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## **The Emergence of El Nino**

The Climate Prediction Center (CPC) declared an active El Nino phase in mid-February, consistent with predictions from this past fall and early winter. El Nino is the warm phase of ENSO (El Nino Southern Oscillation), which arises from sea-surface temperature and atmospheric anomalies in the Equatorial Pacific. Last winter, we saw a weak La Nina episode, which is the cold phase of ENSO. This is the first El Nino episode we've seen since 2015/16, and only the second since 2009.

Ocean and atmospheric models are consistent with a weak El Nino event this winter, likely persisting into the spring and perhaps the summer ahead. Research has shown that different phases of ENSO can have an influence on the weather throughout different parts of the world, including North America. The strongest correlations for El Nino include better chances for wet and cool conditions over the Desert Southwest and southern tier, with warmer and drier conditions over the Pacific Northwest and Northern Rockies.

Here in Colorado, precipitation and temperature correlations are weaker during El Nino episodes, but we can still glean a few details from past events. Realized effects from El Nino typically peak during the fall and spring periods over North America. During these periods, we often see an active southern storm track off the Pacific Ocean, thanks to a strong subtropical jet stream transporting storm systems into Southern California and the Desert Southwest. Sometimes, these storms take a favorable track towards Colorado, contributing to enhanced spring snowfall over portions of the Front Range.

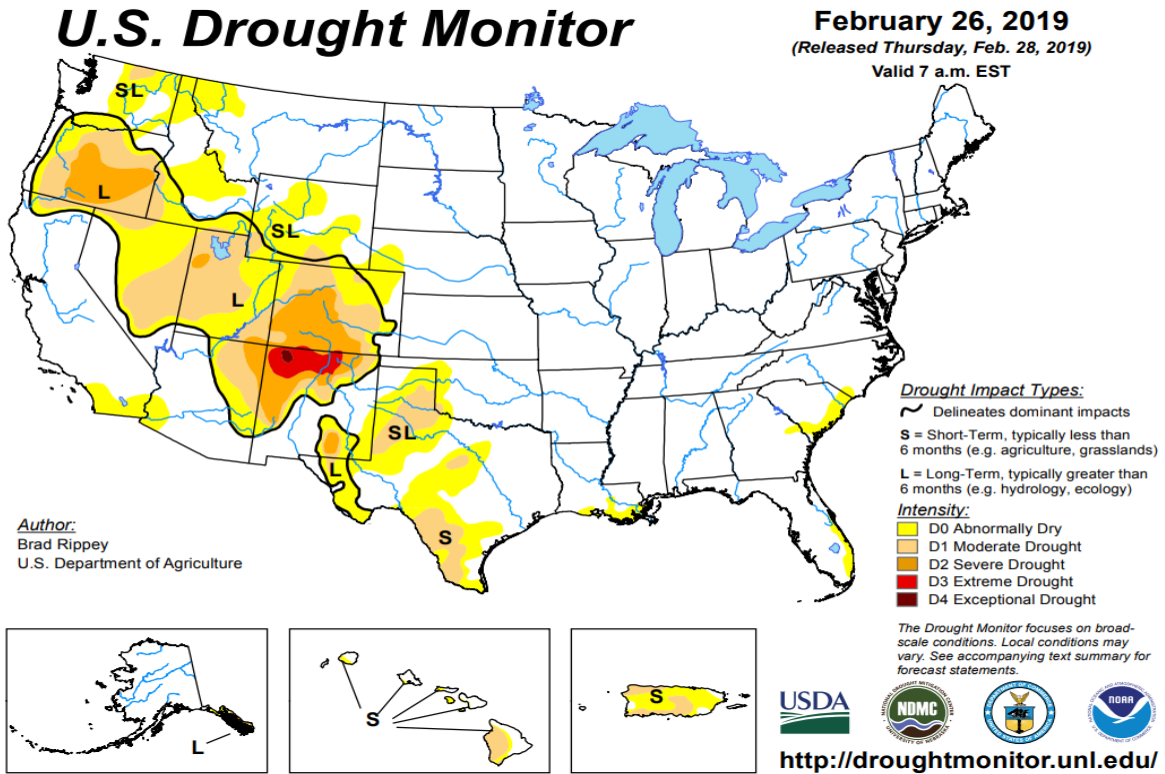
Current long-range climate models do show a slightly better chance of above-average precipitation and cooler conditions for our area during the month of March, but the signal is not very strong right now. Furthermore, because this is a weak El Nino event, it will be difficult to determine if ENSO (or something else) is indeed driving the large-scale weather pattern over the coming weeks and months.

