



**2020**  
**MHFD FLASH FLOOD PREDICTION**  
**PROGRAM - ANNUAL REPORT**

**Submitted by**  
**Skyview Weather**

**December 21, 2020**

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## **1.0 Introduction**

The Mile High Flood District (District or MHFD), formerly known as the Urban Drainage and Flood Control District (UDFCD) has used the forecasting and notification services of a private sector meteorologist for the Flash Flood Prediction Program (F2P2) since 1979. The services of a Private Meteorological Service (PMS) supplement the forecast and warning services of the National Weather Service (NWS) in Boulder, Colorado for the seven-county District area. This is the 42<sup>nd</sup> year MHFD has funded the F2P2.

The MHFD supported by the PMS is shown in Figure 1 and contains a population of approximately 3 million people. The larger forecast area of approximately 3,000 square miles includes the upper basin areas of watercourses that flow into the District. Terrain in the forecast area varies in elevation of around 5,000 feet above sea level to as high as 10,500 feet.

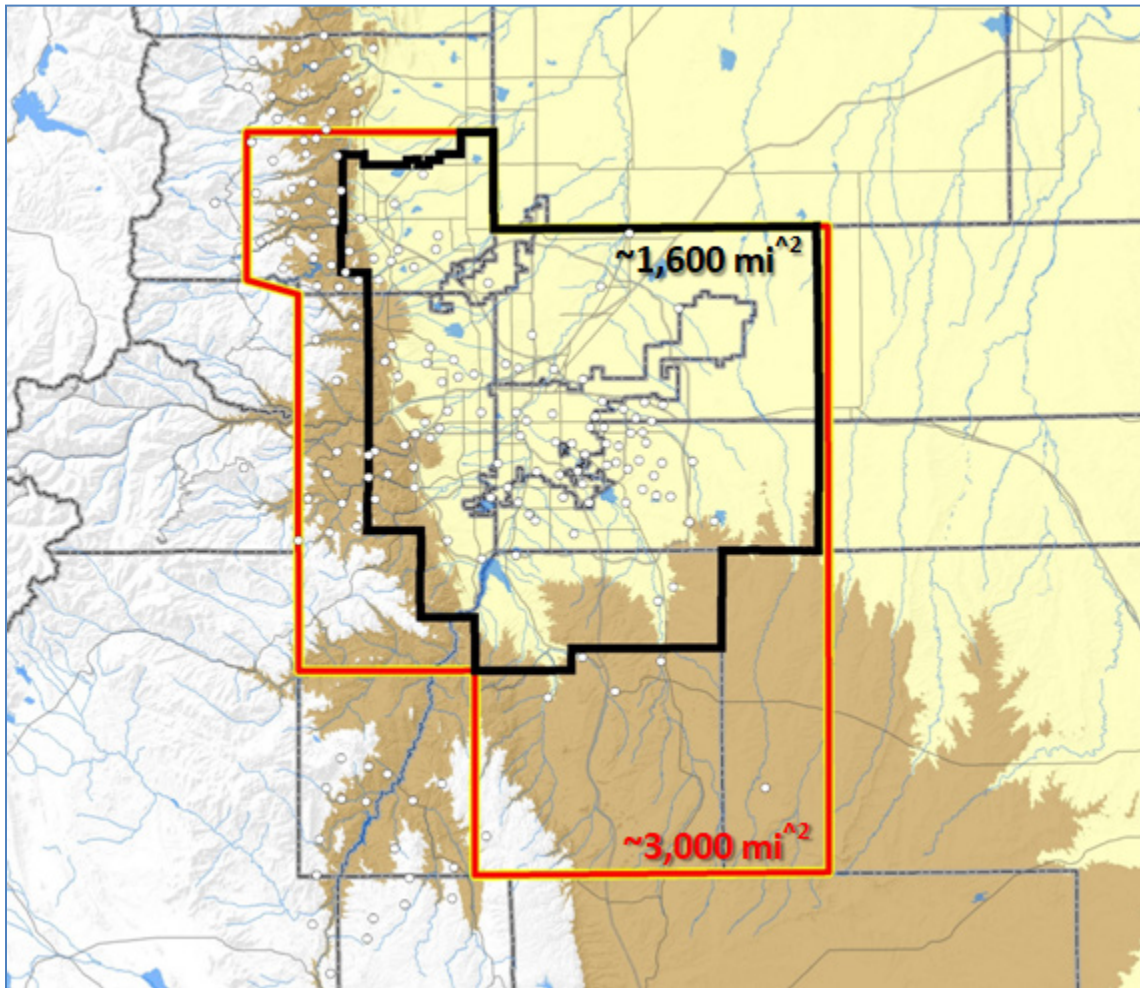
Skyview Weather, a Colorado based company was selected as the 2020 PMS.

Weather prediction personnel Tim Tonge, Brad Simmons and Justin Brooks provided the F2P2 prediction and notification services. Brad Simmons was the Project Manager for the program. Tim Tonge worked his 15<sup>th</sup> season, Brad Simmons his 14<sup>th</sup> season and Justin Brooks his 5<sup>th</sup> season.

## **2.0 2020 Operational Season**

The 2020 F2P2 season began on May 1<sup>st</sup> and concluded on September 30<sup>th</sup> for a total of **153** operational days. Although routine daily forecast service did not begin until May 1<sup>st</sup>, the PMS was prepared to issue messages between April 15<sup>th</sup> and April 30<sup>th</sup>. Normal operational hours were from 7:00 am to 10:00pm. A total of **1034.3** man-hours were expended by the PMS providing support of the F2P2 during normal operational hours. During the time period from 10:00pm to 7:00am the PMS provided an additional **18.0** man-hours of operational support.

Figure 1: MHFD Boundary and Forecast Area



### 3.0 2020 Operational Products

The F2P2 is designed to provide rainfall prediction and notification services of urban flooding and flash flooding threats to the seven District counties and the cities and towns within those counties. Direct support is provided to the District basin-specific flood warning plans, which include the Westerly Creek, Boulder Creek, Toll Gate Creek, Lena Gulch, Ralston Creek, Goldsmith/Harvard Gulch, and the Bear Creek drainage basins.

