



With direct funding support from stakeholders, **CODOS** monitors the presence/absence of dust layers at **10** mountain pass locations throughout Colorado.

With those data, data from nearby Snotel sites, and weather forecasts, CODOS provides its funders with a series of "Update" analyses of how dust-on-snow is likely to influence snowmelt timing and rates during the snowmelt runoff season.

[CODOS 2012 Updates](#) > March 28 Update

MARCH 28, 2012 CODOS UPDATE

Greetings from Silverton -

Since our March 19 Update the Colorado mountains have experienced another prolonged period of largely dry, sunny, and unseasonably warm weather and an additional dust event – D6, March 26th. In the absence of new precipitation, SWE levels continue to fall behind 30-year averages, placing current SWE levels in the lowest quartile of values for the period of record at many Snotel stations, and some sites are beginning to show SWE losses.

Dust-on-snow is affecting snowpacks statewide. The [D4 \(March 6\)](#) dust layer observed at the snowpack surface at all CODOS sites during our first circuit ([see March 14-17 Update](#)) was only thinly covered by new snow in most Colorado mountain ranges on Sunday, March 18, but that new snow also delivered [dust layer D5](#). Here in the San Juan Mountains D5 was associated with as much as 14" of new snow. We've received confirmations of D5 from as far north as Steamboat Springs. New snow associated with D5 just has now largely been ablated and D5 had merged with the underlying D4 layer at the snowpack surface by the weekend of March 24-25. Then, on Monday, March 26th, a new dust layer – [D6-WY2012](#) – was deposited as "dust-on-dust" during the afternoon and evening hours. Thus, the snow surface here in the Senator Beck Basin Study Area now consists of three, effectively merged, dust layers. We are quickly receiving verification of the D6 event from observers in other locales.

As discussed in the March 19th Update, direct absorption of solar energy by these merged dust layers has been either hastening the 'ripening' of the snowpack to isothermal at 0° C throughout, or, if already isothermal, is now enhancing snowmelt rates. While streamflow data reflect a variety of processes influencing runoff rates, recent streamflow data do include the influence of reduced snow albedo by D4 from March 7-17, a restoration of higher snow albedo (with cooler weather) on March 18 for a brief period, followed by warmup and additional reduction in snow albedo as D5 merged with D4. Still further reduction in albedo, by D6, will also soon be integrated into these hydrographs, as long as these merged dust layers remain exposed at the snowpack surface.

This Update presents current, site-specific Snotel data and presents our analyses of past-season snowmelt rates at 15 Snotel sites, prepared by CODOS in spring 2011 ([complete set of Excel workbooks](#)). These site-by-site Snotel station analyses explore snowmelt behavior beginning with Water Year 2006, as CODOS's rigorous dust-on-snow monitoring began at CODOS sites around the state. For each site, the date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature, as measured at the Snotel site, during the period from Peak SWE to SAG is shown for each Water Year.

Dust-on-Snow Events Documented per Month, by Winter
Senator Beck Basin Study Area at Red Mountain Pass – San Juan Mountains

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2002/2003					2		1			3
2003/2004							2	1		3
2004/2005	0	0	0	0	0	1	2	1	0	4
2005/2006	0	0	1	0	1	1	3	2	0	8
2006/2007	0	0	1	0	1	1	3	1	1	8
2007/2008	0	0	0	0	0	3	3	1	0	7
2008/2009	1	0	1	0	1	4	5	0	0	12
2009/2010	1	0	0	0	0	1	4	3	0	9
2010/2011	0	0	0	0	1	3	3	4	0	11
2011/2012	0	2	1	0	0	3 so far				

The CODOS Log of Dust-on-Snow events (above) provides a broad context for these melt rate analyses. However, this Log tallies dust-on-snow events observed at Senator Beck Basin and, as those who have received our CODOS Update products over that period know, seasonal variations in the geography of deposition of dust in Colorado’s mountains, and in the impact of dust during snowmelt season (strongly influenced by spring weather), constrains making direct correlations between the number of dust events in a particular season and snowmelt rates at a particular Snotel site. This variability is reflected in the “adjusted daily mean loss [of] SWE” rate data presented in the site-specific tables and in the table below.

Comparison of those site-specific melt rate analyses shows that none of the past six Water Years produced the maximum melt rates observed at all or even most of the 15 Snotel sites analyzed, not even WY 2009. However, when all 15 sites are analyzed together, WYs 2009 and 2011 did produce the highest “group mean adjusted daily [rate of] loss SWE” rates, at 0.74” and 0.75” respectively, as seen in the Summary table below.

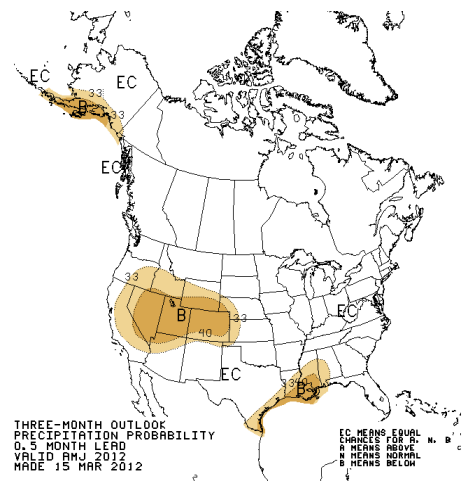
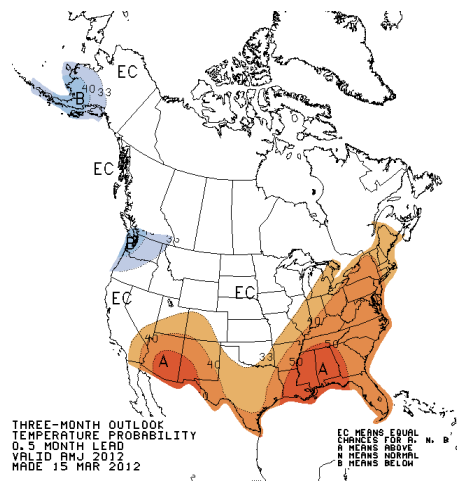
Aggregated CODOS and Other SNOTEL Sites - Snowmelt Season Summary Data

15 total sites including 11 CODOS sites

	Group Mean Date Peak SWE	Group Mean Peak SWE	Group Mean Days to SAG	Group Mean Post-Peak Added SWE	Group Mean Adjusted Daily Loss SWE	Group Mean Period Temp	Total Recorded SBB Dust Events
WY 2006	4/12/06	21.4	40	1.7	0.57	3.6	8
WY 2007	4/18/07	18.8	39	3.3	0.57	3.8	8
WY 2008	4/19/08	29.3	54	4.0	0.62	3.7	7
WY 2009	4/19/09	24.2	37	2.9	0.74	4.4	12
WY 2010	4/19/10	20.1	41	3.1	0.60	3.5	9
WY 2011	5/2/11	29.4	47	3.9	0.75	5.3	11
Max	05/02/11	29.4	54	4.0	0.75	5.3	12
Min	4/12/06	18.8	37	1.7	0.57	3.5	7
Range	21	10.6	17	2.3	0.18	1.8	5

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE

Since Snotel stations are the primary source of continuous snowpack formation and snowmelt rate data, the intent of these analyses is to refresh memories of snowmelt timing and rates experienced during these runoff seasons at these Snotel stations, most of which adjoin CODOS monitoring sites. Spring 2011 demonstrated the impact that late winter weather can have on Colorado snow-based water supplies, delaying the date of Peak SWE to as late as the end of May, producing record-setting SWE totals, and producing high melt rates just as solar inputs were maximizing. However, current NOAA Climate Prediction Center forecasts for April-May-June temperature and precipitation do not favor a repeat of Spring 2011 (below).



Rather, in striking contrast to last spring, Colorado's substantially sub-par reservoir of SWE must be considered vulnerable to continued prolonged periods of dry, sunny weather combined with substantially reduced snow albedo. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates simply match or approach those observed during the past several seasons (see the above summary table and site-specific tables for each CODOS site), SAG may occur early at many of these Snotel sites producing early peak runoff flows, early passage of runoff center of mass, and steep descending limbs on regional hydrographs.

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend's cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

More soon,
Chris

UPDATES BY SITE:

[Berthoud Summit](#) | [Grand Mesa](#) | [Grizzly Peak](#) | [Hoosier Pass](#) | [McClure Pass](#) | [Park Cone](#) | [Rabbit Ears Pass](#) | [Senator Beck Basin](#) | [Spring Creek Pass](#) | [Willow Creek Pass](#) | [Wolf Creek Pass](#)

[Combined Updates from all sites](#) (pdf)

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CODOS UPDATE FOR BERTHOUD SUMMIT: MARCH 28, 2012

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SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary analyses](#) of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Snowpack conditions in this portion of the upper Fraser River watershed are likely still mixed, with some cold content persisting in alpine and higher sub-alpine terrain snow at the same time that the lowest remaining snowcover in Middle Park is isothermal and releasing snowmelt runoff. Merged dust layers D5/D4, and possibly D6, are reducing snow albedo throughout this locale and the Berthoud Summit Snotel site has shown a recent decline in SWE. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at this Snotel site producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on local hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Berthoud Summit site will be in early April, as weather and dust conditions dictate.

MELT RATE

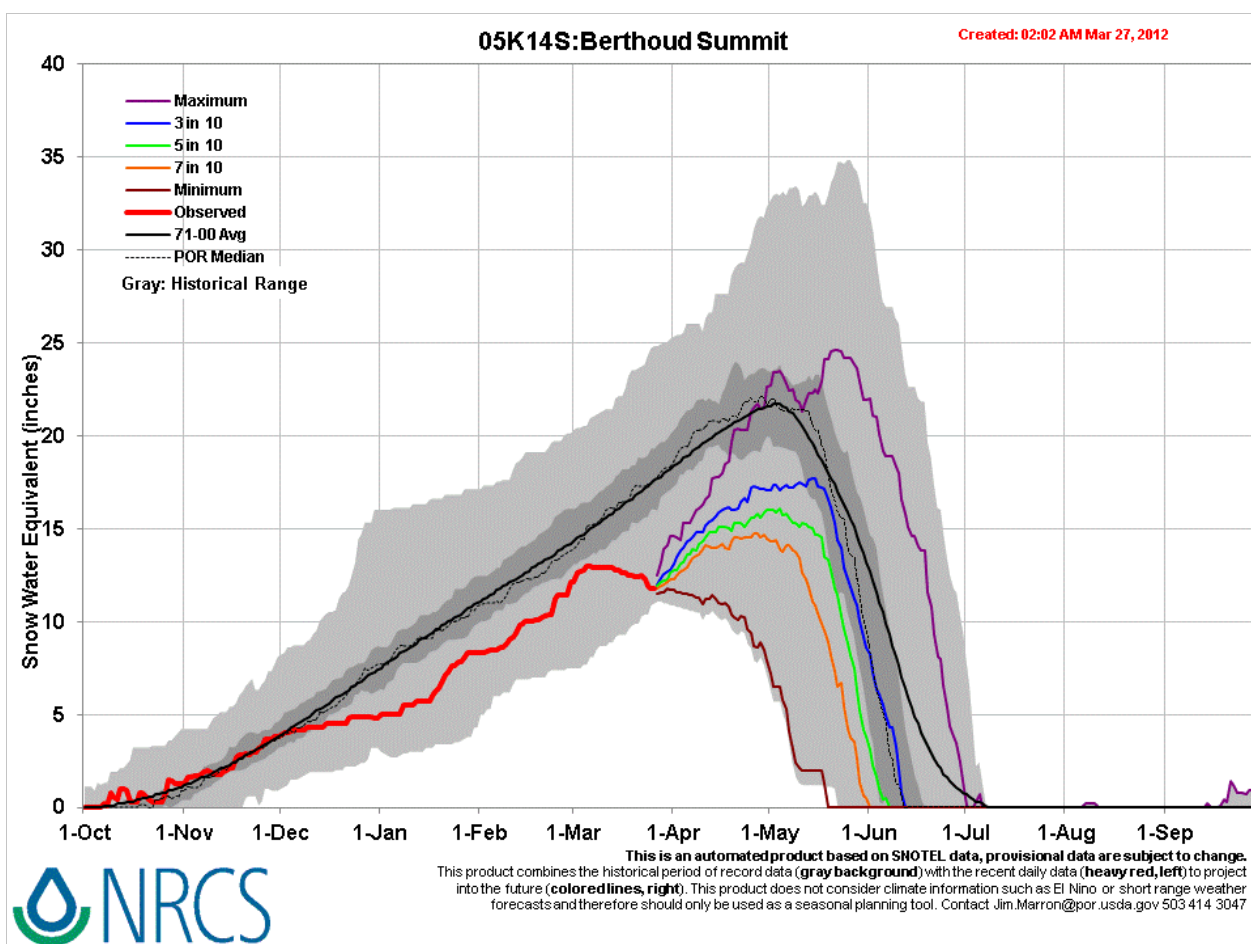
The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

As of Tuesday, March 27, 2012, the Berthoud Summit Snotel reports a loss of 0.9" SWE since March 21. This recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.46" per day, over a 5-day period ending June 12, 2011. As has been discussed in prior seasons, because of its location in an open meadow, with good sky view to the east and south, Berthoud Summit Snotel data do capture the influence of dust-on-snow in open terrain (versus in tree cover).

