

**SUBJECT: Temporary Sediment Control Structures**

1. Purpose: Construction and certification of temporary sediment control structures
2. Definitions: See Below
3. Legal Authority: 38-2-5.4(a)
4. Policy/Procedures: The West Virginia Surface Mining Reclamation Regulations at 38-2-5.4(a) require that sediment control structures be constructed in appropriate locations for the purposes of controlling sedimentation. Furthermore, all runoff from the disturbed area shall pass through a sedimentation control system. The Regulations at 38-2-5.4 (d) (1) require that, prior to any surface mining activities in the component drainage area of a permit controlled by a sediment control structure, that specific structure shall be certified as to construction in accordance with the plans, designs, and specifications set forth in the preplan, or in accordance with as-built plans.

Therefore, in order to comply with these requirements, each application for a new permit must include plans which show that sediment control structures can be constructed and certified prior to any surface mining activities within the area to be controlled by each structure. It is realized, however, that some structures cannot be constructed until a certain amount of mining has occurred, particularly in steep slope areas. This situation would require that a "temporary" sedimentation control system be designed, constructed, and certified in accordance with the preplan and Regulations. These "temporary" structures would then provide the required sediment control for the area being disturbed, until such time that the "permanent" sedimentation control system could be constructed and certified.

It is important to remember that all new permit applications must include specifications for the

design, construction, maintenance, location, and certification of all sediment control structures. Please ensure that you continue to require this information in the preplan.

Furthermore, for existing permits that do not contain plans which adequately comply with these requirements, an application for permit revision should be required at the next mid-term review, permit renewal, or if violations of associated performance standards arise.

# GROUNDWATER MONITORING REPORT

|  |                   |
|--|-------------------|
| <b>Company Name</b>                          |                   |
| <b>Monitoring Frequency</b>                  | <b>Permit No.</b> |
| <b>Reporting period:</b> <b>quarter, 199</b> | <b>NPDES No.</b>  |

| PARAMETER                                 | POINT DATE | POINT DATE | POINT DATE |
|---|------------|------------|------------|
| <b>pH</b>                                 |            |            |            |
| <b>Acidity</b>                            |            |            |            |
| <b>Alkalinity</b>                         |            |            |            |
| <b>Specific Conductance or TDS</b>        |            |            |            |
| <b>Total Iron</b>                         |            |            |            |
| <b>Total Manganese</b>                    |            |            |            |
| <b>Standing Water Level (well)</b>        |            |            |            |
| <b>Flow (spring)</b>                      |            |            |            |
| <b>Flow (other)</b>                       |            |            |            |
| <i>(List Additional Parameters Below)</i> |            |            |            |
|   |            |            |            |
|   |            |            |            |
|   |            |            |            |

**SUBJECT: Elimination of Principal Spillway for Sediment  
Control Structures**

1. **Purpose:** To clarify the requirements emergency spillway design and construction
2. **Definitions:**
3. **Legal Authority/Reference:** 38-2-5.4(c)(1)
4. **Policy/Procedure:** In accordance with the regulations Title 38, CSR 2, Section 5.4 (c)(1), the principal spillway requirements may be waived by the Director if the emergency spillway is designed at a minimum to safely pass the peak rate of discharge of a 25 year, 24-hour frequency storm in an open channel constructed of non-erodible material and capable of maintaining sustained flows.

**SUBJECT: Drainage System Certifications**

1. **Purpose:** To define method of Drainage system certification submission, and/or requirements for as-built plans or modifications.
2. **Definitions:** Minor design change - a change from the pre-plan, such as, but not limited to a minor change in configuration, minor change in location and/or minor change in spillway configuration which is at least equal to or better than the original design.

Major design change - a change in location which results in a larger drainage area, a change in the type of structure and/or a change in spillway design such as construction of a rock spillway instead of a pipe.

3. **Legal Authority/Reference:** 22-3-13(b) (10(c) and  
38-2-5.4(d)
4. **Policy/Procedure:**
  - A. All drainage systems shall be certified on an MR-13 in accordance with Section 5.4(d) of the Rules and Regulations. Disturbance within any component drainage area may not begin until certification in accordance with 5.4(d) is submitted.
  - B. If the structure meets the design requirements, the inspector shall accept the MR-13 and distribute the forms to the appropriate permit files.
  - C. For structures with minor design changes, the operator shall submit as-built plans with the MR-13 in accordance with 5.4(b) of the Rules and Regulations.
  - D. For structures with major design changes, a permit revision in accordance with Rules and Regulations 3.28(c) shall be submitted and approved prior to drainage system certification.