Of note, some of our snowiest events along the Front Range have come during El Nino winters, like the Blizzard of 2003 which brought 20-30+ inches of snow to the area. Also, the October Blizzard of 1997 came during a strong El Nino year. However, it's also worth noting we have seen countless major snowfall events during ENSO neutral years or even La Nina episodes. Likewise, some spring periods have been unusually dry along the Front Range during El Nino as well.

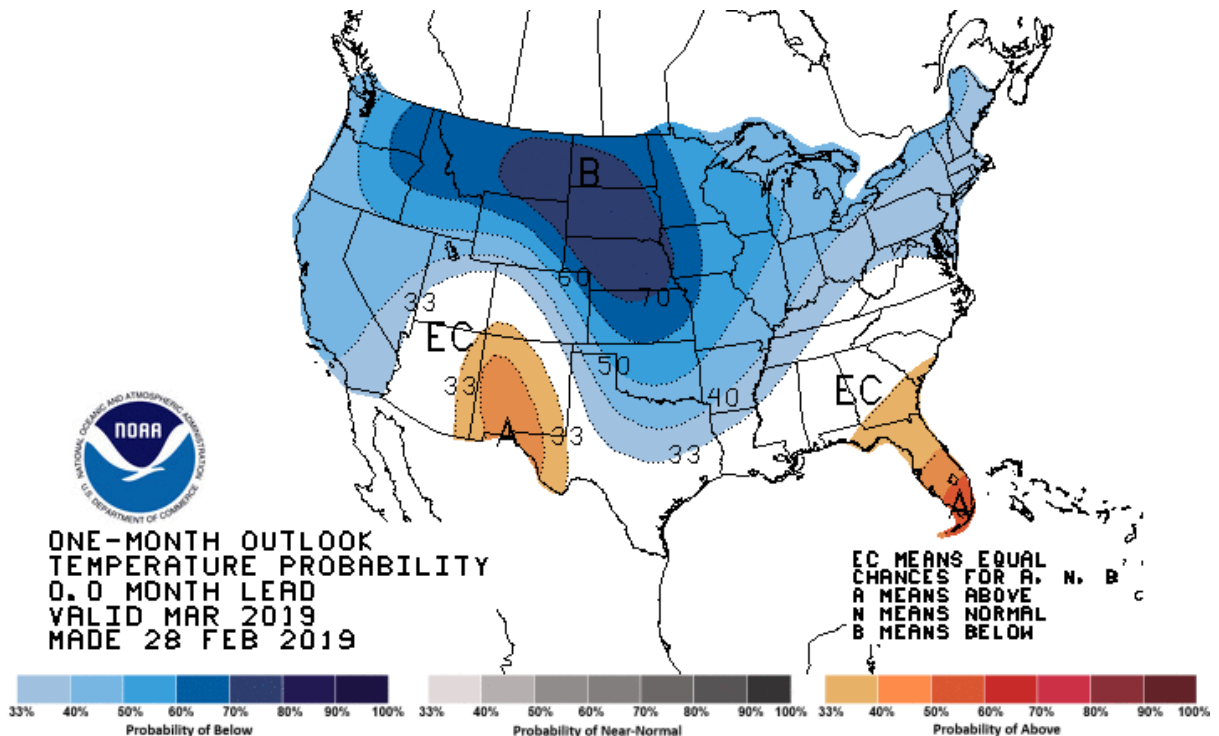
Spring arrives March 20th with the vernal equinox, as the sun moves directly above the equator. Only time will tell over the coming weeks and months what this year's El Nino has in store (or doesn't) for our neighborhood.

