location and TVA Zone 1 share similar orographic characteristics (e.g., both locations exhibit minimal barriers, are of similar elevation, and are located at a similar distance-to-coast).	Avg. Zone 1 OTF: 0.75

Storm	Rationale	Observations
Smethport, PA (Example 3a)	The storm center location and TVA Zone 4 share similar orographic characteristics (e.g., both locations exhibit orographic influence and are a similar distance-to-coast). TVA Zone 4 has higher overall orographic influence than the storm center due to higher terrain elevation and complexity.	Avg. Zone 4 OTF*: 0.66
Smethport, PA (Example 3b)	The storm center location and TVA Zone 2 share similar orographic characteristics (e.g., both locations exhibit orographic influence, are of similar elevation, and are a similar distance-to-coast).	Avg. Zone 2 OTF*: 0.59

**Note: the OTF for the Smethport, PA storm was manually adjusted by the licensee to include rescaling to a maximum value of 1.00. An additional question related to the Smethport, PA storm is included in RAI #7.*

For each of the examples included in Table 1, staff believes that the orographic adjustments should be minimal and the OTF should be close to 1.00; instead, the licensee's analysis results in OTF values significantly less than 1.00 and large reductions in the adjusted rainfall depths.

Request:

Provide a justification for the departure of OTF from 1.00 when transpositioning storms across orographically similar zones (examples provided in Table 1), and discuss whether the reductions in OTF are reasonable. Provide a justification for applying the OTF to the transposition of all storms throughout the TVA Basin, given the example results provided in Table 1.

RAI #7: OTF Reduction for Smethport, PA and Simpson, KY

Technical Deficiency: OTF values for two local storms which control PMP estimates were manually rescaled to a maximum of 1.00 (i.e., all original OTF values were divided by the maximum calculated OTF, resulting in widespread reductions and a maximum value of 1.00). This rescaling greatly reduces the Local Storm PMP.

As described in Section 6.1.1.5 of the Topical Report, the OTF values for two local storms (Smethport, PA and Simpson, KY) were rescaled to a maximum of 1.00. Following discussions with the Review Board and the licensee, "*it was determined that the factors leading to extreme levels of moisture and instability combined with terrain influences*" which produced extreme rainfall at Smethport and Simpson "*were similar to what could occur over the eastern foothills and mountainous terrain in the TVA basin.*"

As a result, the licensee decided it was "*unreasonable to further adjust the events upward based on the OTF", and "the OTF factors for these events were normalized to a maximum of 1.00.*"

Staff's review of the data provided by the licensee suggests that the maximum original (i.e., unadjusted) OTF values for the Smethport and Simpson events are 2.15 and 2.09, respectively. In comparison, the average Zone 4 original OTF is 1.39 for Smethport and 1.35 for Simpson. After rescaling the original OTF, the average Zone 4 OTF is reduced to 0.66 for Smethport and 0.65 for Simpson – approximately a 50% reduction. These modifications to the OTF result in a significant reduction in the adjusted DAD values for these storms. In addition, since these storms control PMP estimates, the resultant PMP values are significantly reduced.

Figure 1 provides a comparison of TVA's rescaled OTF values and the original (i.e., unadjusted) OTF values for the Smethport storm. Similarly, Figure 2 provides a comparison of TVA's rescaled OTF values and the original OTF values for the Simpson storm.

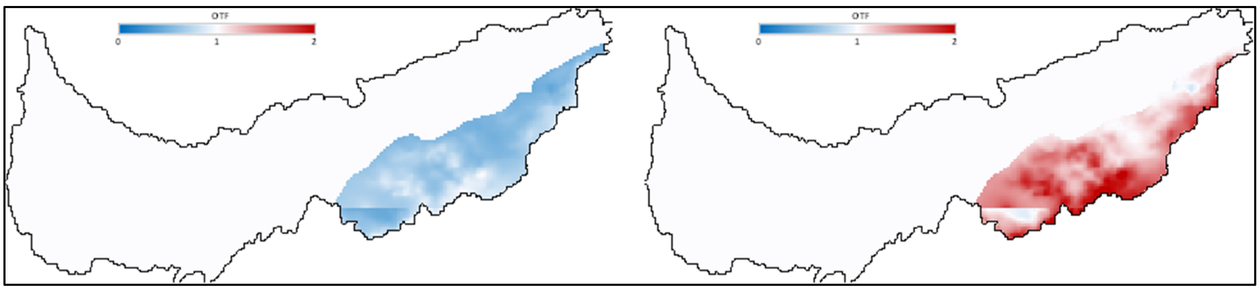

Figure 1. Comparison of Smethport OTF using TVA's rescaling approach (left) and original approach (right) for TRANS=1 grids (i.e, transpositionable zone)

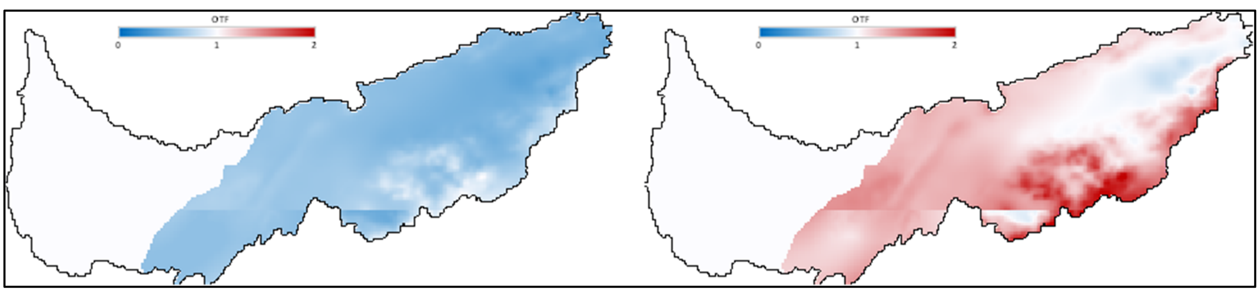

Figure 2. Comparison of Simpson OTF using TVA's rescaling approach (left) and original approach (right) for TRANS=1 grids (i.e., transpositionable zone)

<u>Request</u>:

Provide justification for adjusting the Smethport, PA and Simpson, KY OTF values to a maximum of 1.00, and for using significantly reduced OTF values throughout the transpositionable zone.

RAI #8: OTF Calculation using NWS Atlas 14

Technical Deficiency: The OTF is intended to accurately capture localized spatial variation in orography. However, the NWS Atlas 14 data used to calculate OTF are inherently regionalized, which poses a concern whether the original intention of developing an OTF was fully captured.

Section 4.5 of the Topical Report states that, in comparison to the topographic adjustments used in the TVA HMR, "*the OTF, along with hourly gridded rainfall data from SPAS analyses, is able to evaluate and quantify…variations over a much more refined scale both spatially and temporally.*" Localized refinement is achieved through use of Atlas 14 precipitation frequency (PF) data, which were developed using L-moment regional frequency analysis.