- E. If an MR-13 without as-built plans is received and an on-site inspection reveals a minor or major design change exists, then the inspector shall not accept the MR-13. A simple statement by the inspector shall be attached to each MR-13 stating the reasons for the non-acceptance. The MR-13 shall be distributed to appropriate permit files with the statement attached.
  
- F. If a certification is not accepted, no additional disturbance or mining activity may take place in the component drainage area until an appropriate certification is received.
  
- G. Any certification or as-built drawings believed by the inspector to be factually or materially inaccurate shall not be accepted and shall be returned to the certifying professional along with a simple statement by the inspector identifying the questioned (item(s)). The PE or PS shall provide appropriate documentation that the certification or as-built documents are accurate, or shall revise and resubmit the certification accordingly. The drainage system will not be considered to be certified until any issues of accuracy, raised in good faith by the inspector, are resolved.

**SUBJECT:** Inspection and certified report requirements  
for all water retention structures

1. **Purpose:** To clarify the frequency of examination and reporting requirements for certification of impoundments

2. **Definitions:**

A. INSPECTION REPORT - (Due Annually) must address at a minimum:  
(a) has been (is being) constructed and maintained as designed and in accordance with the approved preplan. (b) report shall include discussion of any appearances of instability, structural weakness or other hazardous conditions. (c) depth and elevation of any impounded waters. (d) existing storage capacity. (e) any existing or required monitoring procedures and instrumentation and any other aspects of the structure affecting stability.

B. EXAMINATION REPORT - (Due Quarterly) must address any appearance (Or lack of) structural weakness and othe hazardous conditions. (i.e., slumps, scarps, cracks, bulges, piping, seeps, etc...).

C. STRUCTURES - Sediment Control Structures and Water Retention Structures.

D. CERTIFICATION - must be submitted on an MR-13 and must affirm that construction was done in accordance with the approved criteria or as otherwise noted in the certification statement.

3. **Legal Authority/Reference:** 38-2-5.4(d) & (e)  
38-2-2.66

4. **Policy/Procedures:** The chart on next page summarizes and clarifies the reporting requirements for each type of inspection or examination.

**SUBJECT: Certification of "In Pit" Sediment Control**

1. **Purpose:** Establish acceptance procedures for additional sediment control certifications
2. **Definitions:**
3. **Legal Authority/Reference:** CSR 38-2-5.4
4. **Policy/Procedures:** For operations utilizing "in pit" temporary sediment control, the following certification requirements will apply.

Each quarter when a certification (Form MR-13) will be submitted for "in pit" sediment control with the statement:

I hereby certify that during the \_\_\_\_\_ quarter of \_\_\_\_\_ (year) there has been and is currently 0.125 AC-FT of storage volume available for each acre disturbed in the watershed. A map or other description of the area being certified should be included.

This type of certification for "in pit" drainage control will comply with the requirements of 38-2-5.4(d)(i) for permits that allow temporary "in-pit" sediment control. Once "permanent" sediment control structures are constructed, they should also be certified as required by 38-2-5.4(d).

**SUBJECT: Removal and/or Reclamation of Sediment Ditches**

1. Purpose: Establish Procedure for abandonment of sediment ditches
2. Definitions: N/A
3. Legal Authority: 38-2-3.6(b) & (h)  
38-2-5.4(h)
4. Policy/Procedures: Abandonment of sediment ditches shall be in accordance with the approved reclamation plan as contained in the permit. In the event that abandonment of sediment ditches has not been specifically addressed in the reclamation plan, refer to the final regrade cross sections to determine if the sediment ditch was proposed to be left in place. If the ditches are shown on the regrade cross sections, then the operator has the option of either regrading or breaching the sediment ditch so that it no longer impounds water. If the ditch is to be breached, the inspector shall work with the operator to choose appropriate places to breach the ditch. A permit revision will not be required to show the actual locations of the breaches of the sediment ditch.

