Water Shortage Contingency Planning

Modeling and Forecasting Working Group

City of Santa Cruz Water Department

January 14, 2015

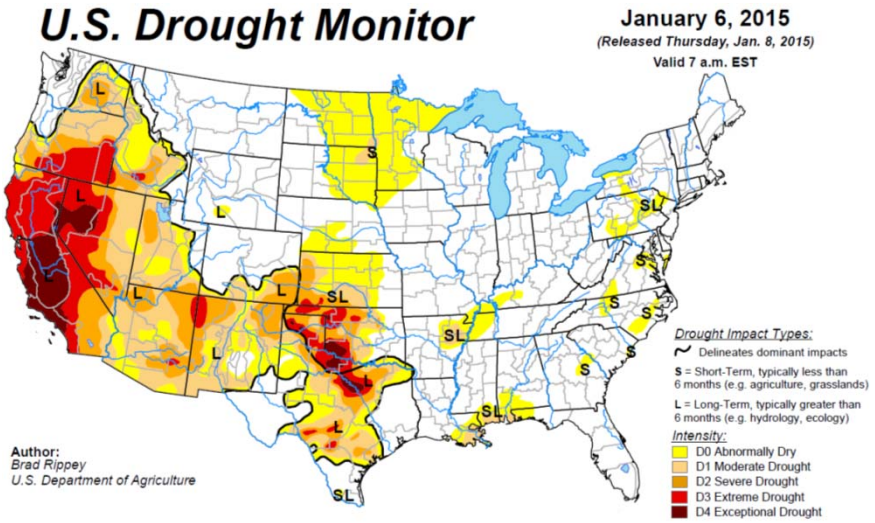
Today's Agenda

* Workshop Goals
* Explain the Process the City Uses to Determine if a Water Shortage is Imminent
* Calendar and Timing for Short-term Forecast
* Important Parameters to Evaluate
* Review System Operations: Normal Year, Drought Year
* Overview of the Spreadsheet Model Using Different Scenarios for 2015
* Opportunity for Discussion, Questions, Comments

Workshop Goals

* Understand the Process Used to Prepare a Seasonal Forecast of Supply and Demand
* Appreciate the Uncertainties Involved – How Different Scenarios are Evaluated
* Understand the Tradeoffs of Different Allocations and Coming to a Recommendation on the Stage of Water Shortage
* Compare and Contrast approach with Confluence Operations Model

Drought vs. Water Shortage



Water Shortage:

When a utility's water supply is insufficient to meet its customer's ordinary drinking water needs -

* Source yield and reliability
* Infrastructure capacity and operating constraints
* Access to alternative sources
* System demand characteristics

Regulatory Background

* **California Water Code 10632** requires all public water suppliers to plan for water shortages of up to 50 percent.
* **California Water Code Section 350** provides the authority and process for public water suppliers to declare a water shortage emergency and adopt emergency rules
* **Santa Cruz Municipal Code Chapter 16.02** – Water Shortage Regulations and Restrictions

General Problem Statement

1. **City's water system is vulnerable to water shortages during periods of drought**
   * Reliance on surface/flowing water sources
   * Physical/geographic isolation
   * Single dry year vs. multiple dry, critically dry years

2. **Balancing surface water diversions with the need to operate in a manner that protects aquatic habitat of threatened and endangered species**

Time of Year When Shortage Occurs

* Ordinarily in **Peak Season:** April/May- October
* Past experience indicates generally adequate water in flowing source to meet system demands during off-peak months when consumption is low
* Notable Exception: Fall 2013

Calendar for Declaring Water Shortage

Date	Action
Oct - Dec	Monitor rainfall, runoff, reservoir storage
Late January	Initial water supply outlook
Late February	First estimate of water supply availability for year ahead
Late March	Final water supply outlook, revised estimate
March - April	Announce shortage, public hearing, declaration of water shortage, publicize situation
May	Water shortage regulations become effective

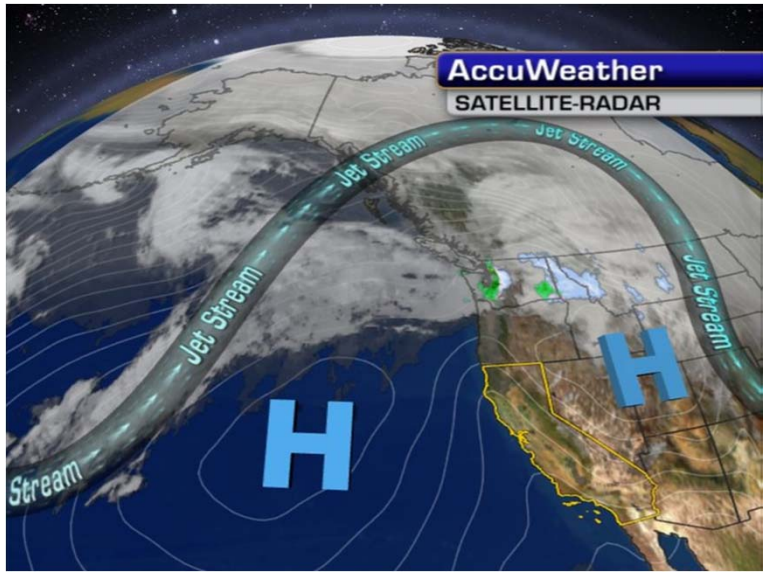
Important Parameters

* Weather!
* Rainfall – City of Santa Cruz and watershed
* Stream Flow – San Lorenzo River at Felton
* Reservoir Storage
* Cumulative Runoff and Water Year Classification
* Groundwater Elevations
* Temperature??

