City of Carson City
Agenda Report

Date Submitted: April 6, 2015

Agenda Date Requested: April 16, 2015
Time Requested: 30 Minutes

To: Mayor and Supervisors

From: Public Works Department

Subject Title: Drought and drinking water supply

Staff Summary: A presentation and discussion only on the relationship between the drought and Carson City's drinking water supply. (Darren Schulz)

Type of Action Requested: (check one)
(__) Resolution (__) Ordinance
(__) Formal Action/Motion (X) Other (Information only)

Does This Action Require A Business Impact Statement: (__) Yes (X) No

Recommended Board Action: Presentation and discussion only

Explanation for Recommended Board Action: N/A

Applicable Statute, Code, Policy, Rule or Regulation: N/A

Fiscal Impact: N/A

Explanation of Impact: N/A

Funding Source: N/A

Alternatives: N/A

Supporting Material:
- Presentation slides
- Action Plan
- Nevada Water Outlook

Prepared By: David Bruketta – Utility Manager

Reviewed By:

DLM Brunette — **Date:** 4/8/15
(Public Works Director)

Nicholas Mariano — **Date:** 4/8/15
(City Manager)

Joseph L. Wanderlich — **Date:** 4/8/15
(District Attorney)

Michael A. Pucci — **Date:** 4/8/15
(Finance Director)

Board Action Taken:

Motion: _____ 1: _____ Aye/Nay

2: _____ _____

_____

_____

_____

_____

_____
(Vote Recorded By)

Board of Supervisors Meeting

Update from Public Works

Drought & Drinking Water

April 16, 2015

Summary first

- Status of the water system
  - Surface water supplies drastically limited
    - Refer to Nevada Water Supply Outlook Report from USDA
  - System will rely heavily on groundwater supplies
    - Cost
    - Contaminants
    - Supply
    - Demand on mechanical system
  - Limited restriction possible during peak demands
    - Unforeseen difficulties
  - **Encourage voluntary reduction of 10%**

In the news…regional discussion and differences

- California
  - Statewide mandatory 25% water reductions
  - Sierra Nevada region is the source of more than 60% of water supply
  - Governor signs $1 billion emergency drought package
- Nevada
  - Governor Sandoval signs executive order creating Nevada Drought Forum
  - TMWA voluntary 10% reductions
  - Lake Mead, Colorado river system facing worst drought on record

Macro view of Carson Valley watershed

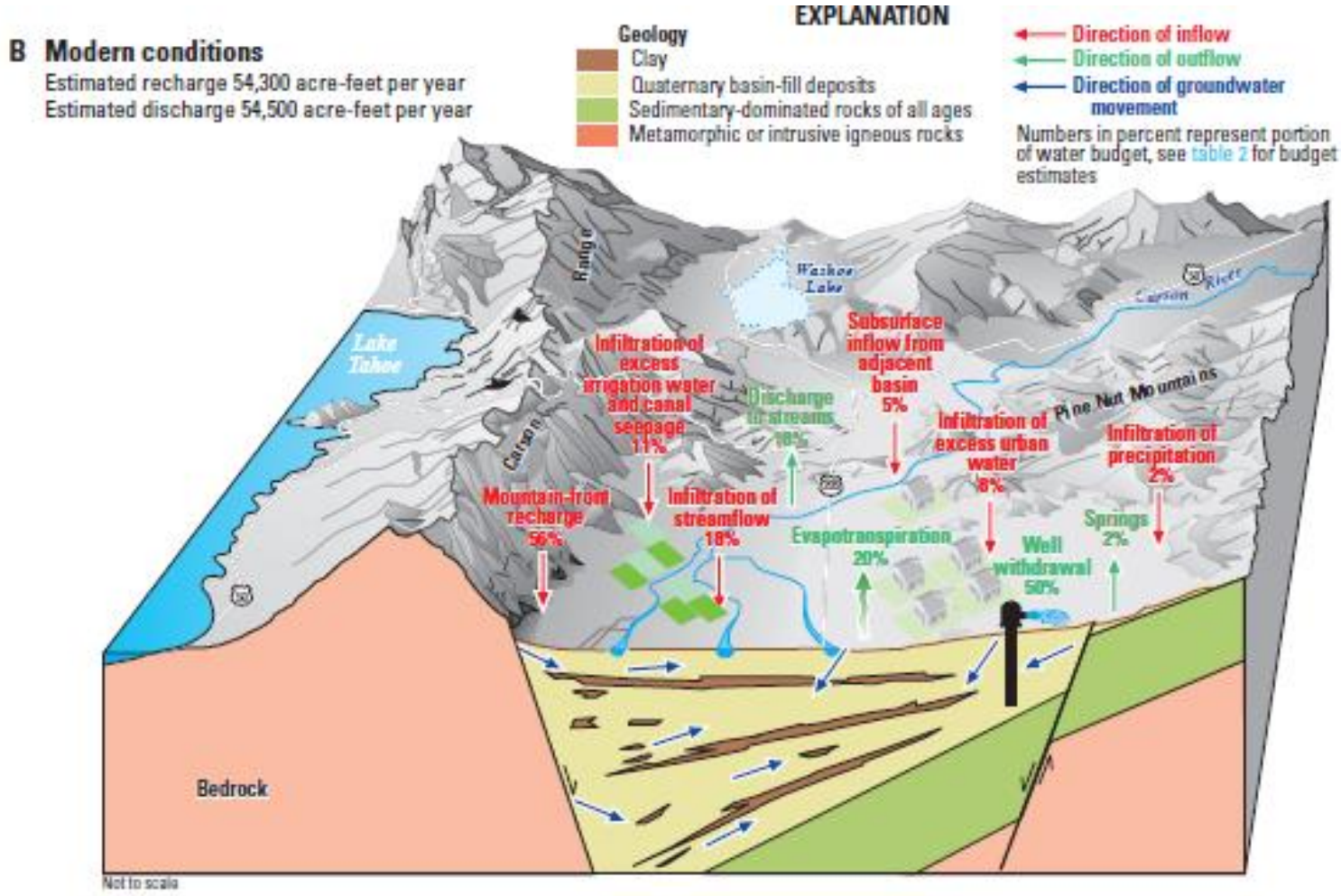
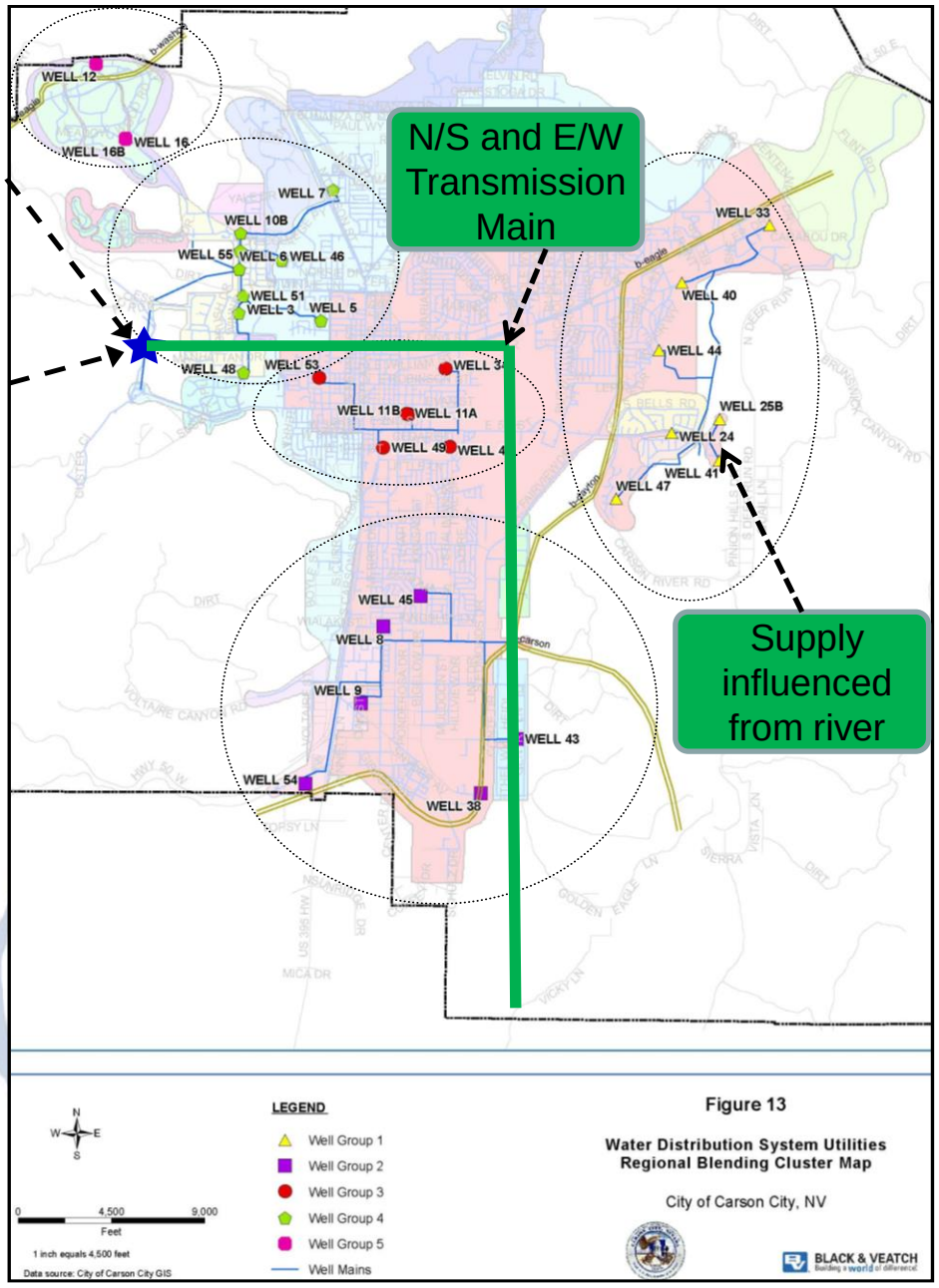


Figure 5. Generalized diagrams for Carson Valley, Nevada, showing the basin-fill deposits and components of the groundwater system under (*A*) predevelopment conditions and (*B*) modern conditions.