Four specific F2P2 products were produced by the PMS. The products included the daily Heavy Precipitation Outlook (HPO), the Internal Message Status (IMS), Storm Track (ST), and Messages. Table 1 provides a description of the first four products and Table 2 provides a description of Messages. Table 3 depicts the number of F2P2 products that were produced and the number of communication contacts made or received by the PMS in 2020.

Table 1. F2P2 Product Descriptions

**Heavy Precipitation Outlook (HPO)/Internal Message Status (IMS).** This HPO is available by 11:00am every day during our primary flood season as noted above and is typically issued between 8:00-9:00am. It provides a weather forecast for the District with emphasis on potential higher end rainfall amounts and where storms are most likely to occur. When flood potentials threaten the District and Message 1's are issued, the HPO will be revised and renamed "Internal Message Status" or IMS. The IMS will indicate the message status for each primary contact point within the District. The contact points include the counties of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas and Jefferson, and the City of Aurora.

**Message 1 (Street Flood Potential).** The Message 1 product is issued when there is a threat for heavy rainfall over the District. Heavy rainfall may or may not occur but the threat is present and may result in excessive runoff or flash flooding.

**Message 1 – Low Impact Flooding (LIF).** The Message 1 LIF is issued when heavy rainfall is either imminent or already occurring and can act as a bridge between the Message 1 and the Message 3 (NWS Flash Flood Warning).

**Message 2 – NWS Flash Flood Watch.** Area and time for MHFD Message 2 may differ from NWS Flash Flood Watch.

**Message 3 – NWS Flash Flood Warning.** Area and time for MHFD Message 3 may differ from NWS Flash Flood Warning.

**Storm Track (ST).** This combination of map/text product is a short lead-time forecast showing where a storm has formed or is forming, the approximate size of the storm(s), the direction (or track) of the storm(s), and the estimated arrival times along the forecast track(s). This is one of the most-anticipated products of the F2P2, but keep in mind that generally it is only available within an hour or less of storm impact. Also, the Storm Track is not prepared for storms that do not pose a flood threat.

All of the above products were produced and delivered to F2P2 participants using the MHFD F2P2 Internet-based Product Generator Interface (PGI). All F2P2 products were made available on the PGI in both HTML and PDF format, with exception of the Storm Track product, which is only available in PDF format.

Voice communication continues to be the principal method of disseminating information within the F2P2 once LIF updates are issued. Email and ham-radio communication are secondary and tertiary forms of communication. Fifty (50) telephone or text contacts were made to F2P2 communication points by the PMS in 2020. Contacts between MHFD and the PMS were not logged but contact was made for each Message period as well as LIF's and Message 3's. There were not any Message 2's issued this year.

Table 2: Message Definitions

## MILE HIGH FLOOD DISTRICT, FLASH FLOOD PREDICTION PROGRAM (F2P2) MESSAGE DEFINITIONS

### **MESSAGE 1 (*Street Flooding Potential*)**

The M1-SFP informs key people that weather conditions are such that low impact street flooding may occur later in the day. Streets, low-lying areas, normally dry gulches, small urban streams, and recreational trails located along streams are areas most likely to be affected. Mud, debris and rock slides are the primary concern in the mountains and foothills. This product is comparable to a **NWS Hazardous Weather Outlook** concerning heavy rainfall.

### **MESSAGE 1 (*Low Impact Flooding*)**

The M1-LIF informs key people that low impact flooding is either imminent or occurring. Streets, low-lying areas, normally dry gulches, small urban streams, and recreational trails located along streams are areas most likely to be affected. Mud, debris and rock slides are the primary concern in the mountains and foothills. This product is comparable to a **NWS Flood Advisory**.

### **MESSAGE 2 (*Flash Flood Watch*)**

The M2 informs key people that a Flash Flood Watch has been issued by NWS indicating that weather conditions are such that a life-threatening flash flood may occur later in the day. Significant stream flooding and property damage is possible. PMS will add any additional information available.

### **MESSAGE 3 (*Flash Flood Warning*)**

The M3 informs key people that a Flash Flood Warning has been issued by NWS or PMS feels that a life-threatening flash flood is imminent or occurring. Significant stream flooding and property damage is expected. PMS will add any additional information available. This warning message should be disseminated as quickly as possible.

### **MESSAGE # UPDATE**

The MU may be used by PMS to update any of the previous messages except for the M1-LIF. For example, this message can be used to narrow a watch or warning area as more information becomes available, or to provide more site-specific data and direction during an event. *MESSAGE UPDATE will not be used for the short-lived M1-LIF product.*

### **MESSAGE 4 (*All Clear*)**

The M4 cancels the flood threat status. It is issued by PMS after consultation with NWS and other entities involved with direct PMS communications.

**SUPPLEMENTAL:** *F2P2 messages are used to notify local governments of potential (M1-SPF and M2) and imminent (M1-LIF and M3) flood threats. All F2P2 messages are designed for internal use and not intended for the public. Standard forms completed by the meteorologist are sent by fax or email to designated communication fan-out points prior to making follow-up contacts by phone. Each county warning point or designated recipient should follow their respective protocol for subsequent dissemination. Beginning in 2015, M1-SPF notifications are only issued electronically unless a problem is detected.*

**ABBREVIATIONS:** NWS...National Weather Service    PMS...Private Meteorological Service



Table 3: 2020 Product/Communication Summary

<b>Product/Communication</b>	<b>Number</b>
Heavy Precipitation Outlook (HPO)	157
Messages and LIF's	53
Internal Message Status (IMS)	55
Storm Tracks (ST)	21
PMS Initiated Telephone/Text Contacts	50
F2P2 Participant Initiated Telephone Contacts	0
Non Message Emails and Ham Radio Interactions are NOT Included	NA
<b>Total</b>	<b>336</b>

#### 4.0 2020 Message Statistics

The primary services provided to F2P2 participants include early prediction and notification of the potential for flash flooding, urban and small stream flooding, and locally heavy rainfall events that can initiate low impact flooding. The PMS indicated the potential for these events in a series of products issued to F2P2 participants by phone, SMS text message, facsimile, email and internet.

