



Sunset over the Valley, looking W from FCD, 07-30-2018, D. Henz

## **Flood Control District of Maricopa County**

### **Flood Warning Branch**

## **MSP Verification Report & Season Recap: Monsoon Season 2018**



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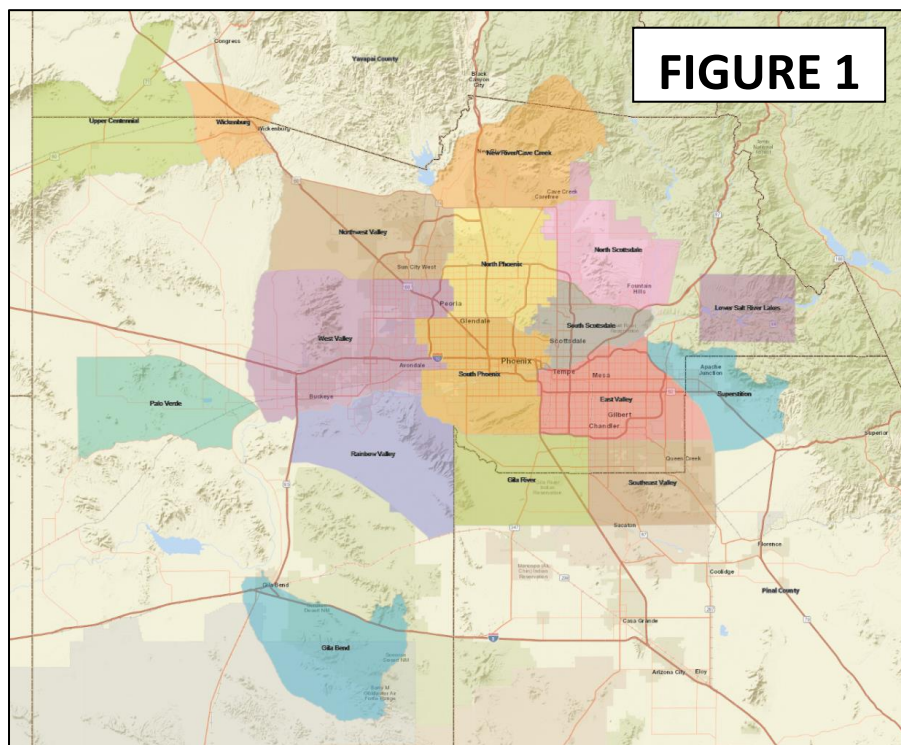
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## INTRODUCTION

This report was generated by the Flood Warning Branch of the Flood Control District of Maricopa County (FCDMC). It covers the length of the monsoon season as defined by the National Weather Service Phoenix WFO: June 15<sup>th</sup>- September 30<sup>th</sup>. This report includes daily records on Weather Outlooks and Statements issued by the Meteorological Services Program (MSP) as well as a complete verification and summary of these products.

The Flood Warning Branch of the FCDMC operates a year-round MSP that's purpose is to provide detailed meteorological forecasts and support to county, city, and other local agencies. The program covers 5,400 square miles encompassing Maricopa County and surrounding watersheds. The goal of the Flood Control District's MSP is to reduce response time for emergency managers by providing timely and accurate weather information, primarily regarding the potential for flood-producing rainfall. During the length of the Monsoon season the MSP goes on a weekly rotating 24/7 manned schedule. A Duty Officer is selected for each day who is responsible for issuing MSP products, providing support to clients, and serves as the on-call supervisor during non-business hours. A supporting officer is also named and can be available to the duty officer in the case of a significant weather event. All MSP forecast products are disseminated via email and text alerts. Emergency managers may also be notified by telephone to aid in decision making.

The MSP has broken down the 5,400 square mile operational area into 17 forecast zones. These zones are the primary warning areas identified by emergency management officials. A map of the forecast zone locations is shown below in Figure 1.



## MSP PRODUCT DESCRIPTION

### Weather Outlook:

The Weather Outlook is disseminated to clients daily no later than 2PM during the monsoon season. This product covers the today through tomorrow period and occasionally the following 2-3 days where appropriate. Occasionally, due to unexpected weather pattern changes, Weather Outlooks will be updated throughout the day or first thing the following morning. Weather Outlooks include a synopsis of expected weather conditions; the “probability of occurrence” of rain; the expected “prime time” for the bulk of the rain; and the amount of rain expected during the prime time period. Temperature forecasts and trends are included as well as a forecast of peak wind speeds. Click [here](#) for an example.

### Message 1 – Alert:

When it is believed developing weather conditions may lead to heavy rain and/or minor to moderate flooding an Alert is issued. Lead time will generally be less than an hour in advance of the expected event. The Alert will normally identify the affected zone(s), the time frame of the event (valid time), rainfall potential, and the type of areas that will be impacted, such as roads and/or washes. Click [here](#) for an example.

### Message 2 – Flash Flood Watch:

When it appears the developing weather event may lead to flash flooding a Watch is issued for the possible affected areas. Lead time will generally be 1 to 2 hours in advance of the expected event, but can stretch to a day or more with reliable guidance. The Watch will include the time frame it will be in effect (valid time), and a section describing what may take place (comments). Click [here](#) for an example.

### Message 3 – Flash Flood Warning:

When it appears that significant flash flooding is imminent or has started to take place, a Warning will be issued for the affected areas. Lead time will generally be less than an hour. The Warning will normally identify the affected zone(s), a time frame of the event, rainfall potential, and a section describing what is expected to take place (comments). Click [here](#) for an example.

### Message 1, 2 and 3 Update:

This product, issued as needed, will update an existing Alert, Watch or Warning. Click [here](#) for an example.

### Message 4 – Cancel:

When an event (Watch or Warning) no longer poses a threat, and the expiration time has not been reached, a Cancel message may be issued. Click [here](#) for an example.

Lake Alerts:

In addition to the above MSP program, weather guidance is provided for Maricopa County lakes/reservoirs from June 15 through September 30. Lake Alerts are issued as needed to inform of approaching adverse weather conditions. Emphasis in these statements is on expected wind gusts and lightning activity. Click [here](#) for an example.

Additional Products:

During the summer months, a program exists to aid the Boy Scouts at Camp Geronimo. Though in Gila County, many of the scouts reside within Maricopa County. The Camp exists below a watershed that was recently burned, and NWS Flagstaff declined a request for localized support. A call is made to the officials at the camp when needed, stating the expected flood problem.

At the request of clients, site specific products may be issued to support unusual or special operations, such as specific wind forecasts to aid in the fighting of fires, or forecasting for special events at the County lakes or parks, or District construction projects.

*Additional information and data regarding the FCDMC can be found online [here](#)*



## 2018 MONSOON SEASON RECAP

According to the FCDMC ALERT rain gage network, the 2018 monsoon season was characterized as being normal to wetter than normal. When averaged across 287 of the oldest county mesonet rain gages, 3.25" of rain fell which was 109% of the mean value of 2.98". An image showing a 36 year period of record can be viewed [here](#). It's worth noting below average rainfall was recorded at Sky Harbor Airport for the third season in a row. The official rain total as reported by the NWS Phoenix office was 2.63" which was 0.08" below the period average of 2.71". Click [here](#) to see a technical summary plot from Sky Harbor Airport covering the monsoon season courtesy of the University of Arizona CSAP/CLIMAS organization. Figure 2, below, offers a more comprehensive picture of the rainfall distribution across the MSP forecast area. This figure was generated using preliminary FCDMC ALERT rain gage data from around the county. The shaded contours depict precipitation totals from June 15<sup>th</sup> – September 30<sup>th</sup>.

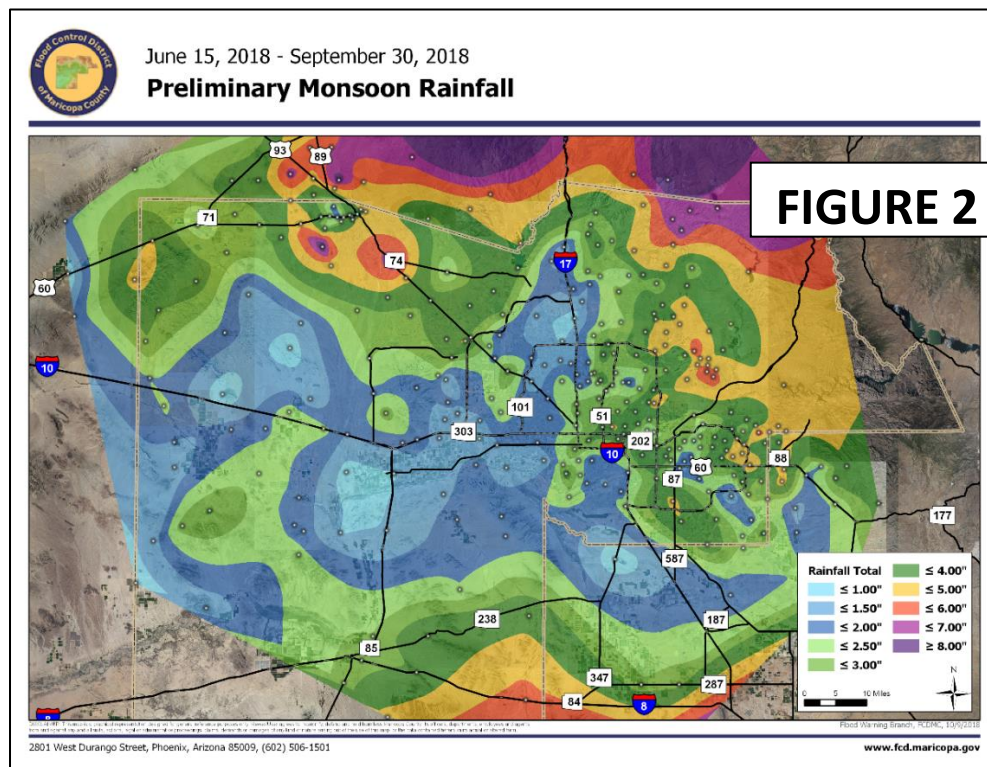
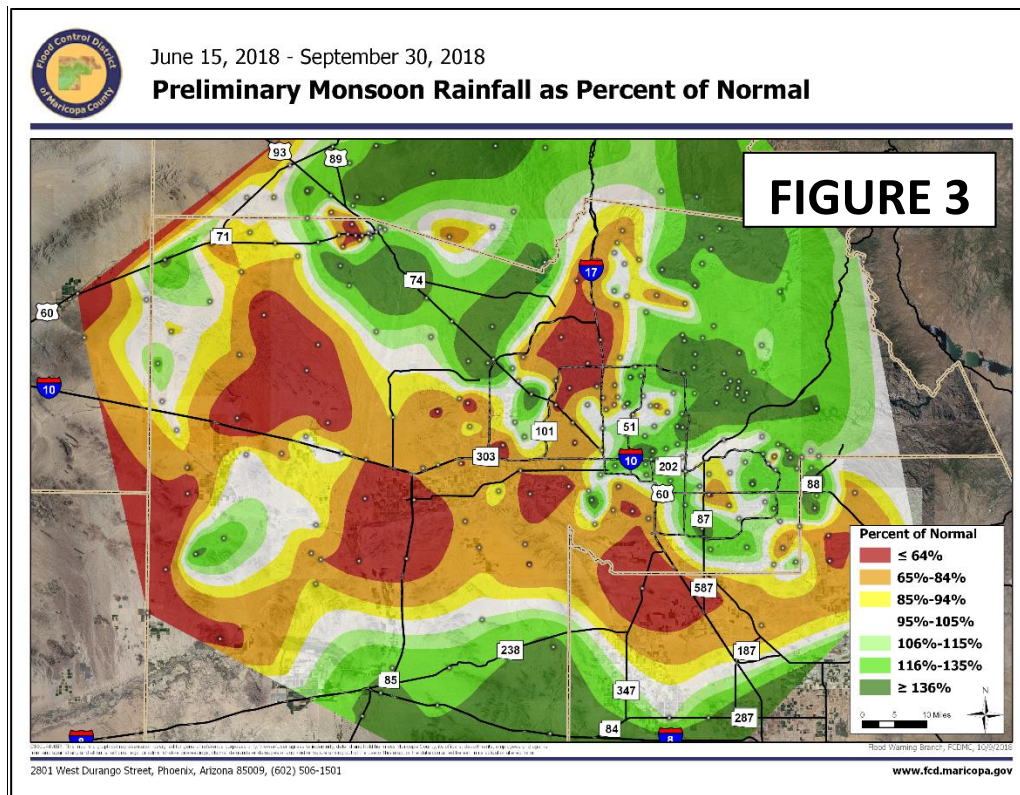


Figure 3, on the next page, shows the ratio of 2018 monsoon precipitation versus average monsoon precipitation. Similar to Figure 2, contours were generated using preliminary FCDMC ALERT rain gage data from around the county. Northcentral Maricopa County extending south down I-17 saw below to well below average rainfall totals for the season. Similarly, Avondale west through Buckeye were equally as dry. Above average rain fell across a large swath of the far Northwest Valley, metro/central Phoenix, Scottsdale and Fountain Hills. Areas in the southeast valley (enclosed by the loop 202 corridor) were also wetter than average. These two figures serve as a strong reminder to the importance of having a widely distributed rain gage network in order to fully capture the distribution of monsoon rains.



The 2018 season got underway with an early and unusual “false start” event. Tropical Cyclone Bud, the second east pacific tropical system of the 2018 season, formed on June 9<sup>th</sup> before strengthening into a hurricane on the 10<sup>th</sup> and a major cat 4 system by the 11<sup>th</sup>. Bud traveled north/northwest into cooler waters off the west coast of Mexico the next few days before making landfall near Cabo San Lucas on the 14<sup>th</sup> as a weakened tropical storm. A loop of all forecast tracks produced by the National Hurricane Center can be viewed [here](#). Remnants of Bud sent a plume of tropical moisture north into AZ lending to early season rainfall on the 15<sup>th</sup> and again on the morning of the 16<sup>th</sup>. The first MSP message statements of the season were issued on the 16<sup>th</sup> for runoff in the Wickenburg area and strong t-storms across Scottsdale. For reference, a quick and easy way to show the “false start” nature of this event is to look at the average June daily dewpoint temperature for Phoenix [here](#). Notice the dewpoint spike from June 14<sup>th</sup>-17<sup>th</sup> before returning back towards the climatological average in the mid 30s. Dry conditions prevailed for the remainder of June and into the first week of July before the Monsoon ridge finally shifted north and settled across the CO/UTAZ region helping to initiate the operational convective season.

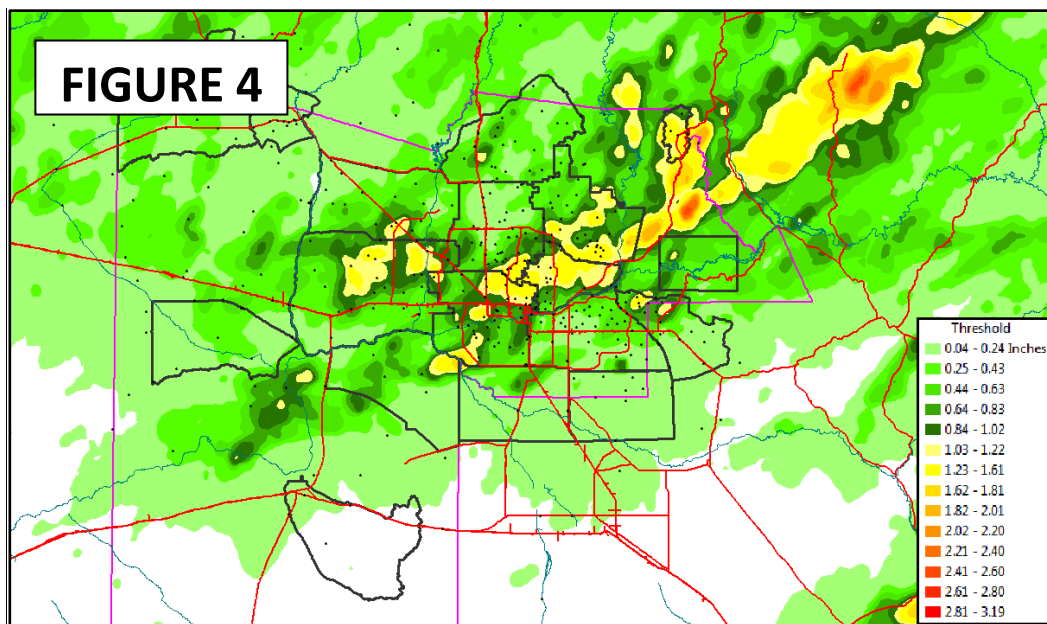
The first MSP message statements of July were issued on the evening of the 8<sup>th</sup> for localized severe t-storms across the West Valley. Anywhere from 0.50”-1.50” of rain fell across Buckeye, Palo Verde, and Gila Bend areas. This event was highlighted by strong downburst winds which caused major structural damage to houses, mobile homes, powerlines and tress around the Buckeye area. The action continued the following night with the help of a passing inverted trough lending to our first widespread wind/rain event across the County. Severe t-storms raced off the Mogollon Rim and into the greater Phoenix Valley where anywhere from 0.75”-1.50” fell after a strong dust storm/wind event. The NWS Phoenix WFO did a storm write

up on this event which can be viewed [here](#). Two days later flash flood watches were issued ahead of another active evening that brought heavy rain to northcentral portions of the County. 260 rain gauges recorded measurable rain, nineteen had 1.00" or greater and ten gauges registered more than 1.50". Unfortunately, storms missed Phoenix Sky Harbor where only a trace was observed. Daily storm activity continued for the next ten days bringing localized rain to various parts of the County. The next noteworthy event occurred on the 21<sup>st</sup> as a strong mesoscale convective vortex lifted north out of Sonora, Mexico on the morning of the 21<sup>st</sup> and into southwestern AZ. Organized severe storms brought nearly 2.00" of rain to areas in and south of the Gila Bend. Large flows were registered on Sand Tank and Saucedo washes. Monsoon storm activity largely tapered off for the next week as we moved into the first break period of the season.

Convective activity quickly ramped back up in the waning days of July. 1.00"-2.00" of rain fell over the Upper Centennial watershed east through Wickenburg and into the New River watershed on the night of the 28<sup>th</sup>. Another Mogollon Rim to Valley widespread wind/rain event then occurred two nights later affecting the entire northern half of the county. A thorough storm report detailing this event was written up by the NWS Phoenix office and can be view [here](#). The month of August picked up where July left off with another noteworthy wind/dust/rain event on the 2<sup>nd</sup>. Storms brought West Valley locales anywhere from 0.50"-2.00" of rain. Residents of Sun City, Surprise, Litchfield Park, and Goodyear were hit especially hard with damaging wind gusts and near zero visibility from blowing dust. Daily isolated t-storm activity continued through the 2<sup>nd</sup> of August before another week long break period.

Luckily, the monsoon ridge quickly redeveloped across the lower Great Basin and stayed nearly stationary through the middle of August lending to a string of active weather days, which have become synonymous with the Great Basin ridge setup. With sufficient moisture in place and favorable northeasterly steering flow, a line of severe t-storms rolled southwest off the Mogollon Rim and into northeastern portions of the county during the evening of the 8<sup>th</sup>. Heavy rain was observed across Scottsdale, Fountain Hills, and Phoenix where 1.00"-2.00" fell. The following night, another round storms came off the rim, this time, taking aim at Apache Junction, Tempe, Mesa, Chandler, and Gilbert. Some of the heaviest rain of the summer was observed with widespread 1.00"-3.00" across the affected areas. A NWS storm summary covering this event in more detail can be viewed [here](#). The steady state upper-level pattern brought yet another round of storms off the Valley and across most of the county on the night of the 10<sup>th</sup>. A flash flood watch was issued earlier in the day to account for soaked watersheds from activity during the previous three days. Figure 4 (on the next page) shows rain totals around the county. Most of the central FZs picked up an additional 1.00"-2.00", which led to numerous urban flooding problems around the greater Phoenix Valley lasting well into the morning of the 11<sup>th</sup>. The active pattern brought additional storms to various portions of the county through the middle of the month before breaking down and leading to another monsoon lull. The region saw a brief relapse of activity from the 23<sup>rd</sup> to the 25<sup>th</sup> as the ridge redeveloped over west Texas. The most noteworthy rains fell on the 23<sup>rd</sup> over north Scottsdale and Phoenix with totals nearing 2.00". Localized heavy rains also fell over portions of metro Phoenix, Gilbert, and Apache Junction.





After another pause to the monsoon through the final week of August, activity picked back up again in early September courtesy of a nearly stationary trough draped across the Desert Southwest. The first shortwave disturbance to rotate around the trough arrived on September 2<sup>nd</sup> helping to initiated scattered t-storms around the County. Heavy rain and small hail was observed west of Wickenburg south through Gila Bend during the afternoon hours of the 2<sup>nd</sup>, before additional evening/overnight activity over Goodyear, Litchfield Park, Metro Phoenix, and Queen Creek. Two additional shortwaves moved through the region between the 3<sup>rd</sup> and 6<sup>th</sup> of September aiding in general rains around various portions of the County, though no severe weather or flooding was observed. As is customary during the transition out of the Monsoon and into the fall season, conditions quickly dried out and the weather remained quiet for the next two weeks. The next rain event held off until the 19<sup>th</sup> when another early fall low pressure system moved into the region pulling deep moisture north out of Mexico and into southcentral AZ. This system was aided by a decaying tropical depression moving northeast through the southern Baja. Anywhere from 1.00"-3.00" fell across portions of southwestern Maricopa with even higher totals over Pinal and Pima Counties. These rains triggered flows in Vekol, Sand Tank, and Saucedo Washes. This event marked the end of the operational monsoon season as no further MSP weather statements were issued. Mainly dry conditions persisted until the official close of the monsoon on September 30<sup>th</sup>.