# Drought Update

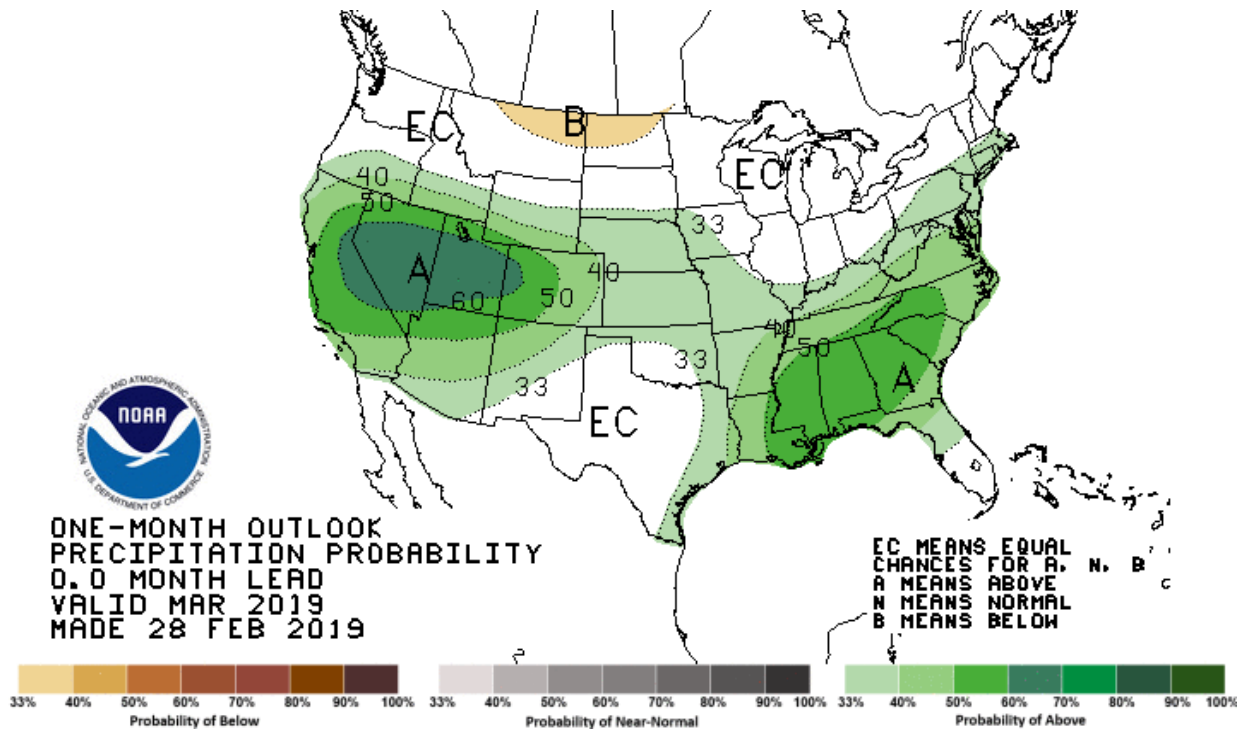
Variable drought conditions continue over most of Colorado with the most severe drought conditions now over northern New Mexico.



The map below shows forecasted temperature deviances for March 2019. There is a bias towards below normal temperatures over NE Colorado with a slight bias towards above normal temperatures far SW Colorado.



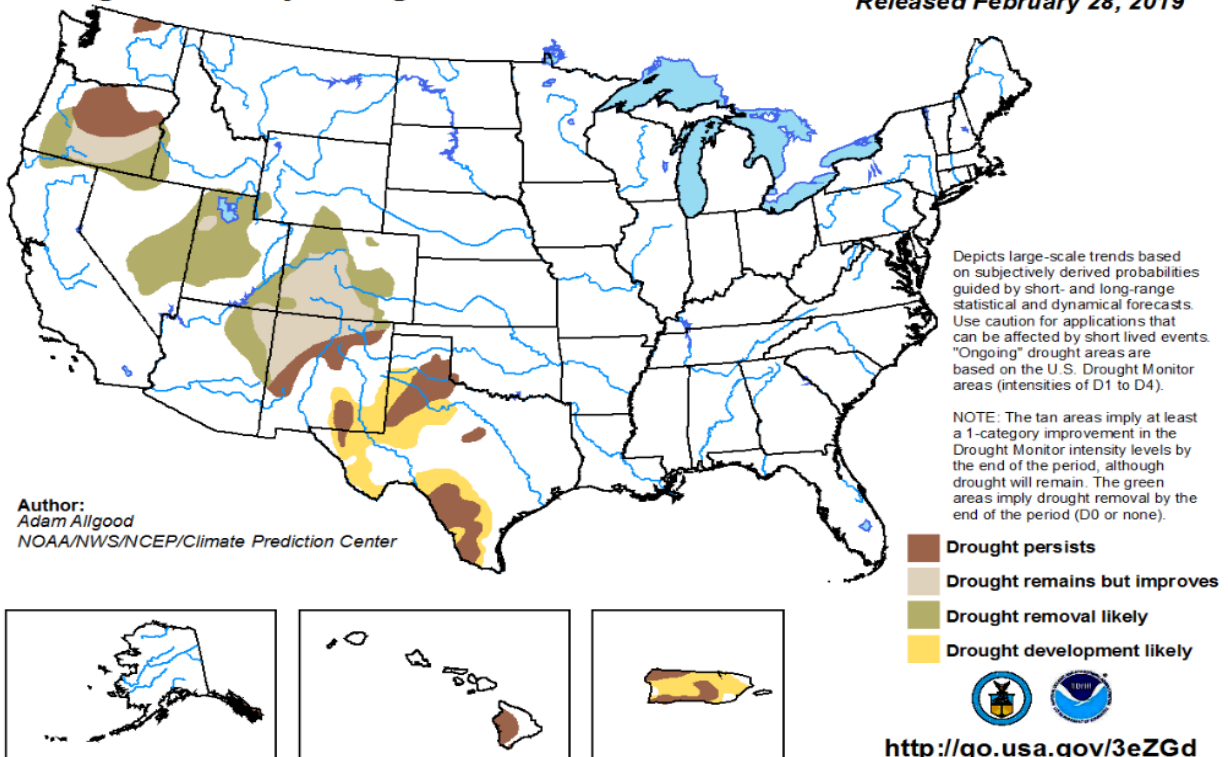
The map below shows forecasted precipitation deviances for March 2019. There is a strong bias towards above normal precipitation over Colorado, favoring areas west.