##### 4.1 Message Verification

A Message period is defined as any time period in which a Message 1, Message 2 or Message 3 is issued based on the criteria depicted in Table 4. A total of 25 Message periods were issued during the 2020 F2P2 season between May 1 and September 30. There were no Message 2's issued during the 2020 season. Message 3's were issued for portions of the District on 6/26 and 7/4. There was a **96%** verification rate of Message periods on a District-wide basis where at least 1 of the 7 counties experienced message level rainfall within the forecast area, not necessarily within District boundaries. There was a 64% verification rate when broken down to a County basis due to the more isolated nature of the thunderstorms this season.

Table 5 depicts the number of Message periods and the number of Messages issued and verified for each month of the 2020 F2P2.

Table 4: Message Criteria

<b>Message 1 “Low Impact Flood Advisory” Criteria</b>	
<ul style="list-style-type: none"> <li>• <b>Message-1</b> (Street or gutter flooding): <b>0.5”/10 minutes or 1”/60 minutes</b></li> <li>• <b>Message-1</b> (Significant urban street and stream flooding): <b>1” to &lt;3”/ 60 minutes</b></li> <li>• <b>Low Impact Flooding (LIF)</b>: Rainfall intensity: <b>0.5”/10 minutes or 1”/60 min AND occurrence is imminent</b></li> </ul>	
<b>Message 2 Flash Flood Watch Criteria</b>	
<ul style="list-style-type: none"> <li>• Option A: National Weather Service issues a Flash Flood Watch affecting the District</li> <li>• Option B: PMS predicts rainfall that will equal/exceed <b>3”/hour (No NWS Flash Flood Watch exists)</b></li> </ul>	
<b>Message 3 Flash Flood Warning Criteria</b>	
<ul style="list-style-type: none"> <li>• Option A: National Weather Service issues a Flash Flood Warning affecting the District</li> <li>• Option B: PMS issues a Flash Flood Warning for a specific District river/stream/drainage (<b>No NWS Flash Flood Warning exists</b>)</li> </ul>	
<b>Message 4</b>	
<ul style="list-style-type: none"> <li>• Message 4 (“All Clear”) is issued whenever Messages are rescinded before their expiration time.</li> </ul>	

Table 5: Monthly Message Verification

Month	Number of Message Periods	Verified Message Periods	% Verifying Message Periods	Messages Issued	Verified Messages	% Verified Messages
May	5	5	100%	33	28	85%
June	3	3	100%	21	15	71%
July	14	14	100%	88	52	59%
August	3	2	67%	21	10	48%
September	0	0	NA	0	0	NA
<b>Total</b>	<b>25</b>	<b>24</b>	<b>96%</b>	<b>163</b>	<b>105</b>	<b>64%</b>

There were no periods where Message 1 level rainfall (0.5”/10mins or 1”/60mins) was observed within a portion of the District and no Message was issued.

The **25** Message periods is the lowest ever recorded for the 2007-2019 timeframe in which Skyview Weather records are available, the average is **42.4** Message periods.

Table 6: Total Number of Message Periods Compared to Average

Month	April	May	June	July	August	September	Total
<b>2020</b>	<b>0</b>	<b>5</b>	<b>3</b>	<b>14</b>	<b>3</b>	<b>0</b>	<b>25</b>
<b>2007-2019 Avg</b>	<b>0.4</b>	<b>5.9</b>	<b>8.6</b>	<b>14.6</b>	<b>10.5</b>	<b>2.5</b>	<b>42.4</b>



## 4.2 County/City Message Statistics

Each Message issued within the F2P2 is disseminated to a primary contact point in which flooding potential has been predicted. The counties and cities that receive Messages are listed in Table 7.

A Message is verified as a “hit” when a rainfall event meeting the Message criteria depicted in Table 4 is observed in the District portion of that City/County or in the drainage area of a watercourse that flows into the jurisdiction. The verifications on a County basis are not performed by the PMS and can be found on the web at: [https://f2p2.udfcd.org/2020\\_summary.html](https://f2p2.udfcd.org/2020_summary.html). Table 7 contains the results of the Message verification on a City and County basis. Message verification for the 2010 Fourmile Burn Area (FMBA) and DIA was conducted by Skyview Weather as 3<sup>rd</sup> party verification is not available from the link listed above.

A Low Impact Flooding (LIF) imminent threat product is issued when the PMS feels there is a **90%** or greater probability that Message level rainfall will occur. There were a total of **8** LIF periods where at least one LIF was issued within a Message period. All 8 LIF periods verified for at least one County/City on any given period; resulting in a verification rate of **100%**. A total of 40 LIF’s were issued when including the cities of Arvada, Lakewood and Wheat Ridge; and 39 verified resulting in total verification rate of **98%**.

Verification of Messages issued for the City of Aurora and Denver International Airport (DIA) are included in the County statistics because Aurora is a primary contact point and Denver County is segmented into two sections, which includes the main developed portion of Denver and DIA in northeast Denver County. The FMBA in Boulder County continued to be recognized as its own forecast zone due to its elevated potential for flooding due to a 2010 wildfire.

The cities of Arvada, Lakewood and Wheat Ridge receive Message 1 notifications from Jefferson County dispatch, but also receive LIFs, Message 2’s and Message 3’s directly from the PMS.

Table 7: County/City Message Verification

Primary Message Contact Points	Messages Issued	Message Hits	% Message Hits	LIFS Issued	LIF Hits	% LIF Hits	Events Missed	Event < 30 min Lead Time
Adams	24	15	63%	5	5	100%	0	1
Arapahoe	25	15	60%	7	7	100%	0	1
Aurora	25	12	48%	6	6	100%	0	0
Boulder	22	16	73%	1	1	100%	0	0
<i>Four Mile Burn</i>	<i>22</i>	<i>12</i>	<i>55%</i>	<i>1</i>	<i>0</i>	<i>0%</i>	<i>0</i>	<i>0</i>
Broomfield	22	8	36%	1	1	100%	0	0
Denver	23	14	61%	2	2	100%	0	0
<i>DIA</i>	<i>24</i>	<i>9</i>	<i>38%</i>	<i>6</i>	<i>6</i>	<i>100%</i>	<i>0</i>	<i>0</i>
Douglas	22	15	68%	4	4	100%	0	0
Jefferson	23	18	78%	1	1	100%	0	0
<b>TOTAL</b>	<b>232</b>	<b>134</b>	<b>58%</b>	<b>34</b>	<b>33</b>	<b>97%</b>	<b>0</b>	<b>2</b>
LIF Contact Points	Messages Issued	Message Hits	% Message Hits	LIFS Issued	LIF Hits	% LIF Hits	Events Missed	Event < 30 min Lead Time
Arvada	N/A	N/A	N/A	2	2	100%	0	0
Lakewood	N/A	N/A	N/A	2	2	100%	0	0
Wheat Ridge	N/A	N/A	N/A	2	2	100%	0	0
<b>TOTAL</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>6</b>	<b>6</b>	<b>100%</b>	<b>0</b>	<b>0</b>
<b>GRAND TOTAL</b>	<b>232</b>	<b>134</b>	<b>58%</b>	<b>40</b>	<b>39</b>	<b>98%</b>	<b>0</b>	<b>0</b>