Weather

Typical winter weather pattern

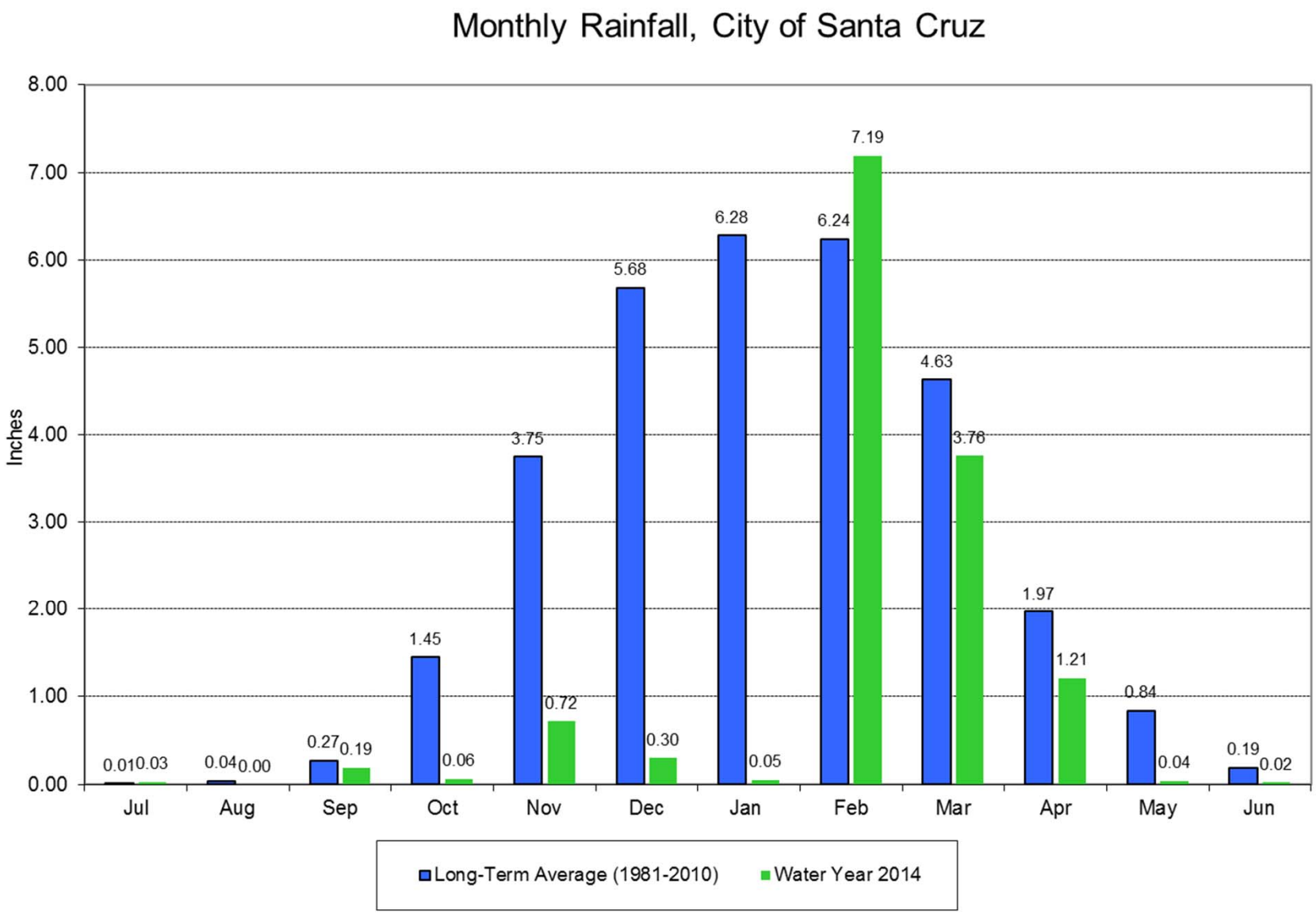
Persistent high atmospheric pressure

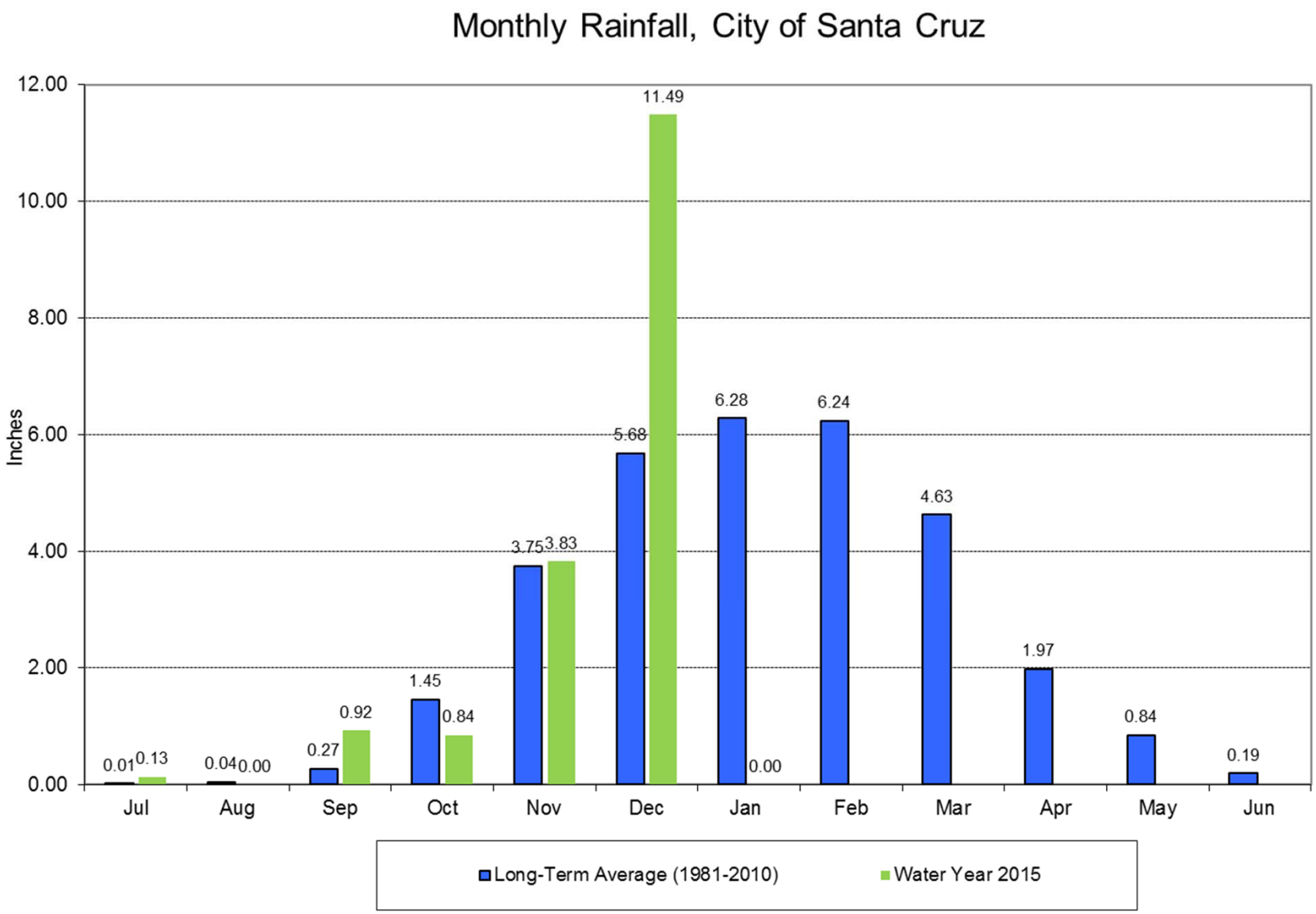


Annual Rainfall

Santa Cruz

Year	Rainfall (inches)
2012	21.7
2013	17.9
2014	13.5
2015 (to date)	17.1
Long-Term Average	31.4


Monthly Rainfall, City of Santa Cruz
Inches
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.01
0.03
0.04
0.00
0.27
0.19
1.45
0.06
3.75
0.72
5.68
0.30
6.28
0.05
6.24
7.19
4.63
3.76
1.97
1.21
0.84
0.04
0.19
0.02
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Long-Term Average (1981-2010)
Water Year 2014