### MSP Issued Products Recap:

A total of 134 forecast zone-specific messages were issued by the MSP spread across twenty-five different days during the length of the monsoon season. Table 1, below, shows the monthly break down by forecast zone of messages issued including season totals.

<b>TABLE 1: MSP Messages Issued - 2018 Monsoon Season</b>					
<b>Forecast Zone</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>September</b>	<b>Total</b>
Gila Bend	0	4	0	1	<b>5</b>
Gila River	0	1	5	0	<b>6</b>
Palo Verde	0	2	3	0	<b>5</b>
Rainbow Valley	0	2	2	0	<b>4</b>
West Valley	0	4	3	0	<b>7</b>
Northwest Valley	0	5	5	0	<b>10</b>
Upper Centennial	0	3	0	0	<b>3</b>
Wickenburg	1	5	3	0	<b>9</b>
New River/Cave Creek	0	6	9	0	<b>15</b>
Phoenix North	0	4	5	0	<b>9</b>
Phoenix South	0	2	7	0	<b>9</b>
Scottsdale North	1	4	10	0	<b>15</b>
Scottsdale South	1	2	7	0	<b>10</b>
East Valley	1	3	7	0	<b>11</b>
Southeast Valley	0	1	5	1	<b>7</b>
Lower Salt River Lakes	0	0	2	0	<b>2</b>
Superstition	0	2	5	0	<b>7</b>
<b>All Zones</b>	<b>4</b>	<b>50</b>	<b>78</b>	<b>2</b>	<b>134</b>

Of the 134 Messages issued, one hundred eighteen were Message-1 Alerts, ten were Message-2 Flash Flood Watches, six were Message-3 Flash Flood Warnings, and zero Message-4 Cancel. Table 2, below, shows the monthly break down by forecast zone of Lake Alerts issued including season totals. Forty-one Lake Alert statements were issued for the County Lakes Program including Lake Pleasant, Bartlett Lake, Saguaro Lake, Canyon Lake, and Apache Lake. The Alert Operation Center (AOC) was not activated during this monsoon season as none of the rain events ended up posing any serious threat to county/city dams or District flood control facilities.

<b>TABLE 2: MSP Lake Alerts Issued - 2018 Monsoon Season</b>					
<b>Recreational Zone</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>September</b>	<b>Total</b>
Lake Pleasant	0	4	4	1	<b>9</b>
Horseshoe Lake	0	0	0	0	<b>0</b>
Bartlett Lake	0	5	2	0	<b>7</b>
Saguaro Lake	0	4	4	0	<b>8</b>
Canyon Lake	0	4	4	0	<b>8</b>
Apache Lake	0	5	4	0	<b>9</b>
<b>All Zones</b>	<b>0</b>	<b>22</b>	<b>18</b>	<b>1</b>	<b>41</b>

## MSP VERIFICATION METRICS AND CRITERIA

Several key verification metrics and a clear set of operational based criteria were adopted in order to conduct a thorough and complete verification of MSP products issued during the 2018 monsoon season. This chapter is broken down into five sections: Outlooks, Messages, Lake Alerts, and Storm Total Precipitation. Each section discusses the verification metrics used and the criteria followed to compute the statistics displayed in the summary chapter sections. A list of frequently used terms including definitions and acronyms as used throughout this report is listed below.

Observed Rainfall: the amounts of total rainfall gathered from either ALERT rain gages, gage corrected radar estimations, or local storm reports (LSRs).

Operationally Significant Event (OSE): a rain event within a MSP forecast zone with observed rainfall equal or greater than 0.50”.

Hit: considered a correct forecast.

Miss: considered an incorrect forecast.

Correct Negative: considered a correct forecast ex. no rain forecast and no rain observed.

Forecast Accuracy: a measure of the ability to correctly forecast daily rainfall potential. Given in percent and calculated using Equation 1 below:

$$(1) \text{ Forecast Accuracy} = \left( \frac{\text{Correct Forecasts}}{\text{Total Forecasts}} \right) \times 100$$

Probability of Detection (POD): a measure of the ability to correctly discriminate heavy rain days (OSEs) from non-rain/minor rain days. Given in percent and calculated using Equation 2 below:

$$(2) \text{ POD} = \left( \frac{\text{OSEs Correctly Detected}}{\text{Total OSEs}} \right) \times 100$$

False Alarm: occurs when an OSE is forecast for a location but does not occur.

False Alarm Rate: measures the number of false alarms compared to forecast days i.e. over-forecasting. Given in percent and calculated using the Equation 3 below:

$$(3) \text{ FAR} = \left( \frac{\text{False Alarms}}{\text{Total Forecasts}} \right) \times 100$$

Threat Score: measures the fraction of observed and/or forecast events that were correctly predicted. TS can be thought of as forecast accuracy when correct negatives have been removed from consideration. Given in percent and calculated using Equation 4 below.

$$(4) \quad TS = \left( \frac{Hits}{Hits + Misses + False Alarms} \right) \times 100$$

Percent Error: a measure of relative error given in percent. Calculated using Equation 4 below:

$$(5) \quad \% Error = \left( \frac{Forecast - Observed}{Observed} \right) \times 100$$

Quantitative Precipitation Forecast (QPF): forecast zone or basin specific rainfall forecast including a rainfall amount given in inches and/or intensity.

Rainfall Intensity: the rate at which rain is falling including an amount in inches over a specific time period i.e. 0.50"/30min.

Storm Total Precipitation (STP): total rainfall from an identified storm or storm complex, given in inches.

Probability of Occurrence: forecast confidence, given in percent, that rainfall that could occur within a forecast zone or basin, usually given in conjunction with a QPF.

Gage Adjusted Quantitative Precipitation Estimate (GAQPE): radar estimated rainfall total, product provided by WDT Inc.

Lead Time: the amount of time between when the forecast statement was issued/valid and the onset of the event (observable).

Qualifying Event: an issued statement/QPF that counts in the verification process.

*The following five sections explain the development of verification statistics as tabulated in Appendix A-E.*

## OUTLOOKS:

### Forecast Accuracy:

Either a hit or a miss was selected for each day. A hit was assigned when observed rainfall met or exceeded the QPF. A miss was assigned when rainfall was observed and no QPF was made or if observed rainfall failed to reasonably meet the QPF. In some cases a hit was assigned when the QPF was not reasonably met by observed rainfall. In these cases the probability of occurrence was 30% or less and the QPF was below the OSE threshold. Values were then populated for each forecast zone and all zones combined. Forecast accuracy was then calculated by month.



Probability of Detection:

A dash was assigned to all days when observed rainfall was below the OSE threshold. On days when observed rainfall met or exceeded the OSE threshold either a hit or a miss was assigned. A hit was selected when the observed rainfall reasonably met the QPF. A miss was assigned when observed rainfall greatly exceeded the QPF or if no QPF was issued. Values were then populated for each forecast zone and all zones combined. A probability of detection was calculated by month and season total.

False Alarm Rate:

False alarms were denoted by an “x”. A false alarm was assigned on days where the observed rainfall failed to meet the OSE threshold, yet the QPF called for an OSE with a high probability of occurrence. The two relationships below outline the above criteria.

$$\begin{aligned} & \text{Probability} \geq 40\% \text{ and QPF} \geq 0.50'' \text{ AND Observed Rain} < 0.50'' \\ & \text{Probability} = 30\% \text{ and QPF} \geq 1.00'' \text{ AND Observed Rain} < 0.50'' \end{aligned}$$

Values were then populated for each forecast zone and all zones combined. False alarm rate was then calculated by month and season total.

Threat Score:

Similar to Forecast Accuracy, a Threat Score or Critical Success Index was calculated. Threat score is only concerned with forecasts that count (days with observable rain) and assumes correct negatives are not important. Values were populated for each forecast zone and all zones combined for the length of the season.

*Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP daily Outlooks can be found in [Appendix A](#).*

**MESSAGES:**Forecast Accuracy:

A hit was assigned if a rain, stream, or dam alarm was triggered during the valid period of the issued Message and/or if observed rainfall reasonably met the QPF during the valid period. Conversely a miss was assigned if neither of these two criteria were met. Values were then populated for each forecast zone and all zones combined. Forecast accuracy was then calculated by month and season total.

Lead Time:

Lead time was calculated for each issued Message when possible. Time was measured from Message issuance to the first ALERT alarm triggered (rain, stream, or impoundment).

*Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP Messages can be found in [Appendix B](#).*

## LAKE ALERTS:

### Forecast Accuracy:

A hit was assigned if any of the following observations occurred during the valid period of the issued Lake Alert: lightning within the recreational area boundary, wind > 30mph, or hail/heavy rain. Conversely a miss was assigned if none of these three criteria were observed. Values were then populated for each recreational zone and all zones combined. Forecast accuracy was then calculated by month and season total.

### Lead Time:

Lead time was calculated for each issued Lake Alert when possible. Time was measured from the Lake Alert issuance to the first observation (lightning within the recreational area boundary, wind > 30mph, or hail/heavy rain).

*Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP Lake Alerts can be found in [Appendix C](#).*

## STORM TOTAL PRECIPITATION:

### Forecast Accuracy:

Only message statements where a QPF storm total precipitation amount was provided were evaluated. Observational data used for this verification included Maricopa County ALERT rain gages, local storm reports, and/or radar GAQPE. Either a hit or a miss was selected for each qualifying event. A hit was assigned if the percent error was less than or equal to 25%. Conversely a miss was assigned if the percent error was greater than 25%. Values were then populated for each forecast zone and all zones combined. Forecast accuracy was then calculated by month and season.

*Tables containing all of the raw data used in generating the verification metrics discussed above for the MSP Messages can be found in [Appendix E](#).*

## OUTLOOK VERIFICATION

Table 3, below, shows the Outlook verification seasonal totals for each Forecast Zone (FZ). Complete data tables for each FZ, separated by month, can be viewed in [Appendix A](#): Table A-1. Overall, Outlook forecast accuracy during the length of the monsoon season for all FZs combined was excellent at 86.1%. Forecast accuracy remained above the 75% threshold for each FZ. Upper Centennial and Wickenburg were the only two FZs to drop below 80%.

<b>TABLE 3: MSP Weather Outlook Verification - SEASON TOTALS, 2018</b>							
<b>Forecast Zone</b>	<b>Accurate Forecasts</b>	<b>AOF (%)</b>	<b>Sig. Events Detected</b>	<b>POD (%)</b>	<b>False Alarms</b>	<b>FAR (%)</b>	<b>TS (%)</b>
Gila Bend	88/108	81.5%	13/20	65%	2/108	1.9%	68.1%
Gila River	97/108	89.8%	6/9	66.7%	2/108	1.9%	81.2%
Palo Verde	94/108	87%	9/11	81.8%	1/108	1%	77.9%
Rainbow Valley	100/108	92.6%	10/11	90.9%	1/108	1%	86.8%
West Valley	92/108	85.2%	11/15	73.3%	0/108	n/a	76.1%
Northwest Valley	88/108	81.5%	12/16	75%	1/108	1%	69.1%
Upper Centennial	86/108	79.6%	15/21	71.4%	2/108	1.9%	65.2%
Wickenburg	86/108	79.6%	10/16	62.5%	4/108	3.7%	63.4%
New River/Cave Creek	96/108	88.9%	21/23	91.3%	3/108	2.8%	78.6%
Phoenix North	89/108	82.4%	7/7	100%	6/108	5.6%	65.8%
Phoenix South	98/108	90.7%	8/8	100%	1/108	1%	83.8%
Scottsdale North	93/108	86.1%	11/12	91.7%	2/108	1.9%	75.4%
Scottsdale South	96/108	88.9%	9/9	100%	0/108	n/a	82.1%
East Valley	96/108	88.9%	8/10	80%	2/108	1.9%	79.7%
Southeast Valley	96/108	88.9%	8/8	100%	1/108	1%	80.9%
Lower Salt River Lakes	90/108	83.3%	12/13	92.3%	2/108	1.9%	71%
Superstition	96/108	88.9%	10/10	100%	0/108	n/a	82.1%
<b>All Zones</b>	<b>1581/1836</b>	<b>86.1%</b>	<b>180/219</b>	<b>82.2%</b>	<b>30/1836</b>	<b>1.6%</b>	<b>75.6%</b>

The next metric computed was probability of detection. This metric was quite important because it distinguished how well MSP forecasters detected operationally significant events. Operationally significant events were defined as having 0.50" of rainfall or more. The POD during the length of the monsoon season for all FZs combined was 82.2%. In general, a POD of over 50% is considered sufficient and over 75% excellent in the forecast community. All of the FZs were above the 60% accuracy threshold with thirteen meeting or exceeding the 75% accuracy threshold. The next metric included in Table 3 was False Alarm Rate (FAR). It is important to keep track of how often MSP forecasters predicted an operationally significant day that did not occur. Too many false alarms can degrade user confidence in the forecasts. In general a FAR below 50% is sufficient and below 25% is considered excellent within the forecast community. The overall FAR for all zones during the length of the monsoon season

was exceptionally low at 1.6% with none of the forecast zones exceeding 6%. The highest FAR was 5.6% at Phoenix North where forecasters consistently over-predicted rainfall totals.

The final metric included in Table 2 was Threat Score (TS). The monsoon season officially runs from June 15<sup>th</sup> through September 30<sup>th</sup> of each year, yet the operational season (active weather days) tends to be much shorter beginning sometime in early July and finishing by mid-September. TS is thought to serve as a better metric for overall forecast skill as it removes correct negatives that are not important when computing forecast accuracy i.e. dry days before and after the active monsoon season. This year forty-one dry days were removed from 108 day total length of the monsoon season. Overall, forecast skill was 75.6% for all FZs over the length of the active season. Eleven of the seventeen FZs exceeded the 75% accuracy threshold, while the remaining six FZs remained well above the 60% threshold.



## MESSAGE VERIFICATION

The MSP messages carry a higher priority threat-wise than the daily outlooks. These statements (Alerts, Watches, and Warnings) serve as the most critical products issued by the MSP during the monsoon season to our clients. A high level of accuracy is required when forecasting these types of events as the information they provide is directly applicable to the potential or imminent flooding situation. All of the messages issued fall under the category of operationally significant events.

Table 4, on the next page, shows the issued message verification broken down by FZ and month. Complete data tables for each FZ can be viewed in [Appendix B](#): Tables B-1, B-2, and B-3. There were 129 qualifying messages (updates and M-4s not included) issued over the length of the season. Forecast accuracy for all FZs combined, over the length of the season, was exceptional at 89.9%. Sixteen out of seventeen FZs met or exceeded the 75% accuracy threshold. As stated earlier, 50% accuracy is considered sufficient and 75% or above is considered excellent within the forecast community. Gila River had the lowest accuracy coming right in at the 66.7%.

Four messages were issued in the month of June and all four verified. They were associated with the remnants of Hurricane Bud which arrived during the middle of the month causing a false start to the monsoon. Following this event, the rest of June remained dry. Forty-nine messages were issued in July. Messages were spread across ten operationally significant days. Overall, forecast accuracy for the month for all FZs combined was 87.8%. July 9<sup>th</sup> was the busiest day in the month where ten messages were issued and all ten verified. There were only six total misses (false alarms) during July spread across four days.

August was the busiest month with seventy-four issued messages spread out across twelve operationally significant days. Forecast accuracy for the month across all FZs combined improved slightly to 90.5%. August 10<sup>th</sup> was the most active day for the month and for the entire season with twenty-two messages being issued including the only MSP Flash Flood Watch of the season. Ten FZs were included in the watch and all but two verified. Just over 70% of the messages issued in August occurred during a very active five-day period from the 8<sup>th</sup> through the 12<sup>th</sup>. Six of the seven false alarms for August occurred during this same stretch.

September ended up being a very quiet month with only two messages issued, both of which verified. No messages were issued after the 19<sup>th</sup> as the county saw little to no t-storm saw activity for the remainder of the month. Lead time was the final metric included for message statement verification this year. The average lead time (data in [Appendix B](#), Table B-3) for all M-1 Alerts combined over the length of the monsoon season was fifty-seven minutes. The average lead time for M-2 Flash Flood Watches was just under eleven hours.

**TABLE 4: MSP Issued Statements Verification, broken down by month and Forecast Zone - Monsoon Season 2018**

	June		July		August		September		Season Totals	
Forecast Zone	Correct Statements	AOF (%)	Correct Statements	AOF (%)	Correct Statements	AOF (%)	Correct Statements	AOF (%)	Correct Statements	AOF (%)
Gila Bend	0/0	n/a	3/4	75%	0/0	n/a	1/1	100%	4/5	80%
Gila River	0/0	n/a	0/1	0%	4/5	80%	0/0	n/a	4/6	66.7%
Palo Verde	0/0	n/a	2/2	100%	3/3	100%	0/0	n/a	5/5	100%
Rainbow Valley	0/0	n/a	2/2	100%	2/2	100%	0/0	n/a	4/4	100%
West Valley	0/0	n/a	3/4	75%	3/3	100%	0/0	n/a	6/7	85.7%
Northwest Valley	0/0	n/a	5/5	100%	5/5	100%	0/0	n/a	10/10	100%
Upper Centennial	0/0	n/a	3/3	100%	0/0	n/a	0/0	n/a	3/3	100%
Wickenburg	1/1	100%	4/4	100%	3/3	100%	0/0	n/a	8/8	100%
New River/Cave Creek	0/0	n/a	6/6	100%	7/8	87.5%	0/0	n/a	13/14	92.9%
Phoenix North	0/0	n/a	3/4	75%	4/5	80%	0/0	n/a	7/9	77.8%
Phoenix South	0/0	n/a	1/2	50%	6/7	85.7%	0/0	n/a	7/9	77.8%
Scottsdale North	1/1	100%	3/4	75%	6/7	85.7%	0/0	n/a	10/12	83.3%
Scottsdale South	1/1	100%	2/2	100%	7/7	100%	0/0	n/a	10/10	100%
East Valley	1/1	100%	3/3	100%	7/7	100%	0/0	n/a	11/11	100%
Southeast Valley	0/0	n/a	1/1	100%	4/5	80%	1/1	100%	6/7	85.7%
Lower Salt River Lakes	0/0	n/a	0/0	n/a	2/2	100%	0/0	n/a	2/2	100%
Superstition	0/0	n/a	2/2	100%	4/5	80%	0/0	n/a	6/7	85.7%
<b>All Zones</b>	<b>4/4</b>	<b>100%</b>	<b>43/49</b>	<b>87.8%</b>	<b>67/74</b>	<b>90.5%</b>	<b>2/2</b>	<b>100%</b>	<b>116/129</b>	<b>89.9%</b>

## LAKE ALERT VERIFICATION

Weather guidance is provided to Maricopa County lakes/reservoirs and the recreational zones which encompass them in the form of lake alerts. These statements are issued as needed to inform staff/personnel of approaching adverse weather conditions with an emphasis on wind gusts and lightning activity and then to a lesser degree hail/heavy rainfall. A high level of accuracy is required when forecasting these types of events as lake alerts are considered warnings to the recreational community (staff, boaters, hikers, and campers).

Table 5, below, shows the issued lake alert verification broken down by recreational zone and month. Complete data tables for each recreational zone can be viewed in [Appendix C: Table C-1](#). There were forty-one lake alerts issued over the length of the season with all but one occurring during the months of July and August. No statements were issued for the Horseshoe Lake recreational zone for the entire season due to a lack of water in the reservoir. Forecast accuracy for the remaining five recreational zones combined, over the length of the season, was 82.9%. All of the five zones met or exceeded the 75% accuracy threshold with the lowest forecast accuracy of 75% recorded at Canyon Lake. As stated earlier, 50% accuracy is considered sufficient and 75% and above is considered excellent within the forecast community. The average lead time (not shown) for all lakes/reservoirs combined over the length of the monsoon season was just over 25 minutes.

<b>TABLE 5: MSP Lake Alerts Issued - 2018 Monsoon Season</b>										
	<b>June</b>		<b>July</b>		<b>August</b>		<b>September</b>		<b>Season Totals</b>	
<b>Recreational Zone</b>	<b>Correct Alerts</b>	<b>AOF (%)</b>	<b>Correct Alerts</b>	<b>AOF (%)</b>	<b>Correct Alerts</b>	<b>AOF (%)</b>	<b>Correct Alerts</b>	<b>AOF (%)</b>	<b>Correct Alerts</b>	<b>AOF (%)</b>
Lake Pleasant	0/0	n/a	4/4	100%	2/4	50%	1/1	100%	<b>7/9</b>	<b>77.8%</b>
Horseshoe Lake	0/0	n/a	0/0	n/a	0/0	n/a	0/0	n/a	<b>0/0</b>	<b>n/a</b>
Bartlett Lake	0/0	n/a	5/5	100%	2/2	100%	0/0	n/a	<b>7/7</b>	<b>100%</b>
Saguaro Lake	0/0	n/a	3/4	75%	4/4	100%	0/0	n/a	<b>7/8</b>	<b>87.5%</b>
Canyon Lake	0/0	n/a	3/4	75%	3/4	75%	0/0	n/a	<b>6/8</b>	<b>75%</b>
Apache Lake	0/0	n/a	4/5	80%	3/4	75%	0/0	n/a	<b>7/9</b>	<b>77.8%</b>
<b>All Zones</b>	<b>0/0</b>	<b>n/a</b>	<b>19/22</b>	<b>86.4%</b>	<b>14/18</b>	<b>87.5%</b>	<b>1/1</b>	<b>100%</b>	<b>34/41</b>	<b>82.9%</b>

## QPF STORM TOTAL PRECIPITATION VERIFICATION

The MSP has placed added emphasis on including QPF information within message statements, specifically M-1 Alerts. These messages are normally issued before the onset of rain events and precede warning issuance in order to maximize lead time for affected locations. Providing STP that will likely accompany thunderstorms moving through a FZ is intended to help clients make well-informed and proactive decisions.