However, during the development of the PF data, Atlas 14 identified homogeneity zones (i.e., regional groups) for data pooling. Based on Section 4.2.2 of Atlas 14, Volume 2, the regional application of L-moments derives "*the shape parameters from all stations in a homogeneous region rather than from each station individually.*" From Section 4.4 of Atlas 14, Volume 2: "*effort was made during the subdivision process to mitigate discrepancies that could be caused by (1) sampling error due to small sample sizes, or (2) regionalization that does not reflect a local situation."* Figure 3 shows the 24-h through 60-day regional groupings identified in Atlas 14, Volume 2.

Generally speaking, all precipitation data within a homogeneity zone were first locally normalized, and then pooled together for probabilistic density function fitting. Therefore, it is important to understand that the NWS Atlas 14 values do not only capture the local precipitation features. It is jointly influenced by the local mean (of annual maximum series at each gauge), regional probability density distribution, and final interpolation by PRISM.

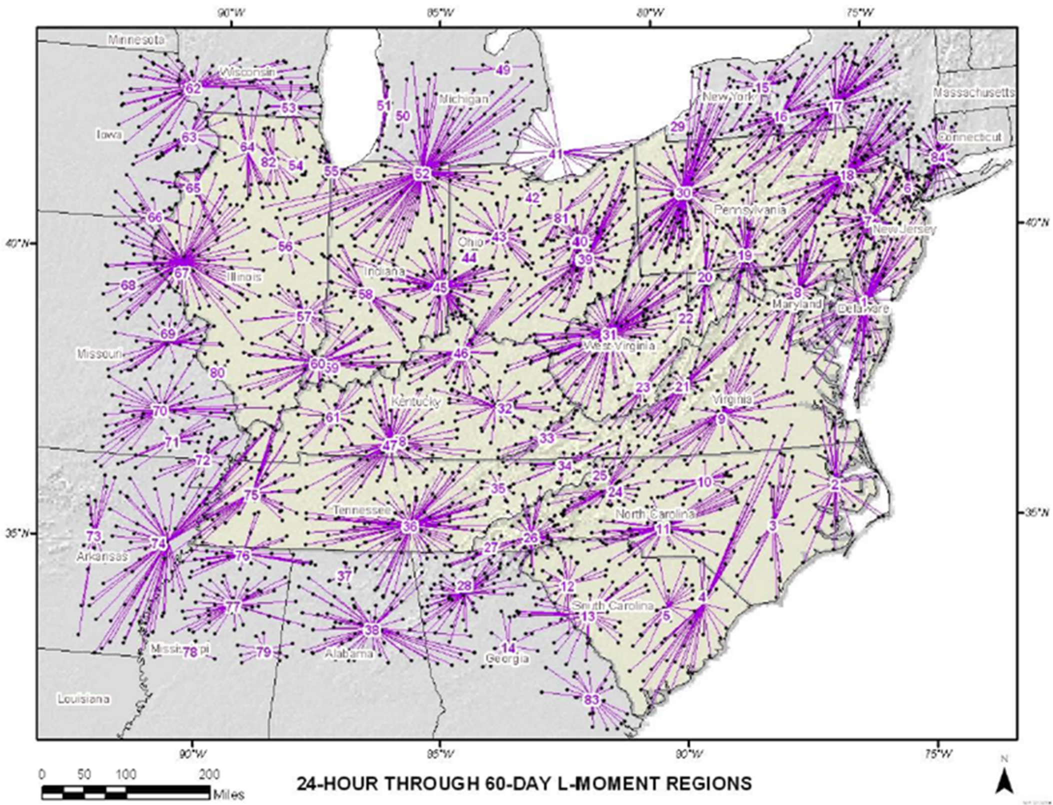

Figure 3. Regional groupings for daily data used to prepare NOAA Atlas 14 Volume 2

Section 3.1.4 of the WMO-No. 1045 Manual on Estimation of Probable Maximum Precipitation states: "*Precipitation-frequency values represent an equal probability level of rainfall. The values for the rarer recurrence intervals, for example the 50-year or 100-year recurrence interval, are associated with severe weather systems. Therefore, they are better indicators of the geographic variation of PMP than mean seasonal or annual precipitation maps*." Thus, staff believes that the specific features of Atlas 14 are important artifacts influencing the OTF and are worth considering. Given that the Atlas 14 method scales station PF data by the mean of the annual maximum series and uses PRISM for basemap smoothing, the final rainfall estimates would induce spatial smoothing based on averages rather than rarer recurrence intervals associated with severe weather systems.

OTF Best Fit Linear Trend Method

The licensee used a 6-h precipitation frequency climatology to compute local storm OTF and a 24-h precipitation frequency climatology to compute general and tropical storm OTF. For each short list storm, the OTF calculation approach used for the TVA Topical Report used linear regression to estimate the ratio between precipitation frequency depths for the recurrence interval associated with the storm's maximum point rainfall at either 6-h or 24-h.

OTF 100-year Ratio Method

Other AWA PMP studies have calculated the OTF using the 100-y precipitation frequency ratio rather than the linear regression approach. Since longer recurrence interval estimates may be

more representative of PMP-type storms but may lack reliable estimates, AWA has used the 100-year precipitation frequency ratio to compute OTF in other studies (e.g., the PMP study for Texas). NRC staff has also conducted limited sensitivity analysis and finds that the 100-year ratio is more stable than the regression approach. For example, precipitation frequency data provide higher precipitation depths at BFN than at WBN and SQN; however, the linear regression method can result in lower OTF values at BFN than at WBN and SQN.

Request:

a) Considering Atlas 14's regional features, provide a justification regarding whether the Atlas 14 PF data represent reasonable spatial variation representative of orographic PMP effects or PMP in general.

b) Provide a justification for using the best fit linear trend method in lieu of the 100-y ratio method for determining LIP and basin-wide PMP values.

RAI #9: OTF Calculation Issues

Technical Deficiency: Potential issues with the OTF calculations in certain regions were identified by staff and require clarification.

Staff's review of the Total Adjustment Factor (TAF) Excel files provided in response to RAI #1 revealed some anomalies in how the OTF was calculated. For a select set of grid cells, the OTF was calculated using an absolute cell value in the Excel spreadsheet rather than using the OTF regression-based formula used in other cells. Visualization of the areas using the absolute cell reference value is provided in Figure 4 (for general and tropical storms) and Figure 5 (for local storms).