Berthoud Summit SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
					SWE	
WY 2006	4/21/2006	24.0	41	3.8	0.68	3.5
WY 2007	4/27/2007	22.2	46	4.5	0.58	4.4
WY 2008	5/16/2008	24.4	34	1.4	0.76	5.8
WY 2009	4/20/2009	24.7	50	5.2	0.60	4.0
WY 2010	5/16/2010	24.5	23	0.6	1.09	6.6
WY 2011	5/26/2011	34.8	35	2.0	1.05	8.4
Max	5/26	34.8	50	5.2	1.09	8.4
Min	4/20	22.2	23	0.6	0.58	3.5
Range	37	12.6	27	4.6	0.51	4.9

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE



STREAM FLOWS

The USGS Fraser River Upper Station near Winter Park stream gauge is reporting a recent rise in streamflows, nearing the 32-year period of record peak flows for this date set in 2004.

FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

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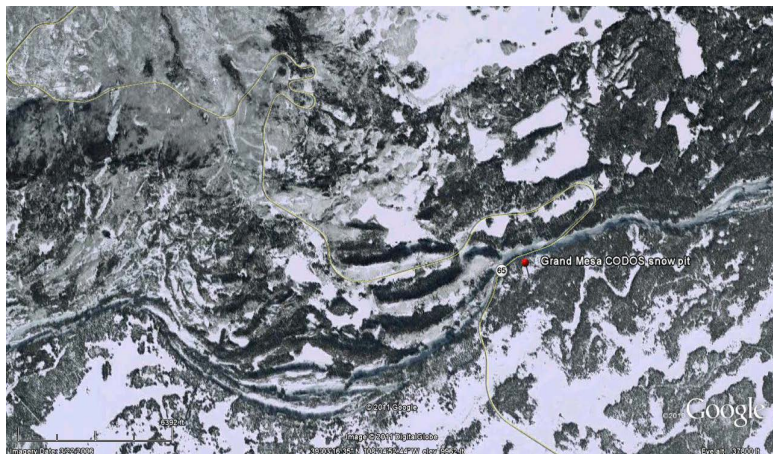
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CODOS UPDATE FOR GRAND MESA: MARCH 28, 2012

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SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary analyses](#) of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Snowpack conditions on Grand Mesa are generally isothermal and snowmelt runoff has begun. Merged dust layers D5/D4, and possibly D6, are reducing snow albedo and the Mesa Lakes Snotel site, near our Grand Mesa Study Plot, reports a small recent decline in SWE. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at this Snotel site producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on local hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Grand Mesa site will be in early April, as weather and dust conditions dictate.

MELT RATE

The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

As of Tuesday, March 27, 2012, the Mesa Lakes Snotel had reported a loss of 0.2" SWE since March 21, following the small bump in SWE produced by the March 18 snowstorm that delivered D5. This recent melt rate falls short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.52" per day, over a 5-day period ending June 9, 2011.

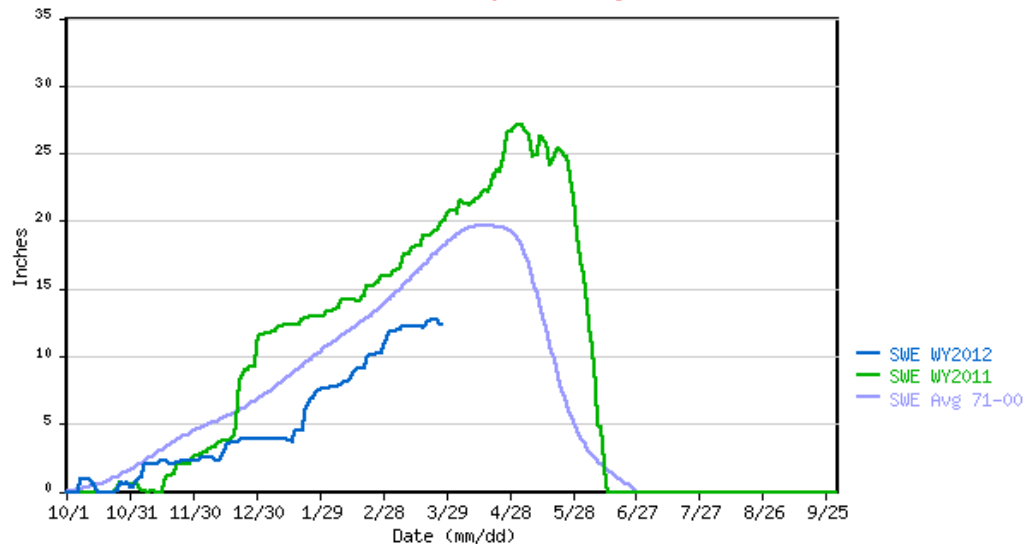
Mesa Lakes SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
WY 2006	4/8/2006	17.9	39	1.6	0.50	3.8
WY 2007	4/14/2007	13.0	31	3.1	0.52	3.3
WY 2008	4/12/2008	23.3	59	5.3	0.48	3.1
WY 2009	4/18/2009	19.2	32	2.5	0.68	5.0
WY 2010	4/9/2010	16.9	51	5.0	0.43	2.9
WY 2011	5/4/2011	27.1	41	4.0	0.76	5.8
Max	5/4	27.1	59	5.3	0.76	5.8
Min	4/8	13.0	31	1.6	0.43	2.9
Range	27	14.1	28	3.7	0.33	2.9

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE

08K04S SNOTEL as of 03/27/2012

*** Provisional Data, Subject to Change ***



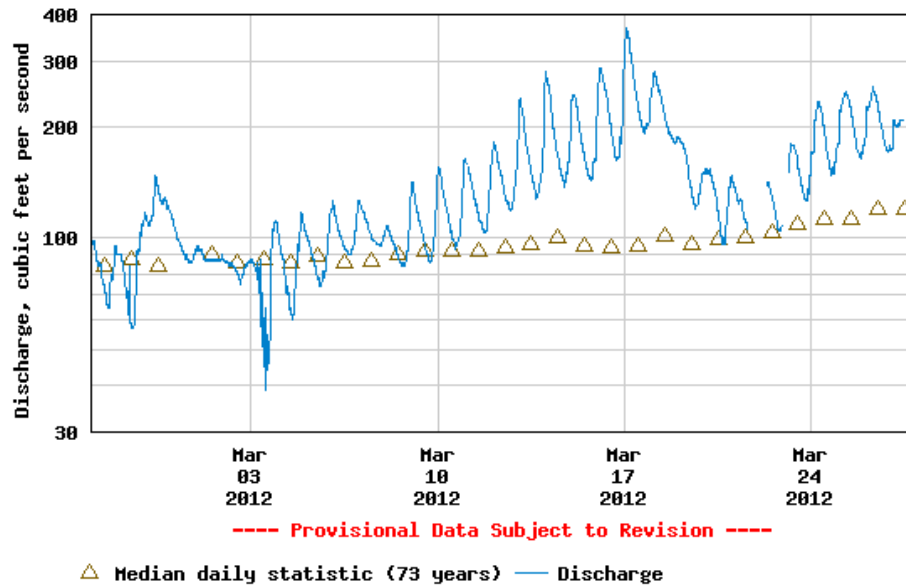
STREAM FLOWS

Streamflow data reflect a variety of processes influencing runoff rates but recent data from the USGS Plateau Creek near Cameo stream gauge may include the influence of the reduction of snow albedo by D4 and very warm temperatures from March 10-17, a decline flows with restoration of higher snow albedo (with cooler weather) on March 18, and then another rapid increase in flows with the subsequent warmup and reduction in snow albedo as D5 emerged and merged with D4. Event D6 may also be contributing to the most recent data. Upstream diversions and storage systems may complicate the interpretation of dust-related effects on Grand Mesa runoff into the Surface Creek watershed.

The seasonal USGS Surface Creek near Cedaredge stream gauge is no yet reporting data.



USGS 09105000 PLATEAU CREEK NEAR CAMEO, CO



FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

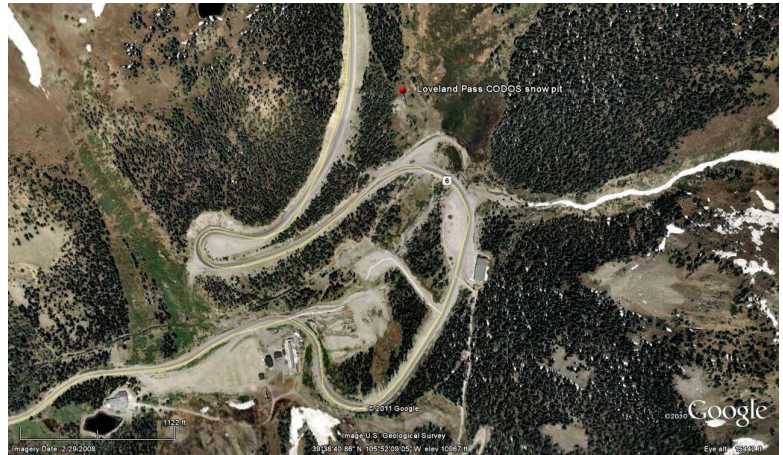
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CODOS UPDATE FOR GRIZZLY PEAK: MARCH 28, 2012

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SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary analyses](#) of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Snowpack conditions in this portion of the upper Blue River watershed are likely still mixed, with some cold content persisting in alpine and higher sub-alpine terrain snow at the same time that the lowest elevation snowcover in Summit County has become largely isothermal and begun releasing snowmelt runoff. Merged dust layers D5/D4, and possibly D6, are reducing snow albedo throughout this locale. Although the shallow snowpack is settling, the Grizzly Peak Snotel site has shown only a small decline in SWE. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at this Snotel site producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on local hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Grizzly Peak site will be in early April, as weather and dust conditions dictate.