Existing Water Supply Sources

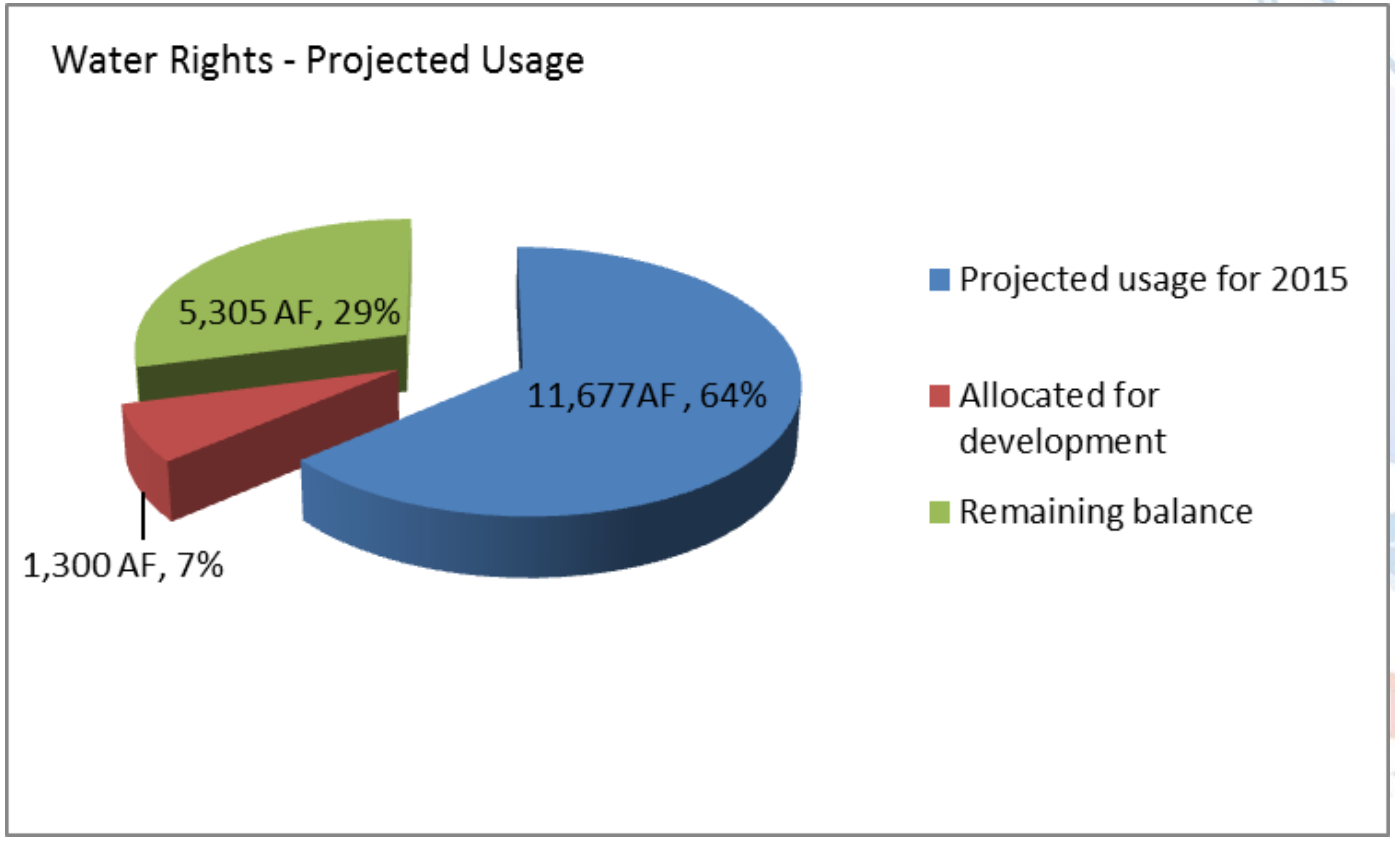
Supply From State MHWS to Quill

Ash and Kings Canyon Supply through Quill



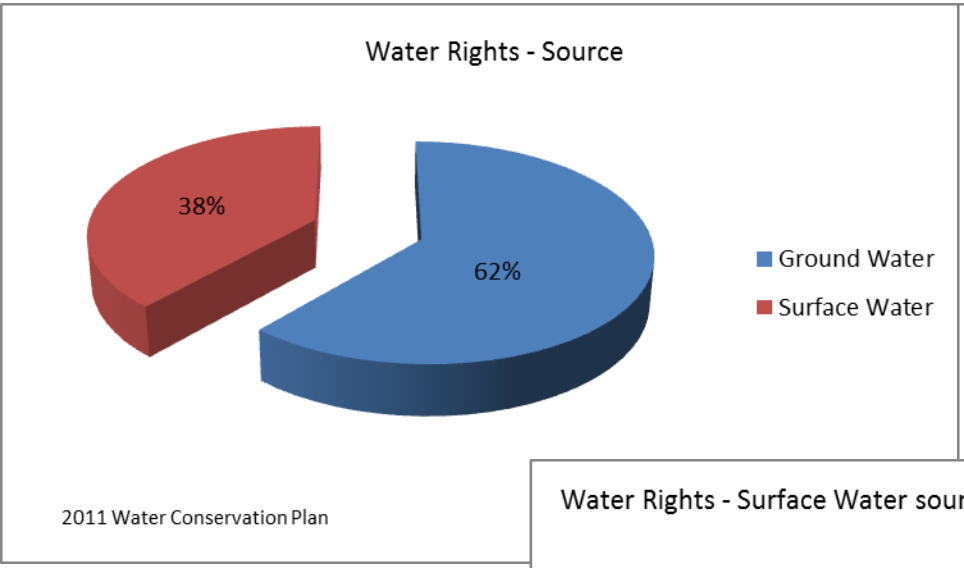
Water System

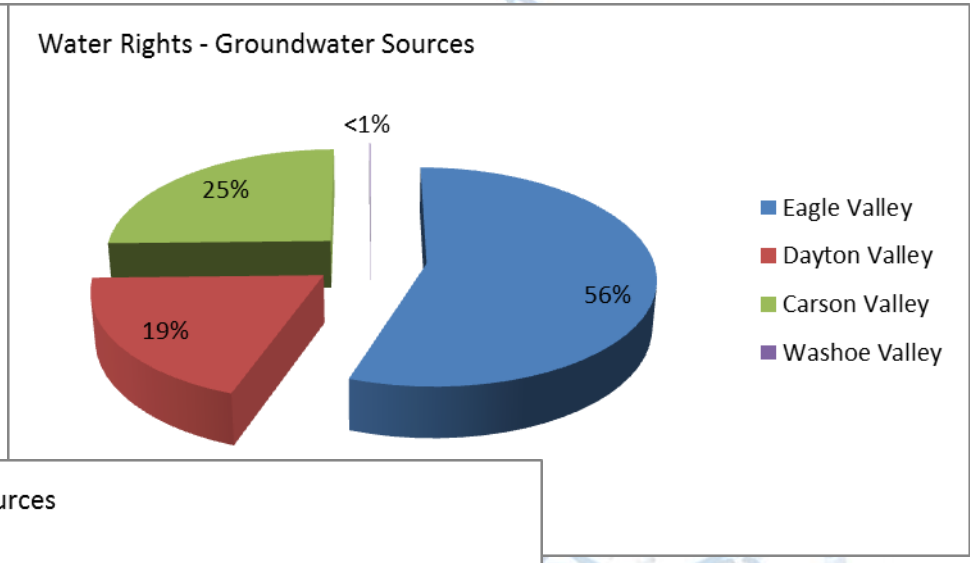
- Water rights
  - Total water rights: 18,282 AF
  - Planning for build out
    - Sources
    - Intertie