Monthly Rainfall, City of Santa Cruz
Inches
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.01
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0.04
0.00
0.27
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0.84
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11.49
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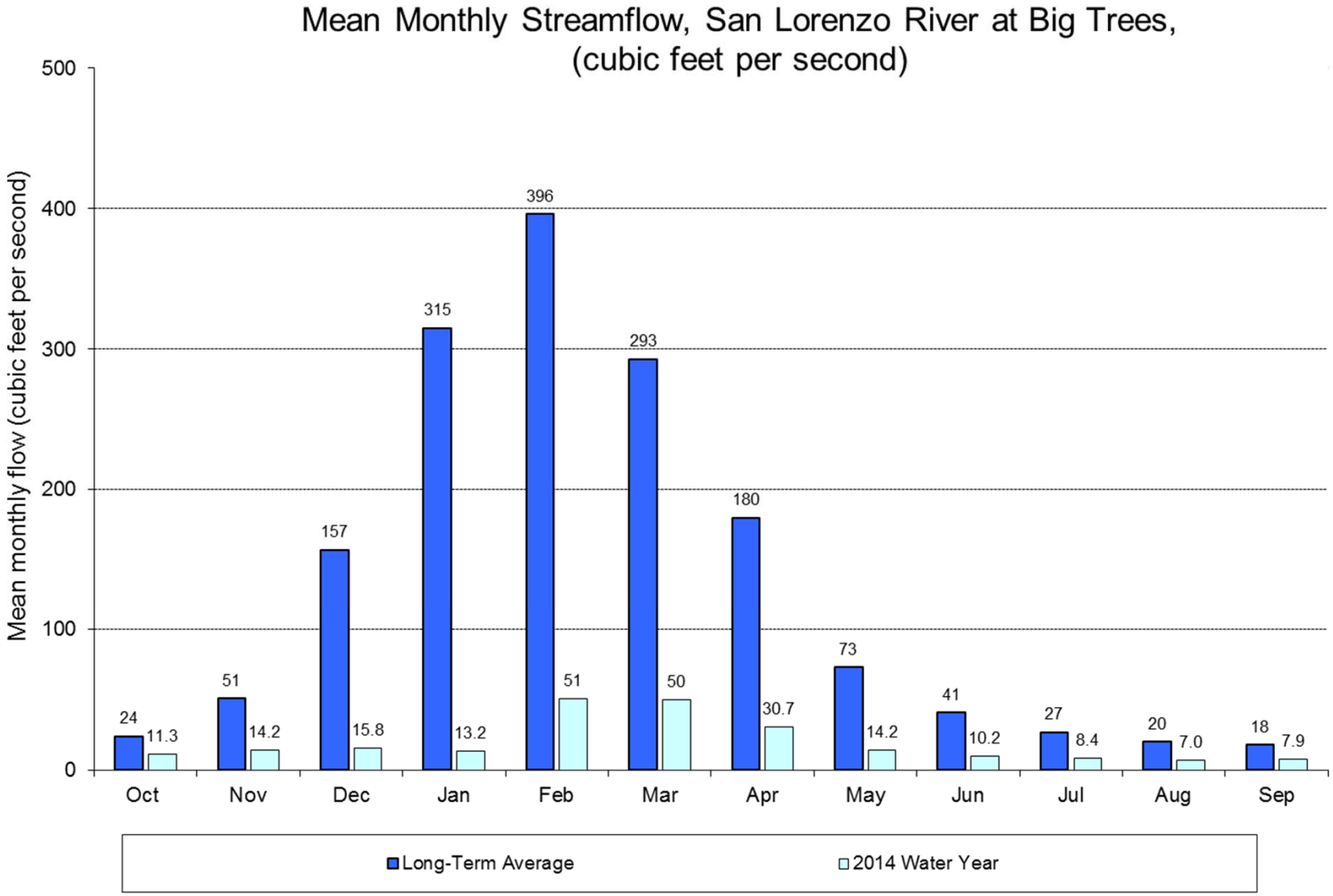
Mean Monthly Streamflow, San Lorenzo River at Big Trees,
(cubic feet per second)
Mean monthly flow (cubic feet per second)
500
400
300
200
100
0
24
11.3
51
14.2
157
15.8
315
13.2
396
51
293
50
180
30.7
73
14.2
41
10.2
27
8.4
20
7.0
18
7.9
Oct
Nov
Dec
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Feb
Mar
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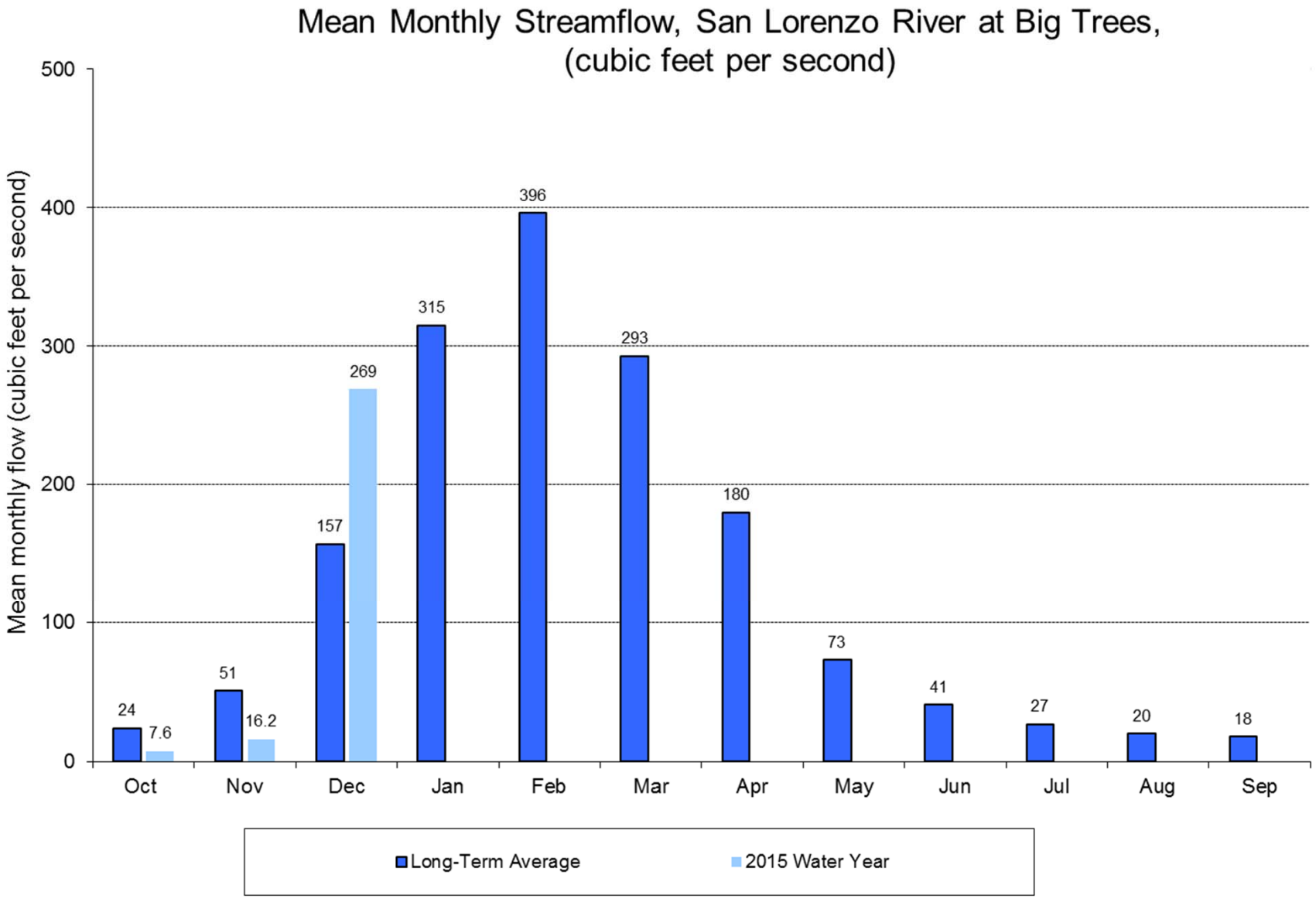
Jul
Aug
Sep
Long-Term Average
2014 Water Year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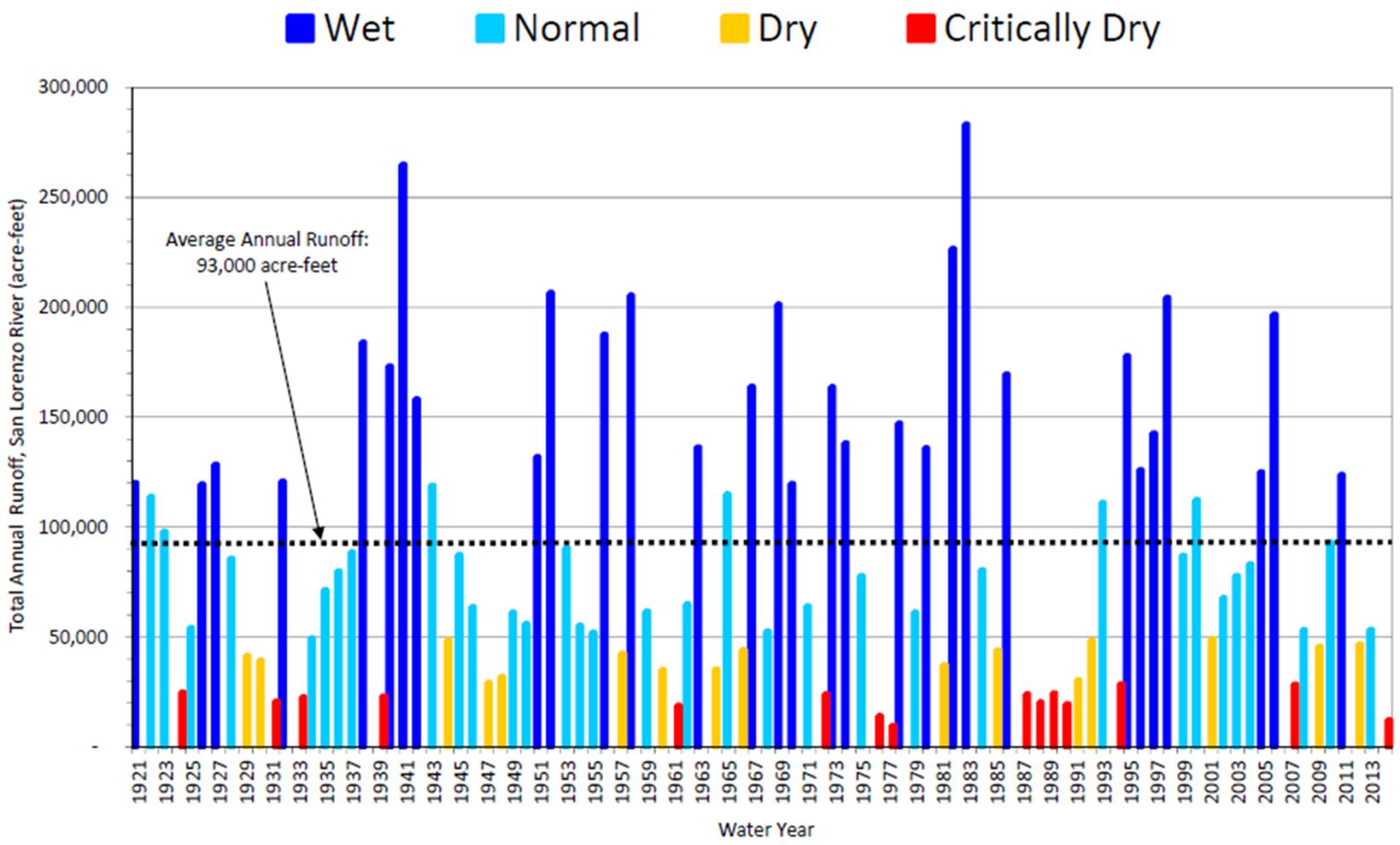
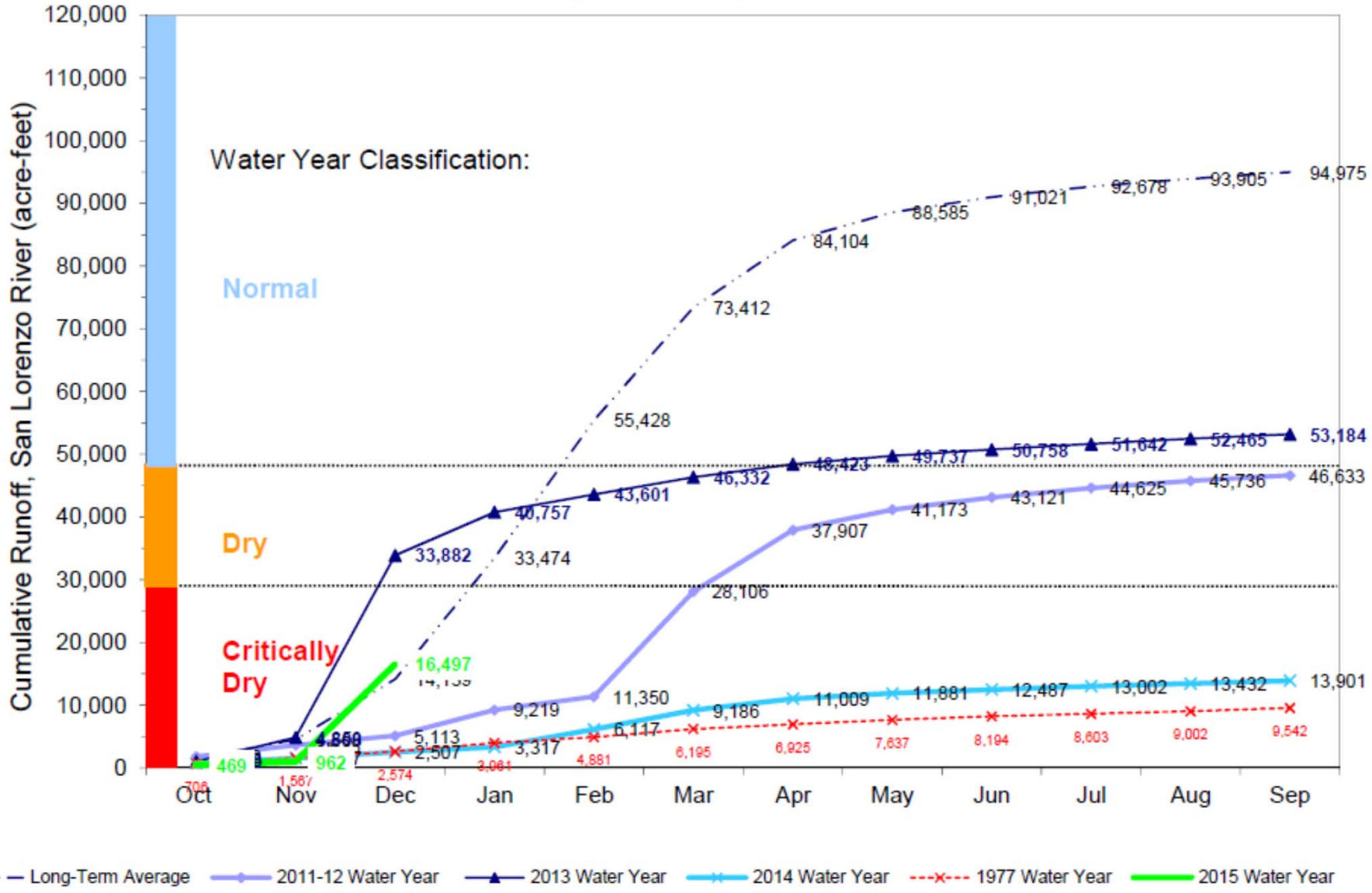
73
41
27
20
18
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Long-Term Average
2015 Water Year