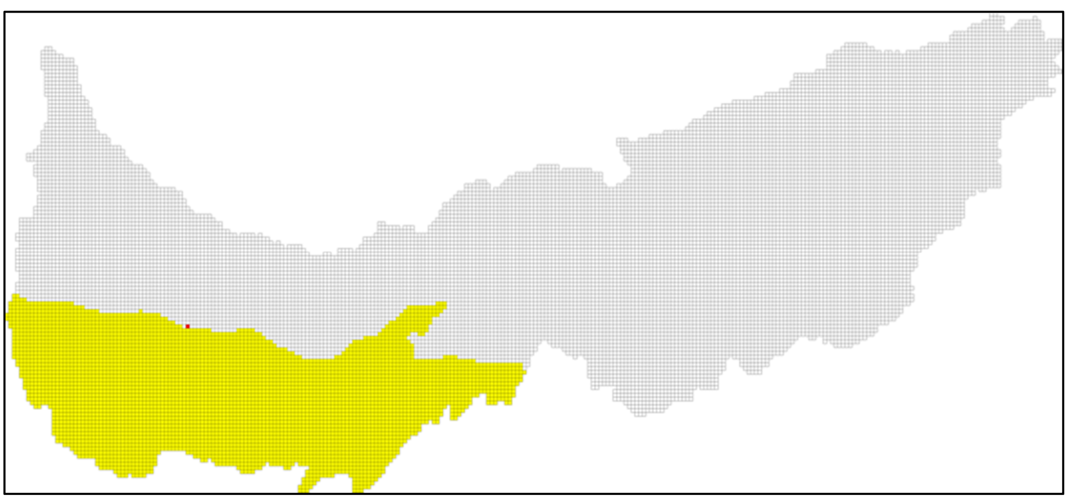

Figure 4: Grid cells for which OTF calculation used an absolute cell reference value for General & Tropical storms (the red grid cell indicates the location of the grid cell used for assigning an OTF value for all yellow colored grid cells)

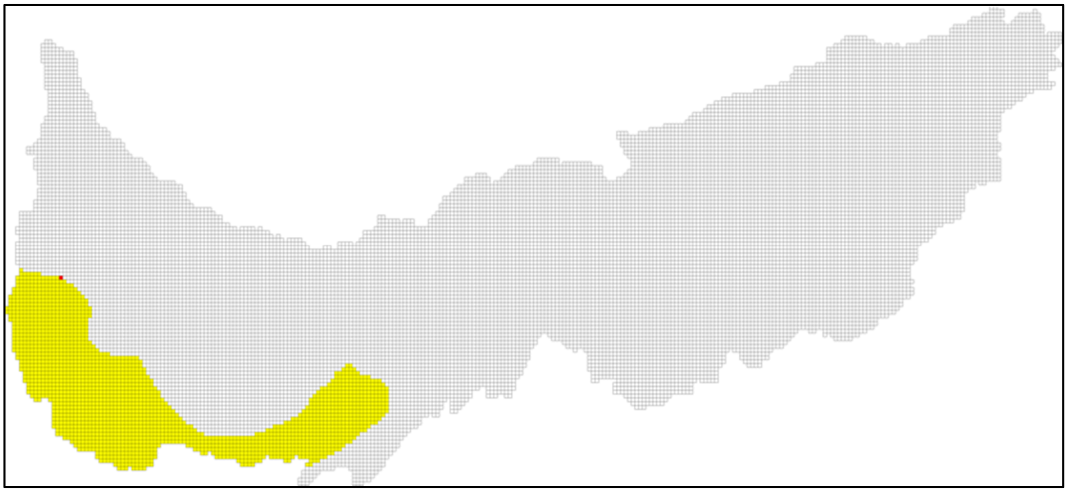

Figure 5: Grid cells (in yellow) for which OTF calculation used an absolute cell reference value for Local storms (the red grid cell indicates the location of the grid cell used for assigning an OTF value for all yellow colored grid cells)

In addition, staff compared the Excel-based OTF values from the RAI #1 response and the GIS-based OTF values from RAI #3. The comparison revealed a discrepancy in calculated OTF values for local storms which was confined to a region of the southern Appalachians. Visualization of the areas affected by this discrepancy is provided in Figure 6.

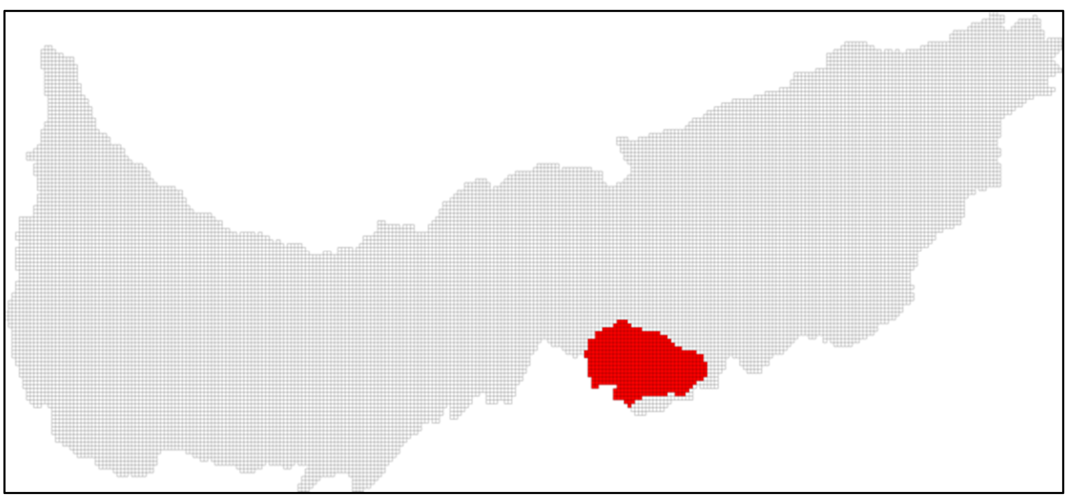

Figure 6: Grid cells (in red) for which OTF differs between RAI #1 & RAI #3 for Local storms

Request:

a) Provide an explanation for why the OTF was calculated using an absolute cell reference value for the grid cells identified in Figure 4 and Figure 5 rather than using the OTF regression-based formula used for the other cells.

b) Provide an explanation for why the OTF values provided in RAI #1 and RAI #3 differ, as illustrated in Figure 6.

RAI #10: Custom Transposition Limits

Technical Deficiency: Based on staff's review of information provided in response to RAI #1, the majority of storms included transposition limits that conform to the TVA Zone boundaries. However, at least four storms appeared to contain custom transposition limits, as listed in Table 2 that don't conform to the TVA Zone boundaries.

Table 2. Summary of storms subjected to custom transposition limits

Storm	SPAS Num	Storm Type	Transposition Limits
Elba, AL	1305	General	South of 35 deg N (exclusive of Zone 4)
Americus, GA	1317	Tropical	Based on TSR L-Cv 0.24 contour*
Larto Lake, LA	1182	Tropical	Based on TSR L-Cv 0.24 contour*
Big Rapids, MI	1206	General	North of 36.5 deg N (exclusive of Zone 4)

**Note: information from TAF Excel file, OTF sheet*

Request:

a) Provide a justification as to why each of the storms listed in Table 2 was subjected to custom transposition limits.

b) Provide a justification for the use of custom transposition limits for the Americus, GA and Larto Lake, LA storm using TSR L-Cv 0.24 contour. Provide the physical basis used to justify this custom approach.

RAI #11: Storm Representative Dew Point Selection: Timeframe and Location

Technical Deficiency: Staff's review of the licensee's storm representative dew point data for short list storms resulted in the identification of several storms for which questionable timeframe and/or location data may have been used when selecting the storm representative dew point. This issue can significantly impact PMP values for controlling storms

As a part of its assessment, staff reviewed the rainfall mass curves, HYSPLIT trajectories, and storm representative dew point information that the licensee provided in response to RAI #1 and RAI #2. Staff also independently evaluated this information to assess the reasonableness of the data application.