If there is no abandonment plan in the permit and the regrade cross sections do not show a ditch being left, then the operator must regrade and revegetate the sediment ditches in accordance with 38-2-5.14(h) (1).

**SUBJECT: Water Retention or other structure(s)**

1. Purpose: Procedure for documentation of water or other structure failure
2. Definitions: N/A
3. Legal Authority: 22-3-13(b) (10)  
38-2-5.4, 38-2-20
4. Policy/Procedures:

The attached form is to be used when investigating reported failures of water retention or other structures.

This format will standardize documentation of this type of events and will serve as a guide for items to look for and findings made.

Completed forms shall be distributed to permitting, regional file, and the appropriate I & E Supervisor.

**INFORMATION ABOUT NOTIFICATION**

When Notified: \_\_\_\_\_ By \_\_\_\_\_

Whom: \_\_\_\_\_

People T

When Notified: \_\_\_\_\_ By \_\_\_\_\_

Whom: \_\_\_\_\_

People T

**INFORMATION TO BE GATHERED ON SITE AT TIME OF INSPECTION OF FAILURE**

Date Arrived on Site: \_\_\_\_\_ Time Arrived on site: \_\_\_\_\_

Others On Site: \_\_\_\_\_

Weather Conditions: \_\_\_\_\_ Rainfall (Amount & Duration): \_\_\_\_\_

**Description Of Failure**

Structure Number: \_\_\_\_\_ Other identifying Features of Structure: \_\_\_\_\_

**FOLLOW-UP ACTIONS**

By Inspector \_\_\_\_\_ Date of Follow-up Inspection: \_\_\_\_\_ Was Structure Certified: \_\_\_\_\_

If Certified, By Who: \_\_\_\_\_

By Company \_\_\_\_\_ Was Structure Repaired: \_\_\_\_\_

Attach map showing location of problem \_\_\_\_\_

Describe What You Believe Caused Failure:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Inspector: \_\_\_\_\_ Office: \_\_\_\_\_  
Date: \_\_\_\_\_

|                  |   |
|------------------|---|
| <b>TO:</b>       | <b>Permitting and I&amp;E Personnel</b>                       |
| <b>SUBJECT:</b>  | <b>Determination of Precipitation Total for Design Storms</b> |
| <b>DATE:</b>     | <b>February 23, 2018</b>                                      |
| <b>APPROVAL:</b> | <b>Harold D. Ward, Director</b>                               |

## **INTRODUCTION**

This policy memorandum sets forth acceptable procedures and practices for determining rainfall precipitation amounts for various frequency Design Storms that are used to perform drainage structure design calculations, Storm Water Runoff Analysis, and/or any other hydrologic calculations that may be required under the West Virginia Surface Mining Reclamation Rule, 38 CSR 2. This policy was developed to provide consistency by establishing permitting design procedures that coincide with other permitting policies, procedures, and guidance and to encourage consistency with current prudent and standard engineering practices.

Because National Oceanic and Atmospheric Administration (NOAA) precipitation frequency estimates have replaced United States Weather Bureau data, as referenced in 38 CSR 2 §2.42, NOAA Atlas 14 (or the most recent Atlas version) is to be used to determine Precipitation Frequency Estimates for all applicable Design Storms specified in the Reclamation Rule.

This policy is prospective and only applies to new permit actions submitted after the above effective date.

## **BACKGROUND**

Per 38 CSR 2 §2.42, “Design Storm means predicted precipitation of given intensity, frequency and duration based on United States Weather Bureau data.” These design storms are utilized to determine the “Peak Runoff” used in various hydrology designs, analyses, and calculations for permit applications and certifications. Per 38 CSR 2 § 2.86, “Peak Runoff means the maximum flow in a specified geographic location resulting from a given design storm.”

United States Weather Bureau precipitation data can be found in the Technical Handbook of Standards and Specifications for Mining Operations in West Virginia, 1984 (the Technical Handbook)<sup>1</sup>. The Technical Handbook includes tables of 24-hour precipitation totals for various storm frequencies by West Virginia county. The tables are based upon the U. S. Weather Bureau Rainfall-Frequency Atlas of the United States, Technical Paper No. 40, which was published in 1961.