Reservoir Storage (mil gal)

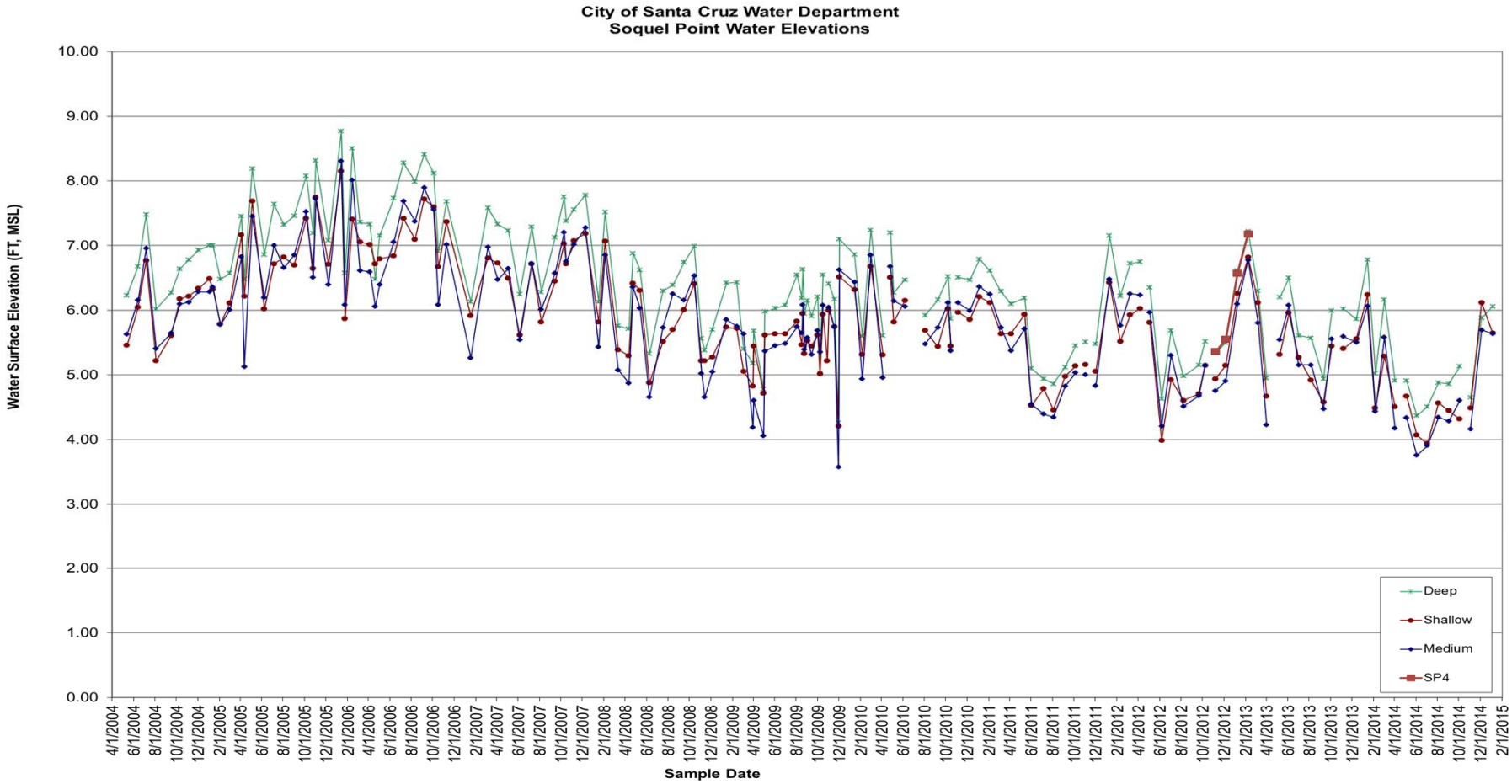
Water Year Classification



Cumulative Runoff and Water Year Classification, 1/01/15 (acre-feet)