A total of **186** Messages were issued within the District on a County basis including Aurora. DIA and the FMBA are not included in the message count but are included in the LIF count. Of the **186** Messages that were issued, **113** Messages verified, resulting in a verification rate of **61%**. Jefferson County had the highest verification rate, **78%**, while Broomfield had the lowest verification rate, **36%** due largely to its relatively small area.

There were 2 events in which Message 1's were issued with a short lead time of 30 minutes or less for LIF issuance which occurred on July 9<sup>th</sup> for Adams and Arapahoe Counties.

The PMS identified **83** lightning days comprising **54%** of the **153** day forecast period between May 1 and September 30, 2020. A lightning day is identified as any day that produces a thunderstorm cell with a cloud-to-ground (CG) lightning strike within the District forecast boundary or multiple cloud-to-cloud (CC) strikes. This was lower than the 2008-2020 annual average of 92 lightning days, and well short of the 2009 record high of 108. Of the **83** "District thunderstorm days" in 2020, **30%** of these days had Messages issued. Jefferson County had the highest number of lightning days with **63** total.

Table 8: MHFD Lightning Statistics for Period of May1-September 30

County	2020 Lightning Days	Percent of Total Days w/Lightning	2008-2020 Average Lightning Days	Highest Yearly Total 2008-2020
Adams	37	24%	53	69 (2016)
Arapahoe	42	27%	51	70 (2015)
Boulder	53	35%	61	76 (2013/14)
Broomfield	28	18%	36	51 (2014)
Denver	28	18%	44	62 (2015)
Douglas	57	37%	70	87 (2009)
Jefferson	63	41%	72	92 (2009)
<b>Fcst Area Total</b>	<b>83</b>	<b>54%</b>	<b>92</b>	<b>108 (2009)</b>

## 5.0 Notable Weather Events

The 2020 F2P2 season featured a record low number (25) of Message periods across the District. The total rainfall for the season was well below average as there was little to no monsoon set up this year beyond a few weeks in July. Northwest flow dominated the overall pattern and the dry/mild spring and continued into a hot and dry summer overall. There were a handful of severe weather outbreaks early in the season and isolated thunderstorms through the heart of the summer that produced small geographical areas of heavy rainfall in the District. The more notable weather events for the season occurred on the 26<sup>th</sup> of June and the 4<sup>th</sup> of July and will be reviewed in more detail below. The 25 message days for the season are the lowest on records kept by Skyview Weather back to 2007, breaking the old record of 26 set in 2008. Of the 25 message days there were many days where there was a moderate to high threat for heavy rainfall but the stronger thunderstorms either failed to come to fruition over the District or developed just outside District boundaries. The more isolated nature of the storms this season resulted in a lower verification rate of Message days compared to historical verification rates. The F2P2 season as a whole only produced 5 ALERT Rain Alarm days in the District with 0.5"/10 minutes or less or 1"/60 minutes which is a record low for a season. The lack of storm activity produced severe to extreme drought conditions by the end of the

flood season over NE Colorado leading to numerous fires in our mountains and foothills which will likely lead to flash flooding and debris flows in the coming flood seasons!

There were no Message 2 (NWS Flash Flood Watch) days this season, but there were 2 days in which Message 3's (NWS Flash Flood Warnings) were issued. Both of the Message 3 days resulted in minimal impact. The majority of the high flood threat days in 2020 occurred in July.

Instead of a single storm in particular the 2020 flood season in the District will be remembered for the very weak to nearly non-existent North American Monsoon and intensifying drought. Moisture from the North American Monsoon was not only well below normal in the District but all of Colorado and the inter-mountain west for that matter. Much of the moisture that was in place to work with was Gulf of Mexico in origin favoring the lower levels of the atmosphere versus the Pacific/Gulf of California moisture we associate with the monsoon season which helps moisten the mid and upper levels of the atmosphere. Occasionally, the District received some low-level moisture from the Gulf of Mexico, and in tandem with a passing upper level disturbance from the dominant NW flow pattern isolated bouts of severe weather developed producing thunderstorms with brief heavy rainfall and some hail in the spring as well as a decent soaker on the 24<sup>th</sup> of May as a low pressure system moved through. May tallied 5 Message periods which was 1 below the normal of 6 Message periods.

June featured only 3 Message periods but also produced the season's most impactful storm on the 26<sup>th</sup>. The 3 Message periods in June tied the record low for the month set back in 2008 and was 6 Message periods below the average of 9.

The season peaked in July with nearly half of the days during the month producing a moderate to high potential for heavy rainfall and subsequently 14 Message periods, but the storm activity rarely resulted in heavy rainfall over more than an isolated area in or around the District. The active July resulted in only 1 Message period short of the normal 15 Message periods.

With no real monsoon moisture to work with in August only 3 Message periods were observed which is well below the normal of between 10-11 Message periods. The last Message period of the season was August 5<sup>th</sup> which is an unusually early end for the last Message period of the season and quite likely the earliest end to the F2P2 flood season on record (not confirmed).

By the time September came along monsoon moisture was nowhere to be found and an early season trough of low pressure produced the season's first snow of the year to the Front Range on the 8-9<sup>th</sup> of September. This was the 2<sup>nd</sup> earliest snow on record for the Denver Metro area and resulted in no Message periods during the month. This was only the 4<sup>th</sup> time since 2007 that September did not record a Message period.