Figure 6, below, is a scatter plot depicting forecast versus observed storm total precipitation. An accurate forecast will have points on or near the solid black diagonal line. Two black dashed lines were also included that show the “+/-” 25 percent error thresholds used in the verification process (discussed in the [MSP Verification Metrics and Criteria](#) section). All events that fall between the upper and lower thresholds were considered hits. There were 110 qualifying message events that counted towards the verification of the STP forecasts and ninety-three events fell within the error threshold.

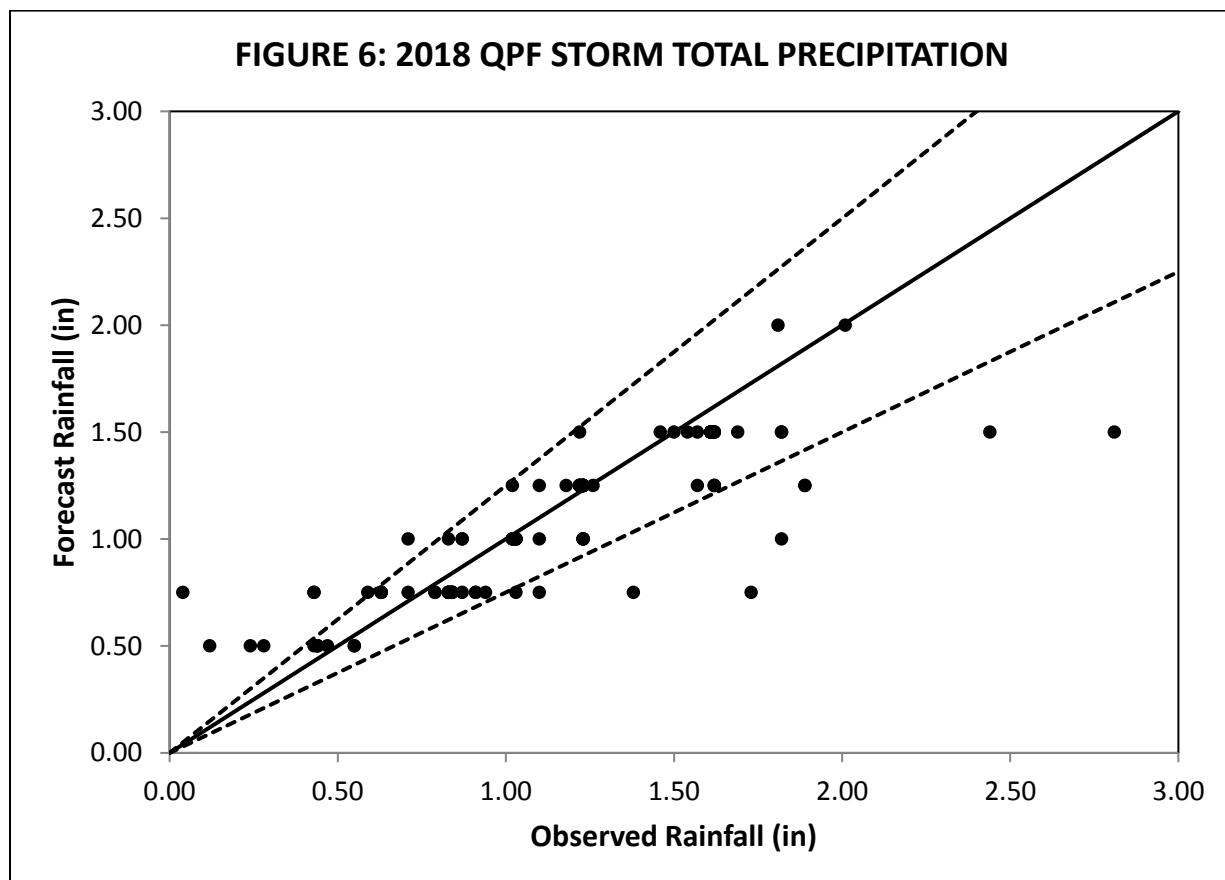


Table 7, on the next page, shows the issued message verification broken down by FZ and month. Complete data tables for each FZ can be viewed in [Appendix E: Table E-1](#). Forecast accuracy for all FZs combined, over the length of the season, was 84.5%. There were three qualifying events in June with two verifying. Accuracy in July came in at 91.5% with forty-seven



qualifying events spread over ten different storm days. Accuracy worsened to 79.7% in August spread across fifty-nine qualifying STP events. August also happened to have the largest number of qualifying events and storm days with twelve. Forecast accuracy was perfect in September. However, there was only one qualifying STP event, which is a very small sample size. Forecast accuracy remained at or above 75% threshold for fourteen FZs. Forecast accuracy over the remaining three FZs remained at or above the 50% threshold with the Gila River Zone the lowest coming in right at 50%.

It is important to remember observed storm total rainfall data is typically gathered from either ALERT rain gages or provided from local storm reports. In either case, accurate measurements of peak rainfall are contingent upon a thunderstorm rain core directly passing over a gage site. In this case, gage adjusted radar rainfall estimates (e.g. GAQPE) were used to fill in the gaps that would otherwise be missed in the FZs.

**TABLE 7: QPF Storm Total Precipitation Verification - Monsoon Season 2018**

	June		July		August		September		Season Totals	
Forecast Zone	Correct QPF	AOF (%)	Correct QPF	AOF (%)	Correct QPF	AOF (%)	Correct QPF	AOF (%)	Correct QPF	AOF (%)
Gila Bend	0/0	n/a	3/3	100%	0/0	n/a	0/0	n/a	3/3	100%
Gila River	0/0	n/a	1/1	100%	1/3	33.3%	0/0	n/a	2/4	50%
Palo Verde	0/0	n/a	2/2	100%	2/3	66.7%	0/0	n/a	4/5	80%
Rainbow Valley	0/0	n/a	2/2	100%	1/2	50%	0/0	n/a	3/4	75%
West Valley	0/0	n/a	4/4	100%	3/3	100%	0/0	n/a	7/7	100%
NW Valley	0/0	n/a	4/5	80%	2/4	50%	0/0	n/a	6/9	66.7%
Upper Centennial	0/0	n/a	3/3	100%	0/0	n/a	0/0	n/a	3/3	100%
Wickenburg	0/0	n/a	3/3	100%	2/2	100%	0/0	n/a	5/5	100%
New River/Cave Creek	0/0	n/a	5/6	83.3%	6/7	85.7%	0/0	n/a	11/13	84.6%
Phoenix North	0/0	n/a	3/4	75%	3/4	75%	0/0	n/a	6/8	75%
Phoenix South	0/0	n/a	2/2	100%	6/6	100%	0/0	n/a	8/8	100%
Scottsdale North	0/1	0%	3/4	75%	4/6	66.7%	0/0	n/a	7/11	63.6%
Scottsdale South	1/1	100%	2/2	100%	4/5	80%	0/0	n/a	7/8	87.5%
East Valley	1/1	100%	3/3	100%	4/5	80%	0/0	n/a	8/9	88.9%
Southeast Valley	0/0	n/a	1/1	100%	4/4	100%	1/1	100%	6/6	100%
Lower Salt River Lakes	0/0	n/a	0/0	n/a	1/1	100%	0/0	n/a	1/1	100%
Superstition	0/0	n/a	2/2	100%	4/4	100%	0/0	n/a	6/6	100%
<b>All Zones</b>	<b>2/3</b>	<b>66.7%</b>	<b>43/47</b>	<b>91.5%</b>	<b>47/59</b>	<b>79.7%</b>	<b>1/1</b>	<b>100%</b>	<b>93/110</b>	<b>84.5%</b>

## SUMMARY

The Flood Warning Branch of the FCDMC operates a year round Meteorological Services Program (MSP) that's purpose is to provide detailed weather forecasts and support to county, city, and other local agencies encompassing Maricopa County and its contributing watersheds. In particular, during the length of the monsoon season, it is the specific the goal of the MSP to reduce response time for emergency managers by providing timely and accurate weather information, primarily regarding the potential for flood-producing rainfall. This report provides a compiled set of verification statistics based on products issued by the MSP during the length of the 2018 monsoon season. Outlooks, Messages, Lake Alerts, and QPF Storm Total Precipitation were the four products analyzed in this report.

Verification of daily outlooks was conducted using four metrics: forecast accuracy, probability of detection, false alarm rate, and threat score. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 86.1%, probability of detection was 82.2%, the false alarm rate was 1.6%, and the Threat Score was 75.6%. Each metric fell into the “excellent” category when equating these results with accepted values within the forecast community. Each metric also improved from the previous year.

Verification of messages was conducted using forecast accuracy. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 89.9%. Any value of over 75% is considered “excellent” within the forecast community. Forecast skill was pretty consistent across each of the months during the length of the season. The average lead time for all M-1 Alerts and M-3 Flash Flood Warnings combined over the length of the Monsoon season improved significantly to fifty-seven minutes. The average lead time for M-2 Flash Flood Watches was just under eleven hours.

Verification of lake alerts was conducted using forecast accuracy. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 82.9% spread across forty-one events. It's worth noting again that no lake alerts were issued for Horseshoe Lake this monsoon season as the reservoir remained mostly empty through the summer months. The average lead time for all lakes/reservoirs combined over the length of the season improved to twenty-five minutes. This improved lead time from previous years likely came at the cost of a lower forecast accuracy due to a larger number of false alarms.

Verification of QPF storm total precipitation was conducted using forecast accuracy. Forecast accuracy was determined using computed percent error when looking at forecasts versus observational data sets. When comparing all forecast zones combined over the length of the monsoon season, forecast accuracy was 84.5%. The addition of gage corrected radar rainfall estimation and cooperative rain gage sites in the verification process has proven to be critical for FZs with greater spatial gaps between gage sites.

<b>TABLE 8: Historic Monsoon Season Verification Comparison</b>										
	<b>Outlooks</b>				<b>Messages</b>		<b>Lake Alerts</b>		<b>QPF STP</b>	
<b>Year</b>	<b>AOF</b>	<b>POD</b>	<b>FAR</b>	<b>TS</b>	<b>Events</b>	<b>AOF</b>	<b>Events</b>	<b>AOF</b>	<b>Events</b>	<b>AOF</b>
2012	79.1%	79.6%	8.9%	n/a	102	86.3%	n/a	n/a	n/a	n/a
2013	79.8%	78.7%	6.2%	n/a	137	88.0%	56	89.3%	54	72.2%
2014	77.7%	76.9%	7.1%	67.4%	263	80.2%	57	84.2%	76	72.4%
2015	74.8%	60.3%	2.8%	67.9%	118	75.4%	40	95%	56	82.1%
2016	84.9%	78%	2.6%	77.5%	112	90.2%	46	82.6%	53	88.7%
2017	83.1%	77.9%	1.8%	72.4%	111	86.5%	53	90.6%	67	93.1%
2018	86.1%	82.2%	1.6%	75.6%	129	89.9%	41	82.9%	110	84.5%

Table 8, above, was included to add more historical perspective in the verification process. Verification metrics for Outlooks, Messages, Lake Alerts, and QPF STP were included for all previous years. All Outlook forecast metrics improved in 2018 when compared to 2017. Of note forecast accuracy, probability of detection, and false alarm rate were the best of any of the previous seasons sampled. Threat score was just shy of the 2016 peak but remained well above longer term average.

Forecast skill for issued messages improved from the 2017 season and narrowly came in behind the highest forecast skill for issued messages in 2016. Lead time of fifty-seven minutes for M-1 Alerts and M-3 Flash Flood Warnings improved by twenty-five minutes from 2017. M-2 Flash Flood Watch lead time dropped dramatically from 2017 but still came in well above the critical six hour requirement at just under eleven hours. Forecast accuracy for Lake Alerts dropped significantly from 2017 and came in just above the lowest benchmark set in 2016. However, lead time was greatly improved and likely came at a cost to forecast skill. STP skill was above the long term average but lower than the two previous seasons. It's important to note that we had by far the largest number of qualifying events from any previous season, but still came in well above the 75% threshold.

When all was said and done, the 2018 monsoon season was considered normal in terms of rainfall and products issued by the MSP. It is hoped that this report serves as quantifiable tool used to evaluate forecast performance on a year to year basis. This report will be continued in subsequent years focusing not only the present year's statistical data, but will also serve as a historical comparison to measure future year's performance.

## APPENDIX A: MSP OUTLOOKS - VERIFICATION TABLES

**TABLE A-1:** This table shows the raw verification data of MSP issued precipitation forecasts contained in the daily Outlooks for the 2018 monsoon season. The valid period for rainfall each day is from 2PM same day through 12PM the following day. The table is broken down by date and MSP Forecast Zone. For brevity two Forecast Zones are included for each day. The columns from left to right are defined as follows:

**Prob.** – Percent probability of measureable rain within the Forecast Zone from 0% to 100% over the period.

**QPF** – Total forecast rainfall in inches within the Forecast Zone over the period.

**ALERT** – Peak total observed ALERT gage rainfall value in inches within the Forecast Zone over the period.

**GAQPE** – Radar rainfall estimate (see [Verification Metrics and Criteria](#) section for more details).

**AOF** – Forecast accuracy, assigned an “h” for a hit and “m” for a miss.

**POD** – Probability of detection, assigned an “h” for a hit, “m” for a miss, or “-” for non-significant rainfall.

**FA** – False alarms, assigned an “x”.

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
	Gila Bend							Gila River						
06/15/18	40	0.50	0.47	1.03-1.22	h	h	-	40	0.25	1.18	0.44-0.63	m	m	-
06/16/18	10	0.10	0.00	0.04-0.24	h	-	-	10	0.10	0.00	0.00	h	-	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-



TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	1/1	0					15	0/1	0
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/18	10	0.10	0.00	0.64-0.83	m	m	-	10	0.10	0.00	0.04-0.24	h	-	-
07/08/18	30	0.50	0.59	1.03-1.22	h	h	-	30	0.50	0.00	0.04-0.24	m	-	-
07/09/18	50	1.50	0.87	2.02-2.20	h	h	-	40	0.75	0.04	1.03-1.22	h	h	-
07/10/18	10	0.25	0.31	1.82-2.01	m	m	-	10	0.10	0.00	0.25-0.43	h	-	-
07/11/18	20	0.75	0.31	0.84-1.02	h	h	-	20	0.75	0.16	0.44-0.63	h	-	-
07/12/18	10	0.75	0.00	0.25-0.43	h	-	-	10	0.50	0.08	0.44-0.63	h	-	-
07/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/18	0	0.00	0.00	0.24-0.43	m	-	-	0	0.00	0.00	0.84-1.02	m	m	-
07/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/16/18	0	0.00	0.31	1.03-1.22	m	m	-	0	0.00	0.00	0.04-0.24	m	-	-
07/17/18	10	0.75	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/18	10	0.75	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/18	30	0.50	0.87	1.23-1.61	m	h	-	30	0.25	0.08	0.25-0.43	h	-	-
07/21/18	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/18	40	1.00	0.00	0.44-0.63	h	h	-	30	0.50	0.04	0.25-0.43	h	-	-
07/29/18	10	0.75	0.00	0.04-0.24	m	-	-	10	0.75	0.00	0.00	h	-	-
07/30/18	10	0.50	0.00	0.04-0.24	h	-	-	10	0.25	0.04	0.44-0.63	h	-	-
07/31/18	10	0.50	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
<b>31 days</b>					<b>25</b>	<b>5/8</b>	<b>0</b>					<b>28</b>	<b>1/2</b>	<b>0</b>
08/01/18	20	0.50	0.00	0.44-0.63	h	-	-	10	0.25	0.00	0.00	h	-	-
08/02/18	20	0.50	0.28	1.62-1.81	m	h	-	10	0.50	0.04	1.03-1.22	h	h	-
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/18	10	0.25	0.08	0.84-1.02	m	m	-	10	0.25	0.04	0.84-1.02	m	m	-
08/08/18	10	0.25	0.20	0.25-0.43	h	-	-	10	0.40	0.08	0.44-0.63	h	-	-
08/09/18	30	1.50	0.47	1.23-1.61	h	h	-	30	1.00	0.43	2.61-2.80	m	h	-
08/10/18	20	1.00	0.00	0.04-0.24	m	-	x	30	1.00	0.04	1.62-1.81	h	h	-
08/11/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
08/12/18	40	1.50	0.20	1.03-1.22	h	h	-	30	0.50	0.24	1.62-1.81	m	h	-
08/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/18	40	1.50	0.20	1.62-1.81	h	h	-	30	1.25	0.00	0.04-0.024	m	-	x
08/15/18	20	0.50	0.00	0.04-0.24	m	-	-	10	0.25	0.00	0.00	h	-	-
08/16/18	50	1.50	0.00	0.25-0.43	m	-	x	40	1.25	0.00	0.25-0.43	m	-	x
08/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/18	30	0.75	0.00	0.04-0.24	m	-	-	30	0.75	0.00	0.04-0.024	m	-	-
08/21/18	20	1.00	0.00	0.25-0.43	m	-	-	20	0.75	0.00	0.44-0.63	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/22/18	20	1.00	0.12	2.21-2.40	m	h	-	20	1.00	0.04	0.44-0.63	h	-	-
08/23/18	20	1.00	0.00	0.00	m	-	-	20	1.00	0.04	1.23-1.61	h	h	-
08/24/18	30	0.75	0.04	1.03-1.22	h	h	-	20	0.50	0.00	0.25-0.43	h	-	-
08/25/18	10	0.50	0.12	0.25-0.43	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					21	6/7	2					25	5/6	2
09/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/02/18	10	0.25	0.63	1.82-2.01	m	m	-	20	0.75	0.00	0.04-0.24	m	-	-
09/03/18	10	0.50	0.08	0.25-0.43	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/18	10	0.50	0.00	0.00	h	-	-	10	0.40	0.00	0.00	h	-	-
09/05/18	0	0.00	0.00	1.23-1.61	m	m	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	30	0.25	0.35	1.62-1.81	m	m	-	20	0.25	0.00	0.04-0.24	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/19/18	40	0.50	0.16	2.81-3.19	m	h	-	40	0.75	0.35	0.44-0.63	h	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					26	1/4	0					29	0/0	0
	Palo Verde							Rainbow Valley						
06/15/18	50	0.50	0.35	1.23-1.61	m	h	-	50	0.50	0.08	0.04-0.24	m	-	-
06/16/18	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
<b>16 days</b>					<b>15</b>	<b>1/1</b>	<b>0</b>					<b>15</b>	<b>0</b>	<b>0</b>
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/18	30	0.40	0.79	1.23-1.61	m	m	-	30	0.30	0.63	0.44-0.63	m	-	-
07/09/18	30	0.50	0.31	1.03-1.22	h	h	-	40	0.75	0.67	1.03-1.22	h	h	-
07/10/18	10	0.10	0.00	0.25-0.43	h	-	-	20	0.25	0.08	0.44-0.63	h	-	-
07/11/18	10	0.35	0.39	1.23-1.61	m	m	-	20	0.50	0.71	0.84-1.02	h	h	-
07/12/18	0	0.00	0.35	0.25-0.43	m	-	-	10	0.50	0.04	0.25-0.43	h	-	-
07/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/18	0	0.00	0.00	0.25-0.43	m	-	-	20	0.70	0.04	1.23-1.61	h	h	-
07/15/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.04-0.24	m	-	-
07/16/18	0	0.00	0.20	0.25-0.43	m	-	-	10	0.25	0.04	0.25-0.43	h	-	-
07/17/18	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/18	30	0.50	0.28	0.84-1.02	h	h	-	30	0.50	0.24	0.64-0.83	h	h	-
07/21/18	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/18	10	0.25	0.00	0.04-0.24	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/18	40	0.75	0.04	0.25-0.43	h	-	-	40	0.75	0.00	0.04-0.24	m	-	x
07/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/30/18	10	0.25	0.12	0.44-0.63	h	-	-	10	0.40	0.00	0.25-0.43	h	-	-
07/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					25	2/4	0					28	4/4	0
08/01/18	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/02/18	20	0.50	0.00	0.00	m	-	-	20	0.50	1.73	1.82-2.01	m	m	-
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/18	0	0.00	0.31	0.64-0.83	m	-	-	10	0.40	0.00	0.04-0.24	h	-	-
08/08/18	10	0.25	0.04	0.25-0.43	h	-	-	10	0.50	0.04	0.25-0.43	h	-	-
08/09/18	30	1.00	0.35	1.23-1.61	h	h	-	30	1.25	0.00	0.84-1.02	h	h	-
08/10/18	20	1.00	0.35	0.64-0.83	h	h	-	30	1.25	0.39	1.62-1.81	h	h	-
08/11/18	0	0.00	0.12	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
08/12/18	40	1.50	0.71	2.21-2.40	h	h	-	40	1.50	0.31	1.23-1.61	h	h	-
08/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/18	30	0.75	0.39	0.44-0.63	h	h	-	30	1.25	0.00	0.04-0.24	m	-	x
08/15/18	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/16/18	40	1.25	0.67	1.03-1.22	h	h	-	40	1.25	0.04	0.64-0.83	h	h	-
08/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/18	20	0.50	0.00	0.00	m	-	-	20	0.50	0.08	0.04-0.24	m	-	-
08/21/18	10	0.50	0.00	0.00	h	-	-	20	0.50	0.00	0.04-0.24	m	-	-
08/22/18	10	0.50	0.24	1.03-1.22	h	h	-	20	0.75	0.16	0.44-0.63	h	-	-
08/23/18	10	0.50	0.00	0.00	h	-	-	20	0.75	0.00	0.84-1.02	h	h	-



TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/24/18	20	0.75	0.00	0.00	m	-	-	20	0.75	0.00	0.44-0.63	h	-	-
08/25/18	0	0.00	0.08	0.25-0.43	m	-	-	0	0.00	0.00	0.00	h	-	-
08/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					25	6/6	0					27	5/6	1
09/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/02/18	10	0.25	0.00	0.00	h	-	-	10	0.50	0.00	0.84-1.02	h	h	-
09/03/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
09/04/18	0	0.00	0.00	0.00	h	-	-	10	0.40	0.00	0.00	h	-	-
09/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	20	0.25	0.00	0.25-0.43	h	-	-	20	0.25	0.04	0.04-0.24	h	-	-
09/19/18	40	0.50	0.00	0.00	m	-	x	30	0.75	0.16	0.25-0.43	h	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					29	0/0	1					30	1/1	0
	West Valley							Northwest Valley						
06/15/18	50	0.50	0.12	0.25-0.43	h	-	-	60	0.75	0.31	0.44-0.63	h	h	-
06/16/18	10	0.10	0.00	0.00	h	-	-	20	0.25	0.00	0.00	m	-	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
16 days					16	0	0					15	1/1	0
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/18	30	0.30	0.31	1.03-1.22	m	m	-	40	0.40	0.20	0.44-0.63	h	-	-
07/09/18	30	0.50	0.35	1.03-1.22	m	h	-	50	1.00	0.55	0.84-1.02	h	h	-
07/10/18	20	0.10	0.08	0.25-0.43	h	-	-	10	0.10	0.08	0.00	h	-	-
07/11/18	20	0.50	1.57	2.02-2.20	m	h	-	10	0.25	1.06	2.02-2.20	m	m	-
07/12/18	0	0.00	0.16	0.25-0.43	m	-	-	10	0.75	0.75	1.03-1.22	h	h	-
07/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/18	20	0.80	0.20	1.23-1.61	h	h	-	30	0.90	0.71	1.23-1.61	h	h	-
07/15/18	20	0.80	0.04	0.04-0.24	m	-	-	30	1.00	0.00	0.04-0.24	m	-	x
07/16/18	10	0.35	0.12	0.44-0.63	h	-	-	10	0.50	0.00	0.04-0.24	m	-	-
07/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/18	20	0.50	0.20	0.44-0.63	h	-	-	20	0.25	0.04	0.25-0.43	h	-	-
07/21/18	10	0.50	0.00	0.04-0.24	m	-	-	10	0.50	0.43	0.44-0.63	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/18	10	0.25	0.00	0.00	h	-	-	10	0.50	0.00	0.04-0.24	m	-	-
07/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
07/28/18	40	0.75	0.08	0.64-0.83	h	h	-	30	1.00	1.10	1.23-1.61	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/30/18	10	0.40	0.43	0.84-1.02	m	m	-	20	0.75	0.94	1.82-2.01	m	h	-
07/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
<b>31 days</b>					<b>24</b>	<b>4/6</b>	<b>0</b>					<b>25</b>	<b>5/6</b>	<b>1</b>
08/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/02/18	0	0.00	0.91	1.82-2.01	m	m	-	0	0.00	1.42	2.02-2.20	m	m	-
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
08/08/18	10	0.50	0.71	1.03-1.22	h	h	-	20	0.50	0.35	0.44-0.63	h	-	-
08/09/18	30	1.00	0.75	0.64-0.82	h	h	-	30	1.00	0.87	0.84-1.02	h	h	-
08/10/18	30	1.00	0.79	1.23-1.61	h	h	-	30	1.00	0.67	1.23-1.61	h	h	-
08/11/18	0	0.00	0.16	0.25-0.43	m	-	-	0	0.00	0.08	0.25-0.43	m	-	-
08/12/18	40	0.75	0.39	0.25-0.43	h	-	-	30	0.50	1.89	2.81-3.19	m	h	-
08/13/18	0	0.00	0.00	0.00	h	-	-	20	0.75	0.00	0.00	m	-	-
08/14/18	30	1.00	0.83	1.03-1.22	h	h	-	30	1.25	0.35	0.84-1.02	h	h	-
08/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/18	30	1.00	0.98	1.23-1.61	h	h	-	30	1.00	1.02	1.23-1.61	h	h	-
08/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.35	0.44-0.63	m	-	-
08/18/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.04-0.24	m	-	-
08/19/18	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/20/18	20	0.50	0.00	0.04-0.24	m	-	-	20	1.00	0.20	0.04-0.24	m	-	-
08/21/18	20	0.50	0.00	0.44-0.63	h	-	-	20	0.50	0.12	0.04-0.24	m	-	-
08/22/18	10	0.50	0.16	0.04-0.24	m	-	-	20	0.50	0.00	0.04-0.24	m	-	-
08/23/18	10	0.50	0.51	0.44-0.63	h	h	-	20	0.50	0.67	0.84-1.02	h	h	-
08/24/18	0	0.00	0.75	1.03-1.22	m	m	-	0	0.00	0.67	1.62-1.81	m	m	-
08/25/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.20	0.25-0.43	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					24	6/8	0					20	6/8	0
09/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/02/18	10	0.50	0.67	1.62-1.81	m	h	-	10	0.30	0.16	1.23-1.61	m	m	-
09/03/18	0	0.00	0.00	0.00	h	-	-	10	0.40	0.00	0.00	h	-	-
09/04/18	10	0.30	0.00	0.04-0.24	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/19/18	30	0.50	0.12	0.25-0.43	h	-	-	30	0.40	0.04	0.04-0.24	h	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					28	1/1	0					28	0/1	0
	Upper Centennial							Wickenburg						
06/15/18	60	0.75	0.51	2.61-2.80	m	h	-	60	1.00	2.01	2.61-2.80	m	h	-
06/16/18	20	0.33	0.00	0.04-0.24	h	-	-	20	0.33	0.00	0.04-0.24	h	-	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					15	1/1	0					15	1/1	0
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-



TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/18	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/07/18	10	0.10	0.00	0.04-0.24	h	-	-	10	0.10	0.00	0.00	h	-	-
07/08/18	40	0.40	0.47	1.62-1.81	m	m	-	40	0.40	0.47	0.84-1.02	m	m	-
07/09/18	50	1.00	0.24	0.44-0.63	m	-	x	50	1.00	0.04	0.04-0.24	m	-	x
07/10/18	10	0.10	0.55	0.25-0.43	m	-	-	10	0.10	0.00	0.04-0.24	h	-	-
07/11/18	10	0.25	0.67	1.62-1.81	m	m	-	10	0.25	1.81	1.62-1.81	m	m	-
07/12/18	20	0.75	0.87	1.23-1.61	h	h	-	20	0.75	2.17	1.23-1.61	h	h	-
07/13/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
07/14/18	40	1.00	0.31	0.84-1.02	h	h	-	40	1.20	1.54	1.03-1.22	h	h	-
07/15/18	40	1.25	0.16	0.44-0.63	m	-	x	40	1.25	0.43	0.44-0.63	m	-	x
07/16/18	10	0.50	0.00	0.25-0.43	h	-	-	10	0.50	0.08	0.25-0.43	h	-	-
07/17/18	10	0.50	0.51	1.23-1.61	h	h	-	10	0.50	0.12	0.25-0.43	h	-	-
07/18/18	10	0.50	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
07/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/18	20	0.50	0.71	0.44-0.63	h	h	-	20	0.25	0.24	0.04-0.24	h	-	-
07/21/18	10	0.50	0.04	0.04-0.24	m	-	-	10	0.50	0.24	0.25-0.43	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/26/18	10	0.50	0.00	0.00	h	-	-	20	0.50	0.00	0.00	m	-	-
07/27/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
07/28/18	20	0.50	0.87	2.21-2.40	m	h	-	20	0.50	0.79	1.23-1.61	m	h	-
07/29/18	10	0.75	0.00	0.00	h	-	-	10	0.75	0.00	0.00	h	-	-
07/30/18	30	1.00	0.39	1.03-1.22	h	h	-	30	1.00	2.28	1.82-2.01	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/31/18	10	0.50	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
31 days					22	6/8	2					25	4/6	2
08/01/18	0	0.00	0.00	0.25-0.43	m	-	-	0	0.00	0.00	0.00	h	-	-
08/02/18	0	0.00	1.06	1.62-1.81	m	m	-	0	0.00	0.98	1.23-1.61	m	m	-
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/08/18	20	0.50	0.24	0.84-1.02	h	h	-	20	0.75	0.24	0.64-0.83	h	h	-
08/09/18	30	1.00	0.08	0.44-0.63	h	h	-	30	1.00	0.04	0.04-0.24	m	-	x
08/10/18	30	1.00	0.24	0.44-0.63	h	h	-	30	1.00	0.24	0.25-0.43	m	-	x
08/11/18	0	0.00	0.00	0.44-0.63	m	-	-	10	0.50	0.00	0.00	h	-	-
08/12/18	20	0.50	0.00	0.04-0.24	h	-	-	20	0.50	0.00	0.00	m	-	-
08/13/18	10	0.50	0.00	0.00	h	-	-	20	0.75	0.00	0.00	m	-	-
08/14/18	30	0.75	0.63	1.03-1.22	h	h	-	30	1.25	0.51	0.84-1.02	h	h	-
08/15/18	0	0.00	0.08	0.25-0.43	m	-	-	0	0.00	0.08	0.04-0.24	m	-	-
08/16/18	20	0.75	0.83	0.64-0.83	h	h	-	20	0.75	0.71	0.44-0.63	h	h	-
08/17/18	0	0.00	1.18	1.23-1.61	m	m	-	0	0.00	1.93	1.62-1.81	m	m	-
08/18/18	10	0.50	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
08/19/18	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/20/18	20	1.00	0.00	0.00	m	-	-	20	1.00	0.00	0.04-0.24	m	-	-
08/21/18	20	0.50	0.00	0.04-0.24	m	-	-	20	0.50	0.00	0.00	m	-	-
08/22/18	20	0.50	0.91	2.02-2.20	m	h	-	20	0.50	0.71	1.23-1.61	m	h	-
08/23/18	20	0.50	0.00	0.84-1.02	h	h	-	20	0.50	0.35	1.03-1.22	m	h	-
08/24/18	0	0.00	0.08	0.25-0.43	m	-	-	0	0.00	0.51	1.23-1.61	m	m	-
08/25/18	0	0.00	1.38	2.41-2.61	m	m	-	0	0.00	1.57	2.41-2.61	m	m	-
08/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					21	7/10	0					18	5/9	2
09/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/02/18	10	0.25	0.47	1.03-1.22	m	m	-	10	0.25	0.31	0.25-0.43	h	-	-
09/03/18	10	0.40	0.00	0.00	h	-	-	10	0.40	0.00	0.00	h	-	-
09/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/19/18	30	1.00	0.00	0.44-0.63	h	h	-	30	0.75	0.00	0.04-0.24	m	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					28	1/2	0					28	0/0	0
	New River/Cave Creek							Phoenix North						
06/15/18	60	1.00	0.39	0.04-0.24	m	-	X	50	0.75	0.00	0.00	m	-	X
06/16/18	30	0.33	1.73	1.23-1.61	m	m	-	30	0.25	0.04	0.04-0.24	h	-	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					14	0/1	1					15	0	1
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/18	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/18	10	0.10	0.00	0.04-0.24	h	-	-	0	0.00	0.00	0.00	h	-	-
07/08/18	50	0.40	0.20	0.25-0.43	h	-	-	40	0.40	0.20	0.04-0.24	h	-	-
07/09/18	50	1.00	1.34	1.62-1.81	h	h	-	40	0.75	0.91	0.84-1.02	h	h	-
07/10/18	20	0.10	0.04	0.04-0.24	h	-	-	20	0.15	0.04	0.04-0.24	h	-	-
07/11/18	20	0.35	1.89	1.82-2.01	m	m	-	20	0.50	1.65	1.82-2.01	m	h	-
07/12/18	10	0.75	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/13/18	20	0.75	0.31	0.64-0.83	h	h	-	10	0.50	0.00	0.04-0.24	m	-	-
07/14/18	40	1.40	1.46	1.23-1.61	h	h	-	10	1.00	0.16	0.44-0.63	h	h	-
07/15/18	40	1.25	0.08	0.25-0.43	m	-	x	30	1.00	0.04	0.04-0.24	m	-	x
07/16/18	20	0.75	0.04	0.25-0.43	h	-	-	20	0.50	0.00	0.04-0.24	h	-	-
07/17/18	10	0.50	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/18/18	10	0.50	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/18	10	1.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/18	20	1.00	0.00	0.04-0.24	m	-	x	0	0.00	0.00	0.04-0.24	m	-	-
07/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/18	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
07/26/18	20	0.50	0.31	1.03-1.22	m	h	-	10	0.25	0.00	0.00	h	-	-
07/27/18	20	0.80	0.47	0.64-0.83	h	h	-	0	0.00	0.08	0.04-0.24	m	-	-
07/28/18	50	1.00	0.47	1.81-2.01	h	h	-	40	1.00	0.04	0.04-0.24	m	-	x
07/29/18	20	0.75	0.00	0.00	m	-	-	10	0.75	0.00	0.00	h	-	-
07/30/18	30	1.00	1.18	1.82-2.01	h	h	-	20	0.50	0.79	0.84-1.02	h	h	-
07/31/18	10	0.50	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					26	7/8	2					25	4/4	2

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/01/18	20	0.50	0.16	0.64-0.83	h	h	-	10	0.35	0.00	0.04-0.24	h	-	-
08/02/18	20	0.75	0.94	0.84-1.02	h	h	-	20	0.50	0.28	0.04-0.24	m	-	-
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.04	0.04-0.24	m	-	-
08/08/18	30	0.75	0.47	0.64-0.83	h	h	-	20	0.75	0.51	1.23-1.61	h	h	-
08/09/18	50	1.50	0.79	0.84-1.02	h	h	-	40	1.25	0.16	0.44-0.63	m	-	x
08/10/18	40	1.50	0.47	1.03-1.22	h	h	-	40	1.25	0.83	1.23-1.61	h	h	-
08/11/18	20	0.75	0.51	1.03-1.22	h	h	-	10	0.50	0.00	0.00	h	-	-
08/12/18	20	0.50	0.47	0.44-0.63	h	h	-	20	0.50	0.08	0.04-0.24	m	-	-
08/13/18	20	0.75	0.12	0.25-0.43	h	-	-	10	0.40	0.00	0.00	h	-	-
08/14/18	40	1.50	1.10	1.03-1.22	h	h	-	30	1.25	0.12	0.25-0.43	m	-	x
08/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/18	20	1.00	0.87	0.84-1.02	h	h	-	20	0.75	0.00	0.00	m	-	-
08/17/18	0	0.00	0.20	0.44-0.63	m	-	-	0	0.00	0.00	0.00	h	-	-
08/18/18	10	0.50	0.35	1.23-1.61	m	h	-	0	0.00	0.04	0.04-0.24	m	-	-
08/19/18	10	0.25	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/18	30	1.00	0.16	0.44-0.63	h	-	-	30	1.00	0.12	0.04-0.24	m	-	x
08/21/18	20	0.75	0.04	0.44-0.63	h	-	-	20	0.75	0.00	0.04-0.24	m	-	-
08/22/18	20	0.75	0.47	0.44-0.63	h	-	-	10	0.75	0.00	0.00	h	-	-
08/23/18	20	0.75	0.91	1.82-2.01	m	h	-	10	0.75	1.77	1.23-1.61	h	h	-
08/24/18	30	1.25	0.87	1.03-1.22	h	h	-	20	1.00	0.00	0.00	m	-	-
08/25/18	20	1.00	0.79	1.03-1.22	h	h	-	0	0.00	0.00	0.00	h	-	-
08/26/18	10	1.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
<b>31 days</b>					<b>28</b>	<b>13/13</b>	<b>0</b>					<b>21</b>	<b>3/3</b>	<b>3</b>
09/01/18	10	0.50	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/02/18	10	0.75	0.00	0.25-0.43	h	-	-	10	0.50	0.00	0.04-0.24	m	-	-
09/03/18	10	0.40	0.04	0.04-0.24	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/18	10	0.50	0.75	0.64-0.83	h	h	-	0	0.00	0.00	0.00	h	-	-
09/05/18	0	0.00	0.04	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/19/18	40	0.75	0.16	0.25-0.43	h	-	-	40	0.50	0.20	0.25-0.43	h	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-



TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					28	1/1	0					28	0/0	0
	Phoenix South							Scottsdale North						
06/15/18	50	0.50	0.51	0.44-0.63	h	h	-	60	0.75	0.59	0.25-0.43	h	h	-
06/16/18	20	0.10	0.12	0.04-0.24	h	-	-	30	0.25	0.63	0.84-1.02	m	m	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					16	1/1	0					15	1/2	0
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/18	0	0.00	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
07/08/18	30	0.25	0.08	0.04-0.24	h	-	-	40	0.40	0.00	0.04-0.24	h	-	-
07/09/18	40	0.75	1.34	1.23-1.61	h	h	-	50	1.00	1.14	1.23-1.61	h	h	-
07/10/18	20	0.15	0.20	0.44-0.63	h	-	-	20	0.25	0.24	0.25-0.43	h	-	-
07/11/18	30	1.00	1.02	1.82-2.01	h	h	-	30	0.75	1.10	1.23-1.61	h	h	-
07/12/18	10	0.50	0.08	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
07/13/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.04-0.24	m	-	-
07/14/18	0	0.00	0.00	0.04-0.24	h	-	-	10	1.00	1.18	1.23-1.61	h	h	-
07/15/18	20	0.80	0.04	0.04-0.24	m	-	-	30	1.00	0.12	0.04-0.24	m	-	x
07/16/18	10	0.50	0.04	0.04-0.24	m	-	-	20	0.75	0.00	0.00	m	-	-
07/17/18	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/18	0	0.00	0.08	0.04-0.24	m	-	-	0	0.00	0.04	0.04-0.24	m	-	-
07/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/18	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
07/26/18	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
07/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.04	0.04-0.24	m	-	-
07/28/18	30	0.50	0.16	0.04-0.24	h	-	-	40	0.75	0.20	0.25-0.43	h	-	-
07/29/18	0	0.00	0.00	0.00	h	-	-	10	0.75	0.00	0.00	h	-	-
07/30/18	10	0.50	0.35	0.44-0.63	h	-	-	20	0.75	1.18	1.62-1.81	h	h	-
07/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
<b>31 days</b>					<b>27</b>	<b>2/2</b>	<b>0</b>					<b>26</b>	<b>4/4</b>	<b>1</b>
08/01/18	10	0.25	0.00	0.04-0.24	h	-	-	10	0.50	0.04	0.25-0.43	h	-	-
08/02/18	20	0.33	0.24	0.44-0.63	h	-	-	20	0.50	0.00	0.04-0.24	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/18	10	0.25	0.28	0.44-0.63	h	-	-	0	0.00	0.04	0.44-0.63	m	-	-
08/08/18	10	0.50	0.79	0.84-1.02	h	h	-	30	0.75	1.89	2.21-2.40	m	h	-
08/09/18	30	1.00	0.67	1.23-1.61	h	h	-	40	1.50	0.43	0.64-0.83	m	-	x
08/10/18	30	1.00	1.06	1.62-1.81	h	h	-	40	1.50	1.38	1.82-2.01	h	h	-
08/11/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
08/12/18	30	0.75	0.12	0.44-0.63	h	-	-	20	0.50	1.46	1.23-1.61	m	h	-
08/13/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
08/14/18	20	1.00	0.08	0.04-0.24	m	-	x	30	1.25	0.83	1.62-1.81	h	h	-
08/15/18	10	0.15	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/16/18	20	0.75	0.00	0.00	m	-	-	20	0.75	0.24	0.25-0.43	h	-	-
08/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.12	0.25-0.43	h	-	-
08/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/18	20	0.50	0.20	0.04-0.24	m	-	-	30	0.75	0.16	0.44-0.63	h	-	-
08/21/18	20	0.50	0.12	0.44-0.63	h	-	-	20	0.75	0.16	0.25-0.43	h	-	-
08/22/18	10	0.50	0.00	0.04-0.24	m	-	-	20	0.75	0.00	0.04-0.24	m	-	-
08/23/18	10	0.50	1.46	1.03-1.22	m	h	-	20	0.75	1.61	1.82-2.01	m	h	-
08/24/18	20	0.75	0.35	0.44-0.63	h	-	-	30	1.25	0.87	0.84-1.02	h	h	-
08/25/18	0	0.00	0.00	0.00	h	-	-	10	0.75	0.08	0.04-0.24	m	-	-
08/26/18	0	0.00	0.00	0.00	h	-	-	10	0.75	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
31 days					26	4/4	1					24	6/6	1
09/01/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.24	0.44-0.63	h	-	-
09/02/18	20	0.75	0.67	1.03-1.22	h	h	-	20	0.50	0.00	0.00	m	-	-
09/03/18	10	0.50	0.00	0.00	h	-	-	10	0.40	0.00	0.00	h	-	-
09/04/18	10	0.30	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.04-0.24	m	-	-
09/19/18	40	0.50	0.28	0.44-0.63	h	-	-	40	0.50	0.16	0.25-0.43	h	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					29	1/1	0					28	0/0	0
	Scottsdale South							East Valley						
06/15/18	50	0.50	1.34	0.84-1.02	m	h	-	60	0.75	1.18	0.44-0.63	h	h	-
06/16/18	20	0.10	0.04	0.04-0.24	h	-	-	20	0.10	0.00	0.00	m	-	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					15	1/1	0					15	1/1	0
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/08/18	30	0.25	0.04	0.04-0.24	h	-	-	30	0.25	0.08	0.04-0.24	h	-	-
07/09/18	40	0.75	0.94	0.84-1.02	h	h	-	40	0.75	1.10	0.84-1.02	h	h	-
07/10/18	20	0.15	0.04	0.04-0.24	h	-	-	20	0.15	0.51	0.64-0.83	m	m	-
07/11/18	30	0.75	1.10	0.84-1.02	h	h	-	30	1.00	0.47	0.44-0.63	h	-	-
07/12/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.08	0.04-0.24	m	-	-
07/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/14/18	0	0.00	0.00	0.04-0.24	m	-	-	0	0.00	0.00	0.00	h	-	-
07/15/18	20	0.80	0.04	0.04-0.24	m	-	-	0	0.00	0.08	0.00	h	-	-
07/16/18	10	0.50	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
07/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/20/18	0	0.00	0.04	0.04-0.24	m	-	-	0	0.00	0.20	0.04-0.24	m	-	-
07/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/18	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.00	h	-	-
07/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/28/18	30	0.50	0.16	0.04-0.24	h	-	-	30	0.50	0.28	0.25-0.43	h	-	-
07/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/30/18	10	0.50	0.71	0.64-0.83	h	h	-	10	0.75	0.63	1.03-1.22	h	h	-
07/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					28	3/3	0					27	2/3	0
08/01/18	0	0.00	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/02/18	20	0.33	0.00	0.00	m	-	-	10	0.33	0.00	0.04-0.24	h	-	-
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/07/18	0	0.00	0.20	0.25-0.43	m	-	-	10	0.40	0.87	0.64-0.83	m	m	-
08/08/18	10	0.50	1.22	1.62-1.81	m	h	-	20	0.75	0.91	0.84-1.02	h	h	-
08/09/18	30	1.00	0.67	1.23-1.61	h	h	-	30	1.25	2.44	2.81-3.19	h	h	-
08/10/18	30	1.00	1.10	1.23-1.61	h	h	-	30	1.25	0.98	0.84-1.02	h	h	-
08/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/12/18	30	0.75	1.46	1.23-1.61	h	h	-	20	0.50	0.55	0.64-0.83	h	h	-
08/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/14/18	20	1.25	0.20	1.03-1.22	h	h	-	30	1.50	0.24	0.04-0.24	m	-	x
08/15/18	10	0.15	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/16/18	20	0.75	0.00	0.04-0.24	m	-	-	20	0.75	0.00	0.00	m	-	-
08/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/18	20	0.50	0.31	0.04-0.24	h	-	-	30	0.75	0.04	0.04-0.24	m	-	-
08/21/18	20	0.50	0.00	0.00	m	-	-	30	0.75	0.04	0.04-0.24	m	-	-
08/22/18	10	0.75	0.00	0.00	h	-	-	20	1.00	0.00	0.04-0.24	m	-	-
08/23/18	10	0.75	0.39	0.25-0.43	h	-	-	20	1.00	1.73	1.62-1.81	h	h	-
08/24/18	20	1.00	0.04	0.04-0.024	m	-	-	20	0.75	0.35	0.44-0.63	h	-	-
08/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
31 days					25	5/5	0					25	5/6	1
09/01/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-



TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/02/18	20	0.75	0.00	0.00	m	-	-	30	1.00	0.16	0.04-0.24	m	-	x
09/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/04/18	0	0.00	0.00	0.00	h	-	-	10	0.30	0.00	0.00	h	-	-
09/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	0	0.00	0.00	0.04-0.24	m	-	-	20	0.25	0.04	0.04-0.24	h	-	-
09/19/18	40	0.50	0.16	0.25-0.43	h	-	-	40	0.75	0.28	0.44-0.63	h	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
30 days					28	0/0	0					29	0/0	1
	Southeast Valley							Lower Salt River Lakes						
06/15/18	60	0.75	0.67	0.25-0.43	h	h	-	60	1.00	0.08	0.84-1.02	h	h	-
06/16/18	20	0.10	0.00	0.00	m	-	-	30	0.25	0.00	0.04-0.24	h	-	-
06/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/18/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
06/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
16 days					15	1/1	0					16	1/1	0
07/01/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/02/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/07/18	0	0.00	0.00	0.04-0.24	m	-	-	20	0.15	0.00	0.00	m	-	-
07/08/18	40	0.25	0.00	0.04-0.24	h	-	-	50	0.40	0.00	0.04-0.24	h	-	-
07/09/18	40	0.75	0.12	0.84-1.02	h	h	-	60	1.00	0.43	1.03-1.22	h	h	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/10/18	20	0.25	0.08	0.44-0.63	m	-	-	30	0.25	0.00	0.84-1.02	m	m	-
07/11/18	30	1.00	0.20	0.44-0.63	h	-	-	30	0.50	0.20	0.44-0.63	h	-	-
07/12/18	10	0.50	0.00	0.04-0.24	m	-	-	10	0.75	0.00	0.00	h	-	-
07/13/18	0	0.00	0.04	0.04-0.24	m	-	-	20	0.75	0.00	0.00	m	-	-
07/14/18	0	0.00	0.04	0.64-0.83	m	-	-	0	0.00	0.00	0.44-0.63	m	-	-
07/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.04-0.24	m	-	-
07/16/18	10	0.50	0.00	0.00	h	-	-	20	0.75	0.00	0.00	m	-	-
07/17/18	10	0.50	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
07/18/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
07/19/18	0	0.00	0.00	0.00	h	-	-	20	0.75	0.00	0.00	m	-	-
07/20/18	0	0.00	0.16	0.25-0.43	m	-	-	0	0.00	0.04	0.04-0.24	m	-	-
07/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
07/25/18	10	0.10	0.00	0.00	h	-	-	10	0.10	0.00	0.04-0.24	h	-	-
07/26/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
07/27/18	0	0.00	0.00	0.00	h	-	-	20	0.70	0.00	0.00	m	-	-
07/28/18	30	0.50	0.04	0.44-0.63	h	-	-	40	0.75	0.00	0.04-0.24	m	-	x
07/29/18	10	0.75	0.00	0.00	h	-	-	10	0.75	0.00	0.00	h	-	-
07/30/18	10	0.50	0.63	1.03-1.22	h	h	-	20	0.75	0.04	1.03-1.22	h	h	-
07/31/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
<b>31 days</b>					<b>25</b>	<b>2/2</b>	<b>0</b>					<b>21</b>	<b>2/3</b>	<b>1</b>
08/01/18	10	0.25	0.00	0.00	h	-	-	20	0.50	0.00	0.00	m	-	-
08/02/18	10	0.33	0.00	0.00	h	-	-	20	0.50	0.00	0.04-0.24	m	-	-
08/03/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/04/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/07/18	10	0.25	0.20	0.24-0.43	h	-	-	20	0.50	0.35	0.44-0.63	h	-	-
08/08/18	10	0.50	0.00	0.04-0.24	h	-	-	30	0.75	0.08	0.44-0.63	h	-	-
08/09/18	30	1.25	1.97	1.82-2.01	h	h	-	40	1.50	0.91	1.03-1.22	h	h	-
08/10/18	30	1.25	0.04	0.84-1.02	h	h	-	40	1.50	0.39	1.23-1.61	h	h	-
08/11/18	0	0.00	0.00	0.00	h	-	-	20	0.75	0.00	0.00	m	-	-
08/12/18	20	0.50	0.87	1.23-1.61	h	h	-	30	0.75	0.12	0.64-0.83	h	h	-
08/13/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
08/14/18	30	1.25	0.00	0.04-0.24	m	-	x	20	0.75	0.12	0.64-0.83	h	h	-
08/15/18	10	0.25	0.00	0.00	h	-	-	10	0.25	0.00	0.00	h	-	-
08/16/18	20	0.75	0.00	0.00	m	-	-	20	1.00	0.00	0.04-0.24	m	-	x
08/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/18/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
08/19/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/20/18	30	0.75	0.00	0.04-0.24	m	-	-	20	0.50	0.20	0.84-1.02	h	h	-
08/21/18	30	0.75	0.00	0.04-0.24	m	-	-	30	0.75	0.04	1.23-1.61	h	h	-
08/22/18	20	1.00	0.04	0.04-0.24	m	-	-	20	0.75	0.28	1.03-1.22	h	h	-
08/23/18	20	1.00	1.61	1.23-1.61	h	h	-	20	0.75	1.02	1.23-1.61	h	h	-
08/24/18	20	0.75	0.16	0.25-0.43	h	-	-	30	1.00	0.00	0.84-1.02	h	h	-
08/25/18	0	0.00	0.00	0.00	h	-	-	20	1.00	0.00	0.00	m	-	-
08/26/18	0	0.00	0.00	0.00	h	-	-	10	1.00	0.00	0.00	h	-	-
08/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
08/31/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
<b>31 days</b>					<b>26</b>	<b>4/4</b>	<b>1</b>					<b>26</b>	<b>9/9</b>	<b>1</b>
09/01/18	0	0.00	0.00	0.00	h	-	-	10	0.50	0.00	0.04-0.24	m	-	-
09/02/18	20	1.00	1.18	1.23-1.61	h	h	-	20	1.00	0.00	0.44-0.63	h	-	-
09/03/18	0	0.00	0.00	0.00	h	-	-	20	0.50	0.00	0.00	m	-	-

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
Date	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/04/18	10	0.40	0.00	0.00	h	-	-	10	0.50	0.00	0.00	h	-	-
09/05/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/06/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/07/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/08/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/09/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/10/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/11/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/12/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/13/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/14/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/15/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/16/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/17/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/18/18	20	0.25	0.00	0.04-0.24	h	-	-	20	0.25	0.00	0.00	m	-	-
09/19/18	40	0.75	0.35	0.44-0.63	h	-	-	40	0.50	0.16	0.25-0.43	h	-	-
09/20/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/21/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/22/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/23/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/24/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/25/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/26/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/27/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/28/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/29/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
09/30/18	0	0.00	0.00	0.00	h	-	-	0	0.00	0.00	0.00	h	-	-
30 days					30	1/1	0					27	0/0	0

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
	Superstition													
06/15/18	60	1.00	0.43	0.44-0.63	h	h	-							
06/16/18	30	0.25	0.04	0.00	m	-	-							
06/17/18	0	0.00	0.00	0.00	h	-	-							
06/18/18	0	0.00	0.00	0.00	h	-	-							
06/19/18	0	0.00	0.00	0.00	h	-	-							
06/20/18	0	0.00	0.00	0.00	h	-	-							
06/21/18	0	0.00	0.00	0.00	h	-	-							
06/22/18	0	0.00	0.00	0.00	h	-	-							
06/23/18	0	0.00	0.00	0.00	h	-	-							
06/24/18	0	0.00	0.00	0.00	h	-	-							
06/25/18	0	0.00	0.00	0.00	h	-	-							
06/26/18	0	0.00	0.00	0.00	h	-	-							
06/27/18	0	0.00	0.00	0.00	h	-	-							
06/28/18	0	0.00	0.00	0.00	h	-	-							
06/29/18	0	0.00	0.00	0.00	h	-	-							
06/30/18	0	0.00	0.00	0.00	h	-	-							
<b>16 days</b>					<b>15</b>	<b>1/1</b>	<b>0</b>							
07/01/18	0	0.00	0.00	0.00	h	-	-							
07/02/18	0	0.00	0.00	0.00	h	-	-							
07/03/18	0	0.00	0.00	0.00	h	-	-							
07/04/18	0	0.00	0.00	0.00	h	-	-							
07/05/18	0	0.00	0.00	0.00	h	-	-							
07/06/18	0	0.00	0.00	0.00	h	-	-							
07/07/18	20	0.15	0.00	0.00	m	-	-							
07/08/18	50	0.40	0.16	0.04-0.24	h	-	-							
07/09/18	60	1.00	1.38	1.23-1.61	h	h	-							
07/10/18	30	0.25	0.04	0.25-0.43	h	-	-							
07/11/18	30	0.75	0.51	0.44-0.63	h	h	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
07/12/18	10	0.75	0.00	0.00	h	-	-							
07/13/18	0	0.00	0.00	0.00	h	-	-							
07/14/18	0	0.00	0.20	0.44-0.63	m	-	-							
07/15/18	0	0.00	0.00	0.00	h	-	-							
07/16/18	20	0.75	0.00	0.00	m	-	-							
07/17/18	10	0.50	0.00	0.00	h	-	-							
07/18/18	0	0.00	0.00	0.00	h	-	-							
07/19/18	10	0.75	0.00	0.00	h	-	-							
07/20/18	0	0.00	0.08	0.25-0.43	m	-	-							
07/21/18	0	0.00	0.00	0.00	h	-	-							
07/22/18	0	0.00	0.00	0.00	h	-	-							
07/23/18	0	0.00	0.00	0.00	h	-	-							
07/24/18	0	0.00	0.00	0.00	h	-	-							
07/25/18	10	0.10	0.00	0.00	h	-	-							
07/26/18	0	0.00	0.00	0.00	h	-	-							
07/27/18	20	0.70	0.00	0.00	m	-	-							
07/28/18	40	0.75	0.12	0.25-0.43	h	-	-							
07/29/18	10	0.75	0.00	0.04-0.24	m	-	-							
07/30/18	20	0.75	1.10	1.23-1.61	h	h	-							
07/31/18	0	0.00	0.00	0.00	h	-	-							
<b>31 days</b>					<b>25</b>	<b>3/3</b>	<b>0</b>							
08/01/18	10	0.50	0.00	0.00	h	-	-							
08/02/18	20	0.50	0.00	0.04-0.24	m	-	-							
08/03/18	0	0.00	0.00	0.00	h	-	-							
08/04/18	0	0.00	0.00	0.00	h	-	-							
08/05/18	0	0.00	0.00	0.00	h	-	-							
08/06/18	0	0.00	0.00	0.00	h	-	-							
08/07/18	20	0.50	0.87	0.64-0.83	h	h	-							
08/08/18	20	0.75	0.31	0.25-0.43	h	-	-							

TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
08/09/18	40	1.50	1.69	2.41-2.60	h	h	-							
08/10/18	40	1.50	1.54	1.23-1.61	h	h	-							
08/11/18	10	0.50	0.00	0.00	h	-	-							
08/12/18	30	0.75	0.59	0.44-0.63	h	-	-							
08/13/18	0	0.00	0.00	0.00	h	-	-							
08/14/18	30	1.00	0.43	0.44-0.63	h	-	-							
08/15/18	10	0.25	0.00	0.00	h	-	-							
08/16/18	20	1.00	0.00	0.00	m	-	-							
08/17/18	0	0.00	0.00	0.00	h	-	-							
08/18/18	10	0.50	0.00	0.00	h	-	-							
08/19/18	0	0.00	0.00	0.00	h	-	-							
08/20/18	20	0.50	0.16	0.25-0.43	h	-	-							
08/21/18	30	0.75	0.08	0.04-0.24	m	-	-							
08/22/18	20	0.75	0.39	0.04-0.24	h	-	-							
08/23/18	20	1.00	1.73	1.23-1.61	h	h	-							
08/24/18	20	1.00	1.18	1.03-1.22	h	h	-							
08/25/18	10	0.75	0.00	0.00	h	-	-							
08/26/18	10	0.75	0.04	0.00	m	-	-							
08/27/18	0	0.00	0.00	0.00	h	-	-							
08/28/18	0	0.00	0.00	0.00	h	-	-							
08/29/18	0	0.00	0.00	0.00	h	-	-							
08/30/18	0	0.00	0.00	0.00	h	-	-							
08/31/18	0	0.00	0.00	0.00	h	-	-							
<b>31 days</b>					<b>27</b>	<b>5/5</b>	<b>0</b>							
09/01/18	10	0.50	0.47	0.25-0.43	h	-	-							
09/02/18	30	1.00	0.00	0.64-0.83	h	h	-							
09/03/18	0	0.00	0.00	0.00	h	-	-							
09/04/18	10	0.50	0.00	0.00	h	-	-							
09/05/18	0	0.00	0.00	0.00	h	-	-							



TABLE A-1: MSP Outlooks Issued, Daily Verification Table - Monsoon Season 2018														
Date	Forecast Zone Data				Verification			Forecast Zone Data				Verification		
	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA	Prob. (%)	QPF (in)	ALERT (in)	GAQPE (in)	AOF	POD	FA
09/06/18	0	0.00	0.00	0.00	h	-	-							
09/07/18	0	0.00	0.00	0.00	h	-	-							
09/08/18	0	0.00	0.00	0.00	h	-	-							
09/09/18	0	0.00	0.00	0.00	h	-	-							
09/10/18	0	0.00	0.00	0.00	h	-	-							
09/11/18	0	0.00	0.00	0.00	h	-	-							
09/12/18	0	0.00	0.00	0.00	h	-	-							
09/13/18	0	0.00	0.00	0.00	h	-	-							
09/14/18	0	0.00	0.00	0.00	h	-	-							
09/15/18	0	0.00	0.00	0.00	h	-	-							
09/16/18	0	0.00	0.00	0.00	h	-	-							
09/17/18	0	0.00	0.00	0.00	h	-	-							
09/18/18	20	0.25	0.00	0.00	m	-	-							
09/19/18	40	0.75	0.24	0.25-0.43	h	-	-							
09/20/18	0	0.00	0.00	0.00	h	-	-							
09/21/18	0	0.00	0.00	0.00	h	-	-							
09/22/18	0	0.00	0.00	0.00	h	-	-							
09/23/18	0	0.00	0.00	0.00	h	-	-							
09/24/18	0	0.00	0.00	0.00	h	-	-							
09/25/18	0	0.00	0.00	0.00	h	-	-							
09/26/18	0	0.00	0.00	0.00	h	-	-							
09/27/18	0	0.00	0.00	0.00	h	-	-							
09/28/18	0	0.00	0.00	0.00	h	-	-							
09/29/18	0	0.00	0.00	0.00	h	-	-							
09/30/18	0	0.00	0.00	0.00	h	-	-							
30 days					29	1/1	0							

**TABLE A-2:** This table shows the verification data of MSP issued precipitation forecasts contained in the daily Outlooks for the 2018 Monsoon Season. It is a monthly tally of the data contained in Table A-1. The table is broken down by month and MSP Forecast Zone. The columns from left to right are defined as follows:

**Accurate Forecasts** – Number of correct forecasts days out of total days in the month.

**Accuracy** – Accuracy of forecasts in percent.

**Op. Sig. Events Detected** – Number of operationally significant days detected correctly.

**POD** – Probability of detection in percent.

**False Alarms** – Number of false alarms that month.

**FAR** – False alarm rate in percent.

<b>TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2018</b>						
<b>Forecast Zone</b>	<b>Accurate Forecasts</b>	<b>AOF (%)</b>	<b>Sig. Events Detected</b>	<b>POD (%)</b>	<b>False Alarms</b>	<b>FAR (%)</b>
<b>JUNE</b>						
Gila Bend	16/16	100%	1/1	100%	0/16	0%
Gila River	15/16	93.8%	0/1	0%	0/16	0%
Palo Verde	15/16	93.8%	1/1	100%	0/16	0%
Rainbow Valley	15/16	93.8%	0/0	n/a	0/16	0%
West Valley	16/16	100%	0/0	n/a	0/16	0%
Northwest Valley	15/16	93.8%	1/1	100%	0/16	0%
Upper Centennial	15/16	93.8%	1/1	100%	0/16	0%
Wickenburg	15/16	93.8%	1/1	100%	0/16	0%
New River/Cave Creek	14/16	87.5%	0/1	0%	1/16	6.3%
Phoenix North	15/16	93.8%	0/0	n/a	1/16	6.3%
Phoenix South	16/16	100%	1/1	100%	0/16	0%
Scottsdale North	15/16	93.8%	1/2	50%	0/16	0%
Scottsdale South	15/16	93.8%	1/1	100%	0/16	0%
East Valley	15/16	93.8%	1/1	100%	0/16	0%
Southeast Valley	15/16	93.8%	1/1	100%	0/16	0%
Lower Salt River Lakes	16/16	100%	1/1	100%	0/16	0%