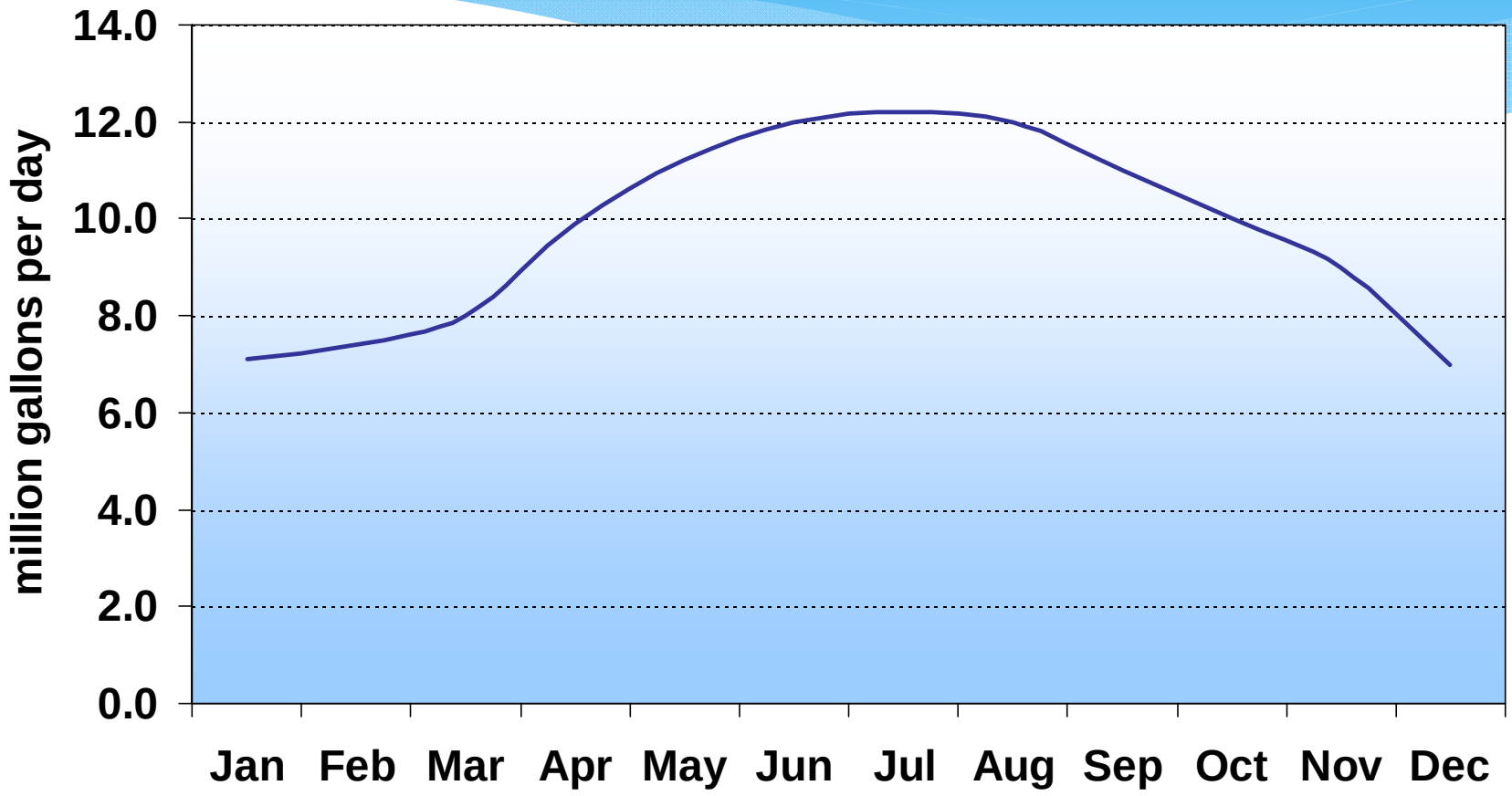


Groundwater Elevation

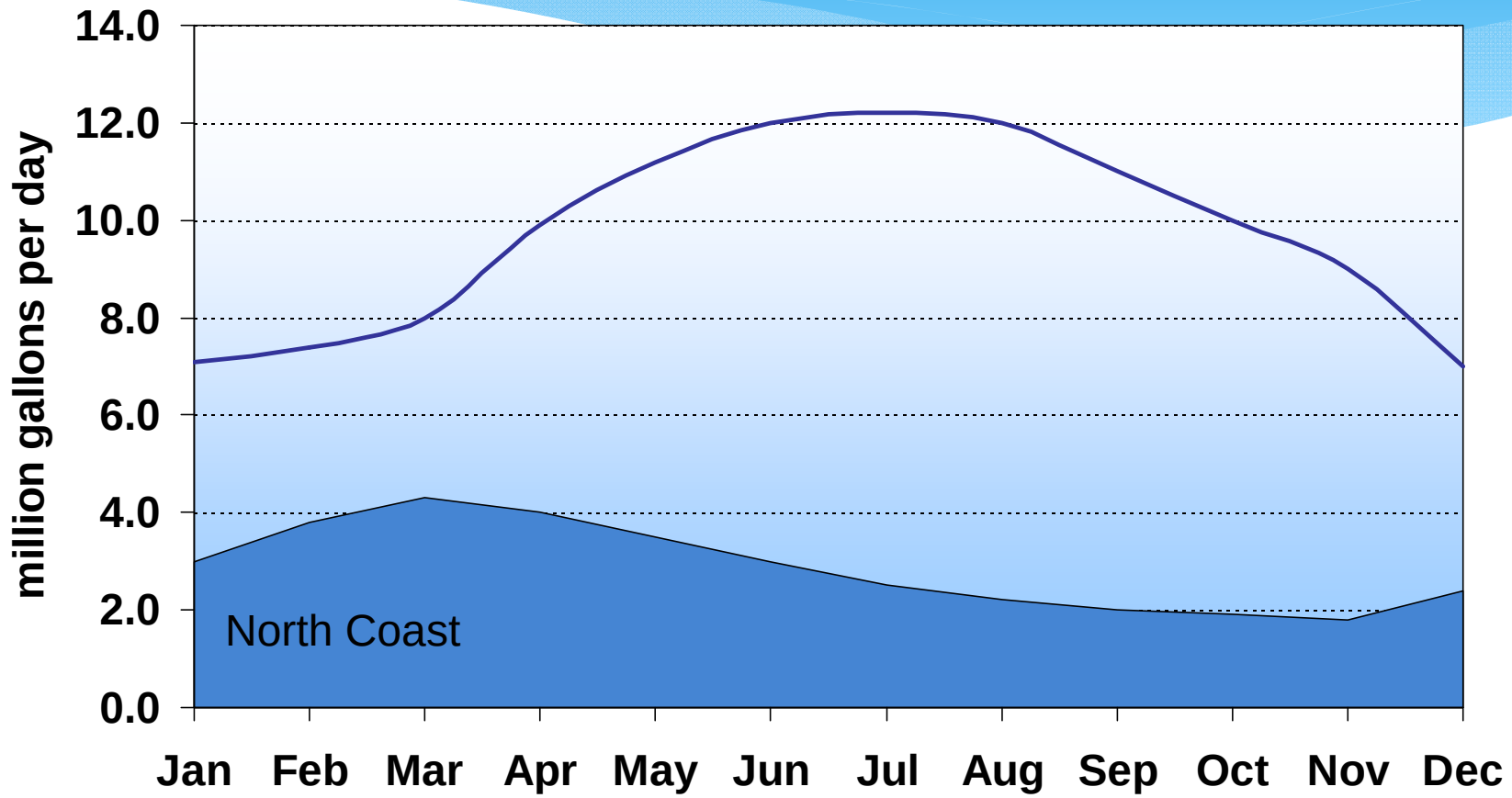


Review of System Operations

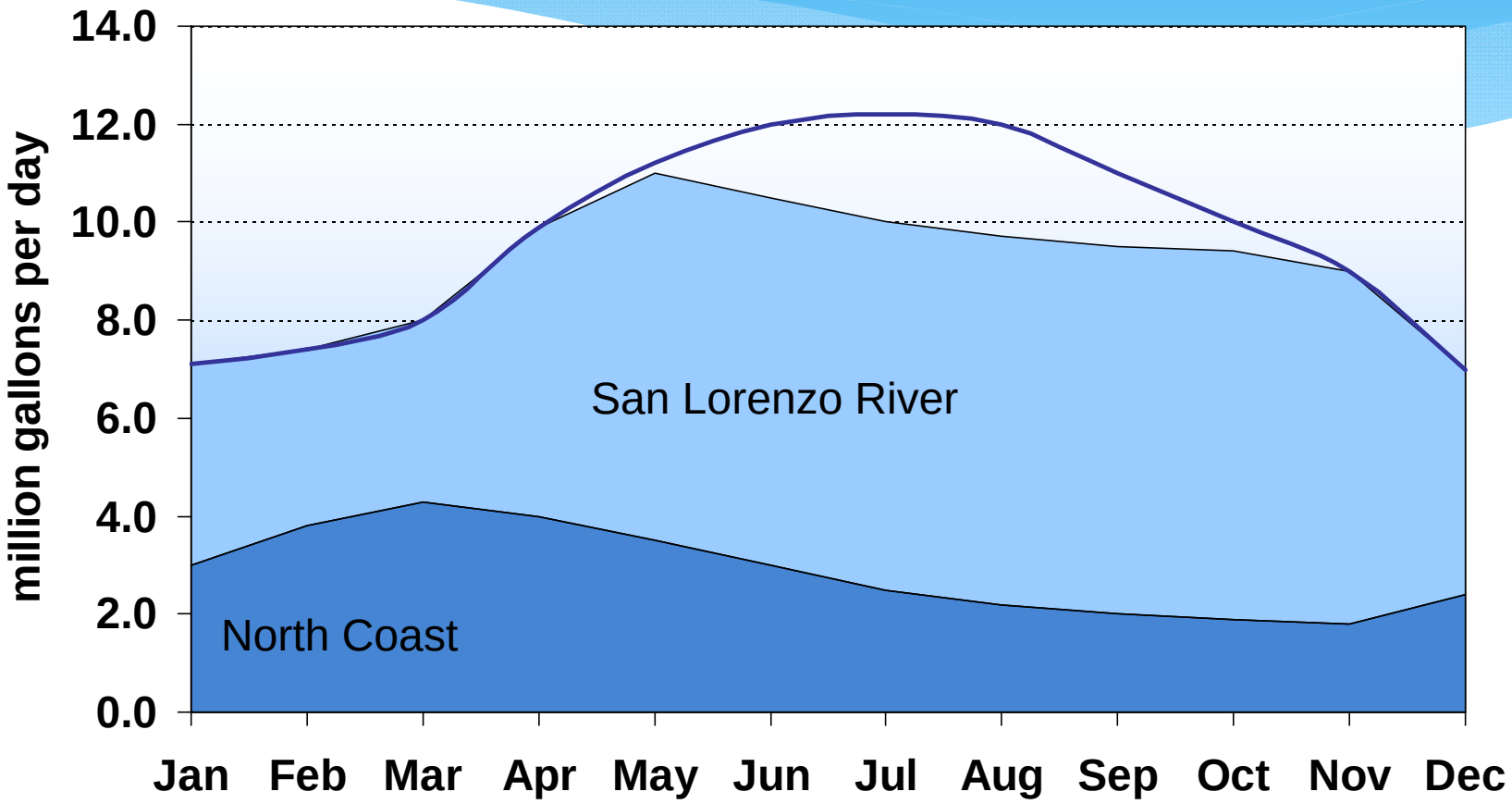