In 1970, the U.S. Weather Bureau, the U.S. Coast and Geodetic Survey, and the U.S. Commission of Fish and Fisheries were brought together to establish the National Oceanic and Atmospheric Administration or NOAA. NOAA is now the federal agency responsible to estimate, maintain and update precipitation frequency data for the United States. Current precipitation frequency data is published in NOAA Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 2, Version 3.0 (revised 2006). The Atlas states that:

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<sup>1</sup>West Virginia Department of Natural Resources Division of Reclamation, Technical Handbook of Standards and Specifications for Erosion and Sediment Control, Excess Spoil Disposal, and Haulageways for Mining Operations in West Virginia, revised 04/84.

“The Atlas is intended as the official documentation of precipitation frequency estimates and associated information for the United States... The Atlas supersedes precipitation frequency estimates contained in Technical Paper No. 40 ‘Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years’ (Hershfield, 1961), NWS HYDRO-35 ‘Five- to 60-minute precipitation frequency for the eastern and central United States’ (Frederick et al., 1977) and Technical Paper No. 49 ‘Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States’ (Miller et al., 1964).”

NOAA precipitation frequency data is available online from the Precipitation Frequency Data Server that was developed and published in tandem with NOAA Atlas 14 to allow delivery of the results and supporting information in multiple forms via the internet.<sup>2</sup>

### **APPLICATION OF POLICY**

Precipitation frequency totals for applicable Design Storms are to be obtained from:

- NOAA Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 2, Version 3.0 (or most recent Atlas version, if subsequently updated).
- The “geographic location” used in determining the Point Precipitation Frequency Estimate – based upon the judgment of the registered professional engineer or licensed land professional surveyor certifying the design calculations - shall be the coordinates for either the approximate center of the permit or the approximate center of the sub-watershed in which the drainage or runoff design calculations are being conducted.
- The Point Precipitation Frequency Estimate to be utilized as the Design Storm total shall be the 90% confidence value estimate (in inches) based on the appropriate Average Recurrence Interval (such as 10, 25, 100-year, etc.) and Storm Duration (such as 6-hour, 24-hour, etc.).
  - It is not intended that the upper limit of the 90% confidence interval estimate be utilized – unless the registered professional engineer or professional surveyor performing the design calculations deems a higher value should be used in order to be consistent with standard or prudent engineering practices.
- All site-specific printouts, tables, and backup data from Atlas 14 are to be included in the permit and drainage calculation documentation.
- Precipitation Frequency Estimates from the Technical Handbook may continue to be used, so long as the precipitation estimate (in inches) is no less than the corresponding 90% confidence value indicated by Atlas 14 for the same approximate location, Average Recurrence Interval, and Storm Duration.

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<sup>2</sup>Current url: [https://hdsc.nws.noaa.gov/hdsc/pfds/pfds\\_map\\_cont.html](https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html)

# Example from NOAA Atlas 14, October 2017

## Precipitation Total (inches) for a 25-year/24-hour Design Storm



NOAA Atlas 14, Volume 2, Version 3  
**Location name: Charleston, West Virginia, USA\***  
**Latitude: 38.3366°, Longitude: -81.5277°**  
**Elevation: 1015.58 ft\*\***