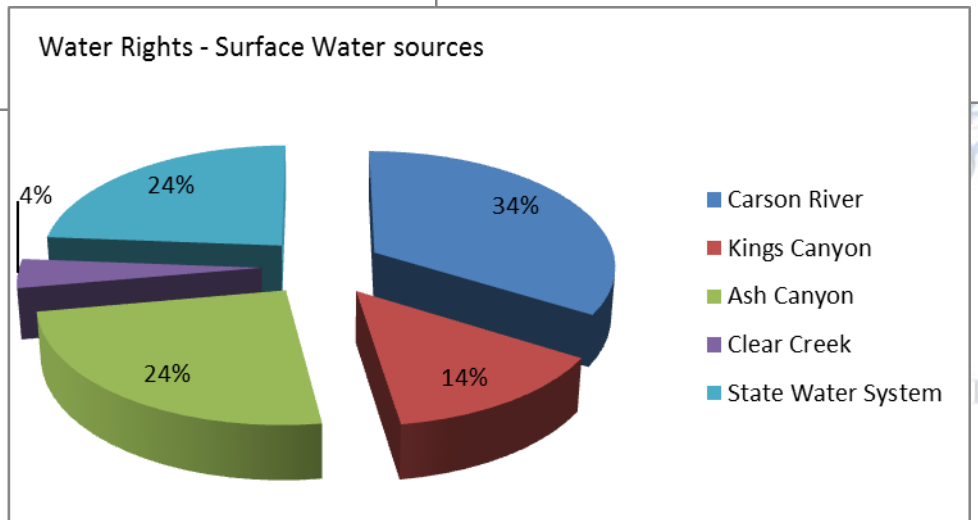


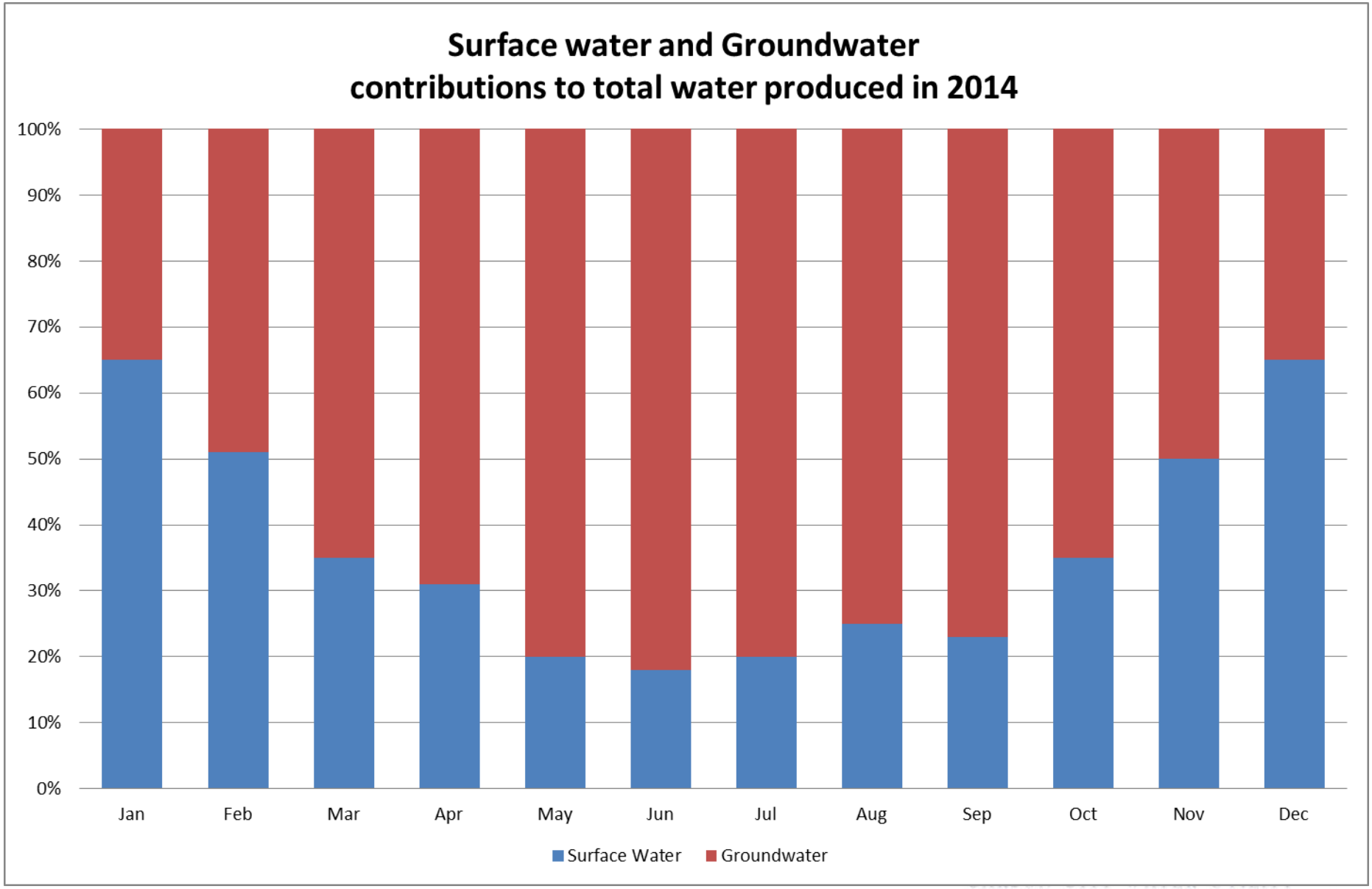
Water Sources

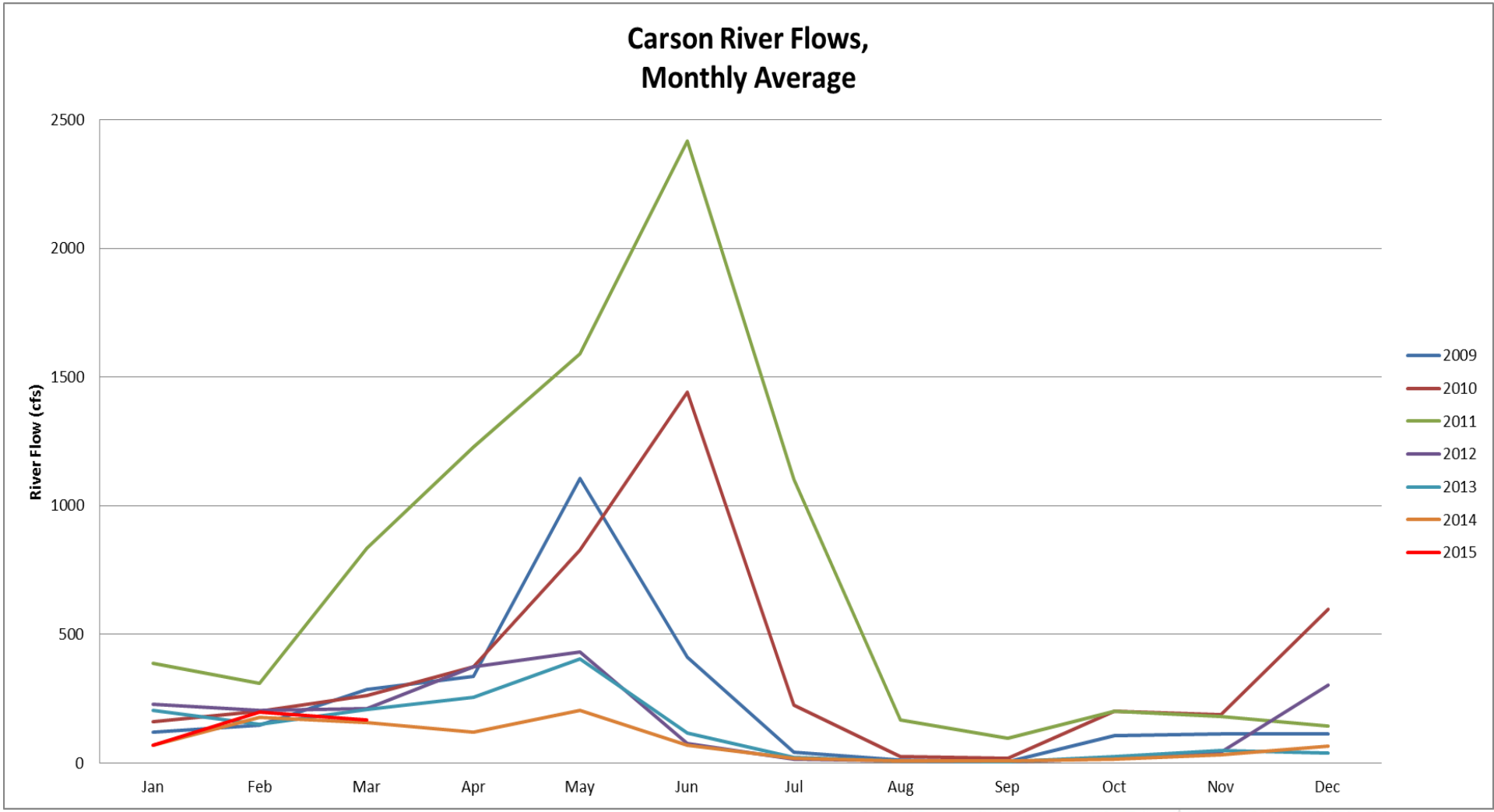
- Water sources and conjunctive use practices
  - Groundwater
  - Surface water
  - Regional water line intertie