MELT RATE

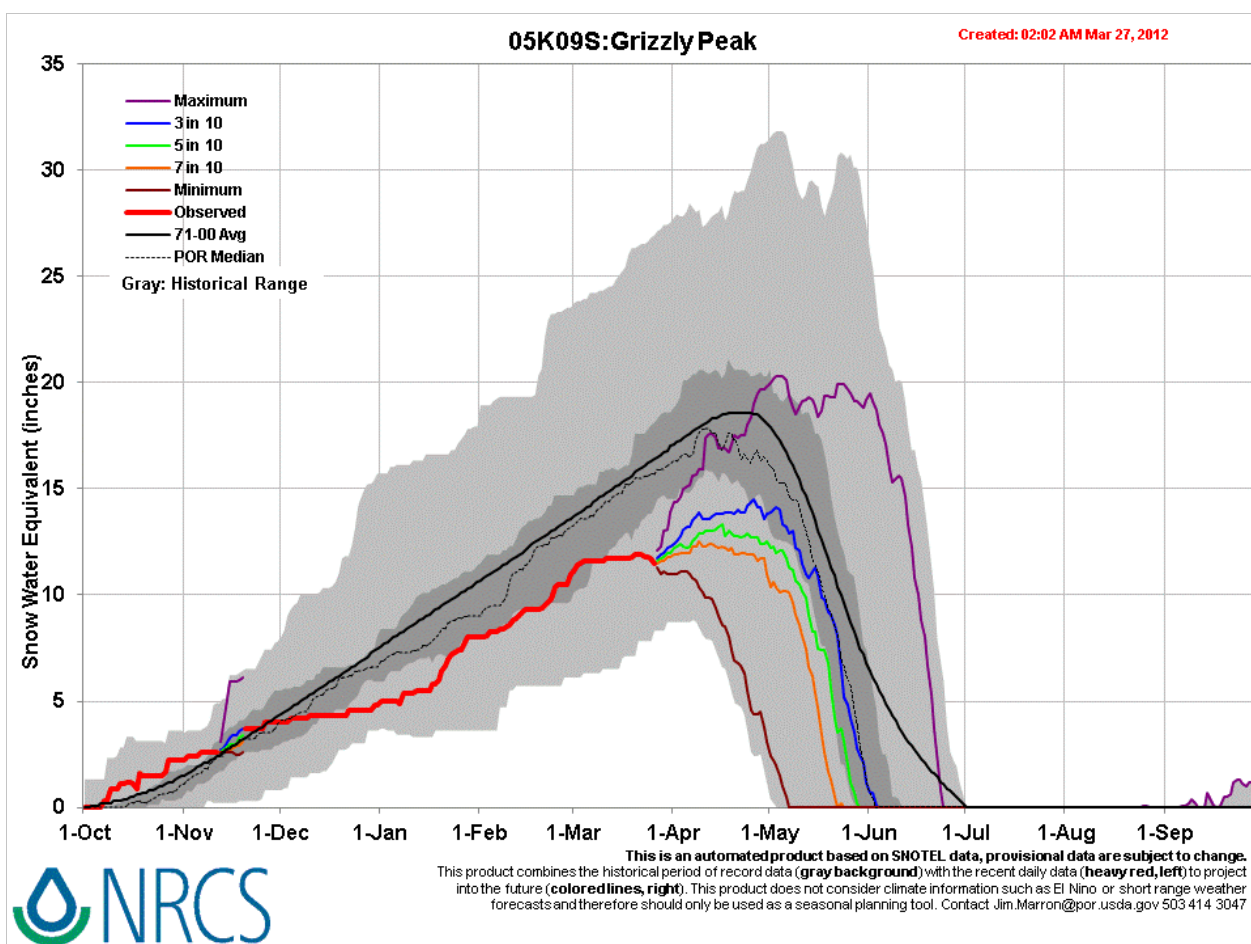
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As of Tuesday, March 27, 2012, the Grizzly Peak Snotel reports a loss of 0.5" SWE since March 21, and only a very small upward bump in SWE produced by the March 18 snowstorm that delivered D5. This recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.38" per day, over a 5-day period ending June 6, 2011.

Grizzly Peak SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
					SWE	
WY 2006	4/4/2006	21.6	49	3.5	0.51	2.3
WY 2007	4/20/2007	20.6	43	3.0	0.55	3.0
WY 2008	4/13/2008	23.0	56	4.8	0.50	1.7
WY 2009	4/20/2009	21.6	47	5.2	0.57	3.7
WY 2010	4/9/2010	12.8	50	6.0	0.38	1.3
WY 2011	5/5/2011	31.8	52	5.8	0.72	5.1
Max	5/5	31.8	56	6.0	0.72	5.1
Min	4/4	12.8	43	3.0	0.38	1.3
Range	32	19.0	13	3.0	0.35	3.9

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE



STREAM FLOWS

Local headwater stream gauges are still iced and not yet producing valid data.

FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

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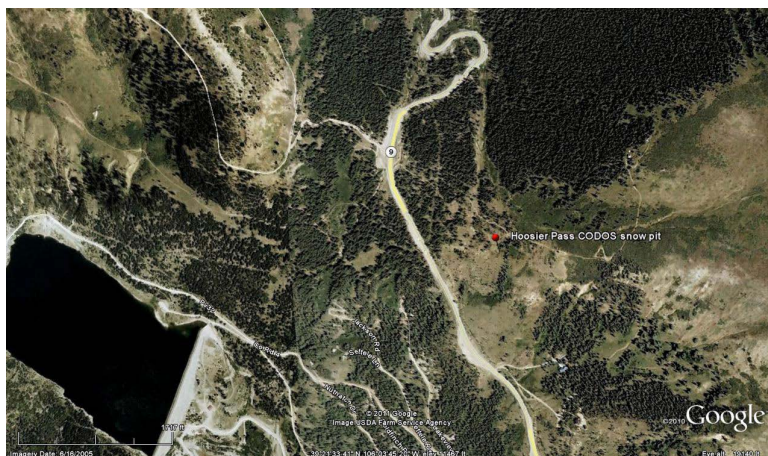
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Snowpack conditions in the upper Blue River and South Platte watersheds are likely still mixed, with some cold content persisting in alpine as well as the higher sub-alpine terrain snow at the same time that the lowest elevation snowcover has become largely isothermal and begun releasing snowmelt runoff. Merged dust layers D5/D4, and possibly D6, are reducing snow albedo throughout this locale. Although the shallow snowpack is settling, the Hoosier Pass Snotel site has shown no recent decline in SWE. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at this Snotel site producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on local hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Hoosier Pass site will be in early April, as weather and dust conditions dictate.

MELT RATE

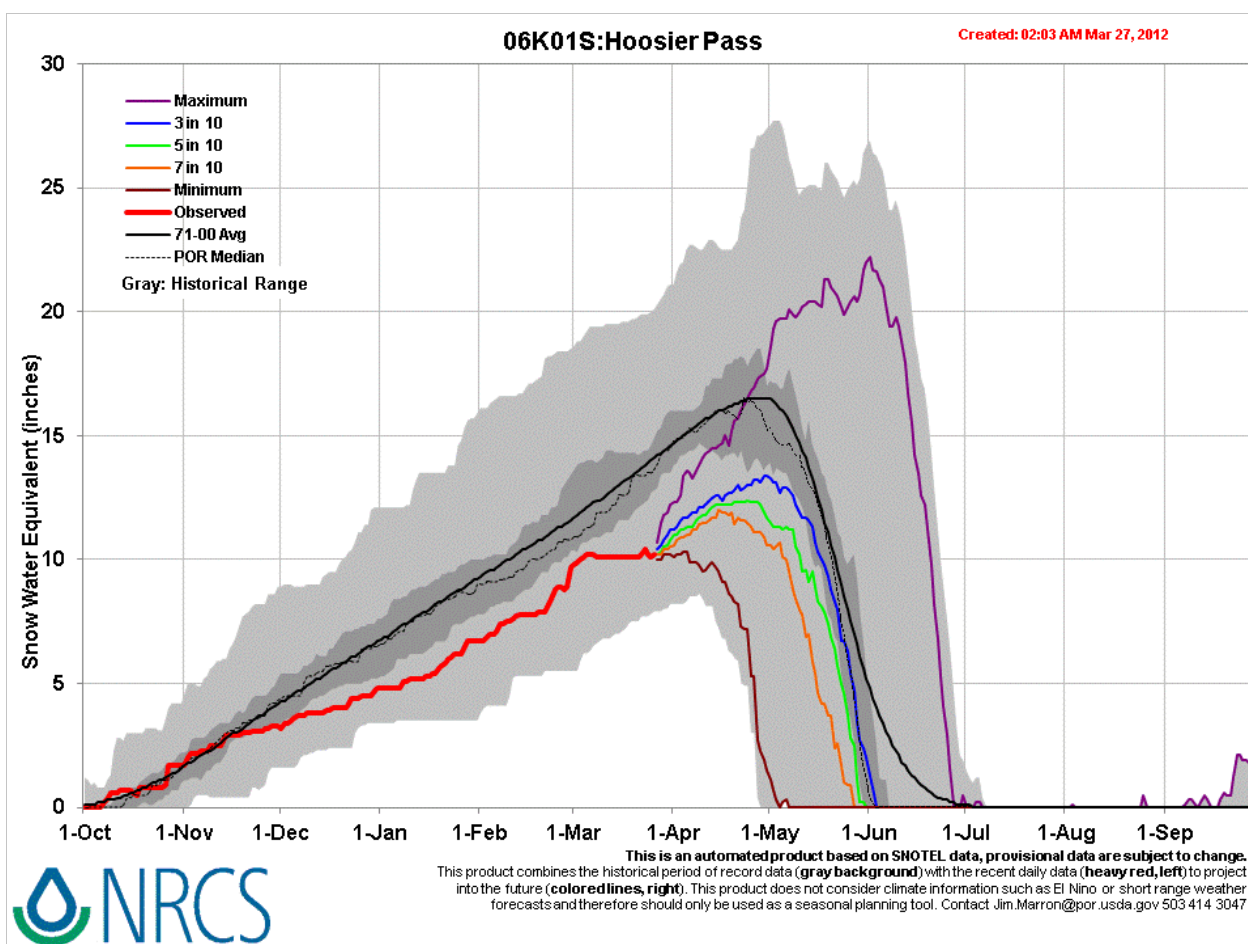
The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

As of Tuesday, March 27, 2012, the Hoosier Pass Snotel reports no loss of SWE since March 21, and no upward bump in SWE produced by the March 18 snowstorm that delivered D5. At zero, this recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.20" per day, over a 5-day period ending June 16, 2011.

Hoosier Pass SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
					SWE	
WY 2006	4/9/2006	19.3	49	2.7	0.45	3.5
WY 2007	4/28/2007	18.5	45	3.2	0.48	4.2
WY 2008	4/15/2008	20.8	61	4.2	0.41	2.5
WY 2009	4/20/2009	17.3	47	5.3	0.48	3.8
WY 2010	5/4/2010	14.7	31	1.8	0.53	3.3
WY 2011	5/5/2011	21.9	44	3.1	0.57	4.2
Max	5/5	21.9	61	5.3	0.57	4.2
Min	4/9	14.7	31	1.8	0.41	2.5
Range	27	7.2	30	3.5	0.16	1.7

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE



STREAM FLOWS

Local headwater stream gauges are still iced and not yet producing valid data.

FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds

for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

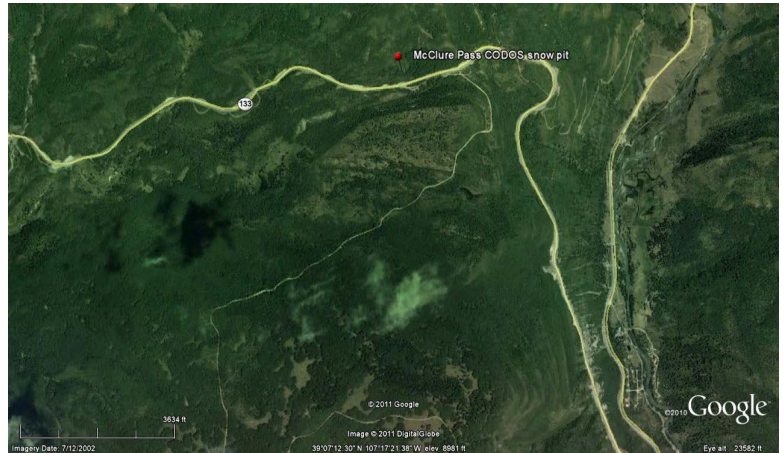
[CODOS 2012 Updates](#) > [March 28](#) > McClure Pass

CODOS UPDATE FOR MCCLURE PASS: MARCH 28, 2012

[Summary](#) | [Snowpack](#) | [Melt Rate](#) | [Stream Flows](#) | [Forecast](#) |
[Previous Update](#) | [pdf](#)

SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary analyses](#) of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Snowpack conditions in the upper Crystal River, North Fork of the Gunnison, and Muddy Creek watersheds are likely still mixed, with cold content persisting in alpine and higher sub-alpine terrain snow at the same time that lower elevation snowcover has become isothermal and begun releasing snowmelt runoff. Merged dust layers D6/D5/D4 are reducing snow albedo throughout these watersheds. The low-elevation McClure Pass Snotel site has shown accelerating declines in SWE while the nearby higher-elevation Schofield Pass Snotel shows only a small decline during the same period. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at these Snotel sites producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on Crystal River, North Fork of the Gunnison, and Muddy Creek hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the McClure Pass site will be in early April, as weather and dust conditions dictate.

MELT RATE

The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

As of Tuesday, March 27, 2012, the McClure Pass Snotel had reported a loss of 1.5" SWE since March 21, for an average of 0.2" SWE loss per day, following the small bump in SWE produced by the March 18 snowstorm that delivered D5. This recent melt rate falls short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.78" per day, over a 5-day period ending May 30, 2011.