Staff's review of the above information revealed that the licensee's storm representative dew point selection used dew point data which were observed at locations far upwind of the storm center and during timeframes in which significant rainfall had already occurred. Conducting the

analysis in this way could inadequately represent the storm characteristics and (in these cases) result in PMP underestimation since the relatively higher moisture observed could not induced the observed rainfall.

Staff believes the storm representative dew point methodology regarding HYSPLIT trajectories and/or dew point timeframes may be flawed for the following storms. A comparison of the TVA and NRC storm representative dew point temperatures these storms is provided in Table 3.

1. General Storm, SPAS 1206 (Big Rapids, MI) – see Figure 7

    a. The licensee's dew point temperature observations correspond to a period after significant rainfall had already occurred. The representative dew point location is approximately 230 miles SW of the storm center location.

2. General Storm, SPAS 1208 (Warner Park, TN) – see Figure 8

    a. The licensee's dew point temperature observations correspond to a period when the most intense rainfall occurred. The representative dew point location is approximately 360 miles SSW of the storm center location.

3. Tropical Storm, SPAS 1276 (Wellsville, NY) – see Figure 9

    a. The licensee's dew point temperature observations correspond to a period when the most intense rainfall occurred. The representative dew point location is approximately 385 miles SSW of the storm center location.

    b. By adjusting the HYSPLIT backward trajectory timing to more closely align with the onset of rainfall, staff identified a moisture inflow direction of SE rather than SSW.

4. Tropical Storm, SPAS 1317 (Americus, GA) – see Figure 10

    a. By adjusting the HYSPLIT backward trajectory timing to more closely align with the onset of rainfall, staff identified a moisture inflow direction of SE-to-S rather than WSW.

5. Additional storms which exhibit timeframe issues but do not control PMP

    a. General Storm, SPAS 1218 (Douglasville, GA & LaFayette, GA) - Figure 11

    b. Local Storm, SPAS 1226 (College Hill, OH) - Figure 12

    c. Local Storm, SPAS 1209 (Wooster, OH) - Figure 13

    d. Tropical Storm, SPAS 1182 (Larto Lake, LA) - Figure 14

Table 3. Comparison of TVA vs NRC storm representative dew point temperature for storms with potential HYSPLIT or timing issues

Num	Storm Name	SPAS Num	Storm Type	Storm Rep. Td (deg F)		Difference (TVA-NRC)
				TVA T_d	NRC T_d	
1	Big Rapids, MI	SPAS 1206	General	70.5	68.5	+2
2	Warner Park, TN	SPAS 1208	General	75	74	+1
3	Wellsville, NY	SPAS 1276	Tropical	72.5	70.5	+2
4	Americus, GA	SPAS 1317	Tropical	76	74.5	+1.5
5a	Douglasville, GA	SPAS 1218_1	General	76	75	+1
5a	LaFayette, GA	SPAS 1218_2	General	76	75	+1
5b	College Hill, OH	SPAS 1226	Local	68.5	66.5	+2
5c	Wooster, OH	SPAS 1209	Local	76	72	+4
5d	Larto Lake, LA	SPAS 1182	Tropical	76	73	+3

Request: Provide justification for the selection of storm representative dew point values for the above storms with respect to timeframe and location selected, especially considering the timeframe of when rainfall occurs at the storm center. If corrections are warranted, provide an updated analysis as it may affect TVA's 3 NPP sites.

TVA Mass Curve | TVA Dew Point Selection

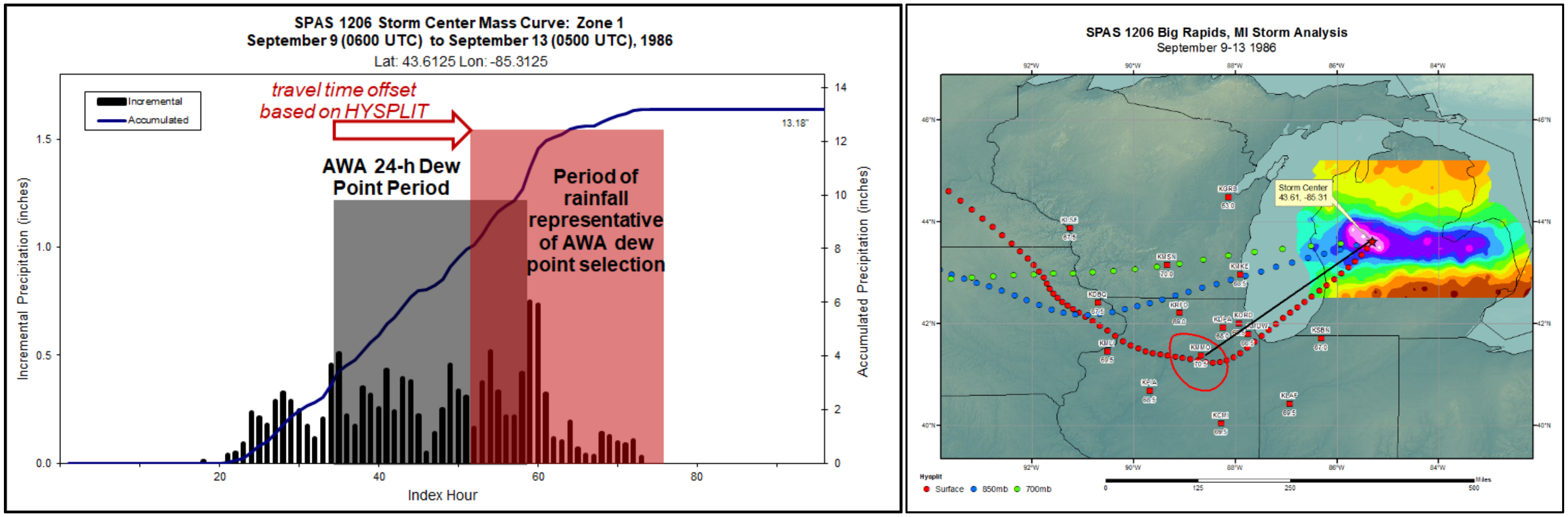

Figure 7. General Storm, SPAS 1206 (Big Rapids, MI) rainfall mass curve (left) and dew point analysis (right)