Many of the active periods across the District were driven by upper level shortwave troughs trapped in a brisk NW flow pattern and subsequently tapping into modest surface moisture E of the Continental Divide to fuel storms, rather than monsoonal moisture intruding from the S/SW with light upper level steering winds and slower moving storms.

Every month this year from May to September came in below average for Message periods. Despite the overall lack of activity there were a couple notable events on June 26<sup>th</sup> and July 4<sup>th</sup>, both of which recorded some of the highest single-day rainfall totals of the season, along with the only Message 3's of the year.

Below are the Message period summaries for the June 26<sup>th</sup> and July 4<sup>th</sup> events. A more detailed analysis for these events can be found on the web at: [https://f2p2.udfcd.org/2020\\_summary.html](https://f2p2.udfcd.org/2020_summary.html).

**June 26<sup>th</sup>:** A potent trough of low pressure would streak across Colorado on Friday June 26<sup>th</sup>, 2020, resulting in a moderate to high risk of heavy rainfall over the District. Overnight Thursday into Friday morning a cold front moved in from the N/NE which ushered in cooler temperatures with highs in the low 80's for the majority of the District. This cold front also brought in an abundance of surface moisture with dew points in the low 50's and provided steady 5-15mph E/NE upslope winds throughout Friday morning. With a W/SW oriented jet stream aloft supplying the needed upper-level support during the afternoon and early evening, this was a perfect recipe for severe thunderstorms, with large hail, strong winds and heavy rainfall resulting in localized flash flooding.

Initial storm development started just after noon with weak showers initiating in the Jefferson County foothills. Around 1pm, the first thunderstorm formed just west of Roxborough Park and by 2pm this thunderstorm experienced explosive intensification as it moved off the foothills into the moisture rich air mass on the plains. This storm moved at around 10-15mph from W to E traversing northern Douglas County. This thunderstorm would also become severe warned by the NWS through the entire southern portion of the District due to the presence of large hail. Rainfall rates in northwestern Douglas County were between 0.5-0.75" in 10-15 minutes, with areas around Castle Rock receiving 1.00-1.25" in 15-25 minutes along with hail up to 1.5" in diameter. By 3pm, this storm had pushed out of the District towards the southeast just as additional thunderstorms developed just west of Boulder along the Jefferson/Boulder County line. Like the first thunderstorm, this storm rapidly developed as it moved off the foothills into the moisture rich air on the plains and became severe warned by the NWS and produced heavy rainfall in Boulder County with 0.50-0.75" in 8-15 minutes. This initial storm weakened while another quickly developed on the southern end over northern Jefferson County. This southern storm would push through the central portions of the District including downtown Denver resulting in a Flash Flood Warning issued by the NWS for east-central Jefferson County, and Denver County as well as Arapahoe County, but the portion in Arapahoe County was cancelled as the storm never entered this zone. Rainfall rates observed prior to the Flash Flood Warning were between 1.0-1.25" in 10-20min along I-70 from Jefferson County through Aurora, which was the heaviest rainfall rates observed in the season. By 6pm, this storm had moved out of the District and out onto the eastern plains. A few scattered showers persisted until sunset which brought minimal additional rainfall as skies cleared into the evening. All counties experienced heavy rainfall over at least a small portion of the County which resulted in moderate to major street flooding. Storm total rain maps may contain a bit of hail corruption (over-estimates) but overall does a good job of pointing to where the heaviest rains occurred.