Nearby, although we do not routinely visit the site, the higher-elevation **Schofield Pass Snotel** data (see [snowmelt analysis table](#) and [SNOTEL graph](#)) also depicts Crystal River watershed snowmelt behavior). As of March 27, this Snotel also reports only a small loss of 0.3" SWE since March 21st, also well short of the mean daily loss rates shown in the table, and very far short of the maximum SWE loss rate last Spring of 2.44" per day, over a 5-day

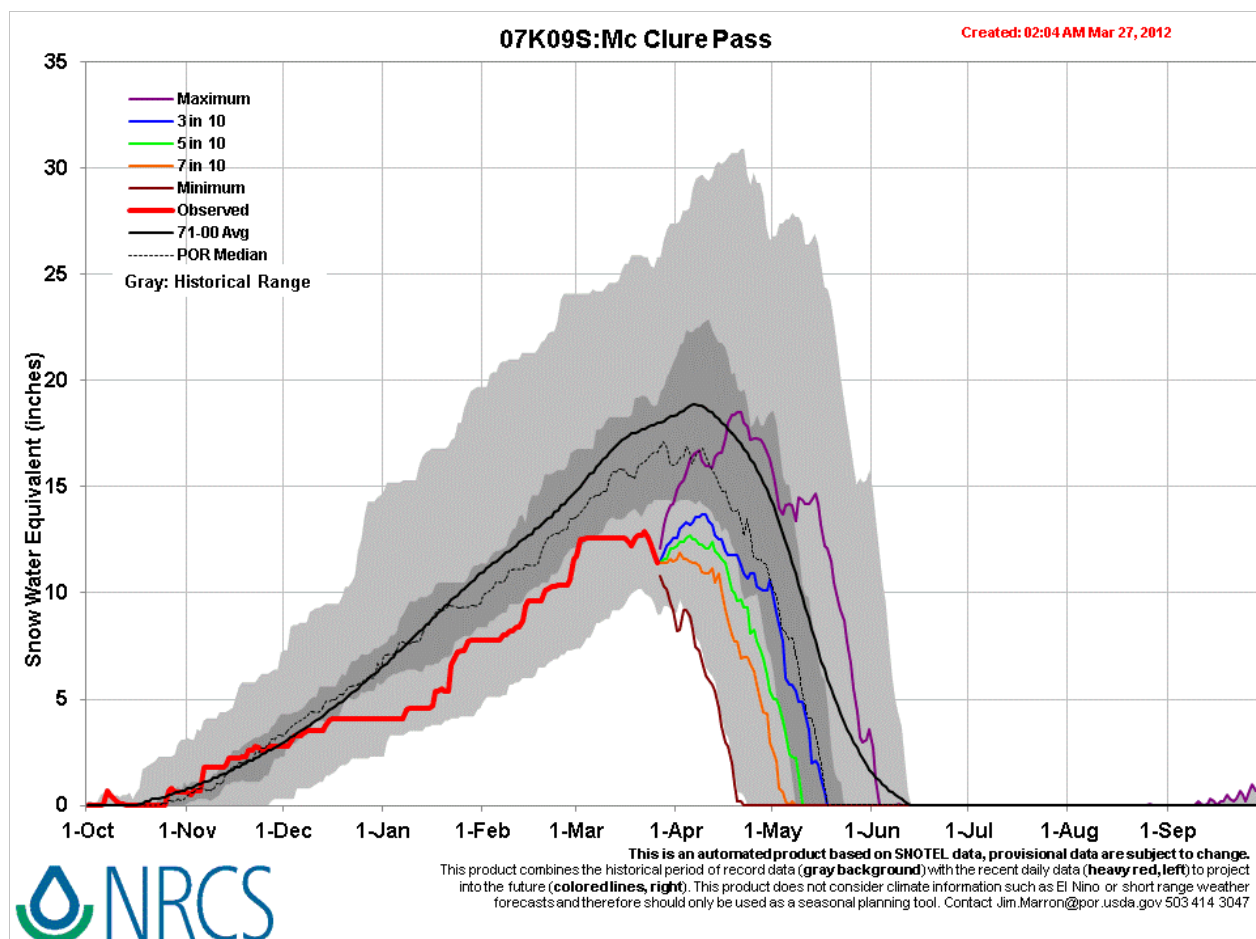
period ending June 29, 2011.

Finally, farther east at the headwater of the Roaring Fork River, the **Independence Pass Snotel** (see [snowmelt analysis table](#) and [SNOTEL graph](#)) reflects snowmelt behavior in that watershed. Recent data show an accelerating decline in SWE to a level outside (below) the historic range at that site.

McClure Pass SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
WY 2006	4/8/2006	20.5	30	1.5	0.73	6.6
WY 2007	3/13/2007	15.5	56	5.9	0.38	4.7
WY 2008	4/16/2008	29.3	40	2.3	0.79	5.5
WY 2009	4/8/2009	24.2	30	2.4	0.89	5.5
WY 2010	4/10/2010	20.3	38	3.0	0.61	5.0
WY 2011	3/31/2011	22.8	62	9.0	0.51	4.5
Max	4/16	29.3	62	9.0	0.89	6.6
Min	3/31	15.5	30	1.5	0.38	4.5
Range	17	13.8	32	7.5	0.50	2.0

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE



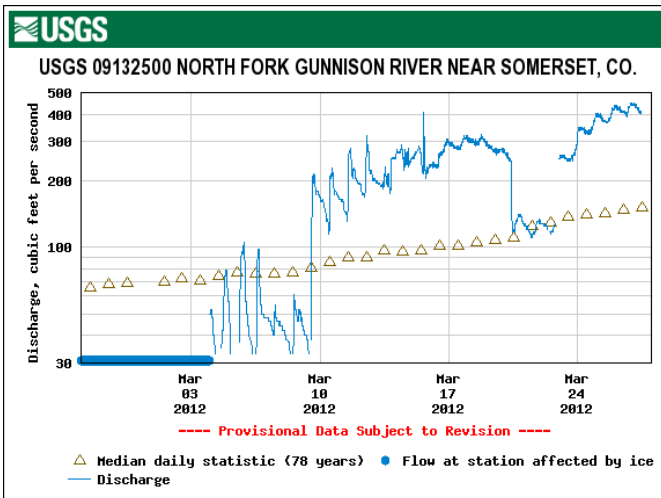
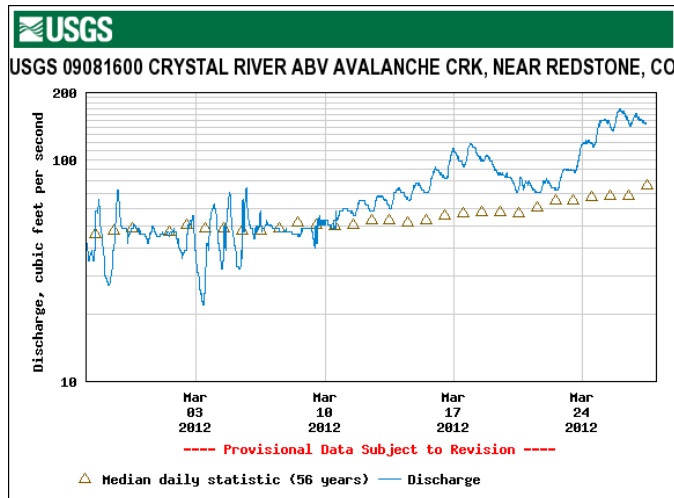
STREAM FLOWS

Streamflow data reflect a variety of processes influencing runoff rates, but recent data from the USGS Crystal River above Avalanche Creek near Redstone stream gauge does include the influence of the reduction of snow albedo by D4 and very warm temperatures from March 10-17, a decline flows with restoration of higher snow albedo (with cooler weather) on March 18, and then another rapid increase in flows with the subsequent

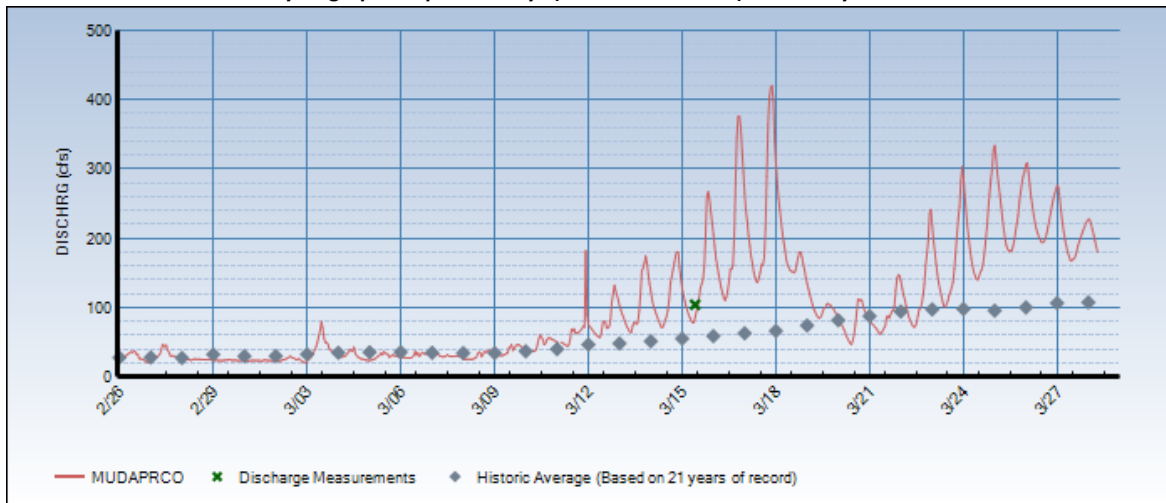
warmup and reduction in snow albedo as D5 emerged and merged with D4. Event D6 may also be contributing to the most recent data.

The Colorado Division of Water Resources' Muddy Creek above Paonia Reservoir stream gauge shows a similar pattern, but most recent flows are declining and may indicate that the center of snowmelt (SWE) mass has already passed.

Data from the USGS North Fork of the Gunnison appear to include ice-related noise but also show increasing flows, above historic median values.



Hydrograph for past 30 days (Feb 26 - March 27) on Muddy Creek



FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

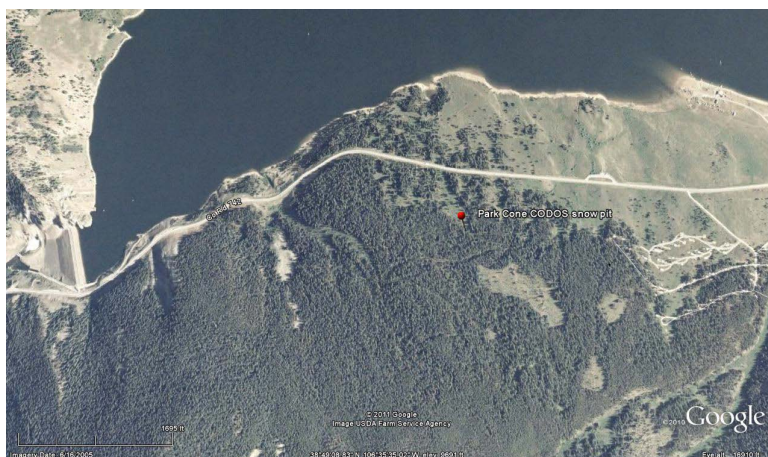
[CODOS 2012 Updates](#) > [March 28](#) > Park Cone site

CODOS UPDATE FOR PARK CONE SITE: MARCH 28, 2012

[Summary](#) | [Snowpack](#) | [Melt Rate](#) | [Stream Flows](#) | [Forecast](#) |
[Previous Update](#) | [pdf](#)

SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary](#) analyses of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Upper Gunnison Basin snowpack conditions are likely still mixed, with cold content persisting in the highest alpine terrain and even on northerly aspects in sub-alpine terrain at the same time that isothermal snow in the lowest snowcovered portions of the Basin has begun releasing snowmelt runoff. The Park Cone Snotel site has shown small recent only very small declines in SWE. Stream gauges show two recent surges associated with reduced snow albedo. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early Park Cone and throughout the Upper Gunnison Basin producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on Basin hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Park Cone site will be in early April, as weather and dust conditions dictate.