<b>TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2018</b>						
<b>Forecast Zone</b>	<b>Accurate Forecasts</b>	<b>AOF (%)</b>	<b>Sig. Events Detected</b>	<b>POD (%)</b>	<b>False Alarms</b>	<b>FAR (%)</b>
Superstition	15/16	93.8%	1/1	100%	0/16	0%
<b>All Zones</b>	<b>258/272</b>	<b>94.9%</b>	<b>12/15</b>	<b>80%</b>	<b>2/272</b>	<b>0.7%</b>
<b>JULY</b>						
Gila Bend	25/31	80.6%	5/8	62.5%	0/31	0%
Gila River	28/31	90.3%	1/2	50%	0/31	0%
Palo Verde	25/31	80.6%	2/4	50%	0/31	0%
Rainbow Valley	28/31	90.3%	4/4	100%	0/31	0%
West Valley	24/31	77.4%	4/6	66.7%	0/31	0%
Northwest Valley	25/31	80.6%	5/6	83.3%	1/31	3.2%
Upper Centennial	22/31	71%	6/8	75%	2/31	6.5%
Wickenburg	25/31	80.6%	4/6	66.7%	2/31	6.5%
New River/Cave Creek	26/31	83.9%	7/8	87.5%	2/31	6.5%
Phoenix North	25/31	80.6%	4/4	100%	2/31	6.5%
Phoenix South	27/31	87.1%	2/2	100%	0/31	0%
Scottsdale North	26/31	83.9%	4/4	100%	1/31	3.2%
Scottsdale South	28/31	90.3%	3/3	100%	0/31	0%
East Valley	27/31	87.1%	2/3	66.7%	0/31	0%
Southeast Valley	25/31	80.6%	2/2	100%	0/31	0%
Lower Salt River Lakes	21/31	67.7%	2/3	66.7%	1/31	3.2%
Superstition	25/31	80.6%	3/3	100%	0/31	0%
<b>All Zones</b>	<b>432/527</b>	<b>82%</b>	<b>60/76</b>	<b>78.9%</b>	<b>11/527</b>	<b>2.1%</b>
<b>AUGUST</b>						
Gila Bend	21/31	67.7%	6/7	85.7%	2/31	6.5%
Gila River	25/31	80.6%	5/6	83.3%	2/31	6.5%
Palo Verde	25/31	80.6%	6/6	100%	0/31	0%
Rainbow Valley	27/31	87.1%	5/6	83.3%	1/31	3.2%
West Valley	24/31	77.4%	6/8	75%	0/31	0%
Northwest Valley	20/31	64.5%	6/8	75%	0/31	0%
Upper Centennial	21/31	67.7%	7/10	70%	0/31	0%

<b>TABLE A-2: MSP Weather Outlook Verification – Monsoon Season 2018</b>						
<b>Forecast Zone</b>	<b>Accurate Forecasts</b>	<b>AOF (%)</b>	<b>Sig. Events Detected</b>	<b>POD (%)</b>	<b>False Alarms</b>	<b>FAR (%)</b>
Wickenburg	18/31	58.1%	5/9	55.6%	2/31	6.5%
New River/Cave Creek	28/31	90.3%	13/13	100%	0/31	0%
Phoenix North	21/31	67.7%	3/3	100%	3/31	9.7%
Phoenix South	26/31	83.9%	4/4	100%	1/31	3.2%
Scottsdale North	24/31	77.4%	6/6	100%	1/31	3.2%
Scottsdale South	25/31	80.6%	5/5	100%	0/31	0%
East Valley	25/31	80.6%	5/6	83.3%	1/31	3.2%
Southeast Valley	26/31	83.9%	4/4	100%	1/31	3.2%
Lower Salt River Lakes	26/31	83.9%	9/9	100%	1/31	3.2%
Superstition	27/31	87.1%	5/5	100%	0/31	0%
<b>All Zones</b>	<b>409/527</b>	<b>77.6%</b>	<b>100/115</b>	<b>87%</b>	<b>15/527</b>	<b>2.9%</b>
<b>SEPTEMBER</b>						
Gila Bend	26/30	86.7%	1/4	25%	0/30	0%
Gila River	29/30	96.7%	0/0	n/a	0/30	0%
Palo Verde	29/30	96.7%	0/0	n/a	1/30	3.3%
Rainbow Valley	30/30	100%	1/1	100%	0/30	0%
West Valley	28/30	93.3%	1/1	100%	0/30	0%
Northwest Valley	28/30	93.3%	0/1	0%	0/30	0%
Upper Centennial	28/30	93.3%	1/2	50%	0/30	0%
Wickenburg	28/30	93.3%	0/0	n/a	0/30	0%
New River/Cave Creek	28/30	93.3%	1/1	n/a	0/30	0%
Phoenix North	28/30	93.3%	0/0	n/a	0/30	0%
Phoenix South	29/30	96.7%	1/1	100%	0/30	0%
Scottsdale North	28/30	93.3%	0/0	n/a	0/30	0%
Scottsdale South	28/30	93.3%	0/0	n/a	0/30	0%
East Valley	29/30	96.7%	0/0	n/a	1/30	3.3%
Southeast Valley	30/30	100%	1/1	100%	0/30	0%
Lower Salt River Lakes	27/30	90%	0/0	n/a	0/30	0%
Superstition	29/30	96.7%	1/1	n/a	0/30	0%
<b>All Zones</b>	<b>482/510</b>	<b>%</b>	<b>8/13</b>	<b>61.5%</b>	<b>2/510</b>	<b>0.4%</b>

## APPENDIX B: MSP MESSAGES - VERIFICATION TABLES

**TABLE B-1:** This table shows each of the individual MSP Statements issued during the 2018 Monsoon season including the detailed forecast rainfall information. The table is broken down by date and MSP Message. The columns from left to right are defined as follows:

**Statement Details** – Message information including date, time issued in local standard time, Forecast Zone, Message type, and issuing forecaster. Data is pulled directly from issued Message.

**Forecast Rain** – Rain information including forecast rainfall intensity and storm total precipitation where applicable. Data is pulled directly from issued Message. It is important to note that not all issued Messages contain forecast rainfall information (noted by an “N/A” in the table).

TABLE B-1: MSP Statements Issued - Monsoon Season 2018							
Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
06/16/18	9:07	Wickenburg	1	Waters	Now-12pm	-	-
06/16/18	9:30	East Valley	1	Waters	Now-1130am	0.75/30min	0.75
06/16/18	10:15	Scottsdale North	1	Waters	Now-1115am	0.75/30min	0.75
06/16/18	10:15	Scottsdale South	1	Waters	Now-1115am	0.75/30min	0.75
07/08/18	17:36	Upper Centennial	1	Henz	Now-7pm	-	0.50-0.75/1.25
07/08/18	21:48	Palo Verde	1	Henz	Now-1115pm	-	0.50-0.75/1.25
07/08/18	22:15	Gila Bend	1	Henz	Now-1130pm	-	0.50-0.75/1.25
07/09/18	14:57	Superstition	1	Henz	Now-430pm	-	0.50-0.75/1.00-1.50
07/09/18	15:25	New River/ Cave Creek	1	Henz	Now-445pm	-	0.50-0.75/1.00-1.50
07/09/18	15:45	East Valley	1	Henz	Now-515pm	-	0.50-0.75/1.00-1.50
07/09/18	15:45	Scottsdale North	1	Henz	Now-515pm	-	0.50-0.75/1.00-1.50
07/09/18	15:45	Scottsdale South	1	Henz	Now-515pm	-	0.50-0.75/1.00-1.50
07/09/18	16:15	Phoenix North	1	Henz	Now-545pm	-	0.50-0.75/1.00-1.50
07/09/18	16:15	Phoenix South	1	Henz	Now-545pm	-	0.50-0.75/1.00-1.50
07/09/18	16:44	West Valley	1	Henz	Now-6pm	-	0.50-0.75/1.00-1.50
07/09/18	16:44	Rainbow Valley	1	Henz	Now-6pm	-	0.50-0.75/1.00-1.50
07/09/18	18:00	Gila Bend	1	Henz	Now-730pm	-	0.50-0.75/1.00-1.50
07/10/18	16:55	East Valley	1	Henz	Now-630pm	-	0.50-0.75/1.25-1.50

**TABLE B-1: MSP Statements Issued - Monsoon Season 2018**

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
07/10/18	17:10	Phoenix South	1	Henz	Now-630pm	-	0.50-0.75/1.25-1.50
07/10/18	16:40	Gila Bend	1	Waters	6-8pm	-	-
07/11/18	18:20	Wickenburg	1	Henz	Now-745pm	-	0.50-0.75/1.25-1.50
07/11/18	18:45	New River/ Cave Creek	1	Henz	Now-830pm	-	0.50-0.75/1.50-2.00
07/11/18	19:00	Wickenburg	3	Henz	Now-9pm	-	-
07/11/18	19:11	Scottsdale North	1	Henz	Now-830pm	-	0.50-0.75/1.25-1.50
07/11/18	22:00	West Valley	1	Henz	Now-1130pm	-	0.50-0.75/1.25-1.50
07/11/18	22:00	Northwest Valley	1	Henz	Now-1130pm	-	0.50-0.75/1.25-1.50
07/11/18	22:00	Phoenix North	1	Henz	Now-1130pm	-	0.50-0.75/1.25-1.50
07/12/18	15:51	Wickenburg	1	Waters	Now-5pm	-	0.75-1.00
07/12/18	16:01	Upper Centennial	1	Waters	Now-530pm	-	0.75-1.00
07/12/18	16:10	Wickenburg	1U	Waters	Now-6pm	-	-
07/12/18	16:55	Northwest Valley	1	Waters	Now-6pm	-	1.50
07/14/18	14:20	New River/ Cave Creek	1	Waters	Now-4pm	-	0.50-0.75/1.00-1.50
07/14/18	15:37	Northwest Valley	1	Waters	Now-5pm	1.50/30min	1.50
07/14/18	15:50	West Valley	1	Waters	Now-515pm	1.50/30min	1.50
07/21/18	4:27	Rainbow Valley	1	Waters	Now-7am	-	0.75-1.00
07/21/18	4:27	Gila Bend	1	Waters	Now-7am	-	0.75-1.00
07/21/18	4:52	West Valley	1	Waters	Now-730am	-	0.75-1.00
07/21/18	4:52	Palo Verde	1	Waters	Now-730am	-	0.75-1.00
07/21/18	7:08	Gila River	1	Waters	Now-8am	-	0.50-0.75
07/27/18	19:40	New River/ Cave Creek	1	Waters	Now-830pm	-	0.50-0.75
07/27/18	19:40	Phoenix North	1	Waters	Now-830pm	-	0.50-0.75
07/28/18	18:00	New River/ Cave Creek	1	Waters	Now-730pm	-	0.75-1.00
07/28/18	18:00	Scottsdale North	1	Waters	Now-730pm	-	0.75-1.00
07/28/18	19:45	Northwest Valley	1	Waters	Now-930pm	-	0.50-0.75
07/28/18	19:45	Wickenburg	1	Waters	Now-930pm	-	0.50-0.75
07/28/18	19:45	Upper Centennial	1	Waters	Now-930pm	-	0.50-0.75
07/30/18	18:05	Superstition	1	Henz	Now-730pm	-	0.50-0.75/1.00-1.25

**TABLE B-1: MSP Statements Issued - Monsoon Season 2018**

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
07/30/18	18:20	Scottsdale North	1	Henz	Now-8pm	-	0.50-0.75/1.25-1.50
07/30/18	18:25	New River/ Cave Creek	1	Henz	Now-8pm	-	0.50-0.75/1.25-1.50
07/30/18	19:05	Southeast Valley	1	Henz	Now-830pm	-	0.50-0.75/1.25-1.50
07/30/18	19:15	Phoenix North	1	Henz	Now-845pm	-	0.50-0.75/1.25-1.50
07/30/18	19:15	Scottsdale South	1	Henz	Now-845pm	-	0.50-0.75/1.25-1.50
07/30/18	19:20	Northwest Valley	1	Henz	Now-845pm	-	0.50-0.75/1.25-1.50
07/30/18	19:50	East Valley	1	Henz	Now-915pm	-	0.50-0.75/1.25-1.50
08/02/18	17:55	Gila River	1	Waters	Now-7pm	-	0.50-0.75
08/02/18	18:34	Rainbow Valley	1	Waters	Now-730pm	-	0.50-0.75
08/02/18	18:34	Phoenix South	1	Waters	Now-730pm	-	0.50-0.75
08/02/18	18:34	West Valley	1	Waters	Now-730pm	-	0.50-0.75
08/02/18	18:47	Gila River	3	Waters	Now-8pm	-	-
08/02/18	19:14	Northwest Valley	1	Waters	Now-815pm	-	0.50-0.75
08/02/18	19:14	West Valley	1	Waters	Now-815pm	-	0.50-0.75
08/02/18	19:40	Phoenix North	1	Waters	Now-830pm	-	0.50-0.75
08/02/18	20:00	New River/ Cave Creek	1	Waters	Now-9pm	-	0.50-0.75
08/08/18	18:11	New River/ Cave Creek	1	Henz	Now-730pm	-	0.50-0.75/1.25
08/08/18	18:35	Phoenix North	1	Henz	Now-8pm	-	0.50-0.75-1.25
08/08/18	18:35	Scottsdale North	1	Henz	Now-8pm	-	0.50-0.75-1.25
08/08/18	19:35	Scottsdale South	1	Henz	Now-9pm	-	0.50-0.75/1.25-1.50
08/08/18	19:48	Scottsdale North	1U	Henz	Now-9pm	-	-
08/08/18	20:00	Phoenix South	1	Henz	Now-930pm	-	0.50-0.75/1.25-1.50
08/08/18	20:08	East Valley	1	Henz	Now-930pm	-	0.50-0.75/1.25-1.50
08/09/18	22:50	Superstition	1	Henz	Now-1215am	-	0.50-0.75/1.25-1.50
08/09/18	23:05	East Valley	1	Henz	Now-1230am	-	0.50-0.75/1.25-1.50
08/09/18	23:05	Southeast Valley	1	Henz	Now-1230am	-	0.50-0.75/1.25-1.50
08/09/18	23:05	Gila River	1	Henz	Now-1230am	-	0.50-0.75/1.25-1.50
08/09/18	23:35	Scottsdale South	1	Henz	Now-115am	-	0.50-0.75/1.25-1.50
07/30/18	18:20	Scottsdale North	1	Henz	Now-8pm	-	0.50-0.75/1.25-1.50

**TABLE B-1: MSP Statements Issued - Monsoon Season 2018**

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
08/09/18	23:45	East Valley	3	Henz	Now-2am	-	-
08/10/18	0:05	Phoenix South	1	Henz	Now-2am	-	0.50-0.75/1.25-1.50
08/10/18	11:28	New River/ Cave Creek	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Phoenix North	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Phoenix South	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Scottsdale North	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Scottsdale South	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	East Valley	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Gila River	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Southeast Valley	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Lower Salt River Lakes	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	11:28	Superstition	2	Henz	Now-11pm 08/11/18	-	-
08/10/18	21:05	Superstition	1	Waters	Now-1030pm	-	0.50/1.25
08/10/18	21:05	Lower Salt River Lakes	1	Waters	Now-1030pm	-	0.50/1.25
08/10/18	21:15	East Valley	1	Waters	Now-1045pm	-	0.75/1.25
08/10/18	21:15	Southeast Valley	1	Waters	Now-1045pm	-	0.75/1.25
08/10/18	21:50	Scottsdale North	1	Waters	Now-1130pm	-	0.75/1.25
08/10/18	21:50	Scottsdale South	1	Waters	Now-1130pm	-	0.75/1.25
08/10/18	22:30	Phoenix South	1	Waters	Now-12am	-	0.75/1.25
08/10/18	22:45	Phoenix North	1	Waters	Now-1215am	-	0.50/1.00
08/10/18	23:25	West Valley	1	Waters	Now-1245am	-	0.75/1.25
08/10/18	23:25	Northwest Valley	1	Waters	Now-1245am	-	0.75/1.25
08/10/18	23:39	Scottsdale North	1U	Waters	Now-1am	-	-
08/11/18	0:02	Rainbow Valley	1	Waters	Now-130am	-	0.75/1.25
08/11/18	0:36	Palo Verde	1	Waters	Now-2am	-	0.50/1.00
08/11/18	2:03	New River/ Cave Creek	1	Waters	Now-4am	-	0.50/1.00
08/11/18	2:03	Scottsdale North	1	Waters	Now-4am	-	0.50/1.00
08/11/18	2:38	Scottsdale South	3	Waters	Now-9am	-	-
08/12/18	17:05	Superstition	1	Waters	Now-615pm	-	0.50/1.00



**TABLE B-1: MSP Statements Issued - Monsoon Season 2018**

Statement Details						Forecast Rain	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Intensity (in/min)	STP (in)
08/12/18	17:25	Scottsdale North	1	Waters	Now-630pm	-	0.50/1.00
08/12/18	17:25	Scottsdale South	1	Waters	Now-630pm	-	0.50/1.00
08/12/18	17:25	East Valley	1	Waters	Now-630pm	-	0.50/1.00
08/12/18	17:45	Southeast Valley	1	Waters	Now-645pm	-	0.50/1.00
08/12/18	18:18	Phoenix South	1	Waters	Now-730pm	-	0.75/1.25
08/12/18	18:18	Gila River	1	Waters	Now-730pm	-	0.75/1.25
08/12/18	18:47	Northwest Valley	1	Waters	Now-745pm	-	0.75/1.25
08/12/18	18:47	New River/ Cave Creek	1	Waters	Now-745pm	-	0.75/1.25
08/12/18	19:23	Northwest Valley	3	Waters	Now-9pm	-	-
08/12/18	21:00	New River/ Cave Creek	1	Waters	Now-1030pm	-	0.75/1.25
08/12/18	21:27	Palo Verde	1	Waters	Now-1030pm	-	0.50/1.00
08/14/18	18:52	New River/ Cave Creek	1	Henz	Now-830pm	-	0.75-1.00/2.00
08/14/18	18:58	Scottsdale North	1	Henz	Now-830pm	-	0.75-1.00/2.00
08/16/18	16:22	Northwest Valley	1	Waters	Now-530pm	-	0.75-1.25
08/16/18	16:22	Palo Verde	1	Waters	Now-530pm	-	0.75-1.25
08/17/18	14:02	Wickenburg	1	Waters	Now-4pm	-	0.50-0.75/1.00-1.25
08/23/18	15:39	Scottsdale North	1	Henz	Now-515pm	-	0.75-1.00/1.50-2.00
08/23/18	17:02	Scottsdale North	1U	Henz	Now-630pm	-	-
08/23/18	17:02	New River/ Cave Creek	1U	Henz	Now-630pm	-	-
08/23/18	17:25	Phoenix North	1	Henz	Now-7pm	-	0.75-1.00/1.50-2.00
08/23/18	18:01	Phoenix South	1	Henz	Now-730pm	-	0.75-1.00/1.50-2.00
08/23/18	18:01	Scottsdale South	1	Henz	Now-730pm	-	0.75-1.00/1.50-2.00
08/23/18	18:51	East Valley	1	Henz	Now-830pm	-	0.75-1.00/1.50-2.00
08/23/18	19:32	Southeast Valley	1	Henz	Now-9pm	-	0.50-0.75/1.50-2.00
08/23/18	20:19	Superstition	1	Henz	Now-10pm	-	0.75-1.00/1.50-2.00
08/24/18	19:09	New River/ Cave Creek	1	Waters	Now-830pm	-	0.75-1.00/1.50-2.00
08/25/18	15:02	Wickenburg	1	Waters	Now-430pm	-	0.50-0.75/1.00-1.25
08/25/18	16:10	Wickenburg	3	Waters	Now-6pm	-	-
09/02/18	17:55	Southeast Valley	1	Henz	Now-9pm	-	0.50-0.75/1.50

<b>TABLE B-1: MSP Statements Issued - Monsoon Season 2018</b>							
<b>Statement Details</b>						<b>Forecast Rain</b>	
<b>Date</b>	<b>LST</b>	<b>MSP Forecast Zone</b>	<b>Message</b>	<b>Forecaster</b>	<b>Valid Time</b>	<b>Intensity (in/min)</b>	<b>STP (in)</b>
09/19/18	12:37	Gila Bend	1	Henz	Now-3pm	-	-

**TABLE B-2:** This table shows the raw verification data of MSP issued Messages for the 2018 Monsoon Season. The valid period for rainfall for each Message can be found in Table B-1. The table is broken down by date and MSP Message. The columns from left to right are defined as follows:

**Statement Details** – Statement information including date, Forecast Zone, and Message type.

**Forecast Rain** – Rain information including forecast rainfall intensity and forecast storm total precipitation where applicable. It is important to note that not all issued statements contain forecast rainfall information (noted by an “n/a” in the table).

**Rain Observations** – Observed rainfall amounts within the forecast zone including ALERT rain gages, gage adjusted radar rainfall totals, and local storm reports submitted to NWS Phoenix WFO.

**Alarms** – Triggered alarms on ALERT gage sensors. These alarms are broken down by alarm type including rain, stream, and dam.