\* source: ESRI Maps  
 \*\* source: USGS

### POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

### PF tabular

| PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup> |                                     |                        |                        |                        |                        |                        |                        |                        |                        |                        |
|--|-------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Duration   | Average recurrence interval (years) |                        |                        |                        |                        |                        |                        |                        |                        |                        |
|  | 1                                   | 2                      | 5                      | 10                     | 25                     | 50                     | 100                    | 200                    | 500                    | 1000                   |
| 5-min  | 0.338<br>(0.310-0.371)              | 0.402<br>(0.367-0.441) | 0.481<br>(0.440-0.528) | 0.540<br>(0.493-0.592) | 0.615<br>(0.560-0.672) | 0.672<br>(0.610-0.733) | 0.724<br>(0.654-0.788) | 0.776<br>(0.699-0.844) | 0.842<br>(0.754-0.914) | 0.890<br>(0.794-0.965) |
| 10-min   | 0.526<br>(0.481-0.576)              | 0.627<br>(0.574-0.689) | 0.748<br>(0.684-0.821) | 0.834<br>(0.762-0.914) | 0.941<br>(0.856-1.03)  | 1.02<br>(0.925-1.11)   | 1.09<br>(0.985-1.19)   | 1.16<br>(1.04-1.26)    | 1.24<br>(1.11-1.34)    | 1.30<br>(1.16-1.41)    |
| 15-min   | 0.644<br>(0.590-0.706)              | 0.767<br>(0.702-0.842) | 0.918<br>(0.840-1.01)  | 1.03<br>(0.937-1.13)   | 1.16<br>(1.06-1.27)    | 1.26<br>(1.15-1.38)    | 1.35<br>(1.22-1.47)    | 1.44<br>(1.30-1.57)    | 1.55<br>(1.38-1.68)    | 1.62<br>(1.45-1.76)    |
| 30-min   | 0.853<br>(0.781-0.934)              | 1.03<br>(0.939-1.13)   | 1.26<br>(1.15-1.38)    | 1.42<br>(1.30-1.56)    | 1.64<br>(1.49-1.79)    | 1.80<br>(1.64-1.97)    | 1.95<br>(1.77-2.13)    | 2.10<br>(1.89-2.29)    | 2.29<br>(2.05-2.49)    | 2.43<br>(2.17-2.63)    |
| 60-min   | 1.04<br>(0.953-1.14)                | 1.26<br>(1.15-1.38)    | 1.58<br>(1.44-1.73)    | 1.81<br>(1.66-1.99)    | 2.13<br>(1.94-2.32)    | 2.37<br>(2.16-2.59)    | 2.61<br>(2.36-2.85)    | 2.85<br>(2.57-3.10)    | 3.17<br>(2.83-3.44)    | 3.41<br>(3.04-3.70)    |
| 2-hr   | 1.21<br>(1.10-1.31)                 | 1.46<br>(1.33-1.60)    | 1.82<br>(1.66-1.99)    | 2.10<br>(1.91-2.29)    | 2.48<br>(2.25-2.69)    | 2.77<br>(2.50-3.01)    | 3.08<br>(2.77-3.33)    | 3.38<br>(3.02-3.65)    | 3.79<br>(3.37-4.09)    | 4.11<br>(3.63-4.43)    |
| 3-hr   | 1.27<br>(1.16-1.39)                 | 1.54<br>(1.41-1.69)    | 1.92<br>(1.75-2.10)    | 2.21<br>(2.02-2.41)    | 2.61<br>(2.38-2.84)    | 2.93<br>(2.66-3.19)    | 3.26<br>(2.94-3.53)    | 3.60<br>(3.22-3.89)    | 4.05<br>(3.60-4.37)    | 4.41<br>(3.90-4.76)    |
| 6-hr   | 1.51<br>(1.40-1.64)                 | 1.80<br>(1.67-1.97)    | 2.23<br>(2.06-2.43)    | 2.57<br>(2.36-2.79)    | 3.04<br>(2.79-3.30)    | 3.42<br>(3.12-3.70)    | 3.82<br>(3.46-4.12)    | 4.23<br>(3.82-4.55)    | 4.79<br>(4.29-5.15)    | 5.24<br>(4.65-5.61)    |