MELT RATE

The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

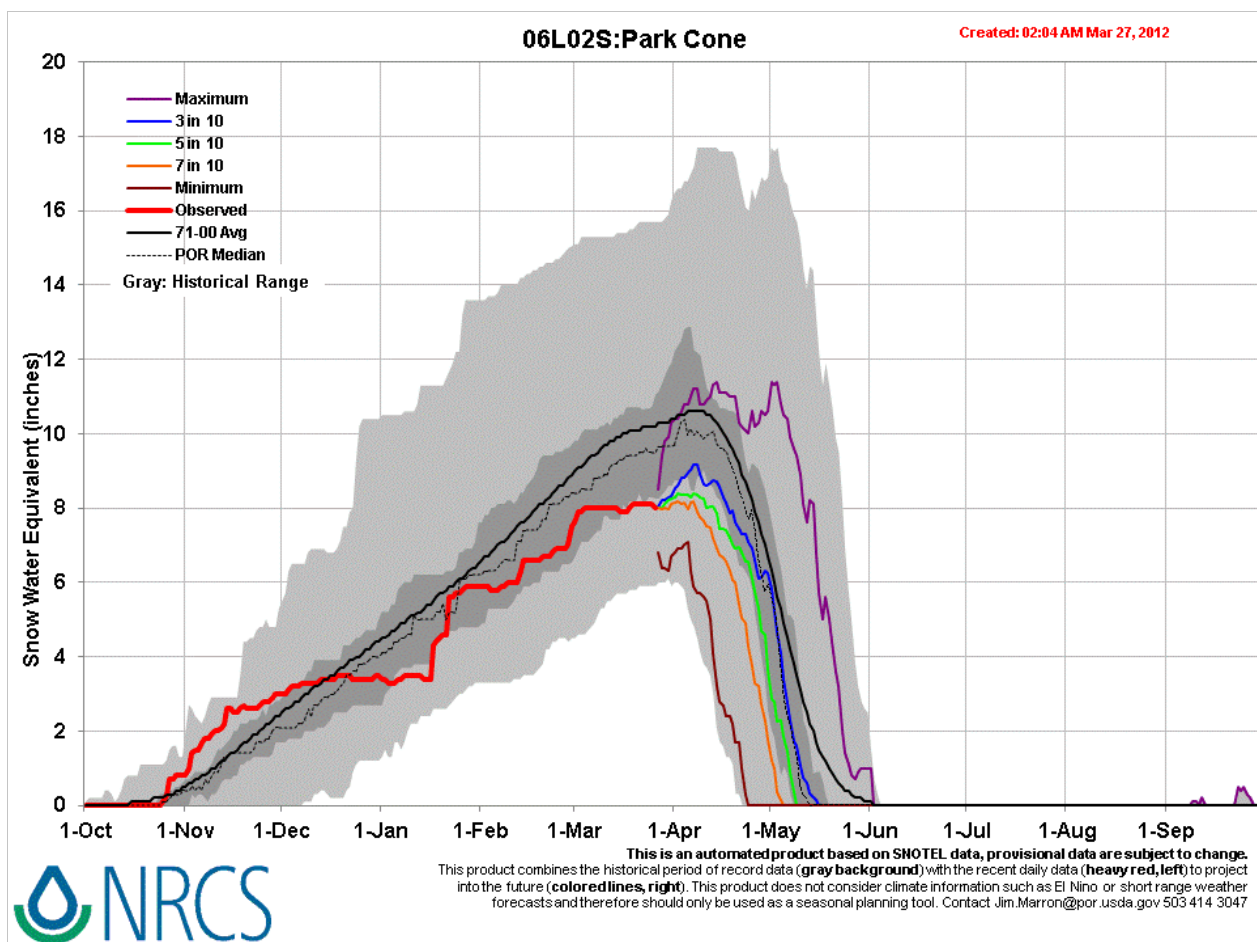
As of Tuesday, March 27, 2012, the Park Cone Snotel reports no loss of SWE since March 21, following the very small bump in SWE produced by the March 18 snowstorm that delivered D5. At zero, this recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.00" per day, over a 5-day period ending May 11, 2011.

Further, although we do not routinely visit the site, the **Schofield Pass Snotel** data (see [snowmelt analysis table](#) and [SNOTEL graph](#)) also reflects Gunnison Basin snowmelt behavior. As of March 27, this Snotel also reports only a small loss of 0.3" SWE since March 21st, also well short of the mean daily loss rates shown in the table, and very far short of the maximum SWE loss rate last Spring of 2.44" per day, over a 5-day period ending June 29, 2011.

Park Cone SNOTEL Snowmelt Season Summary Data

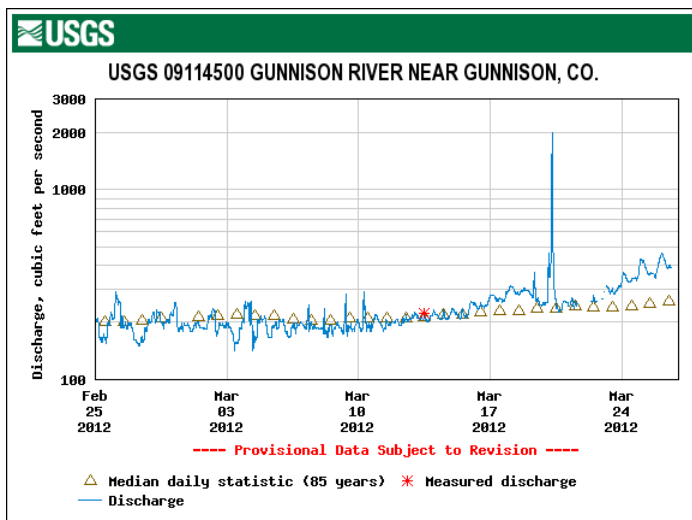
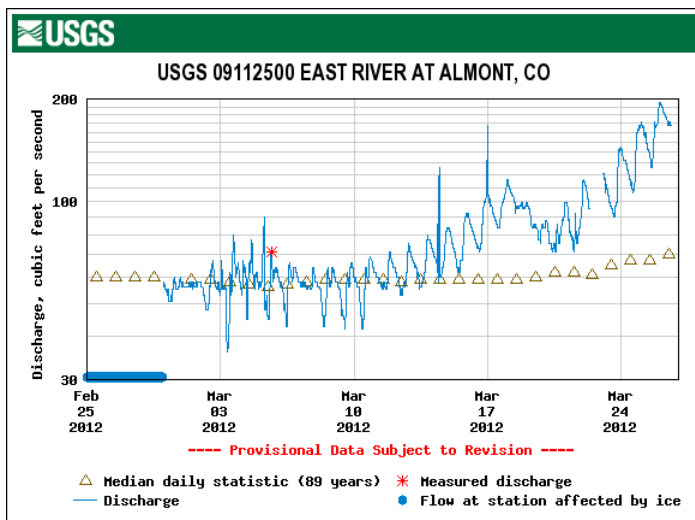
	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
					SWE	
WY 2006	4/7/2006	11.3	31	0.9	0.39	3.7
WY 2007	4/18/2007	7.8	17	0.5	0.49	4.5
WY 2008	4/14/2008	17.7	47	2.8	0.44	3.8
WY 2009	4/6/2009	13.2	38	1.4	0.38	3.5
WY 2010	4/10/2010	10.8	41	2.4	0.32	3.1
WY 2011	4/7/2011	14.5	54	4.1	0.34	3.0
Max	4/18	17.7	54	4.1	0.49	4.5
Min	4/6	7.8	17	0.5	0.32	3.0
Range	13	9.9	37	3.6	0.17	1.5

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE



STREAM FLOWS

Streamflow data reflect a variety of processes influencing runoff rates, but recent data from the USGS's Gunnison River near Gunnison and East River at Almont gauges do include the influence of the reduction of snow albedo by D4 and very warm temperatures from March 7-17, a restoration of higher snow albedo (with cooler weather) on March 18 for a brief period, and then the subsequent warmup and reduction in snow albedo as D5 emerged and merged with D4. Event D6 may also be contributing to the most recent data.



FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

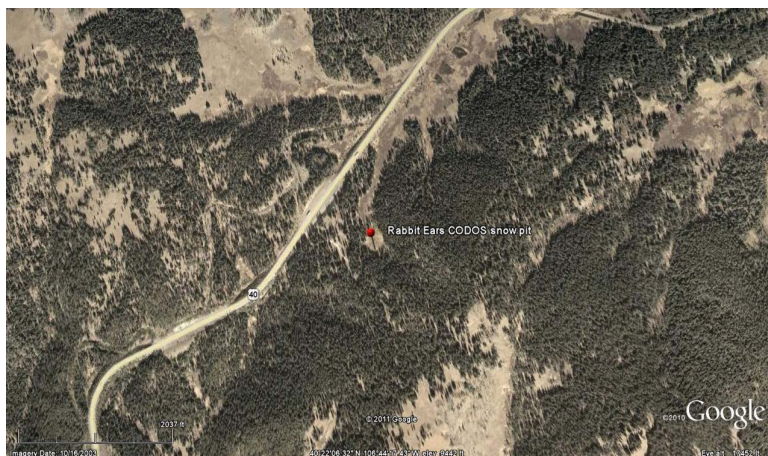
[CODOS 2012 Updates](#) > [March 28](#) > Rabbit Ears Pass

CODOS UPDATE FOR RABBIT EARS PASS: MARCH 28, 2012

[Summary](#) | [Snowpack](#) | [Melt Rate](#) | [Stream Flows](#) | [Forecast](#) |
[Previous Update](#) | [pdf](#)

SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary analyses](#) of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Snowpack conditions on the Rabbit Ears Pass plateau are likely isothermal and releasing snowmelt runoff, with the possible exception of the very highest north-facing terrain. Merged dust layers D5/D4, and possibly D6, are reducing snow albedo throughout this locale and the Rabbit Ears Pass Snotel site has shown a recent decline in SWE. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at this Snotel site producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on local hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Rabbit Ears Pass site will be in early April, as weather and dust conditions dictate.

MELT RATE

The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

As of Tuesday, March 27, 2012, the Rabbit Ears Pass Snotel reports a loss of 1.1" SWE since March 21, a rate of 0.16" per day. This recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.94" per day, over a 5-day period ending June 7, 2011.

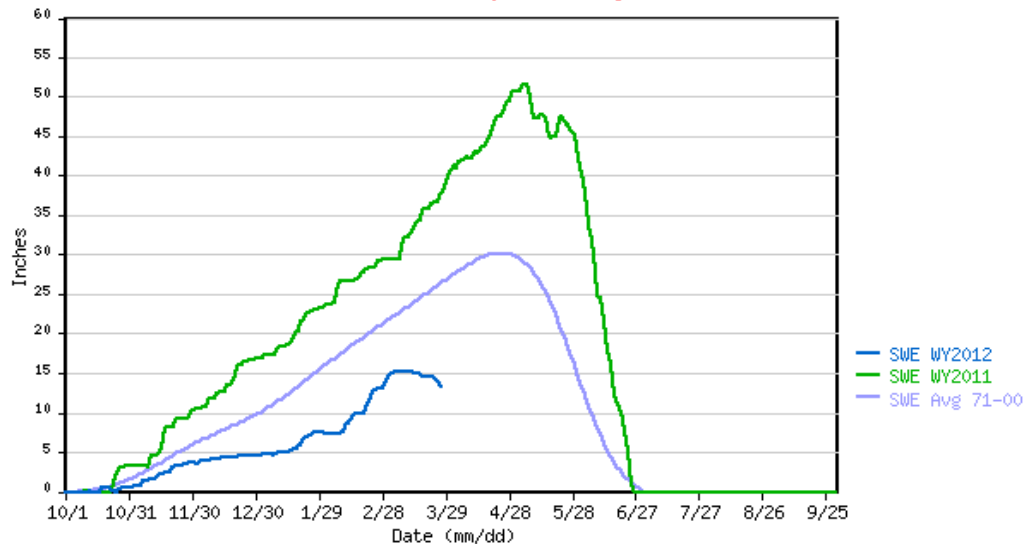
Rabbit Ears SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
WY 2006	4/9/2006	38.0	50	2.3	0.81	4.6
WY 2007	4/14/2007	22.7	37	2.9	0.69	4.9
WY 2008	4/15/2008	38.0	62	8.5	0.75	4.1
WY 2009	4/21/2009	32.8	40	3.8	0.92	5.7
WY 2010	5/16/2010	19.2	22	2.1	0.97	7.9
WY 2011	5/6/2011	51.6	52	5.3	1.09	7.3
Max	5/16	51.6	62	8.5	1.09	7.9
Min	4/9	19.2	22	2.1	0.69	4.1
Range	38	32.4	40	6.4	0.40	3.8