**Verification** – The verification was broken down by rain and by alarm. Hits and misses were assigned based on thresholds previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

<b>TABLE B-2: MSP Statements Issued - Monsoon Season 2018</b>											
<b>Statement Details</b>			<b>Forecast Rain</b>		<b>Rain Observations (in)</b>			<b>Alarms</b>			<b>Verification</b>
<b>Date</b>	<b>MSP Forecast Zone</b>	<b>Message</b>	<b>Intensity (in/min)</b>	<b>STP (in)</b>	<b>ALERT</b>	<b>GAQPE</b>	<b>LSRs</b>	<b>Rain</b>	<b>Stream</b>	<b>Dam</b>	<b>Hit/Miss</b>
06/16/18	Wickenburg	1	-	-	-	-	-	X	X	-	Hit
06/16/18	East Valley	1	0.75/30min	0.75	1.18	0.44-0.63	-	-	-	-	Hit
06/16/18	Scottsdale North	1	0.75/30min	0.75	0.59	0.25-0.43	-	-	-	-	Hit
06/16/18	Scottsdale South	1	0.75/30min	0.75	1.34	0.84-1.02	-	-	-	-	Hit
07/08/18	Upper Centennial	1	-	0.50-0.75/1.25	0.47	1.62-1.81	-	-	-	-	Hit
07/08/18	Palo Verde	1	-	0.50-0.75/1.25	0.79	1.23-1.61	-	X	-	-	Hit
07/08/18	Gila Bend	1	-	0.50-0.75/1.25	0.51	1.03-1.22	-	X	-	-	Hit
07/09/18	Superstition	1	-	0.50-0.75/1.00-1.50	1.34	1.23-1.61	-	X	-	-	Hit
07/09/18	New River/ Cave	1	-	0.50-0.75/1.00-1.50	1.30	1.62-1.81	-	X	-	-	Hit
07/09/18	East Valley	1	-	0.50-0.75/1.00-1.50	1.10	0.84-1.02	-	-	-	-	Hit
07/09/18	Scottsdale North	1	-	0.50-0.75/1.00-1.50	1.10	1.23-1.61	-	X	-	-	Hit
07/09/18	Scottsdale South	1	-	0.50-0.75/1.00-1.50	0.94	0.84-1.02	-	-	-	-	Hit
07/09/18	Phoenix North	1	-	0.50-0.75/1.00-1.50	0.91	0.84-1.02	-	X	X	X	Hit

**TABLE B-2: MSP Statements Issued - Monsoon Season 2018**

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
07/09/18	Phoenix South	1	-	0.50-0.75/1.00-1.50	1.26	1.23-1.61	-	X	-	X	Hit
07/09/18	West Valley	1	-	0.50-0.75/1.00-1.50	0.31	1.03-1.22	-	-	-	-	Hit
07/09/18	Rainbow Valley	1	-	0.50-0.75/1.00-1.50	0.59	1.23-1.61	-	-	-	-	Hit
07/09/18	Gila Bend	1	-	0.50-0.75/1.00-1.50	0.79	1.82-2.01	-	-	-	-	Hit
07/10/18	East Valley	1	-	0.50-0.75/1.25-1.50	0.51	0.64-0.83	-	-	-	-	Hit
07/10/18	Phoenix South	1	-	0.50-0.75/1.25-1.50	0.20	0.44-0.63	-	-	-	-	Miss
07/10/18	Gila Bend	1	-	-	-	-	-	-	-	-	Miss
07/11/18	Wickenburg	1	-	0.50-0.75/1.25-1.50	1.81	1.62-1.81	-	X	-	-	Hit
07/11/18	New River/ Cave	1	-	0.50-0.75/1.50-2.00	1.73	1.82-2.01	-	X	-	-	Hit
07/11/18	Wickenburg	3	-	-	1.81	1.62-1.81	-	X	-	-	Hit
07/11/18	Scottsdale North	1	-	0.50-0.75/1.25-1.50	1.06	1.23-1.61	-	-	-	-	Hit
07/11/18	West Valley	1	-	0.50-0.75/1.25-1.50	1.10	2.02-2.20	-	-	-	-	Hit
07/11/18	Northwest Valley	1	-	0.50-0.75/1.25-1.50	0.63	2.02-2.20	-	-	-	-	Hit
07/11/18	Phoenix North	1	-	0.50-0.75/1.25-1.50	1.02	2.02-2.20	-	-	X	-	Hit
07/12/18	Wickenburg	1	-	0.75-1.00	2.17	1.23-1.61	-	-	-	-	Hit
07/12/18	Upper Centennial	1	-	0.75-1.00	0.83	1.23-1.61	-	-	-	-	Hit
07/12/18	Wickenburg	1U	-	-	-	-	-	-	-	-	Hit
07/12/18	Northwest Valley	1	-	1.50	0.75	1.03-1.22	-	-	-	-	Hit
07/14/18	New River/ Cave	1	-	0.50-0.75/1.00-1.50	1.42	1.23-1.61	-	X	X	-	Hit
07/14/18	Northwest Valley	1	1.50/30min	1.50	0.67	1.23-1.61	-	-	-	-	Hit
07/14/18	West Valley	1	1.50/30min	1.50	0.04	1.23-1.61	-	-	-	-	Hit
07/21/18	Rainbow Valley	1	-	0.75-1.00	0.35	0.64-0.83	-	-	-	-	Hit
07/21/18	Gila Bend	1	-	0.75-1.00	0.87	1.23-1.61	-	-	-	-	Hit
07/21/18	West Valley	1	-	0.75-1.00	0.12	0.44-0.63	-	-	-	-	Miss
07/21/18	Palo Verde	1	-	0.75-1.00	0.24	0.84-1.02	-	-	-	-	Hit
07/21/18	Gila River	1	-	0.50-0.75	0.00	0.25-0.43	-	-	-	-	Miss
07/27/18	New River/ Cave	1	-	0.50-0.75	0.47	0.64-0.83	-	-	-	-	Hit
07/27/18	Phoenix North	1	-	0.50-0.75	0.04	0.04-0.24	-	-	-	-	Miss
07/28/18	New River/ Cave	1	-	0.75-1.00	0.47	1.82-2.01	-	-	-	-	Hit

**TABLE B-2: MSP Statements Issued - Monsoon Season 2018**

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
07/28/18	Scottsdale North	1	-	0.75-1.00	0.20	0.25-0.43	-	-	-	-	Miss
07/28/18	Northwest Valley	1	-	0.50-0.75	1.10	1.23-1.61	-	-	-	-	Hit
07/28/18	Wickenburg	1	-	0.50-0.75	0.79	1.23-1.61	-	X	-	-	Hit
07/28/18	Upper Centennial	1	-	0.50-0.75	0.87	2.21-2.40	-	-	-	-	Hit
07/30/18	Superstition	1	-	0.50-0.75/1.00-1.25	1.10	1.23-1.61	-	-	-	-	Hit
07/30/18	Scottsdale North	1	-	0.50-0.75/1.25-1.50	1.18	1.62-1.81	-	X	-	-	Hit
07/30/18	New River/ Cave	1	-	0.50-0.75/1.25-1.50	1.18	1.81-2.01	-	X	X	-	Hit
07/30/18	Southeast Valley	1	-	0.50-0.75/1.25-1.50	0.63	1.23-1.61	-	-	-	-	Hit
07/30/18	Phoenix North	1	-	0.50-0.75/1.25-1.50	0.79	0.84-1.02	-	-	-	-	Hit
07/30/18	Scottsdale South	1	-	0.50-0.75/1.25-1.50	0.71	0.64-0.83	-	-	-	-	Hit
07/30/18	Northwest Valley	1	-	0.50-0.75/1.25-1.50	0.94	1.82-2.01	-	-	-	-	Hit
07/30/18	East Valley	1	-	0.50-0.75/1.25-1.50	0.63	1.23-1.61	-	-	-	-	Hit
08/02/18	Gila River	1	-	0.50-0.75	0.04	1.03-1.22	-	-	-	-	Hit
08/02/18	Rainbow Valley	1	-	0.50-0.75	1.73	2.02-2.20	-	X	-	-	Hit
08/02/18	Phoenix South	1	-	0.50-0.75	0.24	0.44-0.63	-	-	-	-	Hit
08/02/18	West Valley	1	-	0.50-0.75	0.91	1.82-2.01	-	-	-	-	Hit
08/02/18	Gila River	3	-	-	0.04	1.03-1.22	-	-	-	-	Hit
08/02/18	Northwest Valley	1	-	0.50-0.75	1.38	2.21-2.40	-	X	-	-	Hit
08/02/18	West Valley	1	-	0.50-0.75	0.91	1.82-2.01	-	-	-	-	Hit
08/02/18	Phoenix North	1	-	0.50-0.75	0.28	0.04-0.24	-	-	-	-	Miss
08/02/18	New River/ Cave	1	-	0.50-0.75	0.24	0.84-1.02	-	-	-	-	Hit
08/08/18	New River/ Cave	1	-	0.50-0.75/1.25	0.08	0.64-0.83	-	-	-	-	Hit
08/08/18	Phoenix North	1	-	0.50-0.75-1.25	0.51	1.03-1.22	-	-	-	-	Hit
08/08/18	Scottsdale North	1	-	0.50-0.75-1.25	1.89	2.21-2.40	-	X	X	-	Hit
08/08/18	Scottsdale South	1	-	0.50-0.75/1.25-1.50	1.22	1.62-1.81	-	X	X	-	Hit
08/08/18	Scottsdale North	1U	-	-	-	-	-	-	-	-	Hit
08/08/18	Phoenix South	1	-	0.50-0.75/1.25-1.50	1.22	0.84-1.02	-	-	X	-	Hit
08/08/18	East Valley	1	-	0.50-0.75/1.25-1.50	0.87	0.84-1.02	-	-	-	-	Hit
08/09/18	Superstition	1	-	0.50-0.75/1.25-1.50	1.69	2.41-2.60	-	X	X	X	Hit

**TABLE B-2: MSP Statements Issued - Monsoon Season 2018**

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
08/09/18	East Valley	1	-	0.50-0.75/1.25-1.50	2.44	2.81-3.19	-	X	X	X	Hit
08/09/18	Southeast Valley	1	-	0.50-0.75/1.25-1.50	1.97	1.82-2.01	-	-	X	-	Hit
08/09/18	Gila River	1	-	0.50-0.75/1.25-1.50	0.35	2.81-3.19	-	-	X	-	Hit
08/09/18	Scottsdale South	1	-	0.50-0.75/1.25-1.50	0.67	1.03-1.22	-	-	X	-	Hit
08/09/18	East Valley	3	-	-	2.44	2.81-3.19	-	X	X	X	Hit
08/10/18	Phoenix South	1	-	0.50-0.75/1.25-1.50	0.67	1.23-1.61	-	X	X	X	Hit
08/10/18	New River/ Cave	2	-	-	-	-	-	-	-	-	Hit
08/10/18	Phoenix North	2	-	-	-	-	-	-	-	-	Hit
08/10/18	Phoenix South	2	-	-	-	-	-	-	-	-	Hit
08/10/18	Scottsdale North	2	-	-	-	-	-	-	-	-	Hit
08/10/18	Scottsdale South	2	-	-	-	-	-	-	-	-	Hit
08/10/18	East Valley	2	-	-	-	-	-	-	-	-	Hit
08/10/18	Gila River	2	-	-	-	-	-	-	-	-	Miss
08/10/18	Southeast Valley	2	-	-	-	-	-	-	-	-	Miss
08/10/18	Lower Salt River Lakes	2	-	-	-	-	-	-	-	-	Hit
08/10/18	Superstition	2	-	-	-	-	-	-	-	-	Hit
08/10/18	Superstition	1	-	0.50/1.25	1.50	1.23-1.61	-	X	X	-	Hit
08/10/18	Lower Salt River Lakes	1	-	0.50/1.25	0.31	1.03-1.22	-	-	-	-	Hit
08/10/18	East Valley	1	-	0.75/1.25	0.98	0.84-1.02	-	-	X	-	Hit
08/10/18	Southeast Valley	1	-	0.75/1.25	0.04	0.84-1.02	-	-	-	-	Hit
08/10/18	Scottsdale North	1	-	0.75/1.25	1.26	1.82-2.01	-	X	-	X	Hit
08/10/18	Scottsdale South	1	-	0.75/1.25	1.06	1.23-1.61	-	X	X	-	Hit
08/10/18	Phoenix South	1	-	0.75/1.25	1.02	1.23-1.61	-	X	X	X	Hit
08/10/18	Phoenix North	1	-	0.50/1.00	0.87	1.23-1.61	-	-	X	X	Hit
08/10/18	West Valley	1	-	0.75/1.25	0.63	1.23-1.61	-	-	-	-	Hit
08/10/18	Northwest Valley	1	-	0.75/1.25	0.31	1.23-1.61	-	-	-	-	Hit
08/10/18	Scottsdale North	1U	-	-	-	-	-	-	-	-	Hit
08/11/18	Rainbow Valley	1	-	0.75/1.25	0.39	1.62-1.81	-	-	-	-	Hit
08/11/18	Palo Verde	1	-	0.50/1.00	0.28	0.64-0.83	-	-	-	-	Hit

**TABLE B-2: MSP Statements Issued - Monsoon Season 2018**

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
08/11/18	New River/ Cave	1	-	0.50/1.00	0.47	1.03-1.22	-	-	-	-	Hit
08/11/18	Scottsdale North	1	-	0.50/1.00	0.12	-	-	-	-	-	Miss
08/11/18	Scottsdale South	3	-	-	1.06	1.23-1.61	-	X	X	-	Hit
08/12/18	Superstition	1	-	0.50/1.00	0.31	0.44-0.63	-	-	-	-	Miss
08/12/18	Scottsdale North	1	-	0.50/1.00	1.46	1.23-1.61	-	X	-	-	Hit
08/12/18	Scottsdale South	1	-	0.50/1.00	1.46	1.23-1.61	-	-	X	-	Hit
08/12/18	East Valley	1	-	0.50/1.00	0.55	0.64-0.83	-	-	-	-	Hit
08/12/18	Southeast Valley	1	-	0.50/1.00	0.55	1.23-1.61	-	-	-	-	Hit
08/12/18	Phoenix South	1	-	0.75/1.25	0.31	0.44-0.63	-	-	-	-	Miss
08/12/18	Gila River	1	-	0.75/1.25	0.04	1.62-1.81	-	-	-	-	Hit
08/12/18	Northwest Valley	1	-	0.75/1.25	1.89	2.81-3.19	-	X	-	-	Hit
08/12/18	New River/ Cave	1	-	0.75/1.25	0.04	-	-	-	-	-	Miss
08/12/18	Northwest Valley	3	-	-	1.89	2.81-3.19	-	X	X	-	Hit
08/12/18	New River/ Cave	1	-	0.75/1.25	0.47	0.64-0.83	-	-	-	-	Hit
08/12/18	Palo Verde	1	-	0.50/1.00	0.71	2.21-2.40	-	-	X	-	Hit
08/14/18	New River/ Cave	1	-	0.75-1.00/2.00	1.10	1.03-1.22	-	X	-	-	Hit
08/14/18	Scottsdale North	1	-	0.75-1.00/2.00	0.83	1.62-1.81	-	X	-	-	Hit
08/16/18	Northwest Valley	1	-	0.75-1.25	1.02	1.23-1.61	-	-	X	-	Hit
08/16/18	Palo Verde	1	-	0.75-1.25	0.67	1.03-1.22	-	X	X	-	Hit
08/17/18	Wickenburg	1	-	0.50-0.75/1.00-1.25	1.93	1.62-1.81	-	X	X	-	Hit
08/23/18	Scottsdale North	1	-	0.75-1.00/1.50-2.00	1.57	1.82-2.01	-	X	-	-	Hit
08/23/18	Scottsdale North	1U	-	-	-	-	-	-	-	-	Hit
08/23/18	New River/ Cave	1U	-	-	-	-	-	-	-	-	Hit
08/23/18	Phoenix North	1	-	0.75-1.00/1.50-2.00	1.77	1.23-1.61	-	-	X	X	Hit
08/23/18	Phoenix South	1	-	0.75-1.00/1.50-2.00	1.46	1.03-1.22	-	-	X	-	Hit
08/23/18	Scottsdale South	1	-	0.75-1.00/1.50-2.00	0.39	0.25-0.43	-	-	X	-	Hit
08/23/18	East Valley	1	-	0.75-1.00/1.50-2.00	1.54	1.62-1.81	-	X	-	-	Hit
08/23/18	Southeast Valley	1	-	0.50-0.75/1.50-2.00	1.38	1.23-1.61	-	-	-	-	Hit
08/23/18	Superstition	1	-	0.75-1.00/1.50-2.00	1.73	1.23-1.61	-	X	X	-	Hit

**TABLE B-2: MSP Statements Issued - Monsoon Season 2018**

Statement Details			Forecast Rain		Rain Observations (in)			Alarms			Verification
Date	MSP Forecast Zone	Message	Intensity (in/min)	STP (in)	ALERT	GAQPE	LSRs	Rain	Stream	Dam	Hit/Miss
08/24/18	New River/ Cave	1	-	0.75-1.00/1.50-2.00	0.87	1.03-1.22	-	-	-	-	Hit
08/25/18	Wickenburg	1	-	0.50-0.75/1.00-1.25	1.57	2.41-2.60	-	X	-	-	Hit
08/25/18	Wickenburg	3	-	-	1.57	2.41-2.60	-	X	-	-	Hit
09/02/18	Southeast Valley	1	-	0.50-0.75/1.50	1.18	1.23-1.61		-	-	-	Hit
09/19/18	Gila Bend	1	-	-	0.16	2.81-3.19		-	X	-	Hit



**TABLE B-3:** This table shows the lead time data of MSP issued Messages for the 2018 Monsoon Season. The table is broken down by Statement details and lead time. The columns from left to right are defined as follows:

**Statement Details** – Statement information including date, issue time, forecast zone, message type, forecaster, and valid time.

**Statement Lead time** – The first column denotes the time when the first ALERT Alarm (rain, stream, or impoundment) was triggered if any. The second column depicts the calculated lead time based on beginning statement valid time and when the first alarm was triggered.

<b>TABLE B-3: MSP Statement Lead Time - Monsoon Season 2018</b>							
<b>Statement Details</b>						<b>Statement Lead Time</b>	
<b>Date</b>	<b>LST</b>	<b>MSP Forecast Zone</b>	<b>Message</b>	<b>Forecaster</b>	<b>Valid Time</b>	<b>Alarm Triggered</b>	<b>Lead Time(min)</b>
06/16/18	9:07	Wickenburg	1	Waters	Now-12pm	8:20	0
07/08/18	21:48	Palo Verde	1	Henz	Now-1115pm	21:51	3
07/08/18	22:15	Gila Bend	1	Henz	Now-1130pm	22:23	8
07/09/18	14:57	Superstition	1	Henz	Now-430pm	15:12	15
07/09/18	15:25	New River/ Cave	1	Henz	Now-445pm	15:43	18
07/09/18	15:45	Scottsdale North	1	Henz	Now-515pm	16:28	43
07/09/18	16:15	Phoenix North	1	Henz	Now-545pm	16:50	35
07/09/18	16:15	Phoenix South	1	Henz	Now-545pm	16:53	38
07/11/18	18:20	Wickenburg	1	Henz	Now-745pm	18:40	20
07/11/18	18:45	New River/ Cave	1	Henz	Now-830pm	18:29	0
07/11/18	22:00	Phoenix North	1	Henz	Now-1130pm	23:07	67
07/14/18	14:20	New River/ Cave	1	Waters	Now-4pm	14:39	19
07/28/18	19:45	Wickenburg	1	Waters	Now-930pm	20:34	49
07/30/18	18:20	Scottsdale North	1	Henz	Now-8pm	19:34	74
07/30/18	18:25	New River/ Cave	1	Henz	Now-8pm	19:20	55
08/02/18	18:34	Rainbow Valley	1	Waters	Now-730pm	19:25	51
08/02/18	19:14	Northwest Valley	1	Waters	Now-815pm	19:52	38
08/08/18	18:35	Scottsdale North	1	Henz	Now-8pm	19:18	43
08/08/18	19:35	Scottsdale South	1	Henz	Now-9pm	20:00	25
08/08/18	20:00	Phoenix South	1	Henz	Now-930pm	21:04	64

TABLE B-3: MSP Statement Lead Time - Monsoon Season 2018							
Statement Details						Statement Lead Time	
Date	LST	MSP Forecast Zone	Message	Forecaster	Valid Time	Alarm Triggered	Lead Time(min)
08/09/18	22:50	Superstition	1	Henz	Now-1215am	23:37	47
08/09/18	23:05	East Valley	1	Henz	Now-1230am	23:36	31
08/09/18	23:05	Southeast Valley	1	Henz	Now-1230am	3:14	235
08/09/18	23:05	Gila River	1	Henz	Now-1230am	3:14	235
08/09/18	23:35	Scottsdale South	1	Henz	Now-115am	0:00	25
08/10/18	0:05	Phoenix South	1	Henz	Now-2am	0:31	26
08/10/18	11:28	New River/ Cave	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	875
08/10/18	11:28	Phoenix North	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	677
08/10/18	11:28	Phoenix South	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	662
08/10/18	11:28	Scottsdale North	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	622
08/10/18	11:28	Scottsdale South	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	622
08/10/18	11:28	East Valley	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	587
08/10/18	11:28	Lower Salt River Lakes	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	577
08/10/18	11:28	Superstition	2	Henz	Now-11pm 08/11/18	8/10/2018 11:28	577
08/10/18	21:05	Superstition	1	Waters	Now-1030pm	22:03	58
08/10/18	21:15	East Valley	1	Waters	Now-1045pm	22:07	52
08/10/18	21:50	Scottsdale North	1	Waters	Now-1130pm	22:39	49
08/10/18	21:50	Scottsdale South	1	Waters	Now-1130pm	23:12	82
08/10/18	22:30	Phoenix South	1	Waters	Now-12am	23:34	64
08/10/18	22:45	Phoenix North	1	Waters	Now-1215am	23:36	51
08/12/18	17:25	Scottsdale North	1	Waters	Now-630pm	17:58	33
08/12/18	17:25	Scottsdale South	1	Waters	Now-630pm	18:28	63
08/12/18	18:47	Northwest Valley	1	Waters	Now-745pm	19:09	22
08/12/18	21:27	Palo Verde	1	Waters	Now-1030pm	21:07	0
08/14/18	18:52	New River/ Cave	1	Henz	Now-830pm	20:15	83
08/14/18	18:58	Scottsdale North	1	Henz	Now-830pm	19:40	42
08/16/18	16:22	Northwest Valley	1	Waters	Now-530pm	17:55	93
08/16/18	16:22	Palo Verde	1	Waters	Now-530pm	16:25	3
08/17/18	14:02	Wickenburg	1	Waters	Now-4pm	13:55	0

<b>TABLE B-3: MSP Statement Lead Time - Monsoon Season 2018</b>							
<b>Statement Details</b>						<b>Statement Lead Time</b>	
<b>Date</b>	<b>LST</b>	<b>MSP Forecast Zone</b>	<b>Message</b>	<b>Forecaster</b>	<b>Valid Time</b>	<b>Alarm Triggered</b>	<b>Lead Time(min)</b>
08/23/18	15:39	Scottsdale North	1	Henz	Now-515pm	16:37	58
08/23/18	17:25	Phoenix North	1	Henz	Now-7pm	18:06	41
08/23/18	18:01	Phoenix South	1	Henz	Now-730pm	18:54	53
08/23/18	18:01	Scottsdale South	1	Henz	Now-730pm	20:42	161
08/23/18	18:51	East Valley	1	Henz	Now-830pm	20:46	115
08/23/18	20:19	Superstition	1	Henz	Now-10pm	20:46	27
08/25/18	15:02	Wickenburg	1	Waters	Now-430pm	15:30	28
09/19/18	12:37	Gila Bend	1	Henz	Now-3pm	18:40	363

## APPENDIX C: MSP LAKE ALERTS - VERIFICATION TABLES

**TABLE C-1:** This table shows each of the individual MSP Lake Alerts issued during the 2018 Monsoon season. The table is broken down by statement Details, observations, and verification. The columns from left to right are defined as follows:

**Statement Details** – Message information including date, time issued in local standard time, lake, issuing forecaster, and valid time. Data is pulled directly from issued Message.