TVA Mass Curve | TVA Dew Point Selection

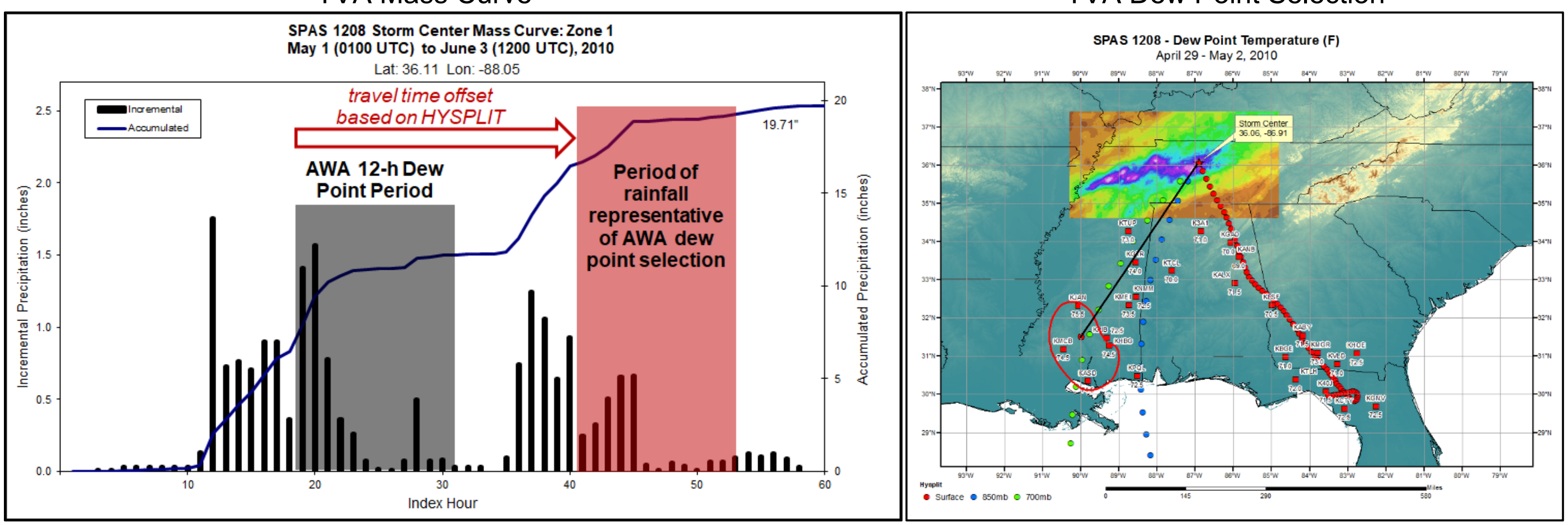

Figure 8. General Storm, SPAS 1208 (Warner Park, TN) rainfall mass curve (left) and dew point analysis (right)

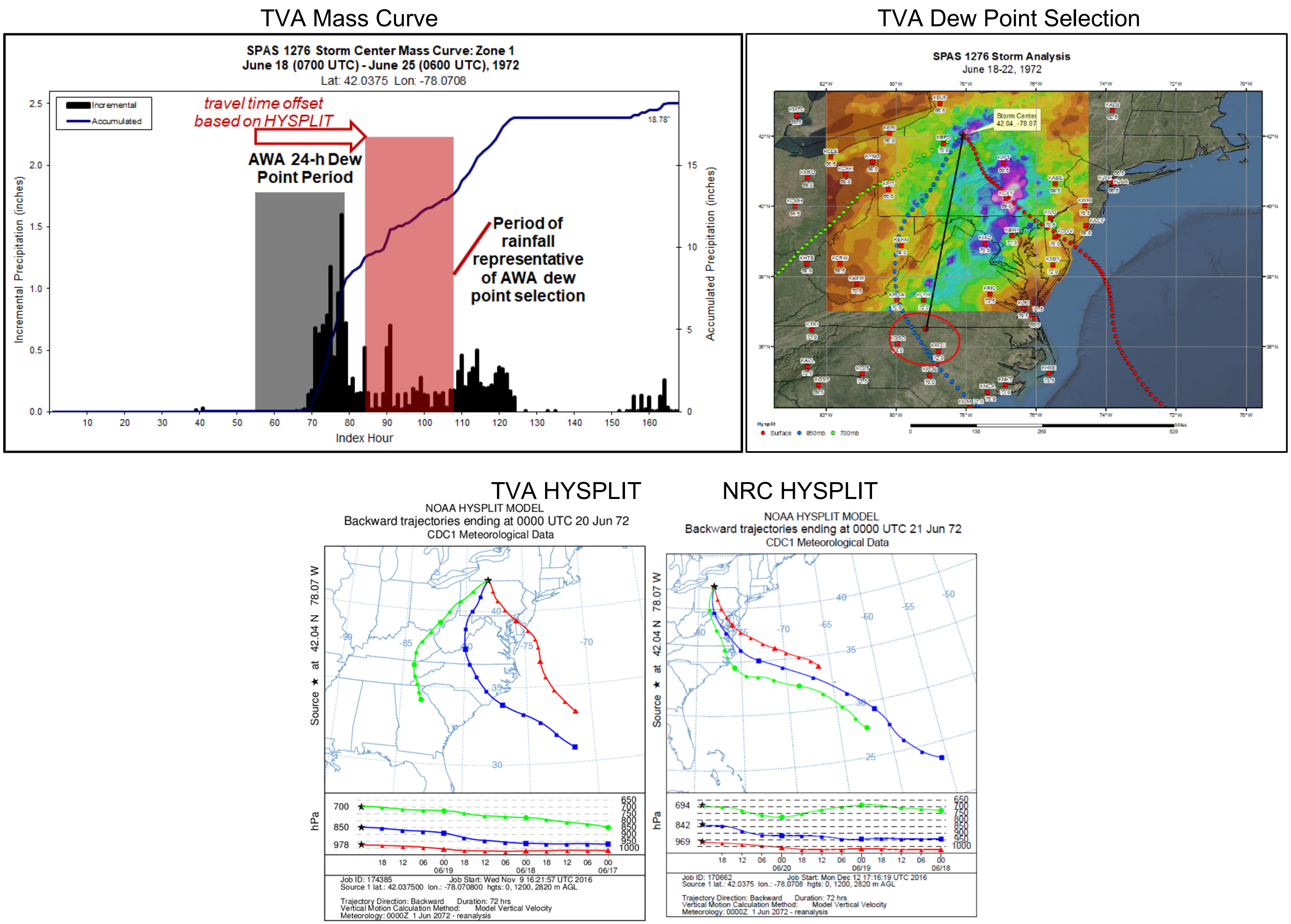

Figure 9. Tropical Storm, SPAS 1276 (Wellsville, NY) rainfall mass curve, dew point analysis, TVA HYSPLIT, and NRC HYSPLIT (from top-left to bottom-right)