System Demand



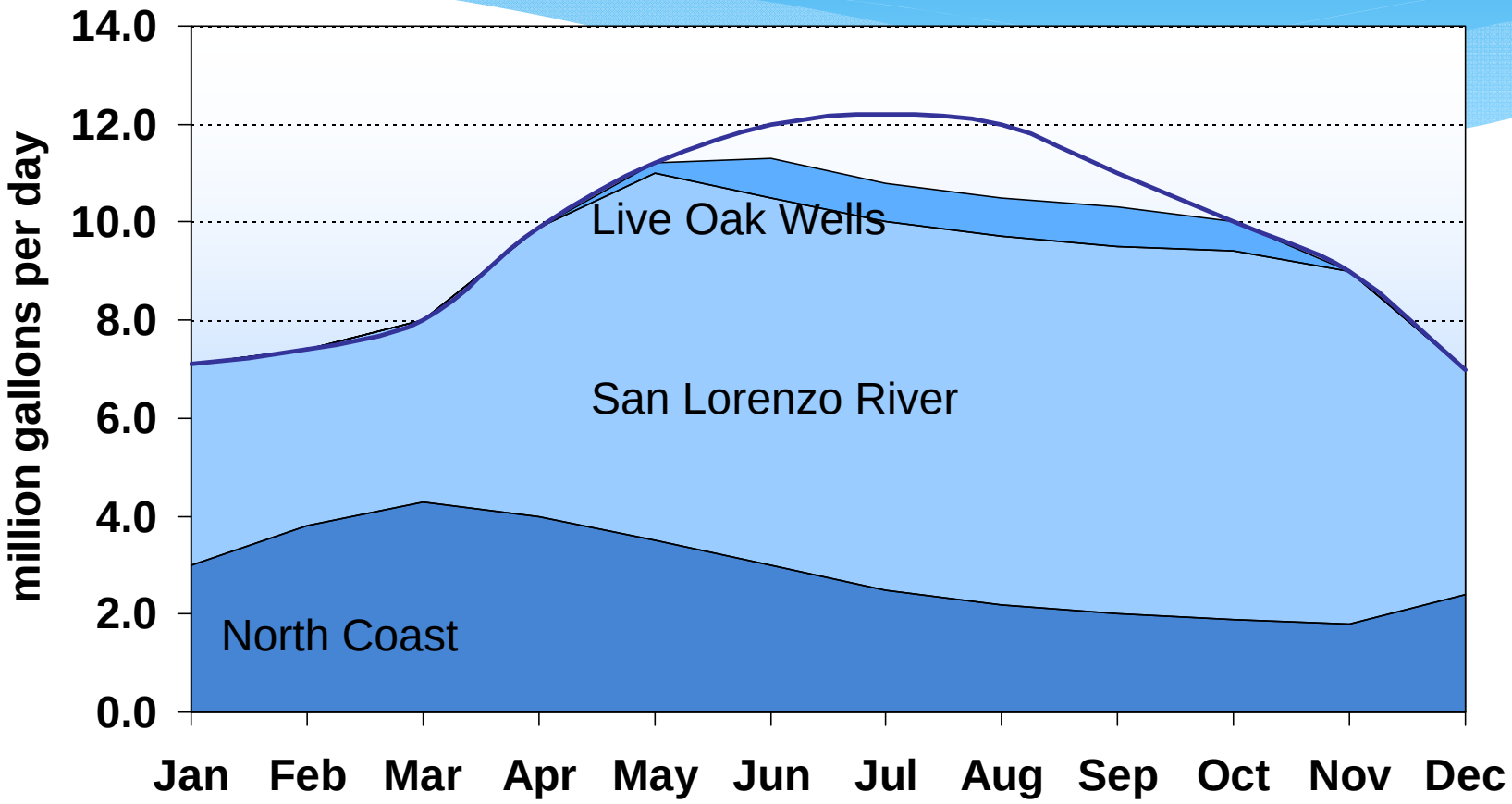
North Coast Supply



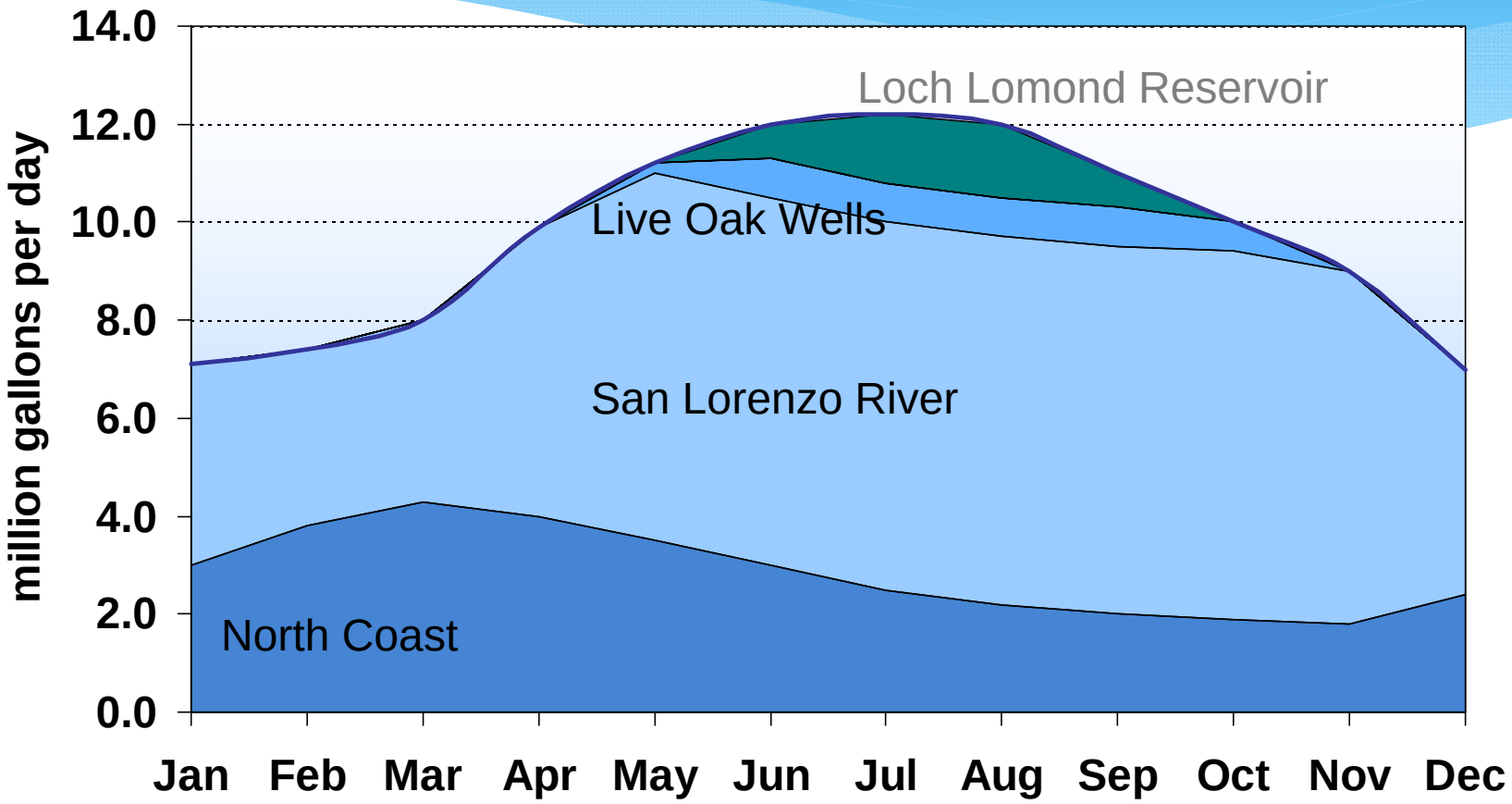
San Lorenzo River



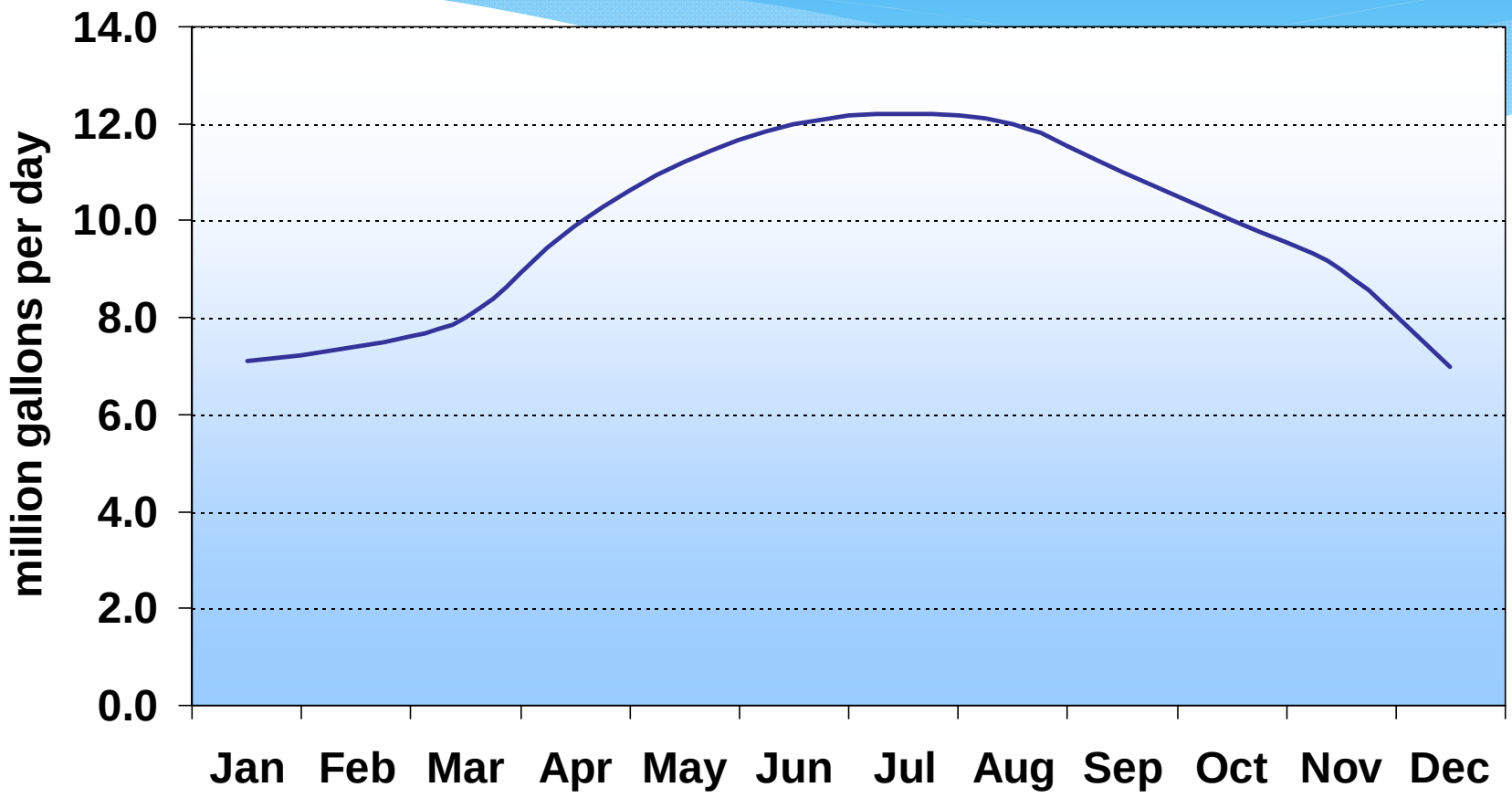