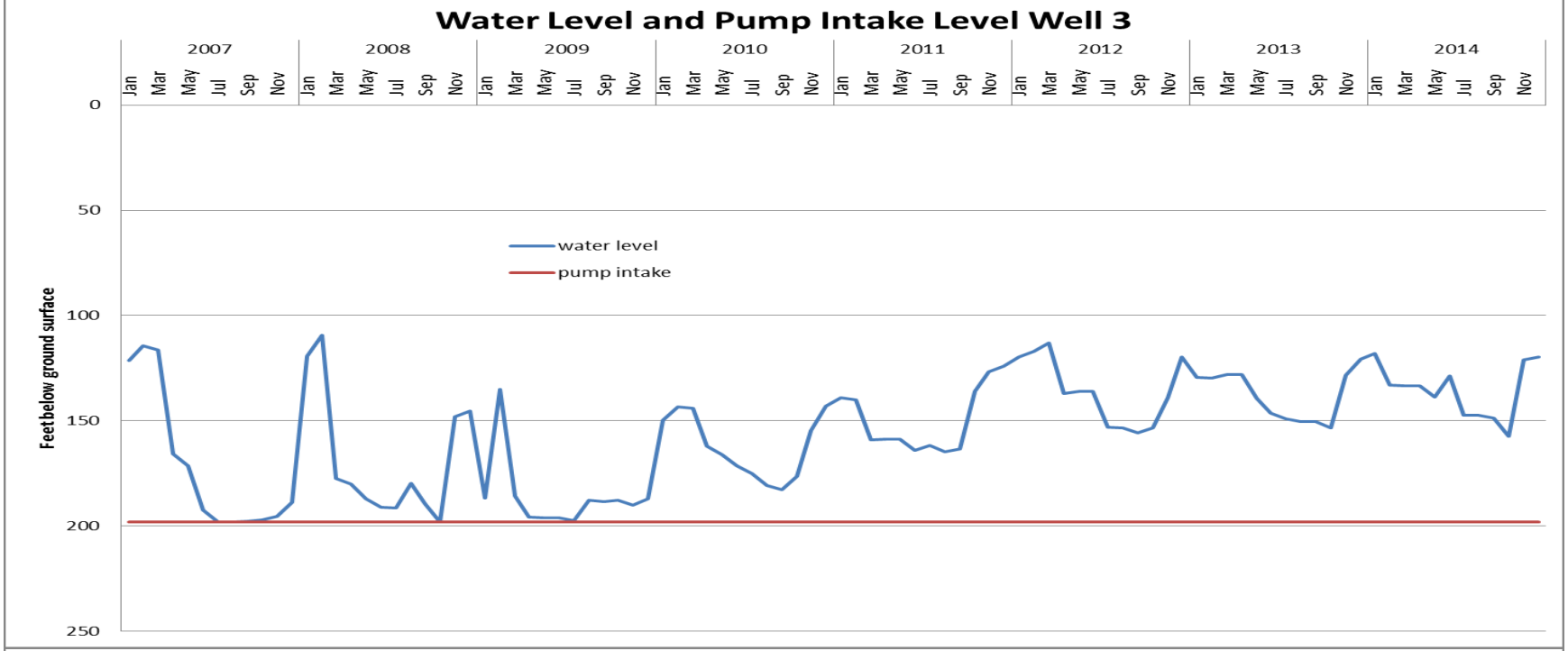


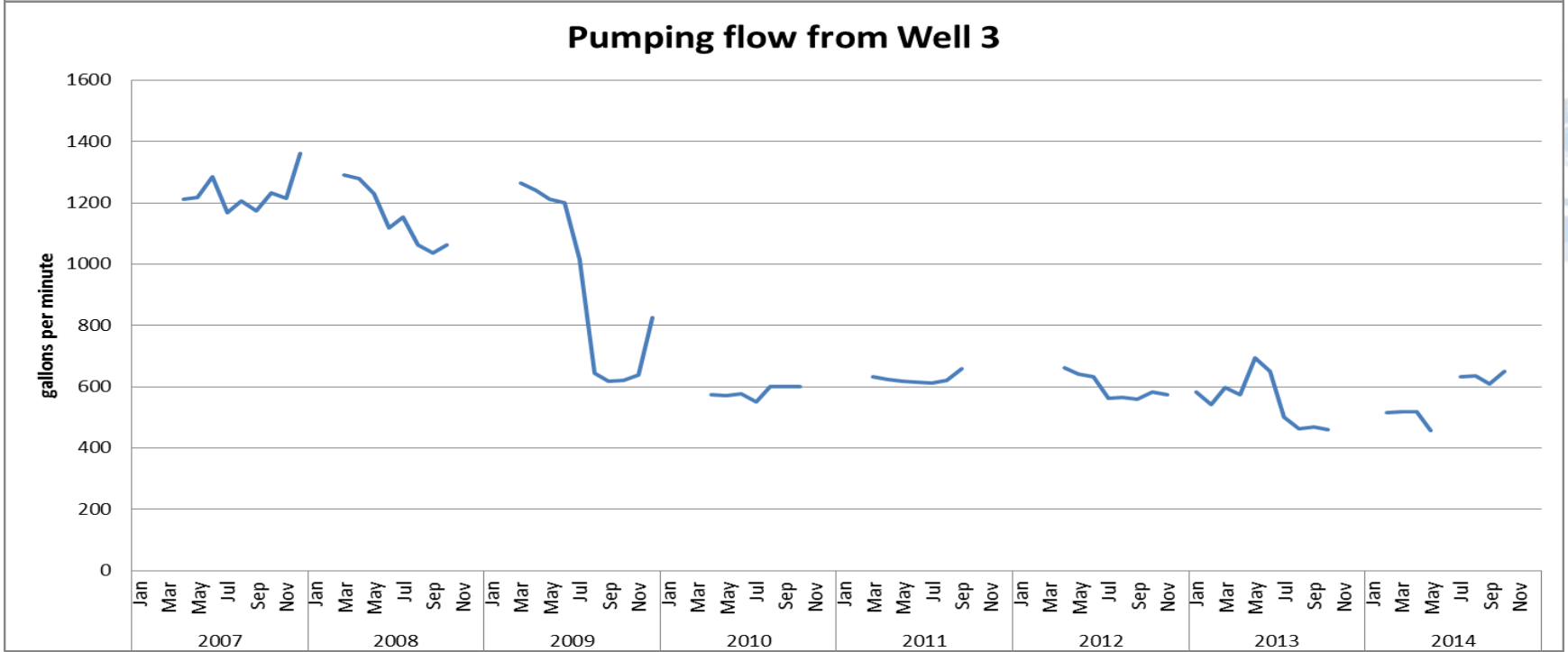





Surface water and Groundwater contributions to total water produced in 2014
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Surface Water
Groundwater

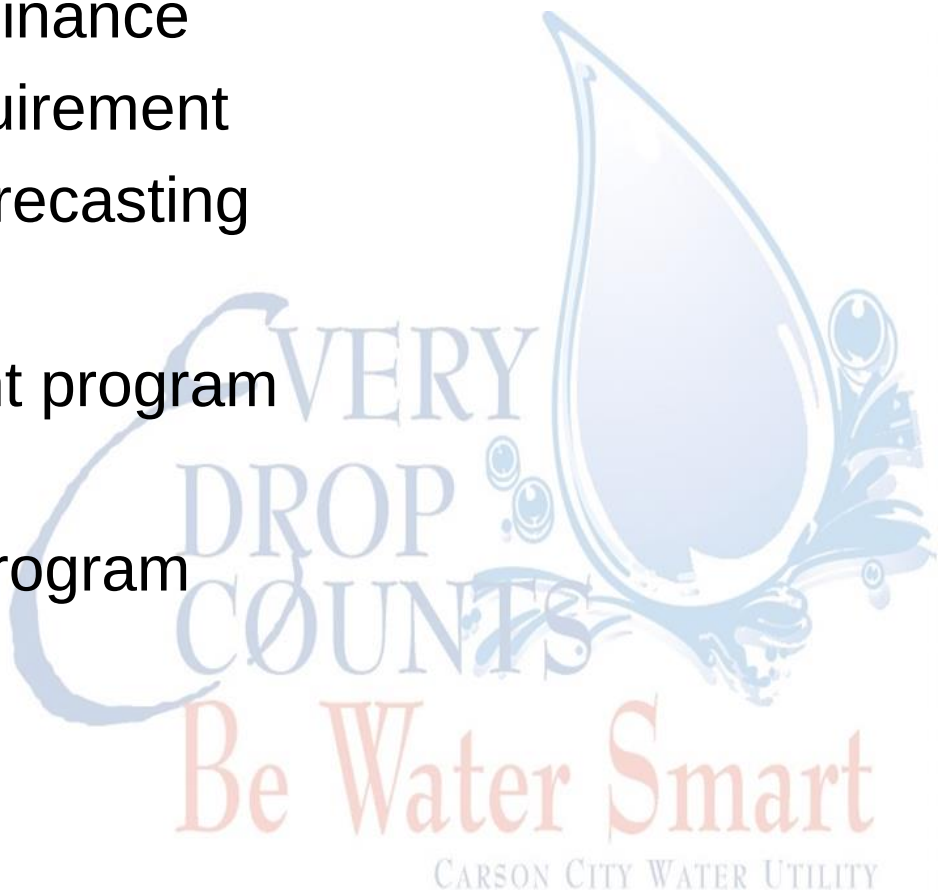

Carson River Flows,
Monthly Average
River Flow (cfs)
2500
2000
1500
1000
500
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2009
2010
2011
2012
2013
2014
2015


Water Level and Pump Intake Level Well 3
2007
2008
2009
2010
2011
2012
2013
2014
Jan Mar May Jul Sep Nov
0
50
100
150
200
250
Feet below ground surface
water level
pump intake


Pumping flow from Well 3
1600
1400
1200
1000
800
600
400
200
0
gallons per minute
Jan Mar May Jul Sep Nov
2007
2008
2009
2010
2011
2012
2013
2014

Conservation Measures

- Watering restrictions ordinance
- Growth management ordinance
- Ultra low-flow fixture requirement
- 5-Year CIP & demand forecasting
- Education program
- Water watch enforcement program
- Leak detection program
- Groundwater recharge program
- Tiered water rates



Planning and Status

- Conservation plan (2011)
  - Farr West Engineering, Adopted by NDEP
  - Elements of plan
    - Water use profile and forecast
    - Conservation incentives and measures
    - Conservation plan implementation schedule
    - Water savings summary
    - Plan metrics
    - Plan objectives
- Water production plan
  - Max day demand vs supply
- Action plan
  - Stage 1
  - Stage 2
  - Stage 3
  - Need to update and address reclaimed water supplementation

Domestic water supplementation of reclaimed water

TIME TO RECOVER FROM SHORTAGE

Estimates of the time needed to recover from the reclaimed water shortfall are based on:

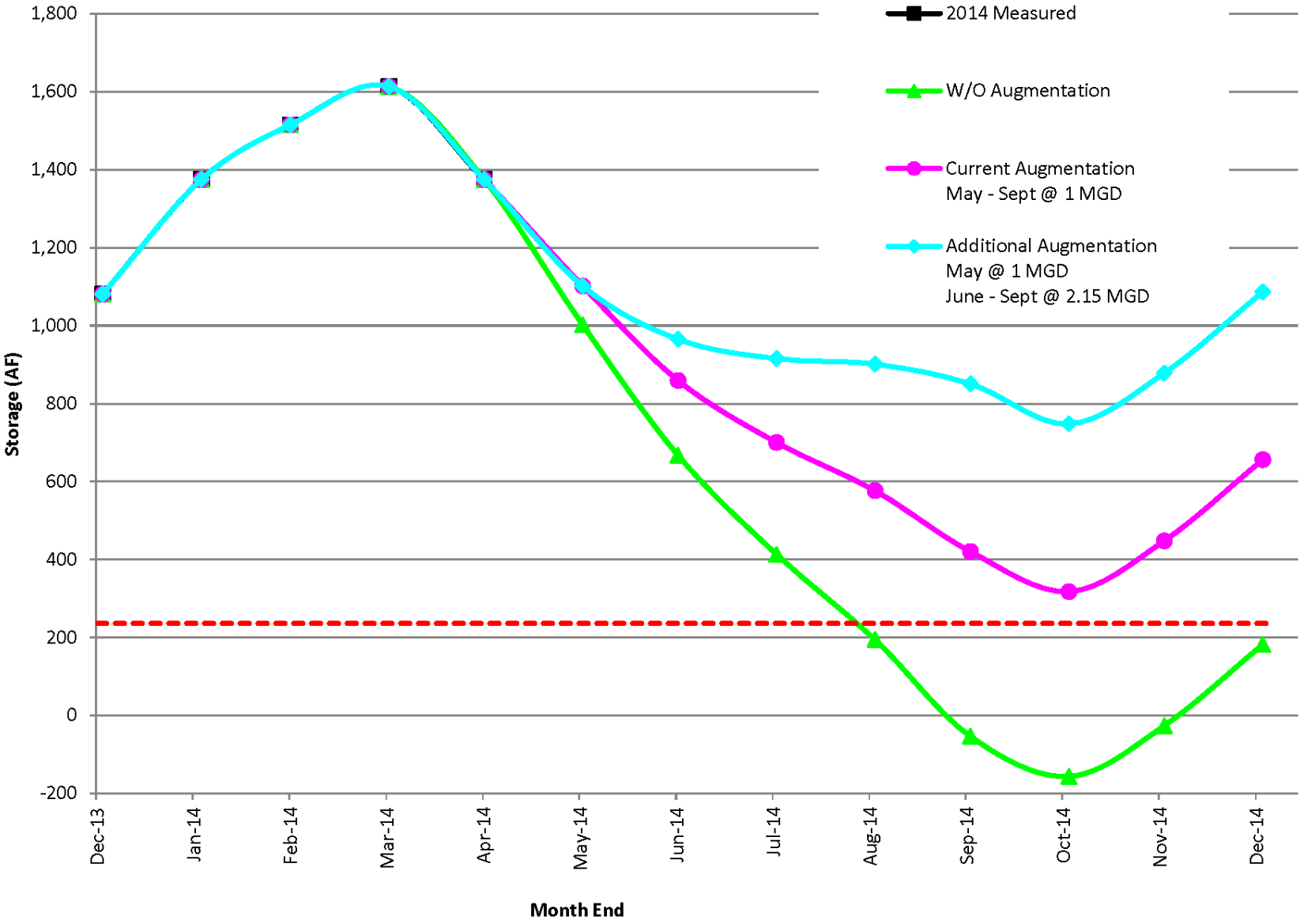
- **0.5% and 2% population growth rates**
- **73 gallons per day per capita of wastewater use**
- **354 acre feet to 890 acre feet shortfall**

Shortage	2.0% Growth	0.5% Growth
354 acre feet	4 years	15 years
890 acre feet	9 years	36 years

Elimination of the shortfall is anticipated to take between 4 to 9 years at 2% growth and 15 to 36 years at 0.5% growth.