| 12-hr  | 1.78<br>(1.66-1.92)                 | 2.12<br>(1.98-2.29)    | 2.59<br>(2.41-2.79)    | 2.97<br>(2.76-3.20)    | 3.52<br>(3.25-3.77)    | 3.96<br>(3.64-4.23)    | 4.42<br>(4.04-4.72)    | 4.91<br>(4.45-5.22)    | 5.59<br>(5.02-5.92)    | 6.14<br>(5.46-6.49)    |
| <span style="border: 2px solid red; border-radius: 50%; padding: 2px;">24-hr</span>                      | 2.16<br>(2.03-2.31)                 | 2.57<br>(2.42-2.75)    | 3.11<br>(2.92-3.33)    | 3.55<br>(3.33-3.79)    | 4.16<br>(3.89-4.44)    | 4.66<br>(4.35-4.96)    | 5.18<br>(4.81-5.50)    | 5.71<br>(5.29-6.07)    | 6.45<br>(5.95-6.84)    | 7.04<br>(6.46-7.46)    |
| 2-day  | 2.59<br>(2.43-2.75)                 | 3.07<br>(2.89-3.27)    | 3.68<br>(3.46-3.91)    | 4.17<br>(3.91-4.43)    | 4.83<br>(4.53-5.13)    | 5.37<br>(5.02-5.69)    | 5.92<br>(5.51-6.27)    | 6.48<br>(6.01-6.86)    | 7.24<br>(6.69-7.66)    | 7.83<br>(7.21-8.28)    |
| 3-day  | 2.80<br>(2.64-2.97)                 | 3.32<br>(3.13-3.52)    | 3.95<br>(3.73-4.20)    | 4.46<br>(4.20-4.74)    | 5.15<br>(4.84-5.46)    | 5.69<br>(5.33-6.03)    | 6.24<br>(5.83-6.61)    | 6.80<br>(6.33-7.20)    | 7.55<br>(7.00-7.98)    | 8.12<br>(7.51-8.58)    |
| 4-day  | 3.01<br>(2.84-3.19)                 | 3.56<br>(3.37-3.78)    | 4.23<br>(4.00-4.49)    | 4.76<br>(4.49-5.04)    | 5.47<br>(5.14-5.79)    | 6.02<br>(5.65-6.37)    | 6.57<br>(6.15-6.95)    | 7.12<br>(6.66-7.53)    | 7.86<br>(7.31-8.30)    | 8.42<br>(7.81-8.89)    |
| 7-day  | 3.62<br>(3.42-3.84)                 | 4.27<br>(4.03-4.53)    | 5.00<br>(4.72-5.31)    | 5.57<br>(5.25-5.91)    | 6.30<br>(5.94-6.68)    | 6.87<br>(6.45-7.27)    | 7.41<br>(6.96-7.85)    | 7.95<br>(7.44-8.41)    | 8.63<br>(8.07-9.14)    | 9.14<br>(8.52-9.68)    |
| 10-day   | 4.19<br>(3.97-4.42)                 | 4.92<br>(4.67-5.21)    | 5.71<br>(5.41-6.04)    | 6.32<br>(5.98-6.67)    | 7.09<br>(6.70-7.48)    | 7.66<br>(7.24-8.09)    | 8.22<br>(7.75-8.67)    | 8.75<br>(8.24-9.23)    | 9.42<br>(8.85-9.94)    | 9.91<br>(9.29-10.5)    |
| 20-day   | 5.86<br>(5.58-6.16)                 | 6.86<br>(6.53-7.22)    | 7.85<br>(7.47-8.26)    | 8.59<br>(8.16-9.03)    | 9.51<br>(9.03-10.0)    | 10.2<br>(9.67-10.7)    | 10.8<br>(10.3-11.4)    | 11.4<br>(10.8-12.0)    | 12.1<br>(11.5-12.8)    | 12.7<br>(11.9-13.3)    |
| 30-day   | 7.37<br>(7.03-7.75)                 | 8.62<br>(8.22-9.04)    | 9.74<br>(9.28-10.2)    | 10.6<br>(10.1-11.1)    | 11.6<br>(11.0-12.2)    | 12.4<br>(11.7-13.0)    | 13.0<br>(12.4-13.7)    | 13.7<br>(13.0-14.3)    | 14.4<br>(13.6-15.1)    | 14.9<br>(14.1-15.7)    |
| 45-day   | 9.42<br>(9.01-9.87)                 | 11.0<br>(10.5-11.5)    | 12.3<br>(11.7-12.8)    | 13.2<br>(12.6-13.8)    | 14.4<br>(13.7-15.1)    | 15.2<br>(14.5-15.9)    | 16.0<br>(15.2-16.7)    | 16.6<br>(15.8-17.4)    | 17.4<br>(16.6-18.2)    | 17.9<br>(17.1-18.8)    |
| 60-day   | 11.4<br>(10.9-11.9)                 | 13.2<br>(12.6-13.8)    | 14.6<br>(14.0-15.3)    | 15.7<br>(15.0-16.4)    | 17.0<br>(16.2-17.7)    | 17.8<br>(17.1-18.6)    | 18.6<br>(17.8-19.5)    | 19.3<br>(18.5-20.2)    | 20.2<br>(19.2-21.1)    | 20.7<br>(19.7-21.7)    |

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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