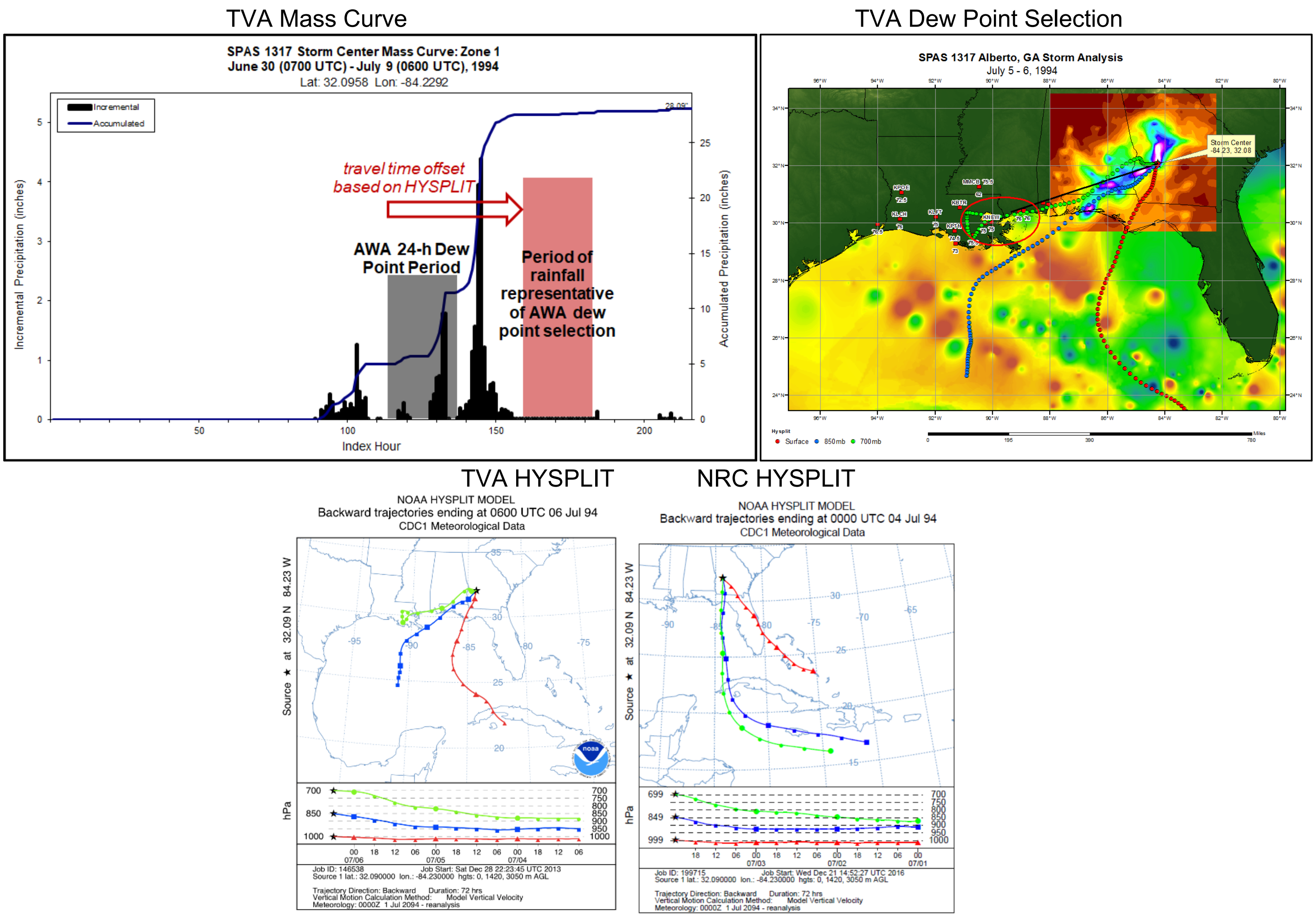

Figure 10. Tropical Storm, SPAS 1317 (Americus, GA) backwards HYSPLIT trajectory from TVA (left) and NRC (right)

TVA Mass Curve | TVA Dew Point Selection

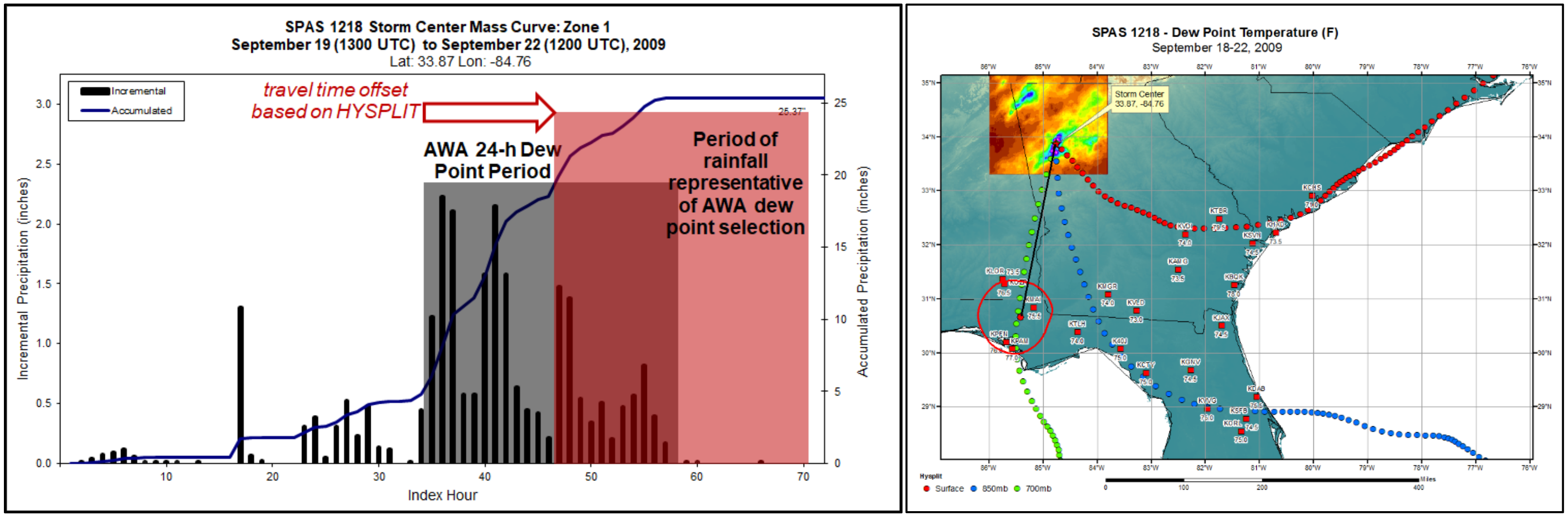

Figure 11. General Storm, SPAS 1218 (Douglasville, GA *[shown]* & LaFayette, GA) rainfall mass curve (left) and dew point analysis (right)

TVA Mass Curve | TVA Dew Point Selection

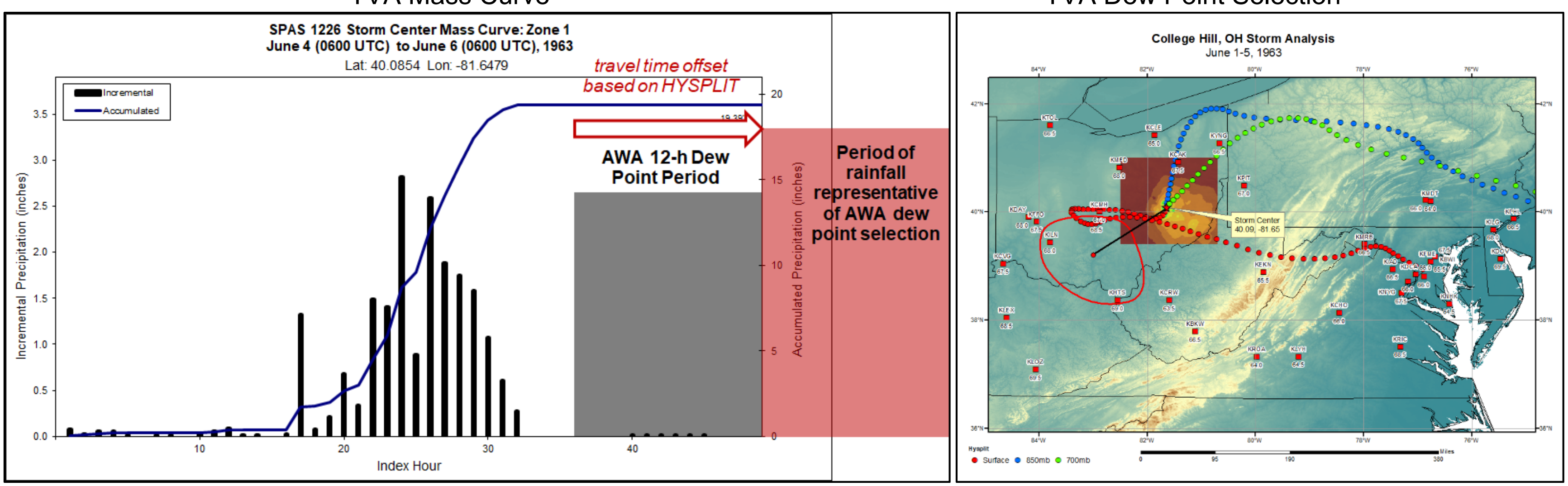

Figure 12. Local Storm, SPAS 1226 (College Hill, OH) rainfall mass curve (left) and dew point analysis (right)