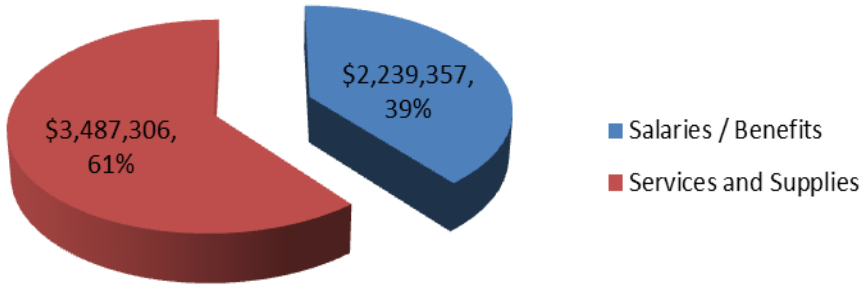
Manhard report to UFOC and BOS

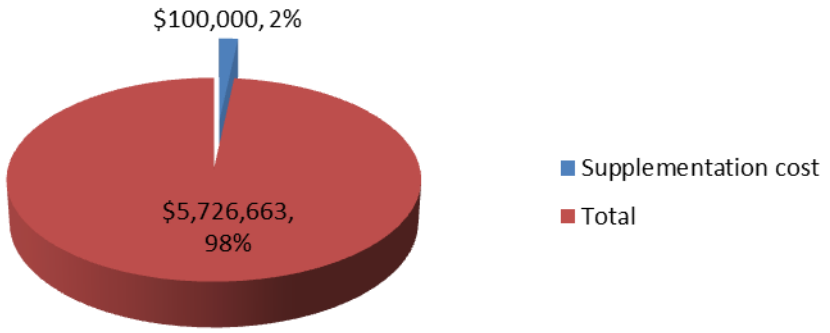
Figure 4 – BRUNSWICK CANYON STORAGE AUGMENTATION

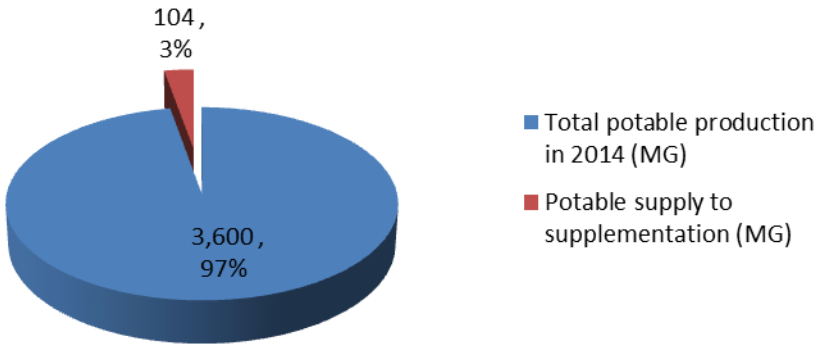


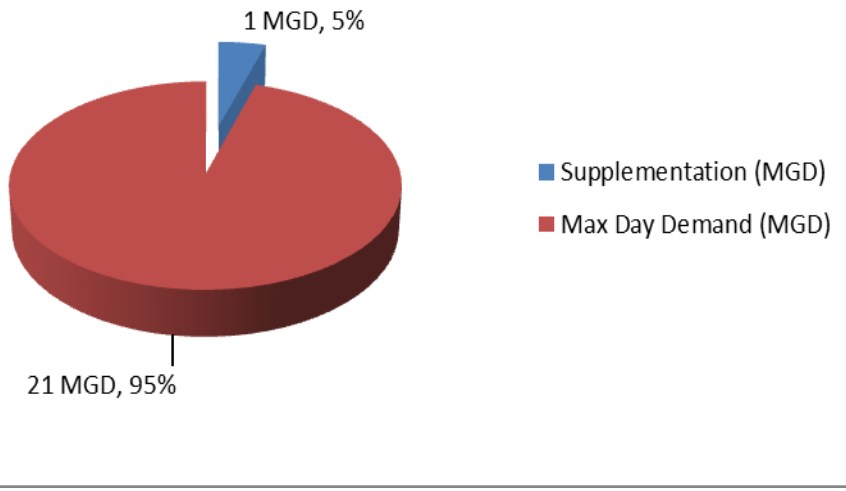
Manhard report to UFOC and BOS

Domestic water supplementation of reclaimed water










Questions ?
“Whisky is for drinking; water is for fighting over”
Mark Twain

CARSON CITY UTILITIES
ACTION PLAN
For dealing with Water Demand that exceeds Supply capabilities

This plan may be put into action upon authorization from the City Manager and/or designee in-order to avoid a city wide water emergency. It is anticipated that most instances of implementation of the plan would be for very short time frames.

✓ City Manager or designee notified by Public Works Director or designee when it is determined that water demand is exceeding production capability in one or more pressure zones and/or storage levels are at the critical level (see attached Standard Operating Procedures for Storage Reservoirs). And that standard operating procedures such as adjusting pressure zones, increasing patrols to ensure compliance with restrictions, all production facilities are in operation, and that all surface water that can be obtained from other users has been diverted to treatment plant have yielded no effect.

✓ City Manager or designee notified by Public Works Director or designee that the following plan is being implemented.

Voluntary cut backs
Stage 1

- Contact the Carson City Parks Department and request they voluntarily cut back outdoor irrigation of City parks, planters and city buildings as much as possible until further notice.

- Contact the Carson City School District and request they voluntarily cut back outdoor irrigation as much as possible until further notice.

- Contact State Buildings and Grounds and request that they voluntarily cut back outdoor irrigation as much as possible until further notice.

- Contact the Legislative Counsel Bureau Grounds Division and request that they voluntarily cut back outdoor irrigation as much as possible until further notice.

- Request the Fire Department suspends all certification testing of Fire trucks and pumping equipment until further notice, suspend all drills with live water flow.

- Request the residence's in affected areas voluntarily cut back outdoor irrigation as much as possible until further notice.

Required reduction of potable water use
Stage 2

- Direct the Carson City Parks Department to **stop** all potable water irrigation of City parks, planters and city buildings until further notice.
- Contact the Carson City School District and direct them to **stop** all outdoor irrigation until further notice.
- Contact State Buildings and Grounds and direct that they **stop** all outdoor irrigation until further notice.
- Contact the Legislative Counsel Bureau Grounds Division and direct that they **stop** all outdoor irrigation until further notice.
- Suspend all certification testing of Fire trucks and pumping equipment until further notice; suspend all drills with live water flow.
- Require all residence's in affected areas to **stop** all outdoor irrigation until further notice.
- Notify the media of additional watering restrictions in the affected areas and ask for everyone's assistance in conserving as much water as possible.

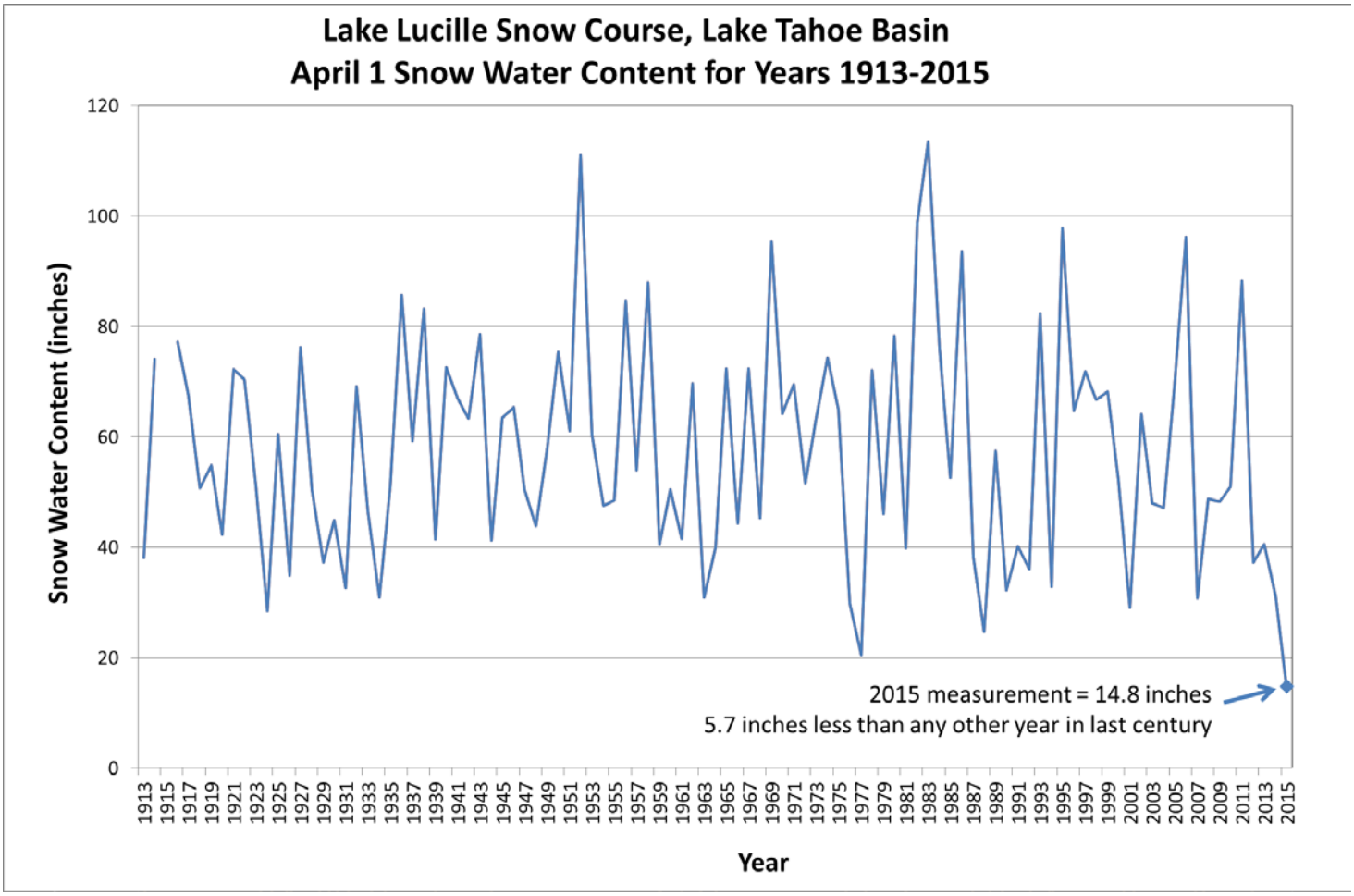
Stage 3

City wide ban on all outside irrigation until further notice.