Drought conditions are expected to improve over the state during the month of March.

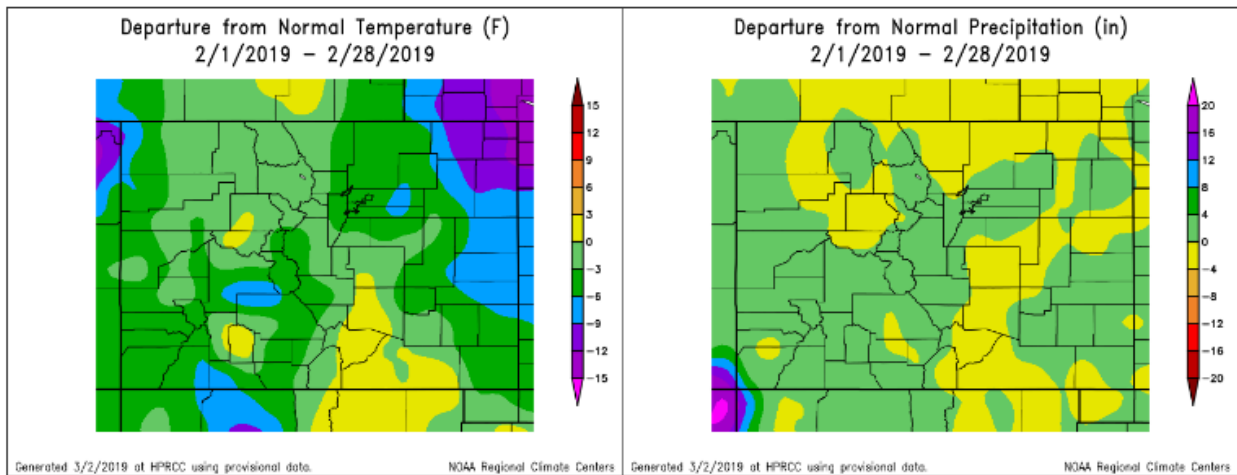
### U.S. Monthly Drought Outlook Drought Tendency During the Valid Period