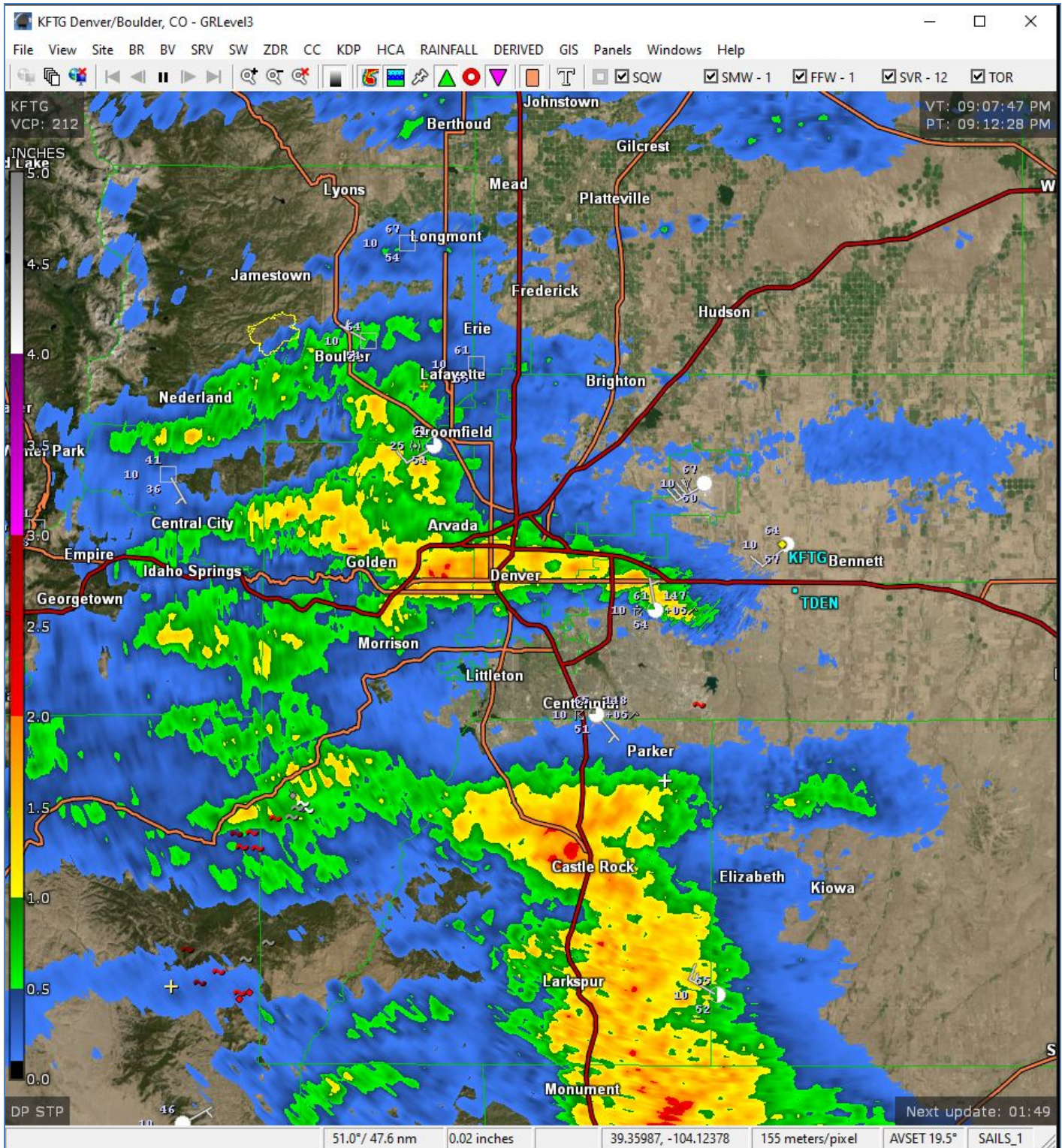


Figure 2: Radar-Estimated Rainfall on 6/26/2020



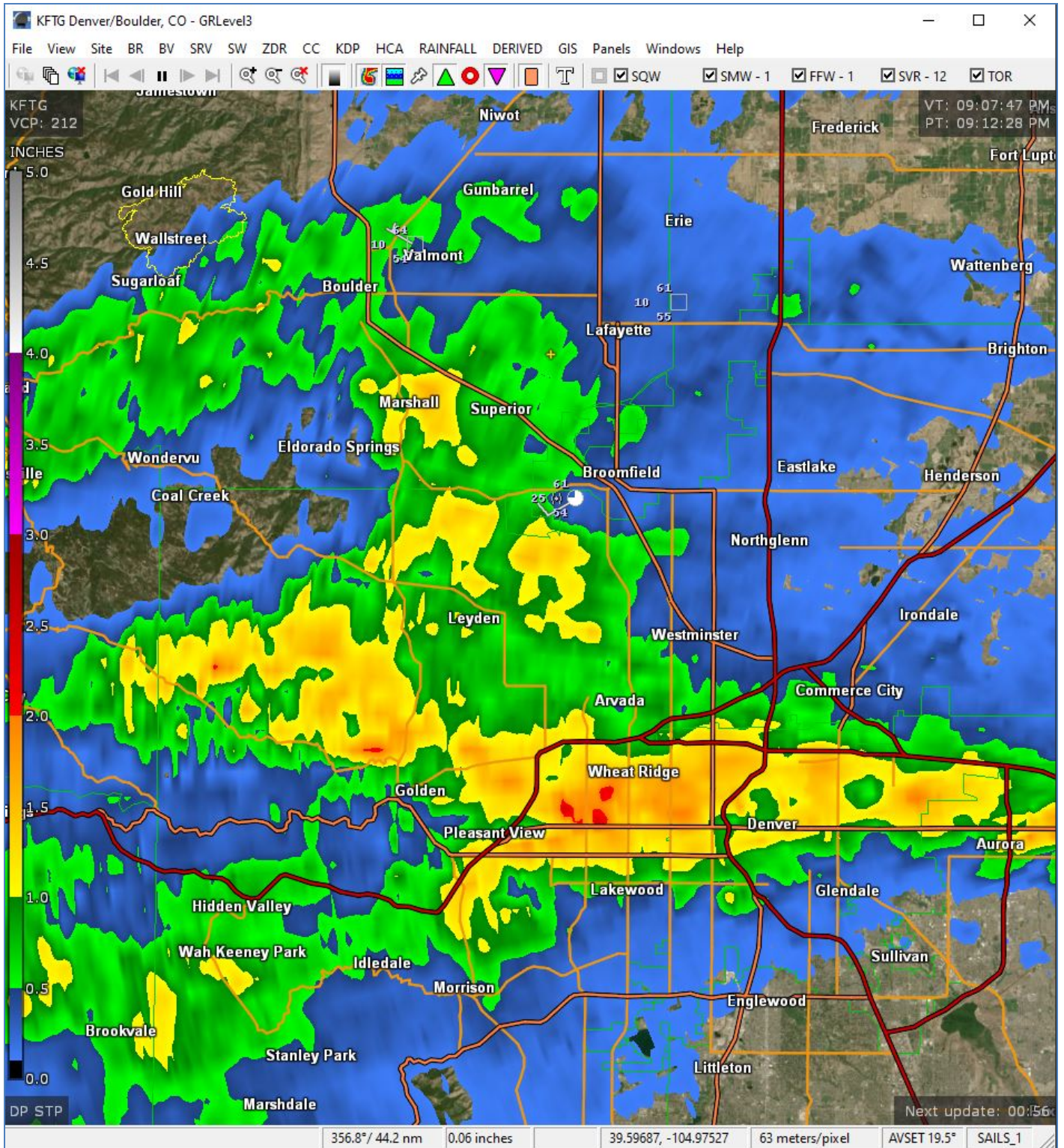


Figure 3: Radar-Estimated Rainfall on 6/26/2020



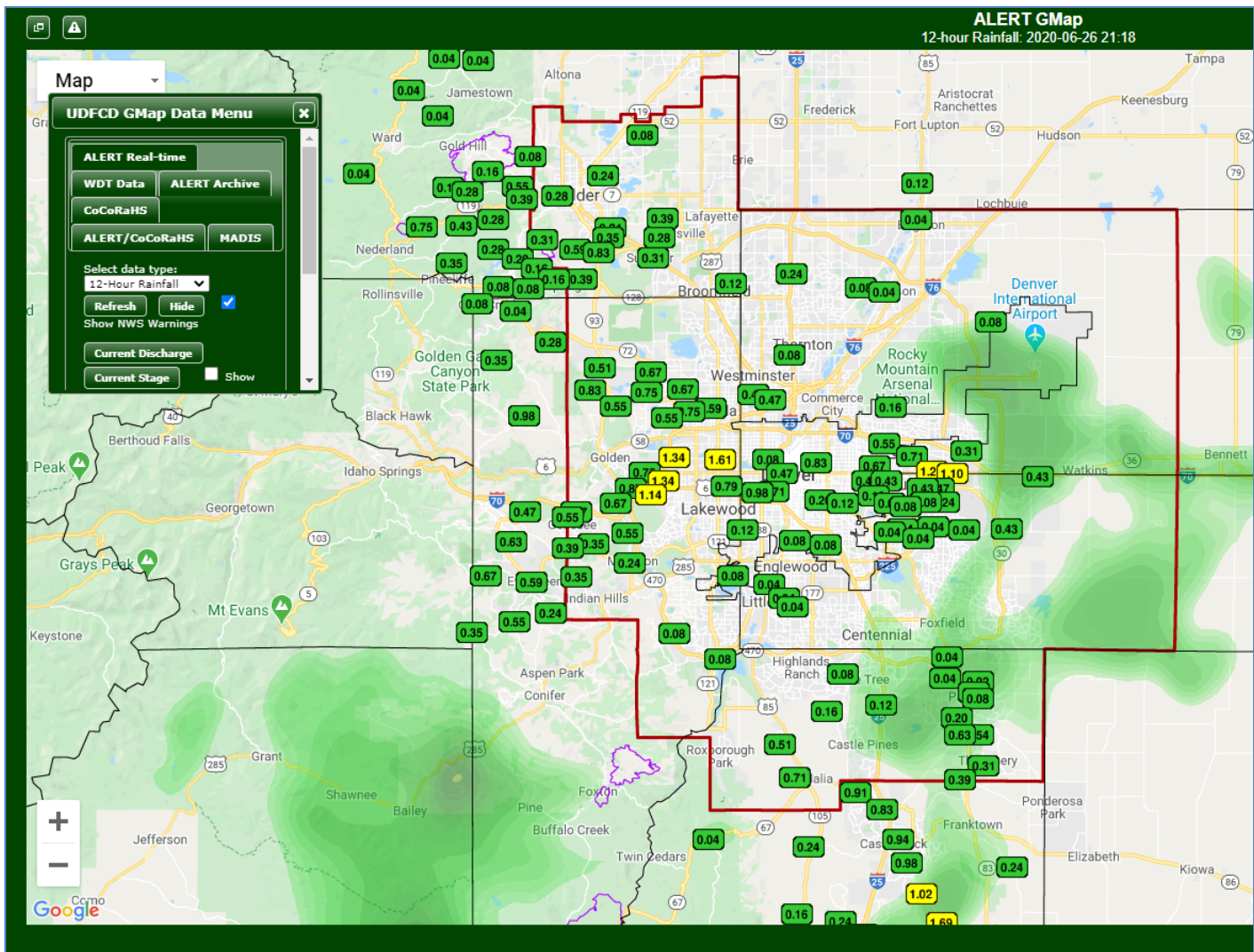


Figure 4: ALERT 12-hr Rain Map on 6/26/2020

**July 4th:** Southwest flow aloft would import subtropical moisture into NE CO on July 4<sup>th</sup>, 2020 while surface moisture remained elevated with dew points in the low to mid 50's during the morning, decreasing to mid 40's by the evening. A weak short-wave trough would move across northeast Colorado around midday, which enabled a stationary Denver surface low to form over the District. This surface low produced a surface wind convergence line which set up on the eastern side of the District. This convergence line, in tandem with weak steering winds aloft enabled strong, stationary storm development over north-central Arapahoe County, including Aurora, and northward into Adams County east of Highway 85. Initially, a relatively weak line of thunderstorms formed from Douglas County into Arapahoe and Adams Counties which produced light to moderate rainfall starting between 1-2pm. By 3pm, a strong thunderstorm cell developed over the Aurora area and would hold there for nearly 2 hours and produce rainfall rates between 0.5-1.0" in 10-30 minutes. Multiple urban and small stream flood advisories were issued at this time from Arapahoe County north into Adams County, with a Flash Flood Warning issued at 4:22pm effective until 6:15pm for north-central



Arapahoe, including Aurora as local storm report had 2.5” of rainfall reported just south of I-70. Around 5pm, storm movement finally started to push eastward as rainfall rates slowly decreased as the storms moved out of the District and out onto the eastern plains. Skies quickly cleared into the evening with no additional rainfall for the District. Multiple rainfall alarms were triggered and a spotter reported 3.13” of rain NNW Buckley but no ALERT gauges or CoCoRaHS spotters captured rain amounts greater than 2”. The 3”+ rainfall amount from NWS local storm report (LSR) appears accurate per the storm total rain maps below. This strong thunderstorm produced the highest rainfall totals of the 2020 flood season but the rainfall was not as intense as the 6/26 heavy rainfall event.