USDA United States Department of Agriculture

Natural Resources Conservation Service

Nevada Water Supply Outlook Report
April 1, 2015



Lowest Snow in a Century

The April 1 snowpack in the mountains around Lake Tahoe is the lowest in over a century of measurements. Dr. James Church, the father of snow surveying, set up the first snow courses in the United States near Lake Tahoe starting in 1910. Today four of these original snow courses have over 100 years of April 1 data making them the oldest snow measuring stations in the United States. These courses have been faithfully measured using snow tubes to take a core of the snowpack to determine the snow's water content. This month's snow measurement at Lake Lucille snow course, located just south of Lake Tahoe at 8,188 feet elevation, was the lowest April 1 snow water amount on record going back to 1913. Same was true at the north end of Tahoe where Donner Summit and Ward Creek #2 snow courses also set new minimum records with data going back to 1910 and 1913 respectively. The Ward Creek course was actually snow free on April 1 for the first time in its long history. Of the four long term sites only Mt. Rose snow course with data back to 1910 was not at a minimum level; it had more snow water this year than was measured in 1926 or 1931.

Water Supply Outlook Reports

Federal - State – Private Cooperative Snow Surveys

For more water supply and resource management information:

Internet: ***www.nv.nrcs.usda.gov/snow/***

Contact: Jeff Anderson, Water Supply Specialist, jeff.anderson@nv.usda.gov or 775-857-8500 x152

Natural Resources Conservation Service, Nevada Snow Survey, 1365 Corporate Blvd, Reno, NV 89502

To join a free email subscription list please email: jeff.anderson@nv.usda.gov

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How forecasts are made

Most of the annual streamflow in the western United States originates as snowfall that has accumulated in the mountains during the winter and early spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when the snow melts. Measurements of snow water equivalent at selected manual snow courses and automated SNOTEL sites, along with precipitation, antecedent streamflow, and indices of the El Niño / Southern Oscillation are used in computerized statistical and simulation models to produce runoff forecasts. Unless otherwise specified, all forecasts are for flows that would occur naturally without any upstream influences.

Forecasts of any kind, of course, are not perfect. Streamflow forecast uncertainty arises from three primary sources: (1) uncertain knowledge of future weather conditions, (2) uncertainty in the forecasting procedure, and (3) errors in the data. The forecast, therefore, must be interpreted not as a single value but rather as a range of values with specific probabilities of occurrence. The middle of the range is expressed by the 50% exceedance probability forecast, for which there is a 50% chance that the actual flow will be above, and a 50% chance that the actual flow will be below, this value. To describe the expected range around this 50% value, four other forecasts are provided, two smaller values (90% and 70% exceedance probability) and two larger values (30%, and 10% exceedance probability). For example, there is a 90% chance that the actual flow will be more than the 90% exceedance probability forecast. The others can be interpreted similarly.

The wider the spread among these values, the more uncertainty is in the forecast. As the season progresses, forecasts become more accurate, primarily because a greater portion of the future weather conditions become known; this is reflected by a narrowing of the range around the 50% exceedance probability forecast. Users should take this uncertainty into consideration when making operational decisions by selecting forecasts corresponding to the level of risk they are willing to assume about the amount of water to be expected. If users anticipate receiving a lesser supply of water, or if they wish to increase their chances of having an adequate supply of water for their operations, they may want to base their decisions on the 90% or 70% exceedance probability forecasts, or something in between. On the other hand, if users are concerned about receiving too much water (for example, threat of flooding), they may want to base their decisions on the 30% or 10% exceedance probability forecasts, or something in between. Regardless of the forecast value users choose for operations, they should be prepared to deal with either more or less water. (Users should remember that even if the 90% exceedance probability forecast is used, there is still a 10% chance of receiving less than this amount.) By using the exceedance probability information, users can easily determine the chances of receiving more or less water.

Nevada Water Supply Outlook Report
April 1, 2015

SUMMARY

Nevadans were hoping for a miracle, but instead ended up with one of the driest March's in the last 35 years and quite possibly the lowest April 1 snow in over a century. Snow surveyors took photos of bare snow courses with flowers blooming, alpine lakes with no ice and passerby hikers wearing flip-flops instead of snow boots. One thing is for sure, 2015 will be one for the record books and not just in our region, but across much of the western United States. Record low snow exists from Arizona to Alaska. In Nevada, an unusually warm March led to earlier than normal snowmelt with some basins losing half or more of this winter's snowpack before April 1. Despite decent soil moisture the snowmelt did not produce a meaningful streamflow response. At this point the snow that is left is isolated to small islands on the highest ground. Streamflow forecasts have dropped significantly and almost all are below, to well below, the lowest observed amounts on record.

SNOWPACK

The lowest snow in over a century was measured at three out of four snow courses with data back to 1913 located in the Truckee and Lake Tahoe basins. Across Nevada and the eastern Sierra over 60 stations with at least 20 years of data set new record low snow water measurements on April 1; most by a large margin creating a new definition of what a dry winter can look like. A total of 86 of 126 snow measuring sites across Nevada and the eastern Sierra had no snow on April 1, just bare ground. Of these, 23 sites were snow-free on April 1 for the first time based on measurement records that extend back between 25 to 102 years. Considering that most snow measuring sites are located in places where snow lingers the longest, these results indicate just how little snow covers the mountain landscape compared to other years. This report combines manual snow course measurements and automated SNOTEL measurements when reporting first of month snowpack percentages. Basin-wide snowpack percentages in the eastern Sierra range from the Carson Basin with 3% of median, to the Lake Tahoe basin with 10%, the Truckee Basin with 13% and the Walker Basin with 18%. Elsewhere snow is 16-29% of median in the Northern Great Basin, Upper and Lower Humboldt basins, Owyhee Basin and Eastern Nevada, and 45-49% of median in the Snake Basin and Clover Valley - Franklin River Basin.

PRECIPITATION

The Pacific-Northwest is experiencing a snow-drought this winter having had near average precipitation which came in the form of rain instead of snow. Nevada's situation continues to be more in keeping with the strict definition of the word "drought", that being a lack of all kinds of precipitation. January was record dry in the Sierra and one of a handful of the driest years across the rest of northern Nevada. March followed suit, with 12% of average monthly precipitation in the Sierra and 30-40% across most of northern Nevada. Most SNOTEL sites in the Sierra recorded the driest or second driest March on record this year; same was true at sites in the Northern Great Basin, the Upper and Lower Humboldt basins, as well as, the Nevada headwaters to the Owyhee, Bruneau, and Salmon Falls basins. As these dry months stack up, the majority of Sierra SNOTEL sites from the Truckee to the Walker basins are setting new record low water year to date precipitation records compared with data back to about 1980. Water year precipitation since the beginning of October is only about half normal

in the Sierra and also in Eastern Nevada. Water year to date precipitation is 66-84% in other northern Nevada basins. Since October 2011, SNOTEL sites in the Sierra have missed up to a year and a half of the average annual precipitation amount. At the Squaw Valley GC SNOTEL, in the Truckee Basin, that equals nearly 7 feet of missed precipitation. During that same time period missed precipitation is equivalent to half an average year of precipitation in Eastern Nevada, and three-quarters of a year in the Humboldt basin.

SOIL MOISTURE

Soil moisture is above normal in basins where snow melt is still occurring. Unfortunately soil moisture may not have a significant impact on runoff this year simply due to the fact that there just isn't much snow to contribute to stream flow.

RESERVOIRS

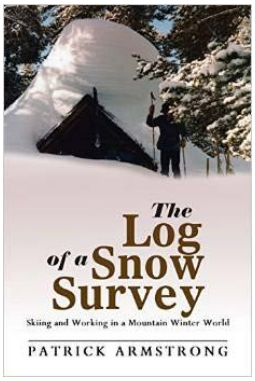
April 1 storage is less than last year at this time in most reservoirs across the region. Lake Tahoe's water surface elevation dropped slightly in March as evaporation outpaced snowmelt. With minimal snow left in the mountains it is unlikely that Lake Tahoe will reach its natural rim this year without help from spring storms. Storage downstream in the Truckee River reservoirs is 28% of capacity, compared with 45% last year. Lahontan Reservoir storage is 20% of capacity, compared with 32% last year. Rye Patch storage is 5% of capacity, similar to last year.

STREAMFLOW FORECASTS

Streamflow forecasts percentages for the April-July period dropped in March. Most forecasts predict record low streamflow volumes this spring and summer. Statewide streamflow forecasts range from 2% to 45% of average for the April-July period. Most forecasts are less than 20%. The Carson River at Fort Churchill and the Humboldt River near Imlay are both forecast at 3% while the Truckee River at Farad is forecast at 19%.

UPCOMING EVENTS AND NEWS

Western Snow Conference, April 20-23, 2015, Grass Valley, CA, www.westernsnowconference.org/
The Conference begins Monday with a short course on "LIDAR Basics, Applications, and Use in Snow Hydrology and Field Studies." Tuesday and Wednesday will include formal paper and poster presentations on topics including: climate variability, climate change impacts on snow and runoff, water management, water supply forecasting, and modeling and climatology of snow. The Wednesday evening banquet features Patrick Armstrong discussing his book (see below). The technical tour on Thursday will visit hydrologic and gold mining points of interest around Grass Valley.



Recommended Reading:

The Log of a Snow Survey – Skiing and Working in a Mountain Winter World, Patrick Armstrong. Abbot Press, 2014.