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE

06J09S SNOTEL as of 03/27/2012

*** Provisional Data, Subject to Change ***

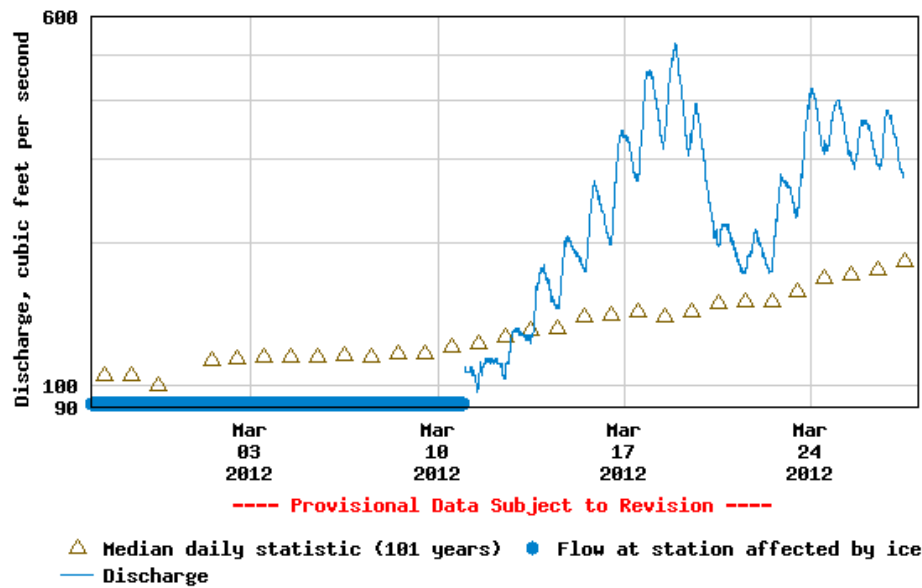


STREAM FLOWS

Streamflow data reflect a variety of processes influencing runoff rates, but recent data from the USGS Yampa River at Steamboat Springs stream gauge does include the influence of the reduction of snow albedo by D4 and very warm temperatures from March 10-17, a decline flows with restoration of higher snow albedo (with cooler weather) on March 18, and then another rapid increase in flows with the subsequent warmup and reduction in snow albedo as D5 emerged and merged with D4. Event D6 may also be contributing to the most recent data.



USGS 09239500 YAMPA RIVER AT STEAMBOAT SPRINGS, CO



FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

[CODOS 2012 Updates](#) > [March 28](#) > Senator Beck Basin

CODOS UPDATE FOR SENATOR BECK BASIN: VISITED MARCH 26-27, 2012

[Summary](#) | [Snowpack](#) | [Melt Rate](#) | [Stream Flows](#) | [Forecast](#) |
[Wind Behavior](#) | [Previous Update](#) | [pdf](#)

SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary](#) analyses of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.

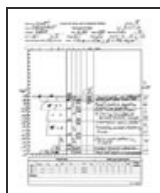
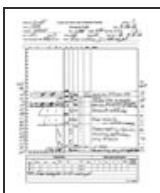


Senator Beck Basin snowpack conditions are mixed, with cold content persisting in the alpine terrain at the same time that isothermal snow in the subalpine portion of the Basin has begun releasing snowmelt runoff. The Red Mountain Pass Snotel site near Senator Beck Basin has shown small recent declines in SWE but the nearby Lizard Head Pass Snotel site is experiencing more rapid loss of SWE. The Senator Beck Basin stream gauge shows two recent surges associated with reduced snow albedo. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at Senator Beck Basin and throughout the western San Juan Mountains producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on hydrographs.

SNOWPACK DISCUSSION

Two recent snowpits were performed in Senator Beck Basin, one at Swamp Angel Study Plot on Monday, March 26, 2012 ([pdf](#)) and the other at Senator Beck Study Plot on Tuesday, March 27, 2012 ([pdf](#)). As of March 26th, dust layer D5 was rapidly emerging on all aspects of Senator Beck Basin and merging with layer D4. By the afternoon of March 26th a new, albeit minor dust-on-snow event (D6-WY2012) was underway and fell on either exposed D5 or on a thin layer of cleaner snow just above D5, as seen in the March 27th profile at Senator Beck Study Plot.

The sub-alpine Swamp Angel snowpack, at 11,060', is virtually isothermal, just shy of 0° C throughout, whereas the snowpack at the alpine Senator Beck Study Plot (12,186') still retains cold content with a mean temperature of -3.7° C and will require many more days of radiative forcing in the D6/5/4 dust at the surface to warm the pack to 0° C. Total snow depth, total SWE, and therefore mean snowpack density were very similar at the two sites – a rarity that reflects the severe redistribution of snow in the alpine terrain this season. The Swamp Angel Study Plot retains about 21" of SWE, about 95% of the precipitation that site has received since October 1.



MELT RATE

The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to “snow all gone” (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an “adjusted daily mean loss [of] SWE” rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A current Snotel plot is presented below the table.

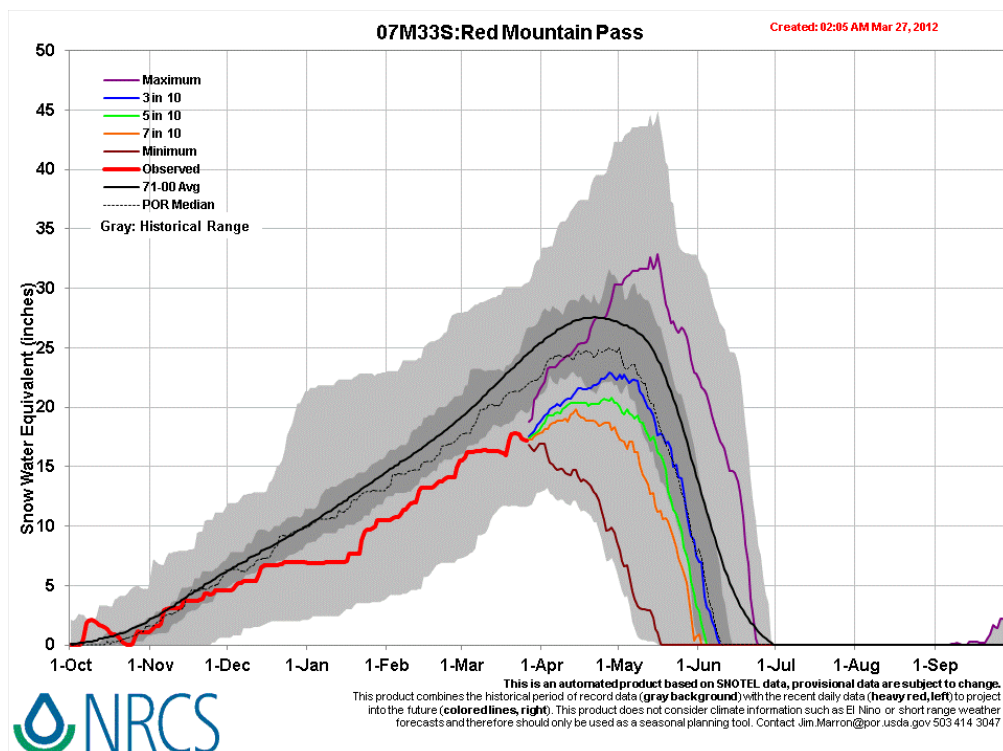
As of Tuesday, March 27, 2012, the nearby Red Mountain Pass Snotel, located just 2 km south of Swamp Angel Study Plot, has lost 0.5” SWE (total) since March 21, following the substantial upward bump in SWE produced by the March 18 snowstorm that delivered D5. This recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.74” per day, over a 5-day period ending June 17, 2011.

Further, although we do not routinely visit the site, the **Lizard Head Pass** Snotel data (see [snowmelt analysis table](#) and [SNOTEL graph](#)) also reflect western San Juan Mountains melt behavior, and the D6/5/4 dust layers present at Senator Beck Basin are also present at Lizard Head Pass. As of March 27, this Snotel reports a loss of 1.5” since March 21st, a rate of 0.2” per day, well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.40” per day, over a 5-day period ending May 31, 2011.

Red Mountain Pass SNOTEL Snowmelt Season Summary Data

	Date Peak SWE	Peak SWE	Days to SAG	Post-Peak Added SWE	Adjusted Daily Mean Loss SWE	Period Mean Temp
WY 2006	4/8/2006	24.4	50	1.2	0.51	3.1
WY 2007	5/9/2007	23.7	34	1.7	0.75	4.7
WY 2008	4/14/2008	34.4	66	4.3	0.59	2.9
WY 2009	4/19/2009	27.5	37	1.8	0.79	4.3
WY 2010	4/8/2010	24.2	54	3.7	0.52	1.5
WY 2011	5/22/2011	33.7	33	1.4	1.06	6.8
Max	5/22	34.4	66	4.3	1.06	6.8
Min	4/8	23.7	33	1.2	0.51	1.5
Range	45	10.7	33	3.1	0.55	5.3

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE

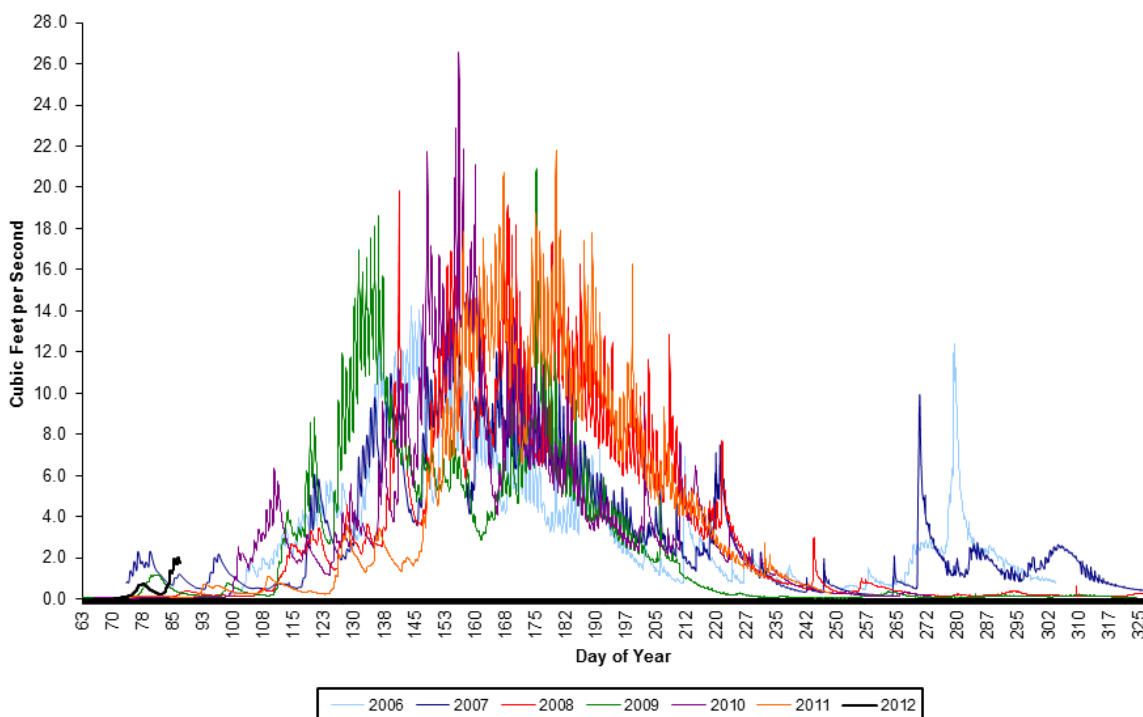


STREAM FLOWS

Senator Beck Stream Gauge data show two small surges in flows to-date, peaking at 2.0 cfs. These small surges and the brief decline between them correspond to reduction of snow albedo by D4 and very warm temperatures from March 7-17, a restoration of higher snow albedo (with cooler weather) on March 18 for a brief period, and then the subsequent warmup and further reduction in snow albedo as D5 emerged and merged with D4 (and D6 made its minor contribution). Given the snowpack temperatures in much of the alpine terrain in Senator Beck Basin, this measured runoff is being largely generated by the lowest elevation, south-facing slopes in Senator Beck Basin, which are recently beginning to show some bare ground.