Live Oak Wells



Loch Lomond Reservoir



Supply and Demand in a Drought



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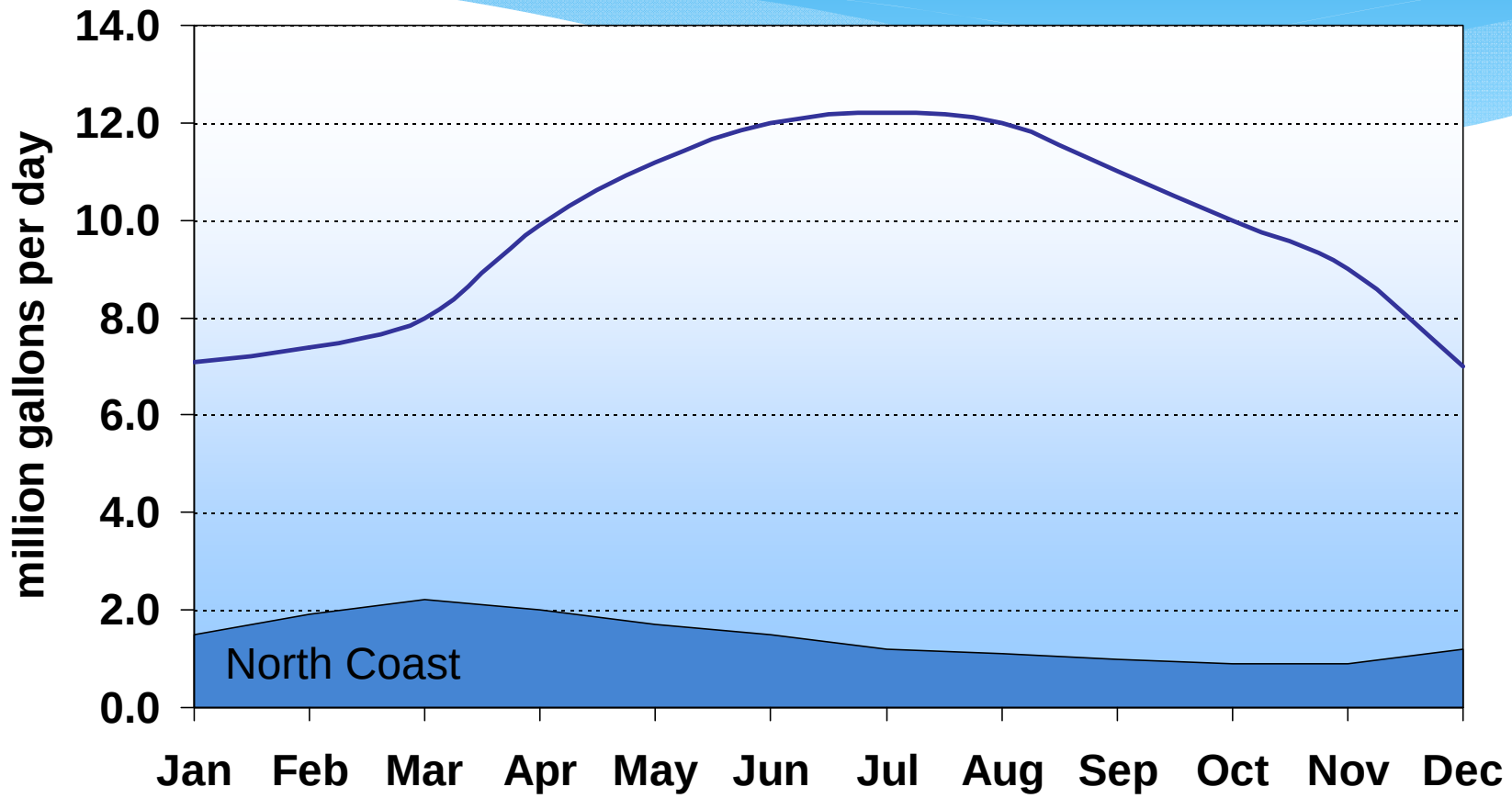