TVA Mass Curve — TVA Dew Point Selection

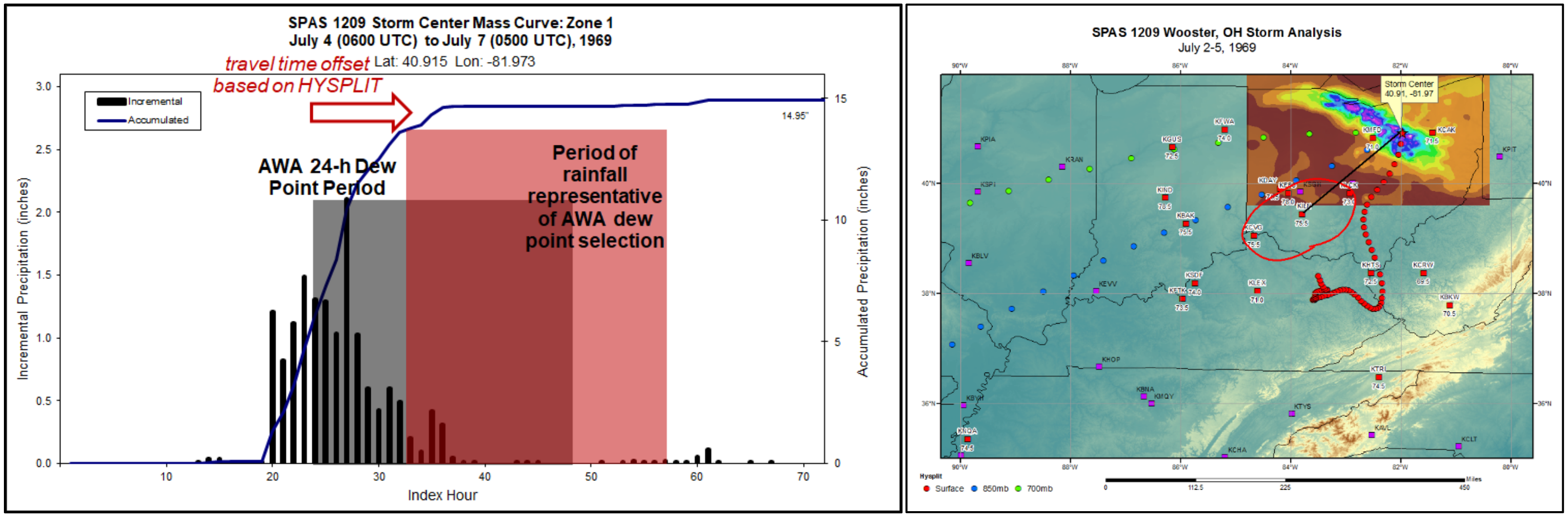

Figure 13. Local Storm, SPAS 1209 (Wooster, OH) rainfall mass curve (left) and dew point analysis (right)

TVA Mass Curve — TVA Dew Point Selection

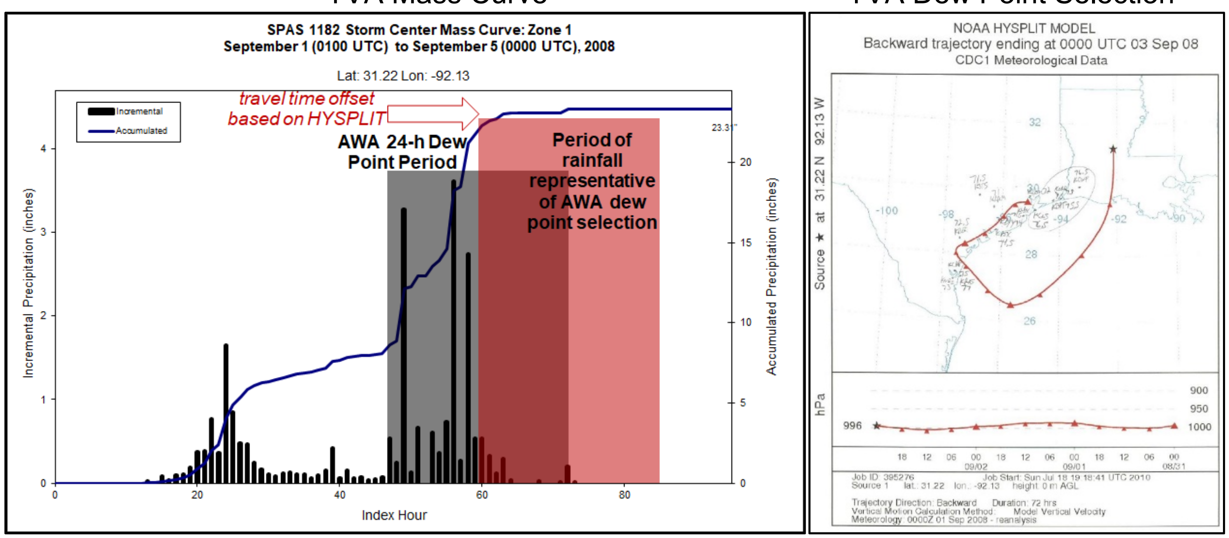

Figure 14. Tropical Storm, SPAS 1182 (Larto Lake, LA) rainfall mass curve (left) and dew point analysis (right)

RAI #12: Staff Independent Analysis of Dew Point Climatology

Technical Deficiency: Staff's independent evaluation of dew point climatology reveals that the licensee's values may be non-conservative due to potential data source and processing issues which may impact the estimated PMP values.

As a part of its assessment, staff reviewed the dew point climatology data provided by the licensee in response to RAI #1 and RAI #4; staff also independently evaluated these data to assess the reasonableness of the climatology data used.

Staff has concerns with the dew point climatology data source and processing used by TVA. While TVA used NOAA's TDL data set, NRC staff used NOAA's TD3505 data set. Both TD3505 and TDL data sets are officially released by NOAA, but the TDL data set used by TVA is basically a collection of instantaneous weather station observations whereas the TD3505 used by NRC is subjected to additional QC and processing by NOAA. Although both data sets are largely similar, there are some differences in the annual maximum series (AMS) caused by missing/erroneous values originally included in the TDL data set. This leads to different AMS and 100 y dew point estimates because of the existence and treatment of missing observations. Such differences result in systematic biases which could affect moisture maximization factors and transposition factors for all storms.