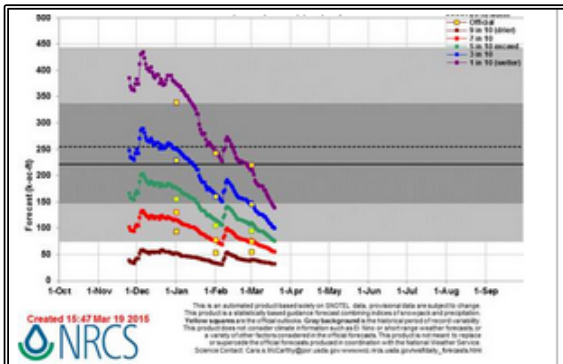
Using an actual account of a snow survey trip Armstrong draws on his 40-plus years of experience to cover the day-to-day joys and dangers of being a snow surveyor in the Sierra Nevada Mountains.

SNOW SURVEY PRODUCT HIGHLIGHT

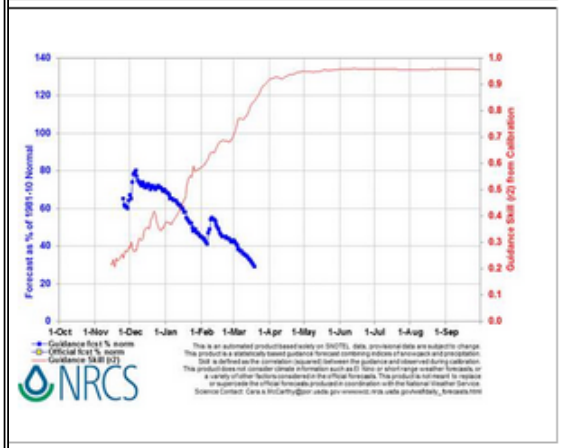
This section highlights products that are linked from the Nevada Snow Program website: www.nv.nrcs.usda.gov/snow/. This month **Daily Water Supply Forecasts** are the highlight.

Daily Water Supply Forecasts have recently been added in Nevada. They are useful to track how recent weather events, such as wet or dry periods, change streamflow forecasts between official first of month and mid-month forecasts. Three graphical products are available (shown below) for 30 different streamflow forecast points in Nevada and the Eastern Sierra. The numerical output data for each forecast point is also available in a spreadsheet. The Daily Water Supply Forecast products are a completely automated set of products based on provisional SNOTEL snow water and precipitation data. These products do not consider climate information such as El Nino/La Nina, or monthly snow course data or other factors that may be considered in the official forecasts.

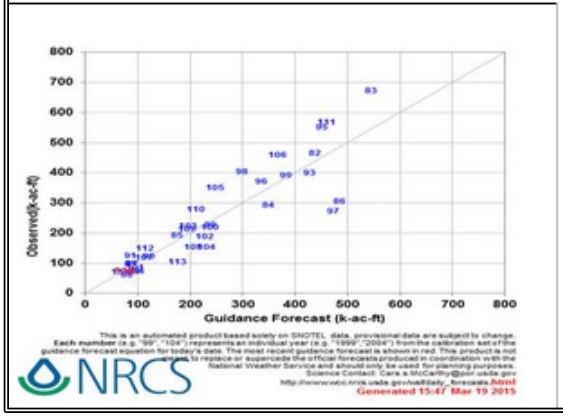
The official forecasts, as well as their input data, undergo more rigorous human review before publication when compared to daily forecasts. The daily products are not meant to replace or supersede the official forecasts produced in coordination with the National Weather Service. Official first of month forecasts are displayed on these daily products for reference purposes. To learn more about these daily products please view the Daily Forecast Technical Note.



Daily Exceedance Guidance Forecasts - displays five exceedance guidance forecasts (colored lines) versus historical range of variability (gray background) and the official monthly forecasts (yellow squares)



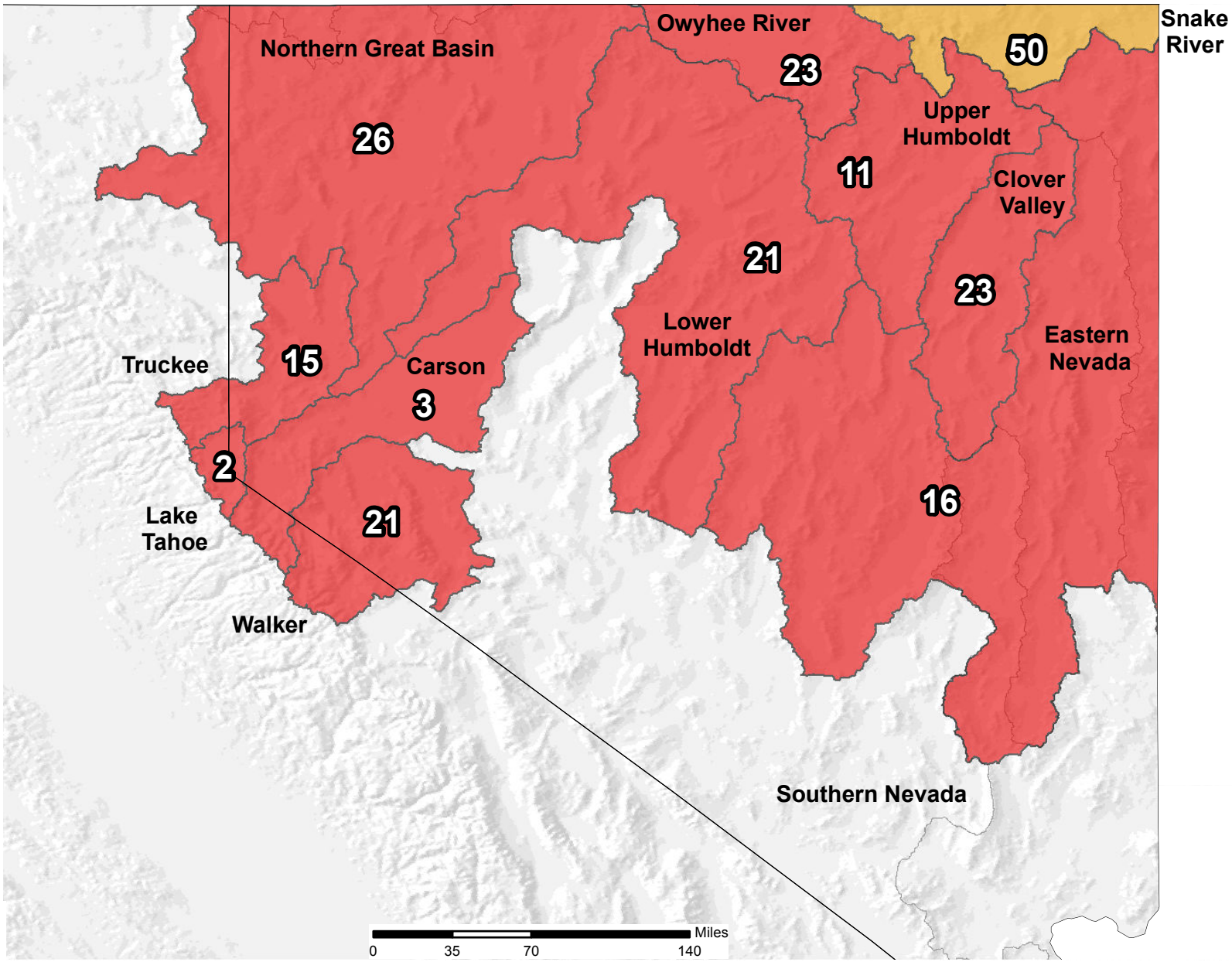
Skill Plot with 50% Exceedance Forecast - displays 50% exceedance guidance volume forecast as percent of normal (blue line) with official forecasts (yellow squares) and guidance skill (r2) from calibration.



Scatter Plot - displays scatter diagram of historical (calibration) and observed volume forecasts

Nevada/California SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Apr 07, 2015



Current Snow Water Equivalent Basin-wide Percent of 1981-2010 Median

- unavailable *
- <50%
- 50 - 69%
- 70 - 89%
- 90 - 109%
- 110 - 129%
- 130 - 149%
- >= 150%

* *Data unavailable at time of posting or measurement is not representative at this time of year*

Provisional data subject to revision

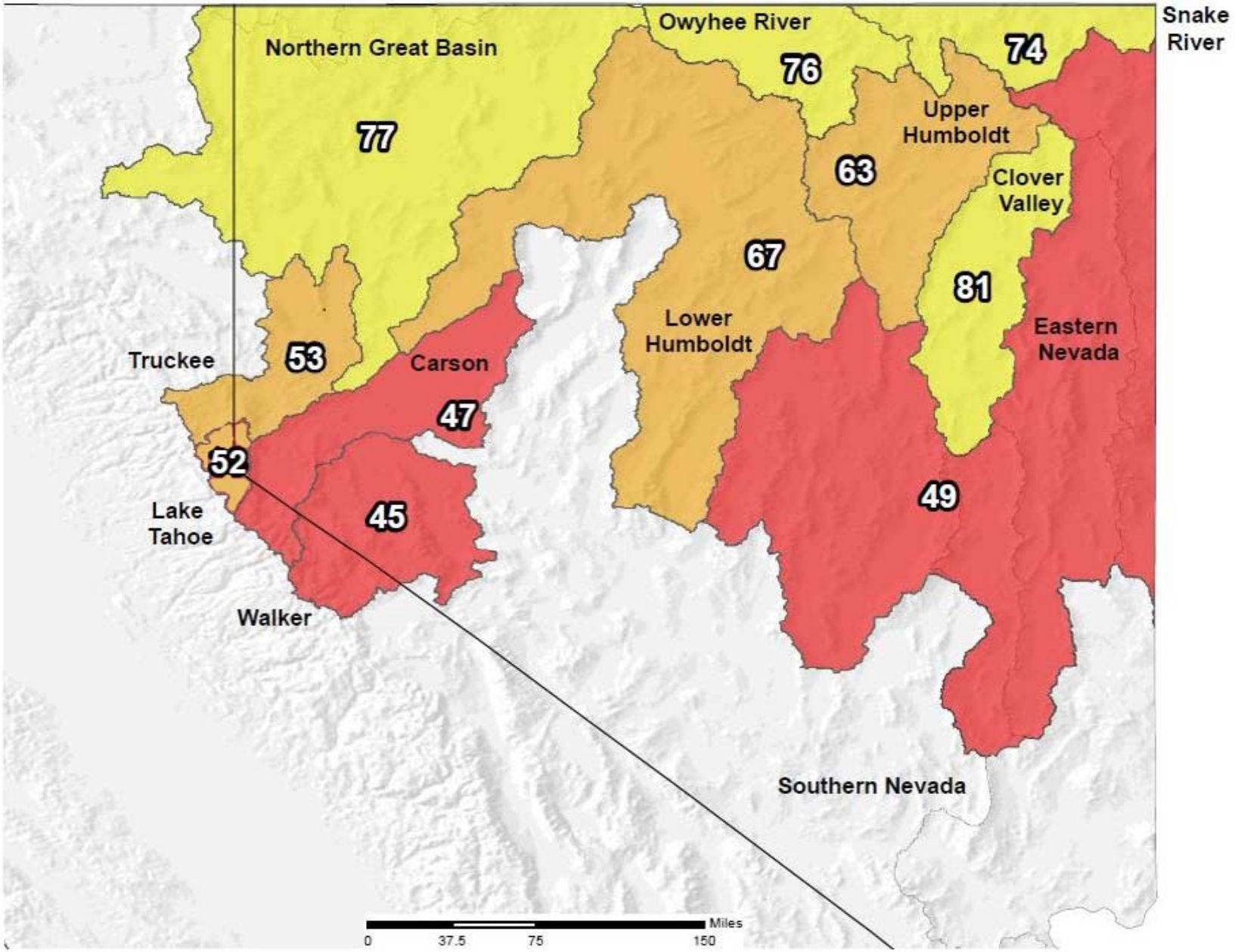
USDA NRCS

The current snow water equivalent percent of normal represents the snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov

Nevada/California SNOTEL Water Year (Oct 1) to Date Precipitation % of Normal

Apr 07, 2015



Water Year (Oct 1) to Date Precipitation Basin-wide Percent of 1981-2010 Average

- unavailable *
- <50%
- 50 - 69%
- 70 - 89%
- 90 - 109%
- 110 - 129%
- 130 - 149%
- >= 150%

* *Data unavailable at time of posting or measurement is not representative at this time of year*

Provisional data subject to revision

USDA NRCS

The water year to date precipitation percent of normal represents the accumulated precipitation found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

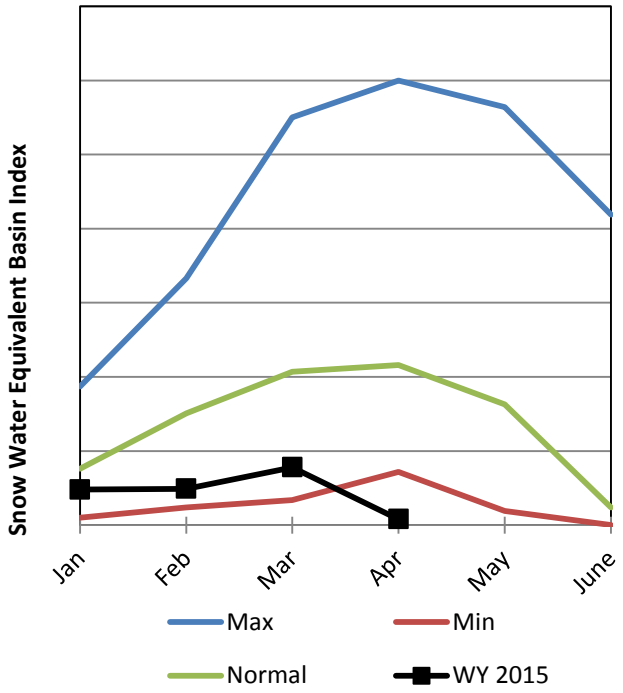
Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov

Carson River Basin

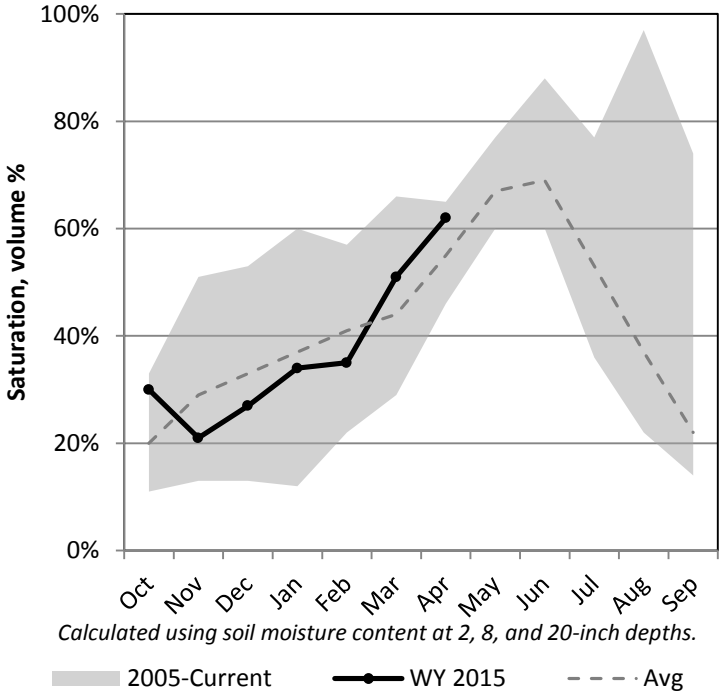
4/1/2015

Snowpack in the Carson River Basin is much below average at 3% of normal, compared to 56% last year. Precipitation in March was much below average at 12%, which brings the seasonal accumulation (Oct-Mar) to 47% of average. Soil moisture is at 62% compared to 46% last year. Storage in Lahontan Reservoir is 20% of capacity, compared to 32% last year. Forecast streamflow volumes range from -9% to 18% of average.

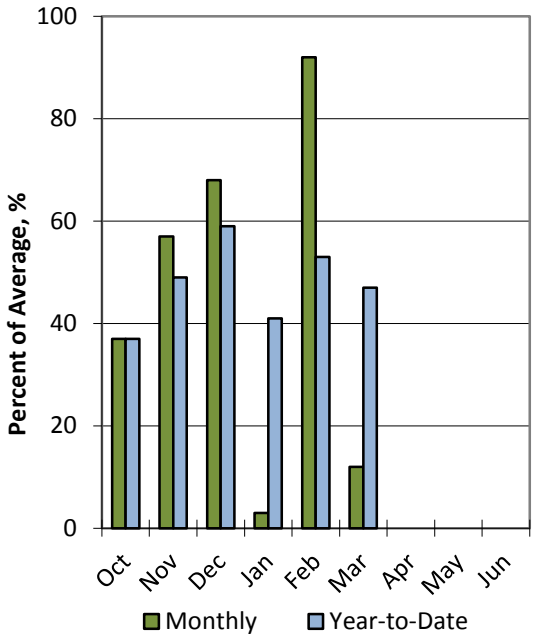
Snowpack



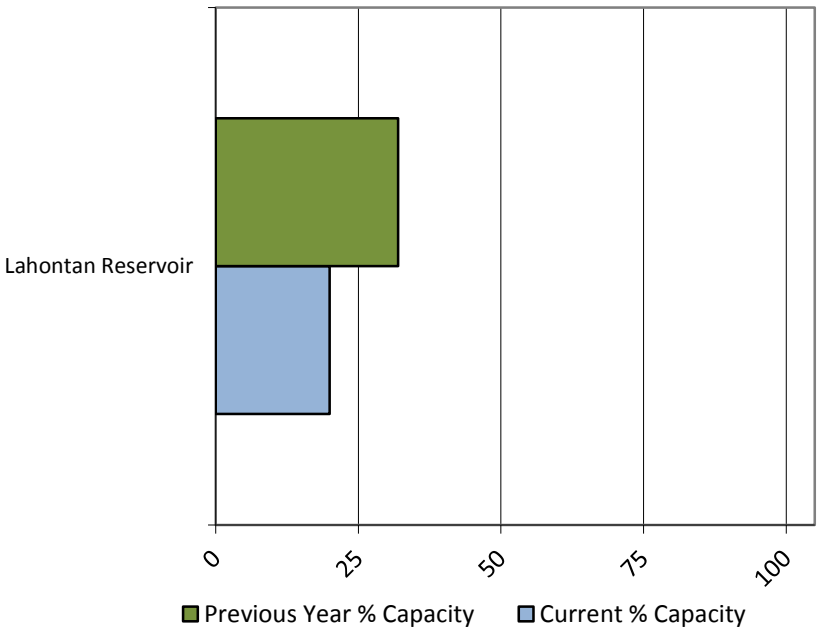
Soil Moisture



Precipitation



Reservoir Storage



Data Current as of: 4/6/2015 9:20:58 AM

Carson River
Streamflow Forecasts - April 1, 2015

Carson River	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
		Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast						
EF Carson R nr Gardnerville								
	APR-JUL	3.7	14	34	18%	54	83	186
	MAY-JUL	1.51	4.5	20	13%	39	68	151
	200 cfs	19 May	29 May	05 Jun		12 Jun	22 Jun	25 Jul
	500 cfs	26 Apr	06 May	12 May		18 May	28 May	01 Jul
WF Carson R nr Woodfords								
	APR-JUL	0	2.1	9	17%	15.9	26	54
	MAY-JUL	0.42	1.26	5	12%	13.3	26	42
Carson R nr Carson City								
	APR-JUL	6	10.2	14	8%	18.6	27	179
	MAY-JUL	2.6	5.8	9	6%	13.2	22	144
Marlette Lake Inflow								
	APR-JUL	-686	-325	-80	-9%	165	526	911
	MAY-JUL	-891	-539	-300	-48%	-61	291	630
King Canyon Ck nr Carson City								
	APR-JUL	0	0.008	0.04	11%	0.133	0.28	0.38
	MAY-JUL	0	0.005	0.02	7%	0.105	0.192	0.27
Carson R at Ft Churchill								
	APR-JUL	0.8	2	5	3%	15	24	171
	MAY-JUL	0.12	1.03	2.5	2%	5	10.9	138
Ash Canyon Ck nr Carson City								
	APR-JUL	0	0.02	0.2	18%	0.41	0.71	1.12
	MAY-JUL	0	0.009	0.04	4%	0.2	0.43	0.91

1) 90% and 10% exceedance probabilities are actually 95% and 5%
2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions
3) Median value used in place of average

Reservoir Storage End of March, 2015	Current (KAF)	Last Year (KAF)	Average (KAF)	Capacity (KAF)
Lahontan Reservoir	57.9	95.8	198.8	295.1
Basin-wide Total	57.9	95.8	198.8	295.1
# of reservoirs	1	1	1	1

Watershed Snowpack Analysis April 1, 2015	# of Sites	% Median	Last Year % Median
Carson River Basin	9	3%	56%
E.F. Carson River	4	0%	54%
W.F. Carson River	9	3%	56%