Valid for March 2019  
Released February 28, 2019



## February Summary

February of 2019 was well below normal in temperature with well above normal precipitation and snowfall. Average highs for the month were 40.8 degrees which was 5.4 degrees below the normal of 46.2 degrees. Average lows for the month was 15.3 which was 3.6 degrees below the normal of 18.9 degrees. The combination of average monthly highs and lows yielded a monthly mean temperature on 28.0 degrees which was 4.5 degrees below normal. Precipitation for the month came in at 0.72", 0.41" of which occurred on the 22<sup>nd</sup> of the month. The 0.72" was 0.35" above the normal of 0.37". For the year so far precipitation is 1.47" which is 0.69" above normal through March 1<sup>st</sup>. Snowfall at DIA was 13.4" in February, which was 7.7" above the normal of 5.7". For the snow season through the end of February snowfall at DIA stands at 27.8" which is 7.4" below the normal of 35.2". There were 8 snow events for all of northeastern Colorado during February with 3 snowfall events that had limited snowfall production along the plains where most of the snow fell in the foothills. February 6-7<sup>th</sup>, 15-16<sup>th</sup>, 17-18<sup>th</sup>, 18-19<sup>th</sup>, 21-22<sup>nd</sup>, 22-23<sup>rd</sup>, 26<sup>th</sup>, 27-28<sup>th</sup> were all snowfall events that impacted all of northeastern Colorado, whereas the 13-14<sup>th</sup>, 14-15<sup>th</sup> and the 28<sup>th</sup> which impacted the foothills. The 13.4" of snow at DIA was in line with most of the Denver Metro area receiving between 9-15" of total snowfall for February. Areas north in Ft. Collins, Loveland and Greeley received less snowfall for the month of February with anywhere between 3-6". The foothills had the widest snowfall range, with areas in Jefferson County such as Golden, Conifer and Roxborough Park receiving between 13-20", with Boulder foothills, including Allenspark and Nederland receiving between 7-11". South towards highlands ranch and the rest of northern and central Douglas including Parker and Castle Rock received between 8-11" of total snow during February. Below are maps of Colorado showing departure from normal temperature and precipitation.



## February Stats

### TEMPERATURE (IN DEGREES F)

AVERAGE MAX	40.8	NORMAL 46.2	DEPARTURE -5.4
AVERAGE MIN	15.3	NORMAL 18.9	DEPARTURE -3.6

MONTHLY MEAN	28.0	NORMAL 32.5	DEPARTURE	-4.5
HIGHEST	65 on the 3 <sup>rd</sup>			
LOWEST	-11 on the 7 <sup>th</sup>			

DAYS WITH MAX 90 OR ABOVE	0	NORMAL	0.0
DAYS WITH MAX 32 OR BELOW	8	NORMAL	3.9
DAYS WITH MIN 32 OR BELOW	26	NORMAL	26.9
DAYS WITH MIN ZERO OR BELOW	3	NORMAL	1.3

### TEMPERATURE RECORDS

NA

### HEATING DEGREE DAYS

MONTHLY TOTAL	1029	NORMAL 908	DEPARTURE	121
SEASONAL TOTAL	4417	NORMAL 4439	DEPARTURE	-22

### COOLING DEGREE DAYS

MONTHLY TOTAL	0	NORMAL 0	DEPARTURE	0
YEARLY TOTAL	0	NORMAL 0	DEPARTURE	0

### PRECIPITATION (IN INCHES)

MONTHLY TOTAL	0.72	NORMAL	0.37	DEPARTURE	0.35
YEARLY TOTAL	1.47	NORMAL	0.41	DEPARTURE	0.69
GREATEST IN 24 HOURS	0.41" on the 22 <sup>nd</sup>				
DAYS WITH MEASURABLE PRECIP.	6				

### SNOWFALL (IN INCHES)

MONTHLY TOTAL	13.4	NORMAL 5.7	DEPARTURE	7.7
SEASONAL TOTAL	27.8	NORMAL 35.2	DEPARTURE	-7.4
GREATEST IN 24 HOURS	6.8"			
GREATEST DEPTH	7.0"			

### WIND (IN MILES PER HOUR)

AVERAGE SPEED	9.5 mph		
PEAK WIND GUST	42 mph from the N on the 14 <sup>th</sup>		

### MISCELLANEOUS WEATHER

NUMBER OF DAYS WITH THUNDERSTORM	0	NORMAL	0
NUMBER OF DAYS WITH HEAVY FOG	11	NORMAL	2
NUMBER OF DAYS WITH HAIL	0		
NUMBER OF SUNNY DAYS	3		
NUMBER OF PARTLY CLOUDY DAYS	20		
NUMBER OF CLOUDY DAYS	5		
AVERAGE RELATIVE HUMIDITY	66%		