To assess the impacts of using different data (and some minor differences in processing), NRC staff conducted independent evaluation of dew point climatology for all short list storms, and it yielded a number of differences from TVA's evaluation. In general, NRC's independent evaluation resulted in higher dew point climatology values, with variation both temporally and spatially. For all else being equal, an increase in dew point climatology values will result in higher PMP estimates since historical storms would be subject to higher levels of moisture maximization.

Figure 15 shows the difference in the NRC and TVA dew point climatology values for each comparable station for all short list storms. The stations selected represent the stations which would have most influenced the dew point climatology at the transpositioned moisture source location and for which climatology values were available from both the TVA and NRC data sets. Positive values indicate that NRC's evaluation resulted in higher dew point climatology values than TVA, while negative values indicate that NRC's evaluation resulted in lower dew point climatology values than TVA. On average, the difference for General, Local, and Tropical storms is +0.69 F, +0.61 F, and +0.52 F, respectively, with an overall average station difference of +0.65 F. Individual station differences range from -1.44 F to +3.67 F.

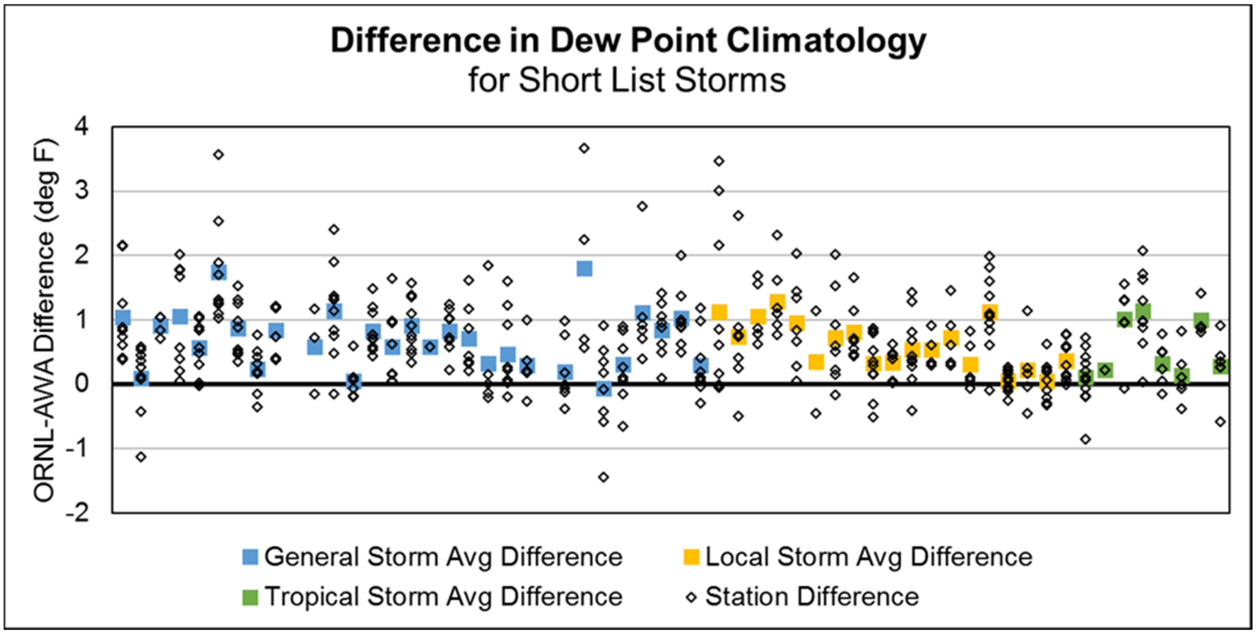

Figure 15. Difference in dew point climatology values between NRC (ORNL) evaluation and TVA(AWA) evaluation for all short list storms. Each column of data points corresponds to one short list storm. Black-outlined diamonds represent station data (one diamond corresponds to the NRC-TVA difference for a single station; for most storms, multiple stations were available for comparison) which influenced the dew point climatology at the transpositioned moisture source location and for which a direct comparison could be made. Colored squared represent the average difference in station data for each storm.

The deviations in climatology values resulting from the two analyses indicates a systematic bias in the overall values, with NRC's values typically 0.5 to 1.0 degree F higher than TVA's values.

Request:

Given the significant impacts noted above please update the dew point climatology using TD3505 dew point data and revising both the LIP and basin-wide PMP values accordingly or provide a justification for not updating it.

RAI #13: Warner Park, TN Dew Point Duration Clarification

Technical Deficiency: Staff's review of the licensee's documentation and files related to the Warner Park, TN (SPAS 1208) storm representative dew point and dew point climatology data appears to indicate inconsistent use of dew point duration.

As a part of its assessment, staff reviewed the text and digital information related to the Warner Park storm representative dew point and dew point climatology provided by the licensee. Figure 404 in the Topical Report shows that a 12-h duration was used to analyze the Warner Park storm representative dew point; however, upon further review, staff believe that a 24-h duration was used.

Figure 415 in the Topical Report shows maximum average dew point data for several stations. Comparison with the “surface_summary” worksheet in the “SPAS_1208_Obs_data.xlsx” file reveals that the data plotted in Figure 415 correspond to the 24-h maximum average dew point. Also, staff confirmed that the licensee used a 12-h duration for the Warner Park dew point climatology. Therefore, it appears that the dew point duration was used inconsistently.

Staff understand that if this is the case, then the licensee’s application could be slightly overly conservative; however, since it appears that a 12-h duration was intended, only the storm representative dew point would change. The 24-h value used by the licensee is 74.8 F based on the average of 4 stations (KHBG, KASD, KJAN, and KMCB); this value was rounded to 75.0 F by the licensee. The 12-h value computed by the licensee is 75.1 F based on the average of the same 4 stations and would be rounded to 75.0 F. Therefore, it appears that changing the storm representative dew point would not change the results of the Warner Park analysis.

Request: Provide confirmation of whether this dew point duration discrepancy exists, what the intended dew point duration is, and what (if any) changes are needed.

RAI #14: Scope of NRC’s Review

Regulatory Deficiency: This topical report describes the work performed to calculate the Probable Maximum Precipitation for any location within the overall TVA basin and Local Intense Precipitation (LIP) at the BFN, SQN, and WBN sites. The Summary and Conclusions section of the Topical Report states that the precipitation values in the report replace those in HMRs 41, 45, 47, and 56 (which provide PMP estimates for the Tennessee River Basin, including LIP), as well as HMRs 51 and 52 (which provide PMP estimates for the eastern half of the continental US). NRC’s regulatory authority limits its approval of the precipitation values contained in the Topical Report to only those values that could potentially result in flooding at TVA’s nuclear plant sites.

Request: Please clarify that the scope of the NRC’s requested review is concerned with potential SSPMP impacts at the 3 TVA nuclear power plant sites and does not necessarily reflect positions with respect to the entire Tennessee River watershed except as it impacts river flooding effects and local rainfall effects at the sites.