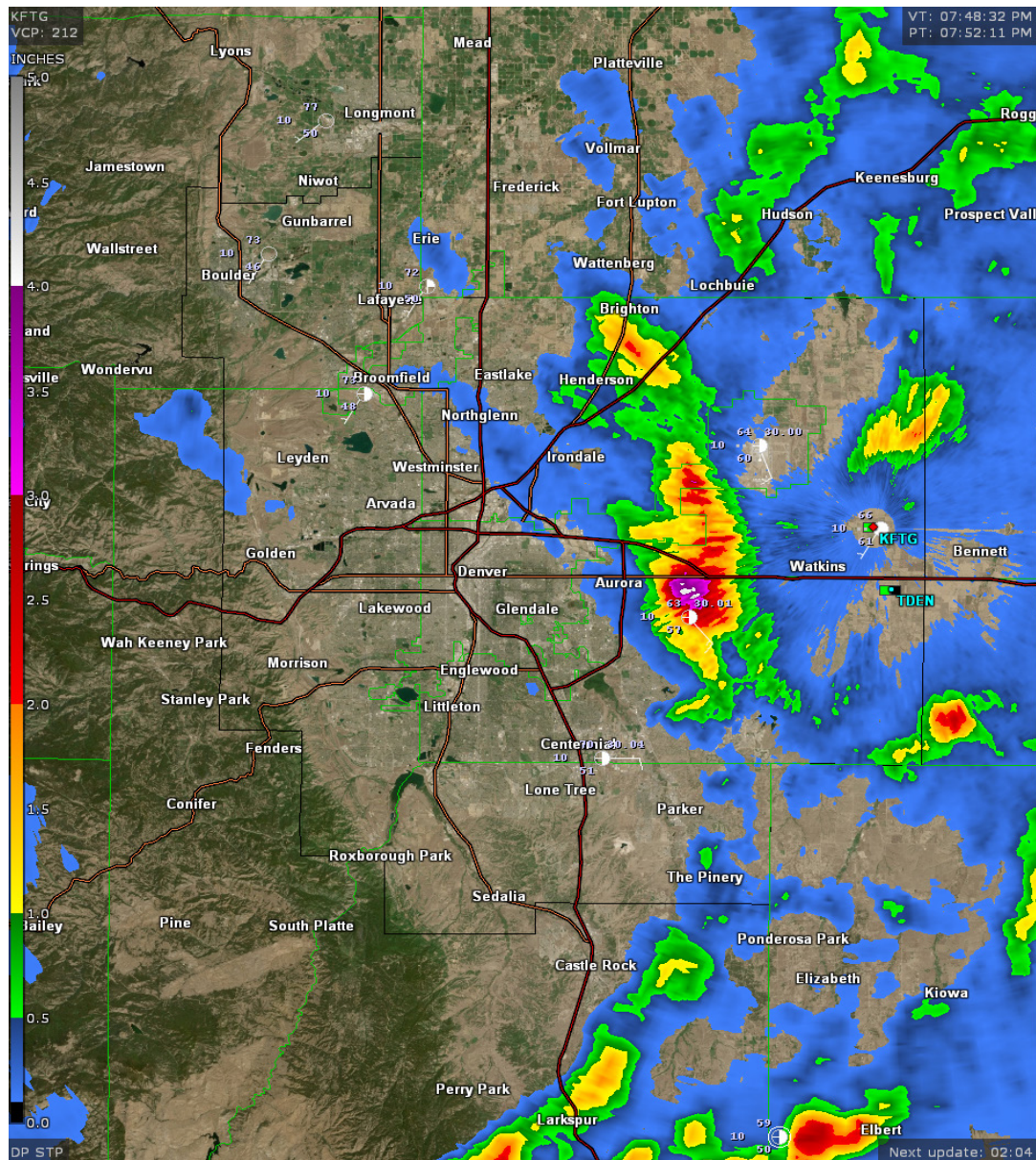


Figure 5: Rainfall-Estimated Radar from KFTG on 7/4/2020



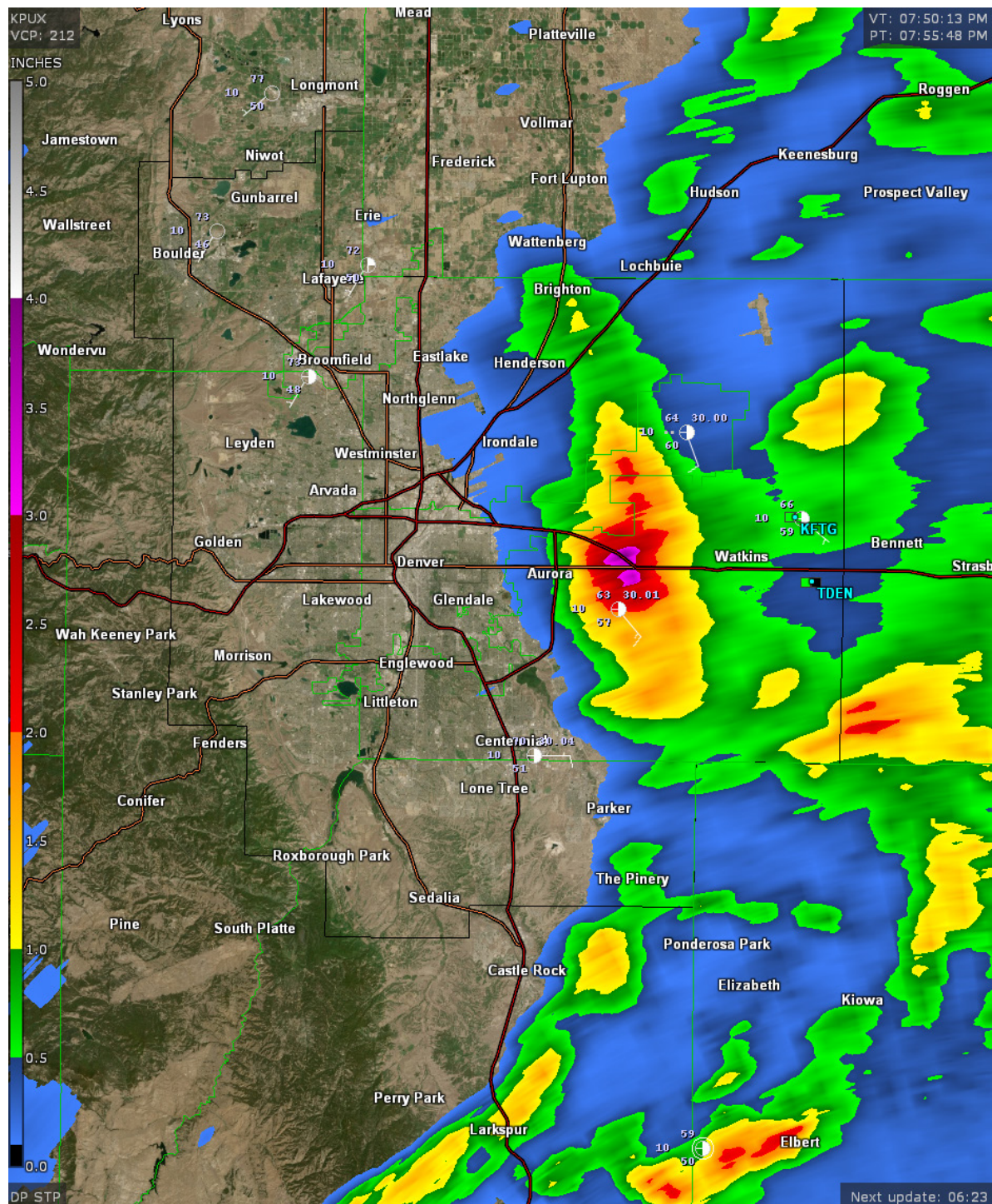


Figure 6: Rainfall-Estimated Radar from KPIX on 7/4/2020