**Observations** – Rain information including forecast rainfall intensity and storm total precipitation where applicable. Data is pulled directly from issued Message. It is important to note that not all issued Messages contain forecast rainfall information (noted by an “N/A” in the table).

**Lead Time** – amount of lead time in minutes from when Lake Alert was issued to when first observation occurred.

**Verification** – Hits and misses were assigned based on thresholds previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2018									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
07/08/18	15:55	Bartlett	Henz	Now-5pm	X	-	-	0	Hit
07/09/18	14:15	Bartlett	Henz	Now-330pm	X	-	X	7	Hit
07/09/18	15:16	Apache	Henz	Now-430pm	X	-	-	10	Hit
07/09/18	15:16	Canyon	Henz	Now-430pm	X	-	-	20	Hit
07/09/18	15:16	Saguaro	Henz	Now-430pm	X	-	X	20	Hit
07/10/18	15:13	Apache	Henz	Now-445pm	X	-	-	15	Hit
07/10/18	15:13	Canyon	Henz	Now-445pm	X	-	-	45	Hit
07/10/18	15:38	Saguaro	Henz	Now-445pm	X	-	-	22	Hit
07/13/18	16:20	Pleasant	Waters	Now-5pm	X	X	-	20	Hit
07/13/18	16:30	Bartlett	Waters	Now-515pm	X	-	X	0	Hit
07/14/18	13:00	Pleasant	Waters	Now-3pm	X	-	-	44	Hit
07/14/18	15:31	Apache	Waters	Now-415pm	X	-	-	0	Hit
07/14/18	15:31	Canyon	Waters	Now-415pm	X	-	-	5	Hit

TABLE C-1: MSP Lake Alerts Issued - Monsoon Season 2018									
Statement Details					Observations			Lead Time	Verification
Date	LST	Lake	Forecaster	Valid Time	Lightning	Wind > 30mph	Hail/Heavy Rain	1st Obs.	Hit/Miss
07/14/18	15:31	Saguaro	Waters	Now-415pm	X	-	-	14	Hit
07/28/18	16:50	Bartlett	Waters	Now-630pm	X	X	-	40	Hit
07/28/18	16:50	Apache	Waters	Now-630pm	-	-	-	-	Miss
07/28/18	16:50	Canyon	Waters	Now-630pm	-	-	-	-	Miss
07/28/18	16:50	Saguaro	Waters	Now-630pm	-	-	-	-	Miss
07/28/18	19:00	Pleasant	Waters	Now-8pm	X	X	X	-	Hit
07/30/18	16:45	Apache	Henz	Now-545pm	X	-	-	40	Hit
07/30/18	18:15	Bartlett	Henz	Now-715pm	X	X	X	10	Hit
07/30/18	18:40	Pleasant	Henz	Now-8pm	X	X	X	5	Hit
08/08/18	17:50	Pleasant	Henz	Now-7pm	X	X	-	40	Hit
08/08/18	18:02	Apache	Henz	Now-7pm	X	-	-	80	Hit
08/08/18	18:02	Canyon	Henz	Now-7pm	X	-	-	85	Hit
08/08/18	18:02	Saguaro	Henz	Now-7pm	X	-	-	85	Hit
08/12/18	16:25	Apache	Waters	Now-530pm	X	-	-	28	Hit
08/12/18	16:25	Canyon	Waters	Now-530pm	X	-	-	28	Hit
08/12/18	16:25	Saguaro	Waters	Now-530pm	X	-	-	22	Hit
08/12/18	18:45	Pleasant	Waters	Now-8pm	X	-	-	1	Hit
08/14/18	18:14	Bartlett	Henz	Now-715pm	X	X	X	36	Hit
08/14/18	18:18	Apache	Henz	Now-730pm	-	-	-	-	Miss
08/14/18	18:18	Canyon	Henz	Now-730pm	X	-	-	50	Hit
08/14/18	18:18	Saguaro	Henz	Now-730pm	X	-	-	50	Hit
08/18/18	16:33	Bartlett	Henz	Now-530pm	X	-	X	0	Hit
08/22/18	16:33	Apache	Henz	Now-530pm	X	-	-	1	Hit
08/23/18	15:17	Pleasant	Henz	Now-430pm	X	-	X	40	Hit
08/23/18	16:47	Saguaro	Henz	Now-545pm	X	-	X	0	Hit
08/23/18	16:47	Canyon	Henz	Now-545pm	-	-	-	-	Miss
08/25/18	14:55	Pleasant	Waters	Now-4pm		X	-	0	Hit
09/02/18	18:17	Pleasant	Henz	Now-730pm	X	-	-	20	Hit

## APPENDIX E: QPF STORM TOTAL PRECIPITATION - VERIFICATION TABLES

**TABLE E-1:** This table shows each of the individual MSP Lake Alerts issued during the 2018 Monsoon season including the detailed forecast rainfall information. The table is broken down by statement Details, observations, and verification. The columns from left to right are defined as follows:

**Statement Details** – Message information including date and forecast zone. Data is pulled directly from issued Message.

**Peak Storm Total Precipitation** – Rain information including forecast (QPF), observed (ALERT), radar estimated (GAQPE), and local storm report total (LSR). Data is pulled directly from issued Message. Observations are gathered the ALERT database, WDT Inc radar products, and NWS local storm reports.

**Error** – Percent error was calculated based on Equation 4 previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

**Verification** – Hits and misses were assigned based on thresholds previously discussed in the [MSP Verification Metrics and Criteria](#) section of this report.

TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2018											
Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
06/16/18	East Valley	0.75	1.18	0.44	0.63	-	-36.44	70.45	19.05	-	Hit
06/16/18	North Scottsdale	0.75	0.59	0.25	0.43	-	27.12	200.00	74.42	-	Miss
06/16/18	Scottsdale South	0.75	1.34	0.84	1.02	-	-44.03	-10.71	-26.47	-	Hit
07/08/18	Upper Centennial	0.50	0.47	1.62	1.81	-	6.38	-69.14	-72.38	-	Hit
07/08/18	Palo Verde	1.25	0.79	1.23	1.61	-	58.23	1.63	-22.36	-	Hit
07/08/18	Gila Bend	1.25	0.51	1.03	1.22	-	145.10	21.36	2.46	-	Hit
07/09/18	Superstition	1.50	1.34	1.23	1.61	-	11.94	21.95	-6.83	-	Hit
07/09/18	New River/ Cave Creek	1.50	1.30	1.62	1.81	-	15.38	-7.41	-17.13	-	Hit
07/09/18	East Valley	1.00	1.10	0.84	1.02	-	-9.09	19.05	-1.96	-	Hit
07/09/18	Scottsdale North	1.00	1.10	1.23	1.61	-	-9.09	-18.70	-37.89	-	Hit
07/09/18	Scottsdale South	1.00	0.94	0.84	1.02	-	6.38	19.05	-1.96	-	Hit
07/09/18	Phoenix North	1.00	0.91	0.84	1.02	-	9.89	19.05	-1.96	-	Hit

**TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2018**

Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
07/09/18	Phoenix South	1.50	1.26	1.23	1.61	-	19.05	21.95	-6.83	-	Hit
07/09/18	West Valley	1.00	0.31	1.03	1.22	-	222.58	-2.91	-18.03	-	Hit
07/09/18	Rainbow Valley	1.50	0.59	1.23	1.61	-	154.24	21.95	-6.83	-	Hit
07/09/18	Gila Bend	1.50	0.79	1.82	2.01	-	89.87	-17.58	-25.37	-	Hit
07/10/18	East Valley	0.75	0.51	0.64	0.83	-	47.06	17.19	-9.64	-	Hit
07/10/18	Phoenix South	0.50	0.20	0.44	0.63	-	150.00	13.64	-20.63	-	Hit
07/11/18	Wickenburg	1.50	1.81	1.62	1.81	-	-17.13	-7.41	-17.13	-	Hit
07/11/18	New River/ Cave Creek	2.00	1.73	1.82	2.01	-	15.61	9.89	-0.50	-	Hit
07/11/18	Scottsdale North	1.25	1.06	1.23	1.61	-	17.92	1.63	-22.36	-	Hit
07/11/18	West Valley	1.25	1.10	2.02	2.20	-	13.64	-38.12	-43.18	-	Hit
07/11/18	Northwest Valley	0.75	0.63	2.02	2.20	-	19.05	-62.87	-65.91	-	Hit
07/11/18	Phoenix North	1.25	1.02	2.02	2.20	-	22.55	-38.12	-43.18	-	Hit
07/12/18	Wickenburg	1.00	2.17	1.23	1.61	-	-53.92	-18.70	-37.89	-	Hit
07/12/18	Upper Centennial	1.00	0.83	1.23	1.61	-	20.48	-18.70	-37.89	-	Hit
07/12/18	Northwest Valley	1.50	0.75	1.03	1.22	-	100.00	45.63	22.95	-	Hit
07/14/18	New River/ Cave Creek	1.50	1.42	1.23	1.61	-	5.63	21.95	-6.83	-	Hit
07/14/18	Northwest Valley	1.50	0.67	1.23	1.61	-	123.88	21.95	-6.83	-	Hit
07/14/18	West Valley	1.50	0.04	1.23	1.61	-	3650.00	21.95	-6.83	-	Hit
07/21/18	Rainbow Valley	0.75	0.35	0.64	0.83	-	114.29	17.19	-9.64	-	Hit
07/21/18	Gila Bend	1.00	0.87	1.23	1.61	-	14.94	-18.70	-37.89	-	Hit
07/21/18	West Valley	0.75	0.12	0.44	0.63	-	525.00	70.45	19.05	-	Hit
07/21/18	Palo Verde	1.00	0.24	0.84	1.03	-	316.67	19.05	-2.91	-	Hit
07/21/18	Gila River	0.50	0.00	0.25	0.43	-	-	100.00	16.28	-	Hit
07/27/18	New River/ Cave Creek	0.75	0.47	0.64	0.83	-	59.57	17.19	-9.64	-	Hit
07/27/18	Phoenix North	0.50	0.04	0.04	0.24	-	1150.00	1150.00	108.33	-	Miss
07/28/18	New River/ Cave Creek	1.00	0.47	1.82	2.01	-	112.77	-45.05	-50.25	-	Miss
07/28/18	Scottsdale North	0.75	0.20	0.25	0.43	-	275.00	200.00	74.42	-	Miss
07/28/18	Northwest Valley	0.75	1.10	1.23	1.61	-	-31.82	-39.02	-53.42	-	Miss
07/28/18	Wickenburg	0.75	0.79	1.23	1.61	-	-5.06	-39.02	-53.42	-	Hit

**TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2018**

Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
07/28/18	Upper Centennial	0.75	0.87	2.21	2.40	-	-13.79	-66.06	-68.75	-	Hit
07/30/18	Superstition	1.25	1.10	1.23	1.61	-	13.64	1.63	-22.36	-	Hit
07/30/18	Scottsdale North	1.50	1.18	1.62	1.81	-	27.12	-7.41	-17.13	-	Hit
07/30/18	New River/ Cave Creek	1.25	1.18	1.81	2.01	-	5.93	-30.94	-37.81	-	Hit
07/30/18	Southeast Valley	1.25	0.63	1.23	1.61	-	98.41	1.63	-22.36	-	Hit
07/30/18	Phoenix North	0.75	0.79	0.84	1.02	-	-5.06	-10.71	-26.47	-	Hit
07/30/18	Scottsdale South	0.75	0.71	0.64	0.83	-	5.63	17.19	-9.64	-	Hit
07/30/18	Northwest Valley	0.75	0.94	1.82	2.01	-	-20.21	-58.79	-62.69	-	Hit
07/30/18	East Valley	1.25	0.63	1.23	1.61	-	98.41	1.63	-22.36	-	Hit
08/02/18	Gila River	0.75	0.04	1.03	1.22	-	1775.00	-27.18	-38.52	-	Miss
08/02/18	Rainbow Valley	0.75	1.73	2.02	2.20	-	-56.65	-62.87	-65.91	-	Miss
08/02/18	Phoenix South	0.50	0.24	0.44	0.63	-	108.33	13.64	-20.63	-	Hit
08/02/18	West Valley	0.75	0.91	1.82	2.01	-	-17.58	-58.79	-62.69	-	Hit
08/02/18	Northwest Valley	0.75	1.38	2.21	2.40	-	-45.65	-66.06	-68.75	-	Miss
08/02/18	West Valley	0.75	0.91	1.82	2.01	-	-17.58	-58.79	-62.69	-	Hit
08/02/18	Phoenix North	0.50	0.28	0.04	0.24	-	78.57	1150.00	108.33	-	Miss
08/02/18	New River/ Cave Creek	0.75	0.24	0.84	1.02	-	212.50	-10.71	-26.47	-	Hit
08/08/18	New River/ Cave Creek	0.75	0.08	0.64	0.83	-	837.50	17.19	-9.64	-	Hit
08/08/18	Phoenix North	1.25	0.51	1.03	1.22	-	145.10	21.36	2.46	-	Hit
08/08/18	Scottsdale North	1.25	1.89	2.21	2.40	-	-33.86	-43.44	-47.92	-	Miss
08/08/18	Scottsdale South	1.50	1.22	1.62	1.81	-	22.95	-7.41	-17.13	-	Hit
08/08/18	Phoenix South	1.25	1.22	0.84	1.02	-	2.46	48.81	22.55	-	Hit
08/08/18	East Valley	0.75	0.87	0.84	1.02	-	-13.79	-10.71	-26.47	-	Hit
08/09/18	Superstition	1.50	1.69	2.41	2.60	-	-11.24	-37.76	-42.31	-	Hit
08/09/18	East Valley	1.50	2.44	2.81	3.19	-	-38.52	-46.62	-52.98	-	Miss
08/09/18	Southeast Valley	1.50	1.97	1.82	2.01	-	-23.86	-17.58	-25.37	-	Hit
08/09/18	Gila River	1.50	0.35	2.81	3.19	-	328.57	-46.62	-52.98	-	Miss
08/09/18	Scottsdale South	1.25	0.67	1.03	1.22	-	86.57	21.36	2.46	-	Hit
08/10/18	Phoenix South	1.25	0.67	1.23	1.61	-	86.57	1.63	-22.36	-	Hit



**TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2018**

Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
08/10/18	Superstition	1.50	1.50	1.23	1.61	-	0.00	21.95	-6.83	-	Hit
08/10/18	Lower Salt River Lakes	1.25	0.31	1.03	1.22	-	303.23	21.36	2.46	-	Hit
08/10/18	East Valley	0.75	0.98	0.84	1.02	-	-23.47	-10.71	-26.47	-	Hit
08/10/18	Southeast Valley	0.75	0.04	0.84	1.02	-	1775.00	-10.71	-26.47	-	Hit
08/10/18	Scottsdale North	1.25	1.26	1.82	2.01	-	-0.79	-31.32	-37.81	-	Hit
08/10/18	Scottsdale South	1.25	1.06	1.23	1.61	-	17.92	1.63	-22.36	-	Hit
08/10/18	Phoenix South	1.25	1.02	1.23	1.61	-	22.55	1.63	-22.36	-	Hit
08/10/18	Phoenix North	1.00	0.87	1.23	1.61	-	14.94	-18.70	-37.89	-	Hit
08/10/18	West Valley	1.25	0.63	1.23	1.61	-	98.41	1.63	-22.36	-	Hit
08/10/18	Northwest Valley	1.25	0.31	1.23	1.61	-	303.23	1.63	-22.36	-	Hit
08/11/18	Rainbow Valley	1.25	0.39	1.62	1.81	-	220.51	-22.84	-30.94	-	Hit
08/11/18	Palo Verde	1.00	0.28	0.64	0.83	-	257.14	56.25	20.48	-	Hit
08/11/18	New River/ Cave Creek	1.00	0.47	1.03	1.22	-	112.77	-2.91	-18.03	-	Hit
08/11/18	Scottsdale North	0.50	0.12	0.00	0.00	-	316.67	#DIV/0!	#DIV/0!	-	Miss
08/12/18	Superstition	0.50	0.31	0.44	0.63	-	61.29	13.64	-20.63	-	Hit
08/12/18	Scottsdale North	1.00	1.46	1.23	1.61	-	-31.51	-18.70	-37.89	-	Hit
08/12/18	Scottsdale South	1.00	1.46	1.23	1.61	-	-31.51	-18.70	-37.89	-	Hit
08/12/18	East Valley	0.50	0.55	0.64	0.83	-	-9.09	-21.88	-39.76	-	Hit
08/12/18	Southeast Valley	0.50	0.55	1.23	1.61	-	-9.09	-59.35	-68.94	-	Hit
08/12/18	Phoenix South	0.75	0.31	0.44	0.63	-	141.94	70.45	19.05	-	Hit
08/12/18	Gila River	1.25	0.04	1.62	1.81	-	3025.00	-22.84	-30.94	-	Hit
08/12/18	Northwest Valley	1.25	1.89	2.81	3.19	-	-33.86	-55.52	-60.82	-	Miss
08/12/18	New River/ Cave Creek	0.75	0.04	0.00	0.00	-	1775.00	#DIV/0!	#DIV/0!	-	Miss
08/12/18	New River/ Cave Creek	0.75	0.47	0.64	0.83	-	59.57	17.19	-9.64	-	Hit
08/12/18	Palo Verde	1.00	0.71	2.21	2.40	-	40.85	-54.75	-58.33	-	Miss
08/14/18	New River/ Cave Creek	1.00	1.10	1.03	1.22	-	-9.09	-2.91	-18.03	-	Hit
08/14/18	Scottsdale North	2.00	0.83	1.62	1.81	-	140.96	23.46	10.50	-	Hit
08/16/18	Northwest Valley	1.25	1.02	1.23	1.61	-	22.55	1.63	-22.36	-	Hit
08/16/18	Palo Verde	1.25	0.67	1.03	1.22	-	86.57	21.36	2.46	-	Hit

**TABLE E-1: MSP QPF Peak Storm Total Rainfall Verification - Monsoon Season 2018**

Statement Details		Peak STP (in)					Error (%)				Verification
Date	MSP Forecast Zone	QPF	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	ALERT	GAQPE (LT)	GAQPE (UT)	LSRs	Hit/Miss
08/17/18	Wickenburg	1.25	1.93	1.62	1.81	-	-35.23	-22.84	-30.94	-	Hit
08/23/18	Scottsdale North	1.50	1.57	1.82	2.01	-	-4.46	-17.58	-25.37	-	Hit
08/23/18	Phoenix North	1.50	1.77	1.23	1.61	-	-15.25	21.95	-6.83	-	Hit
08/23/18	Phoenix South	1.50	1.46	1.03	1.22	-	2.74	45.63	22.95	-	Hit
08/23/18	Scottsdale South	0.75	0.39	0.25	0.43	-	92.31	200.00	74.42	-	Miss
08/23/18	East Valley	1.50	1.54	1.62	1.81	-	-2.60	-7.41	-17.13	-	Hit
08/23/18	Southeast Valley	1.50	1.38	1.23	1.61	-	8.70	21.95	-6.83	-	Hit
08/23/18	Superstition	1.50	1.73	1.23	1.61	-	-13.29	21.95	-6.83	-	Hit
08/24/18	New River/ Cave Creek	1.00	0.87	1.03	1.22	-	14.94	-2.91	-18.03	-	Hit
08/25/18	Wickenburg	1.25	1.57	2.41	2.60	-	-20.38	-48.13	-51.92	-	Hit
09/02/18	Southeast Valley	1.50	1.18	1.23	1.61	-	27.12	21.95	-6.83	-	Hit
* GAQPE (Radar) estimated data given in ranges: (LT) Lower Total and (UT) Upper Total											