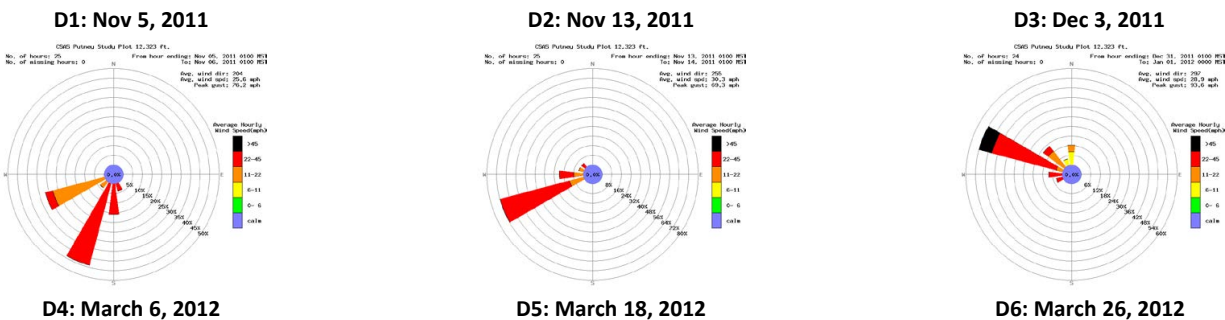
Similar patterns in runoff behavior are seen in the following regional hydrographs of the last 10 days: [Animas near Durango](#), [Dolores](#), [San Miguel near Placerville](#), and the [Uncompahgre near Ridgway](#).

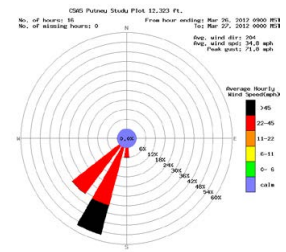
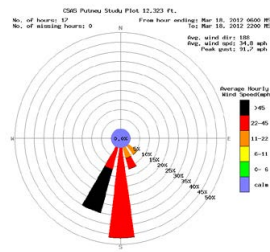
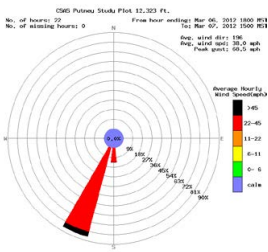
Senator Beck Basin Hourly Discharge - 2006, 2007, 2008, 2009, 2010, 2011, 2012



WIND BEHAVIOR

The following graphs show wind behavior during the Water Year 2012 dust-on-snow events at our Putney Study Plot (best wind data for Senator Beck Basin Study Area and Red Mountain Pass). We have estimated beginning and end times of each event based on observations from Silverton, CO. For more on this wind analysis, see the [CODOS dust log and wind rose table](#).





FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

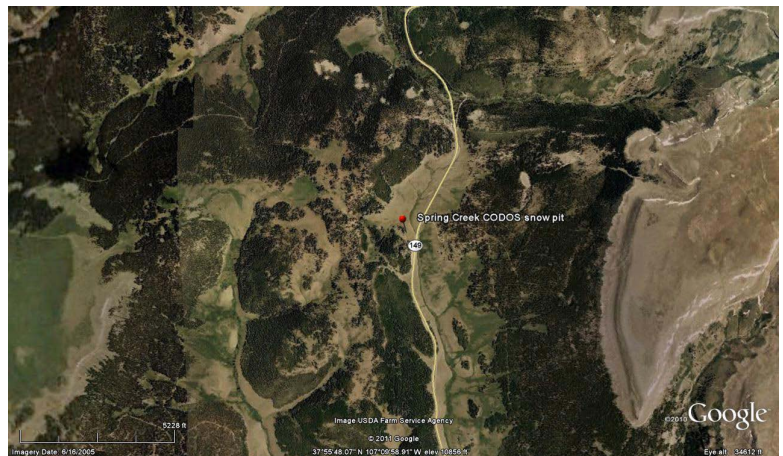
[CODOS 2012 Updates](#) > [March 28](#) > Spring Creek Pass

CODOS UPDATE FOR SPRING CREEK PASS: MARCH 28, 2012

[Summary](#) | [Snowpack](#) | [Melt Rate](#) | [Stream Flows](#) | [Forecast](#) |
[Previous Update](#) | [pdf](#)

SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary](#) analyses of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Snowpack conditions in the Upper Rio Grande are likely still mixed, with cold content persisting in the alpine terrain at the same time that isothermal snow in the subalpine portion of the Basin has begun releasing snowmelt runoff. Merged dust layers D6/D5/D4 are reducing snow albedo throughout the watershed. The Slumgullion Pass Snotel site near Spring Creek Pass has shown virtually no recent decline in SWE but the Beartown Snotel site is experiencing loss of SWE. The Rio Grande at Del Norte stream gauge shows two mild surges associated with reduced snow albedo and warm weather. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at these Snotel sites and throughout the upper Rio Grande watershed producing early peak streamflows, early passage of runoff center of mass, and a steep descending limb on the Rio Grande hydrograph.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Spring Creek Pass site will be in early April, as weather and dust conditions dictate.

MELT RATE

The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

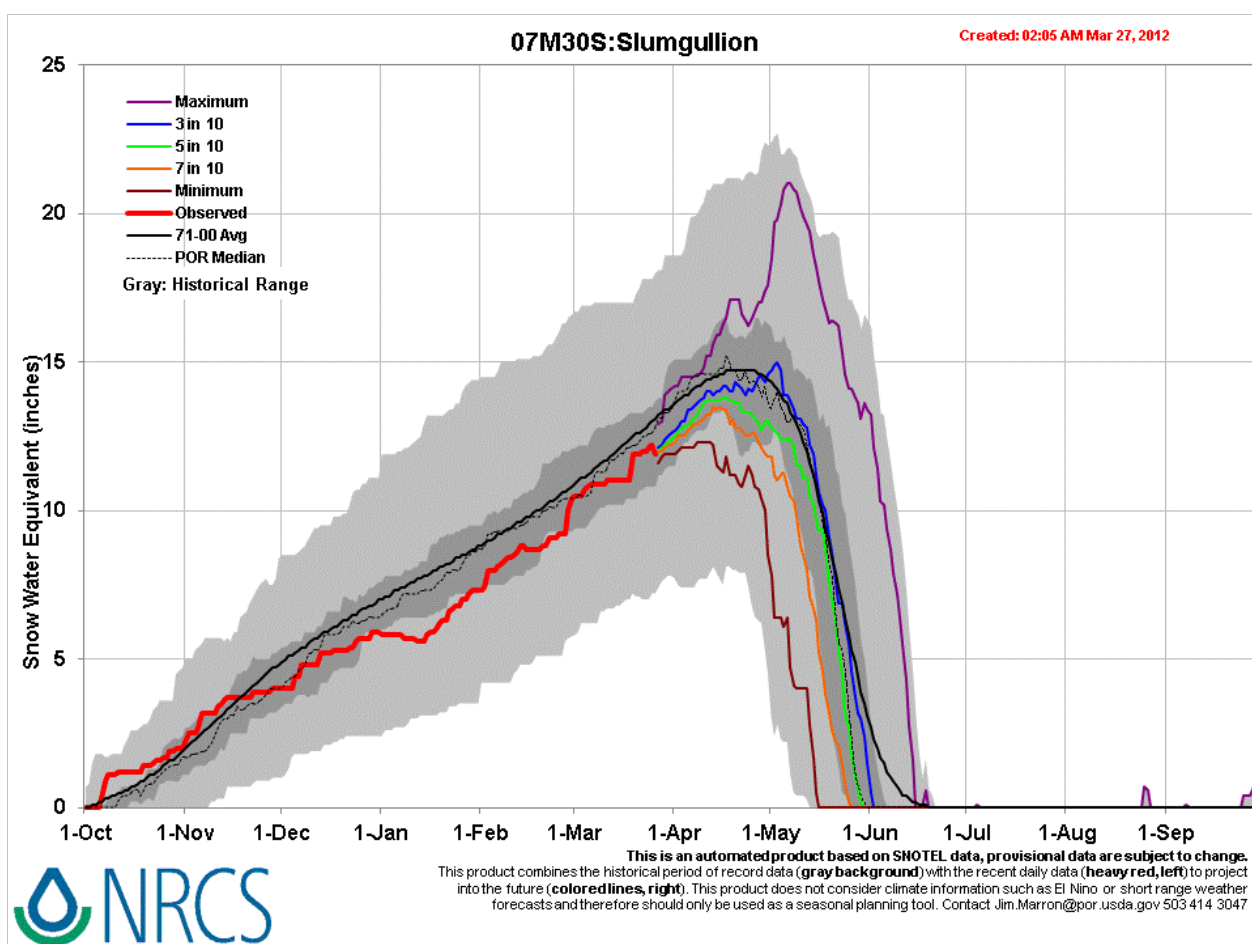
As of Tuesday, March 27, 2012, the nearby **Slumgullion Pass Snotel** reports no loss of SWE since March 21, following the small bump in SWE produced by the March 18 snowstorm that delivered D5. At zero, this recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.28" per day, over a 5-day period ending June 4, 2011.

Further, although we do not routinely visit the site, the **Beartown Snotel** data (see [snowmelt analysis table](#) and [SNOTEL graph](#)) also reflects upper Rio Grande basin snowmelt behavior. As of March 27, this Snotel reports a loss of 2.0" SWE since March 21st, a rate of 0.3" per day, still short of the mean daily loss rates shown in the table, and very far short of the maximum SWE loss rate last Spring of 1.74" per day, over a 5-day period ending June 8, 2011.

Slumgullion Pass SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
					SWE	
WY 2006	4/17/2006	15.9	38	0.4	0.43	2.2
WY 2007	4/18/2007	16.6	50	3.6	0.40	3.3
WY 2008	4/20/2008	19.6	49	2.3	0.45	2.9
WY 2009	4/21/2009	16.0	27	0.4	0.61	4.5
WY 2010	4/11/2010	14.7	45	2.6	0.38	1.1
WY 2011	5/4/2011	16.9	35	2.1	0.54	4.1
Max	5/4	19.6	50	3.6	0.61	4.5
Min	4/11	14.7	27	0.4	0.38	1.1
Range	24	4.9	23	3.2	0.22	3.4

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE



STREAM FLOWS

Streamflow data reflect a variety of processes influencing runoff rates, but recent data from the Rio Grande at Del Norte stream gauge does include the influence of the reduction of snow albedo by D4 and very warm temperatures from March 7-17, a decline in flows with restoration of higher snow albedo (with cooler weather) on March 18, and then another increase in flows with the subsequent warmup and reduction in snow albedo as D5 emerged and merged with D4. Event D6 may also be contributing to the most recent data.



FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

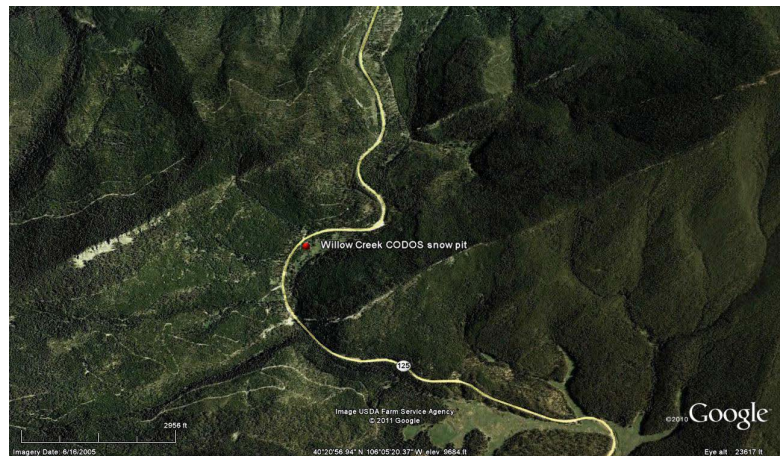
[CODOS 2012 Updates](#) > [March 28](#) > Willow Creek Pass

CODOS UPDATE FOR WILLOW CREEK PASS: MARCH 28, 2012

[Summary](#) | [Snowpack](#) | [Melt Rate](#) | [Forecast](#) | [Previous Update](#) | [pdf](#)

SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary analyses](#) of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Willow Creek watershed snowpacks are largely isothermal and releasing snowmelt runoff, with the possible exception of the very highest north-facing terrain. Merged dust layers D5/D4, and possibly D6, are reducing snow albedo throughout this locale. Although the site has been erratic, recent data from the Willow Creek Pass Snotel show stable SWE and small declines in snow depth. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at this Snotel site producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on local hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Willow Creek Pass site will be in early April, as weather and dust conditions dictate.