## March Preview

March is the first month of meteorological spring (Spring begins March 20<sup>th</sup>), but is typically one of Denver's most active weather months, including the highest average snowfall of any month with 10.7". Denver's average precipitation in March of 0.92" is more than double February's average precipitation, which indicates how quickly moisture typically increases as we head into the spring season. Due to the rapidly increasing solar angle that occurs during March, as well as increasing average temperatures, snow that falls in March tends to melt more quickly after storms are over, relative to the mid-winter months, and snow usually does not accumulate as much on pavement. However, big snowstorms are more likely to occur in March than any other month, which can result in significant travel impacts. Denver's largest snowstorm in March history, and second largest storm in its overall history, occurred on March 17-19, 2003 when 31.8" of snow fell at Stapleton Airport (formerly Denver's "official" climate station before the move to DIA). This incredible storm was one of the most significant snow events in the history of Colorado. In the foothills, a few locations received more than 80" of snow during the storm! March can sometimes be hit-or-miss with snowfall, with only minor snowfall amounts occurring in 2014 and 2015, but March of 2016 was a big month for snowfall in Denver with 18.4" falling at DIA, mostly over the second half of the month. Much of this snow fell during a blizzard event on March 23, where some locations in northern Denver metro received over two feet of snow. Temperatures during March can be quite pleasant and spring-like during drier patterns, with an average high of 54.4 for the month (more than 10 degrees above December and January) and a record high of 84, which occurred in 1971. Arctic blasts are much less common compared to mid-winter, but brief cold snaps happen on occasion as we have experienced early this month. The coldest temperature on record in March is -11, which occurred in 1886. On the 3<sup>rd</sup> of this month we hit -6 and the 4<sup>th</sup> -5 and the 5<sup>th</sup> -1, so it has been a cold start to the month. For March 2019, we are expecting slightly below normal temperatures and above normal precipitation and snowfall. Some areas may end up well above normal in snowfall.

### DENVER'S MARCH CLIMATOLOGICALLY NORMAL (NORMAL PERIOD 1981-2010 DIA Data)

#### TEMPERATURE

AVERAGE HIGH	54.4
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AVERAGE LOW	26.4
MONTHLY MEAN	40.4
DAYS WITH HIGH 90 OR ABOVE	0
DAYS WITH HIGH 32 OR BELOW	2
DAYS WITH LOW 32 OR BELOW	24
DAYS WITH LOWS ZERO OR BELOW	0

### PRECIPITATION

MONTHLY MEAN	0.92"
DAYS WITH MEASURABLE PRECIPITATION	6
AVERAGE SNOWFALL IN INCHES	10.7"
DAYS WITH TRACE OR MORE OF SNOW	NA

### MISCELLANEOUS AVERAGES

HEATING DEGREE DAYS	763
COOLING DEGREE DAYS	0
WIND SPEED (MPH)	9.7mph
WIND DIRECTION	South
DAYS WITH THUNDERSTORMS	0
DAYS WITH DENSE FOG	1
PERCENT OF SUNSHINE POSSIBLE	69%

### EXTREMES

RECORD HIGH	84 on 3/26/1971
RECORD LOW	-11 on 3/28/1886
WARMEST	50.4 in 1910
COLDEST	26.4 in 1912
WETTEST	4.56" in 1983
DRIEST	0.11" in 1908
SNOWIEST	35.2" in 2003
LEAST SNOWIEST	Trace in 2012

## Snowfall

### October 2018 to May 2019

City	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
Aurora (Central)	2.5	4.6	0.9	12.7	9.5				30.2
Boulder	10.0	15.9	5.7	13.9	12.8				58.3
Brighton	3.4	4.6	0.7	3.4	8.5				20.6
Broomfield	5.1	8.3	2.1	20.0	11.3				46.8
Castle Rock	5.5	9.2	3.2	25.0	8.3				51.2
Colo Sprgs Airpor	5.3	2.8	1.5	2.6	6.1				18.3
Denver DIA	3.2	4.5	0.5	6.2	13.4				27.8
Denver Downtowr	2.5	6.0	1.4	15.1	12.4				37.4
Golden	7.0	7.0	2.4	16.9	13.0				46.3
Fort Collins	6.0	5.6	1.1	1.6	3.8				18.1
Highlands Ranch	6.5	7.0	1.2	19.8	9.4				43.9



Lakewood	3.4	6.6	1.2	15.2	12.0				<b>38.4</b>
Littleton	4.5	6.2	2.2	16.5	15.5				<b>44.9</b>
Parker	3.8	7.4	2.1	17.6	8.3				<b>39.2</b>
Sedalia - Hwy 67	5.2	6.6	2.4	23.1	8.8				<b>46.1</b>
Thornton	5.0	5.9	0.7	13.4	10.6				<b>35.6</b>
Westminster	3.2	6.8	2.5	19.8	9.1				<b>41.4</b>
Wheat Ridge	4.1	8.5	1.5	13.8	13.7				<b>41.6</b>

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