MELT RATE

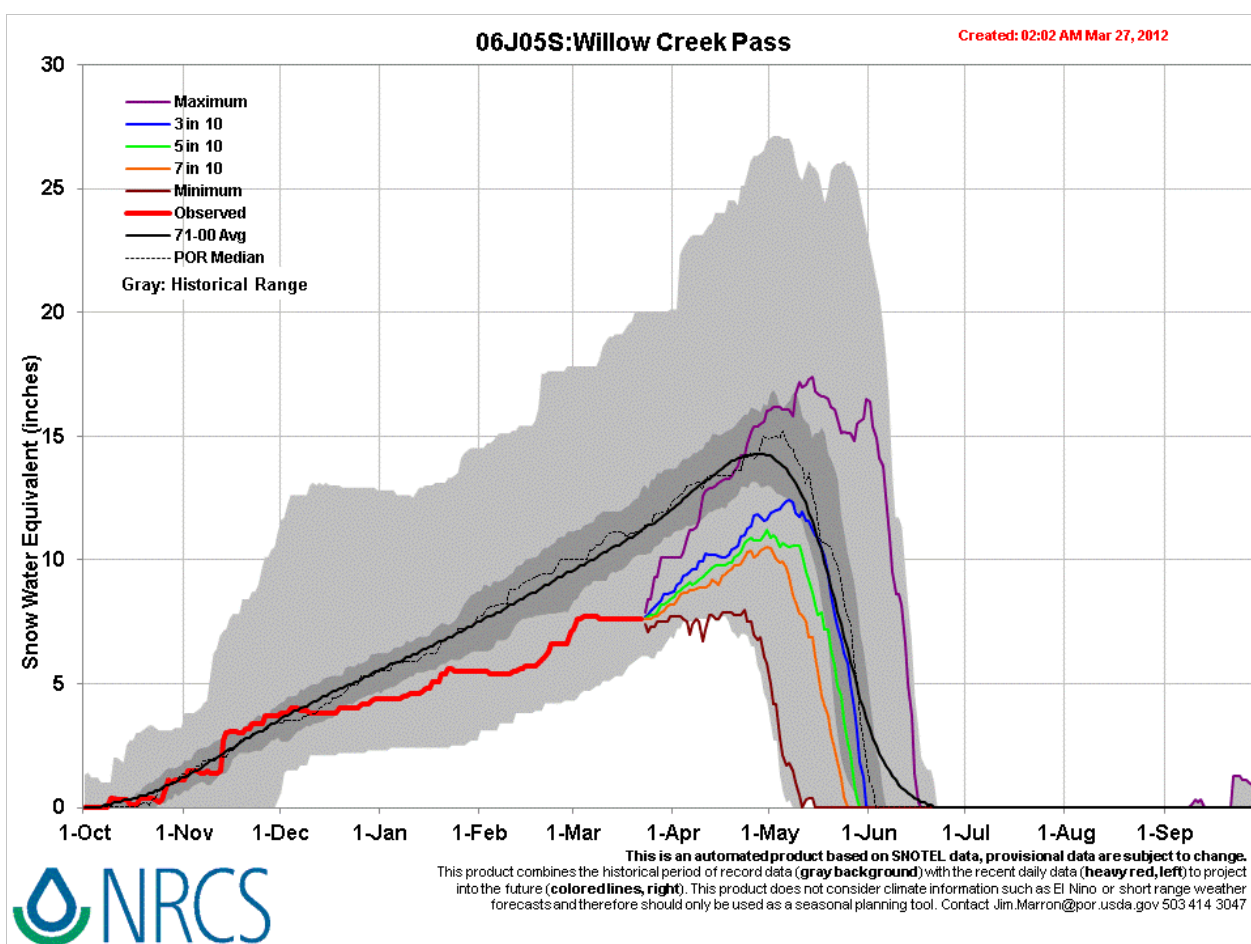
The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

The Willow Creek Pass Snotel website has only intermittently reported SWE data but the graphical representation below shows virtually no loss of SWE since March 21. This recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 2.40" per day, over a 5-day period ending June 11, 2011.

Willow Creek Pass SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
					SWE	
WY 2006	4/27/2006	13.4	28	0.8	0.51	3.8
WY 2007	4/28/2007	16.8	37	1.7	0.50	4.5
WY 2008	5/16/2008	21.9	30	2.0	0.80	5.8
WY 2009	4/20/2009	14.7	37	3.4	0.49	4.8
WY 2010	5/16/2010	14.4	21	0.5	0.71	6.6
WY 2011	5/4/2011	27.1	43	3.8	0.72	5.4
Max	5/16	27.1	43	3.8	0.80	6.6
Min	4/20	13.4	21	0.5	0.49	3.8
Range	27	13.7	22	3.3	0.31	2.8

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE



FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend

cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.

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[CODOS 2012 Updates](#) > [March 28](#) > Wolf Creek Pass

CODOS UPDATE FOR WOLF CREEK PASS: MARCH 28, 2012

[Summary](#) | [Snowpack](#) | [Melt Rate](#) | [Stream Flows](#) | [Forecast](#) |
[Previous Update](#) | [pdf](#)

SUMMARY

Colorado's substantially sub-par reservoir of SWE now contains two significant (D5 and D4) and one minor (D6) dust layers at/near the snowpack surface statewide, and is vulnerable to continued prolonged periods of dry, sunny weather combined with reduced snow albedo. This Update presents site-by-site and [summary](#) analyses of snowmelt rates at CODOS and other Snotel sites for Water Years 2006-2011.



Snowpack conditions in the Upper Rio Grande and upper San Juan River watersheds are likely still mixed, with some cold content persisting in the alpine terrain at the same time that isothermal snow in the subalpine portion of the Basin has begun releasing snowmelt runoff. Merged dust layers D6/D5/D4 are reducing snow albedo throughout the watershed. The Wolf Creek Summit Snotel site has shown no recent decline in SWE but the Beartown Snotel site on the Rio Grande main stem is experiencing loss of SWE. The Rio Grande at Del Norte stream gauge shows two mild surges associated with reduced snow albedo and warm weather, while the San Juan River at Pagosa Springs gauge shows stronger surges. Should dry weather continue to dominate this spring season, and dust-enhanced snowmelt rates approach the average or maximum rates discussed below, snow all gone (SAG) may occur early at these Snotel sites and throughout the upper Rio Grande and San Juan River watersheds producing early peak streamflows, early passage of runoff center of mass, and steep descending limbs on the Rio Grande and San Juan river hydrographs.

SNOWPACK DISCUSSION

We have no new first-hand snowpack observations to present. Our next visit to the Wolf Creek Summit site will be in early April, as weather and dust conditions dictate.

MELT RATE

The [table below](#) presents Water Year analyses of snowmelt behavior at the Snotel station adjoining this CODOS site beginning with WY 2006. The date of Peak SWE and subsequent number of days to "snow all gone" (SAG) are shown for each Water Year. Then, the amount of additional SWE received *after* the date of Peak SWE is added to Peak SWE to calculate an "adjusted daily mean loss [of] SWE" rate during the snowmelt season that Year. Finally, the mean air temperature during the period from Peak SWE to SAG, as measured at the Snotel site, is shown for each Water Year. A [current Snotel plot](#) is presented below the table. The intent of this table is to refresh memories of snowmelt rates during the past several dust-influenced Spring seasons, and to assess this year's snowpack conditions in light of those past years.

As of Tuesday, March 27, 2012, the Wolf Creek Summit Snotel reports no loss of SWE since March 21, following the upward bump in SWE produced by the March 18 snowstorm that delivered D5. At zero, this recent melt rate falls well short of the mean daily loss rates shown in the table below, and very far short of the maximum SWE loss rate last Spring of 1.48" per day, over a 5-day period ending June 19, 2011.

Further, although we do not routinely visit the site, the **Beartown Snotel** data (see [snowmelt table](#) and [SNOTEL graph](#)) also reflects upper Rio Grande basin snowmelt behavior. As of March 27, this Snotel reports a loss of 2.0" SWE since March 21st, a rate of 0.3" per day, still short of the mean daily loss rates shown in the table, and very far short of the maximum SWE loss rate last Spring of 1.74" per day, over a 5-day period ending June 8, 2011.

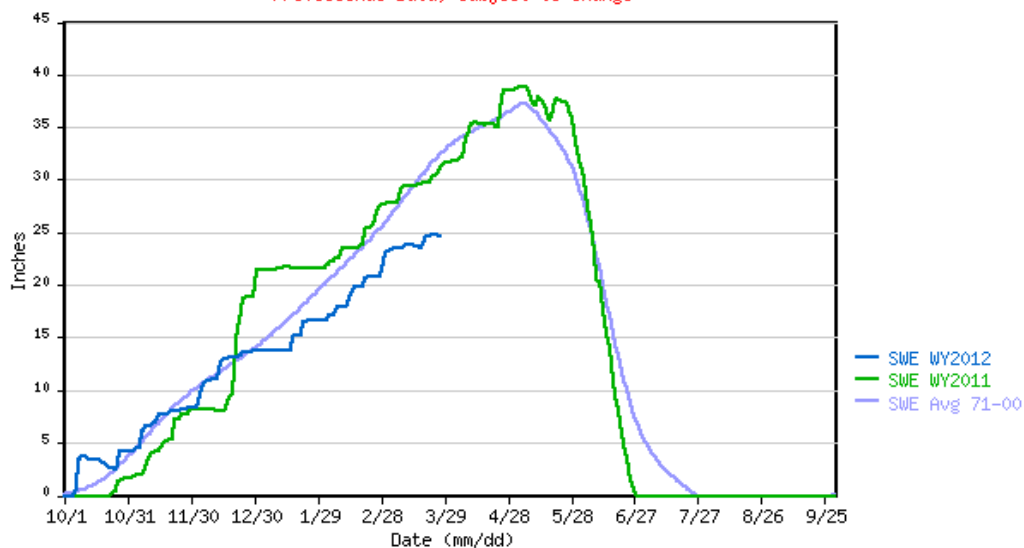
Wolf Creek Summit SNOTEL Snowmelt Season Summary Data

	Date	Peak	Days	Post-Peak	Adjusted	Period
	Peak SWE	SWE	to SAG	Added	Daily	Mean
				SWE	Mean Loss	Temp
					SWE	
WY 2006	5/1/2006	25.7	40	1.2	0.67	7.7
WY 2007	4/26/2007	32.3	59	5.6	0.64	6.5
WY 2008	4/26/2008	47.5	71	3.7	0.72	6.7
WY 2009	5/6/2009	35.9	49	3.5	0.80	7.1
WY 2010	5/5/2010	37.1	44	1.4	0.88	7.1
WY 2011	5/5/2011	38.9	54	4.5	0.80	7.4
Max	5/6	47.5	71	5.6	0.88	7.7
Min	4/26	25.7	40	1.2	0.64	6.5
Range	11	21.8	31	4.4	0.23	1.1

Adjusted Daily Mean Loss SWE rates include additional SWE received after date of Peak SWE

06M17S SNOTEL as of 03/27/2012

*** Provisional Data, Subject to Change ***



STREAM FLOWS

Streamflow data reflect a variety of processes influencing runoff rates, but recent data from the Rio Grande at Del Norte stream gauge does include the influence of the reduction of snow albedo by D4 and very warm temperatures from March 7-17, a decline flows with restoration of higher snow albedo (with cooler weather) on March 18, and then another increase in flows with the subsequent warmup and reduction in snow albedo as D5 emerged and merged with D4. Event D6 may also be contributing to the most recent data. The [San Juan River at Pagosa Springs gauge](#) shows a similar, but somewhat more amplified response to the same sequence of weather and dust events.



FORECAST

As of Tuesday afternoon forecasters at the Grand Junction National Weather Service anticipate continued warm and generally dry weather through the remainder of this week, with the warmest temperatures of the week on Saturday. The northern mountains may experience some light showers and more cloudiness than the southern half of the state. Snowmelt rates are likely to continue to increase through Saturday.

By Saturday afternoon an approaching trough and associated cold front are expected to generate another episode of strong pre-frontal SW'ly winds for the State. Winds will sustain and become W'ly on Sunday. Dust source areas in the Colorado Plateau may yield to these SW'ly and W'ly winds and produce another dust event beginning Saturday afternoon. This weekend's cold front may, once again, *not* deliver a significant winter storm. However, a return to cooler, more seasonable temperatures by Sunday/Monday does seem likely. In the absence of new snow with this weekend cold front, a dry D7 event, should it occur, would generally fall directly onto already exposed and merged D6/D5/D4 dust, further reducing snowpack albedo throughout the Colorado mountains.