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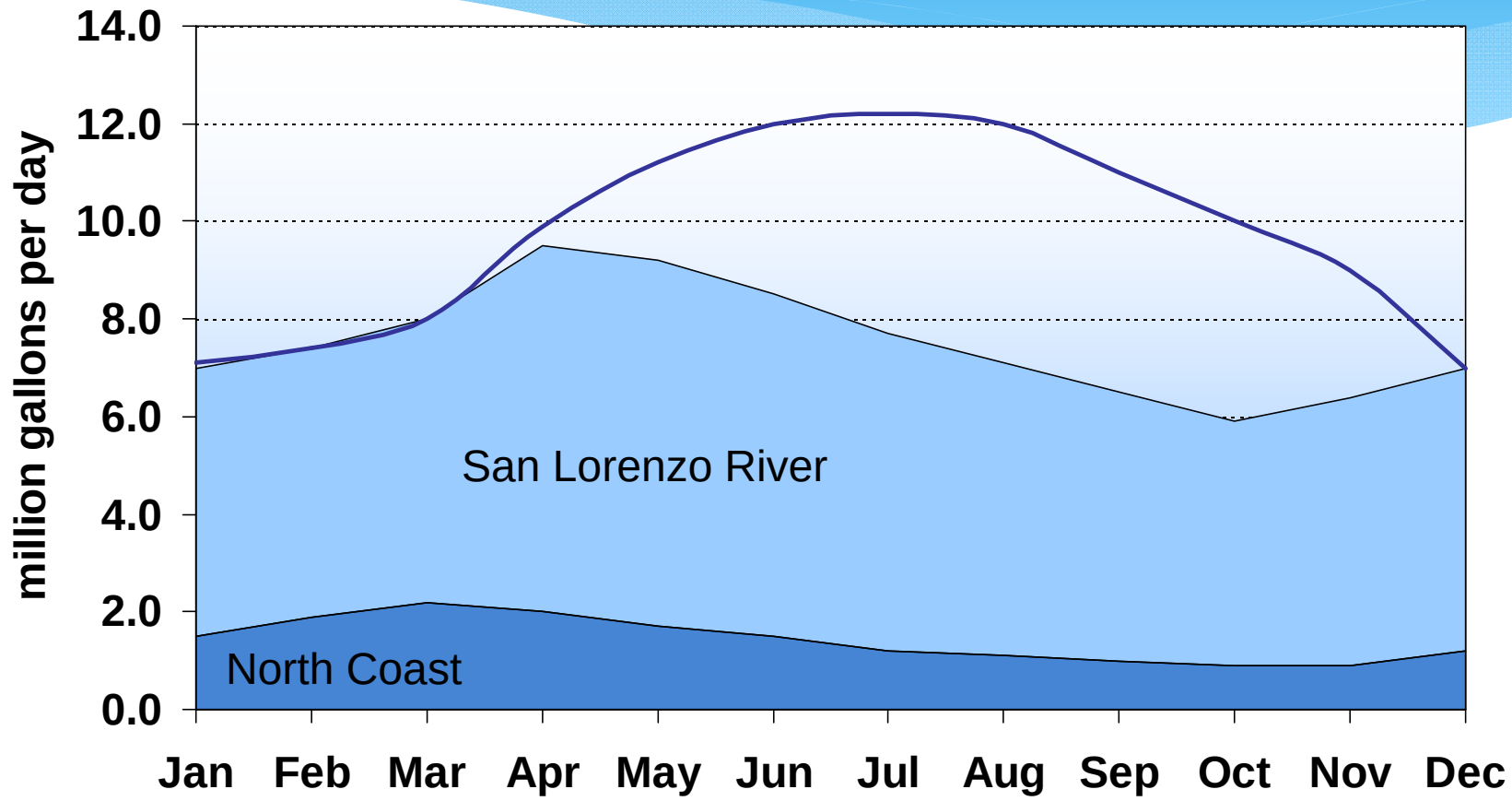
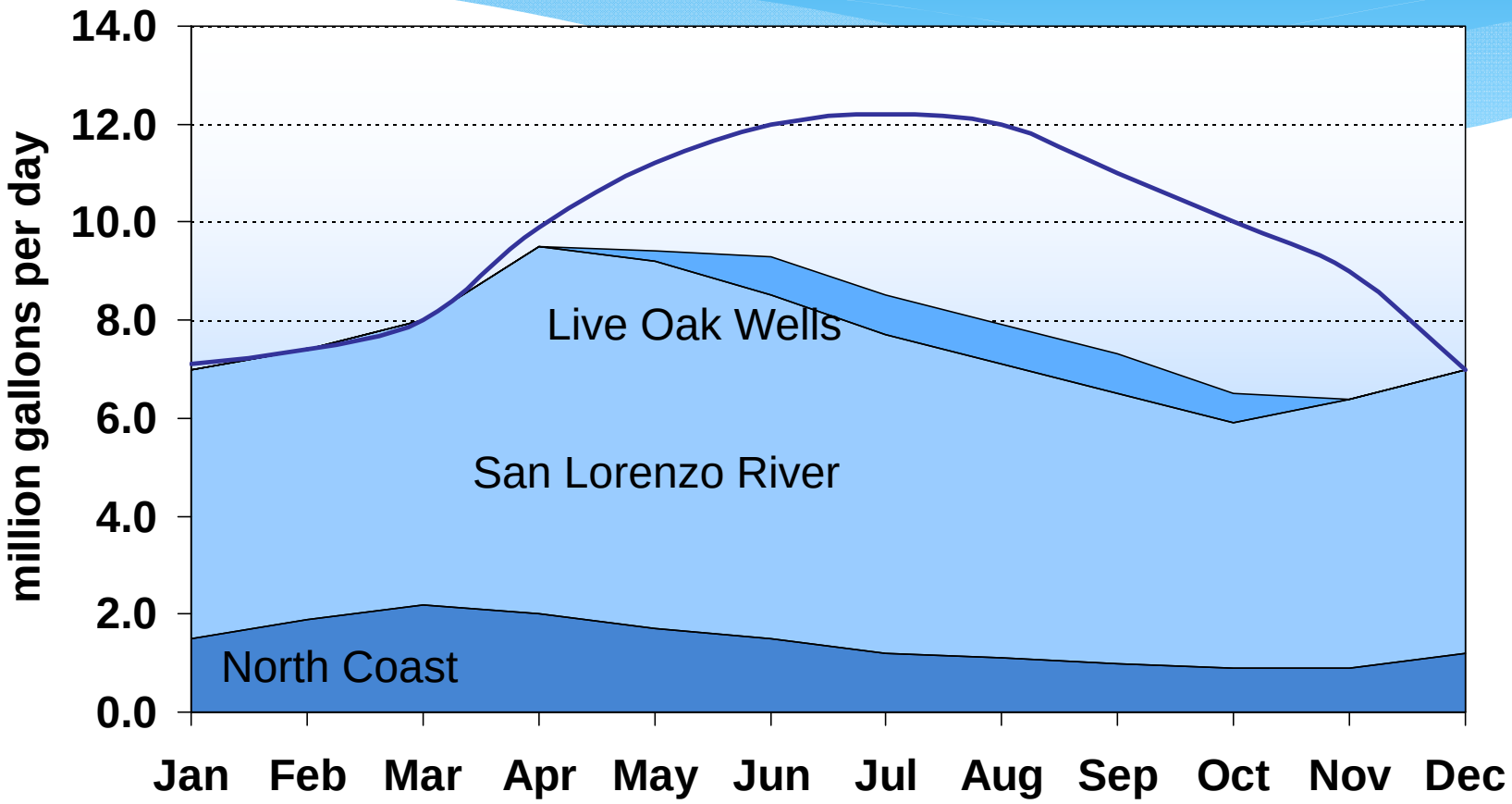


Supply and Demand in a Drought



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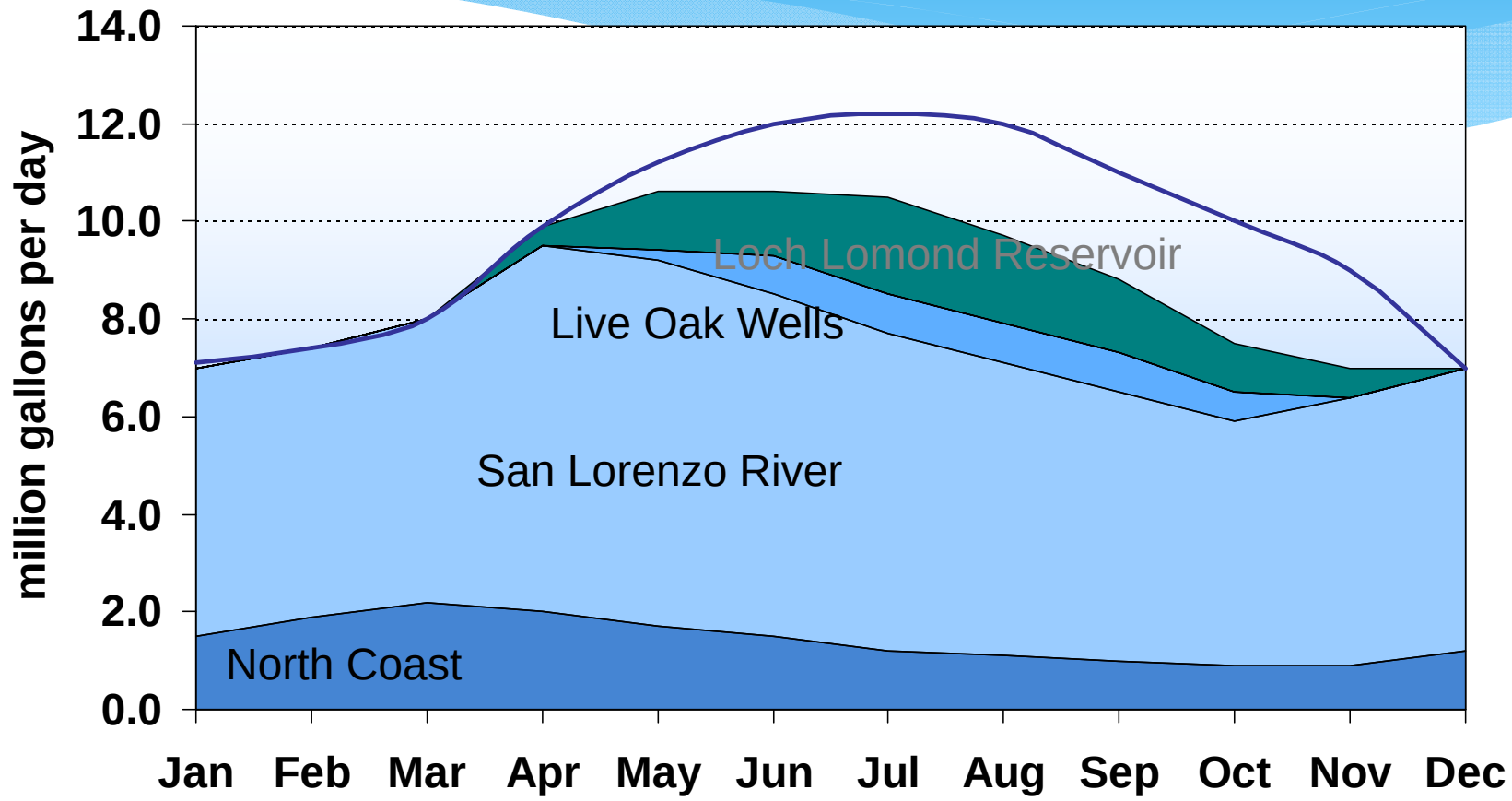

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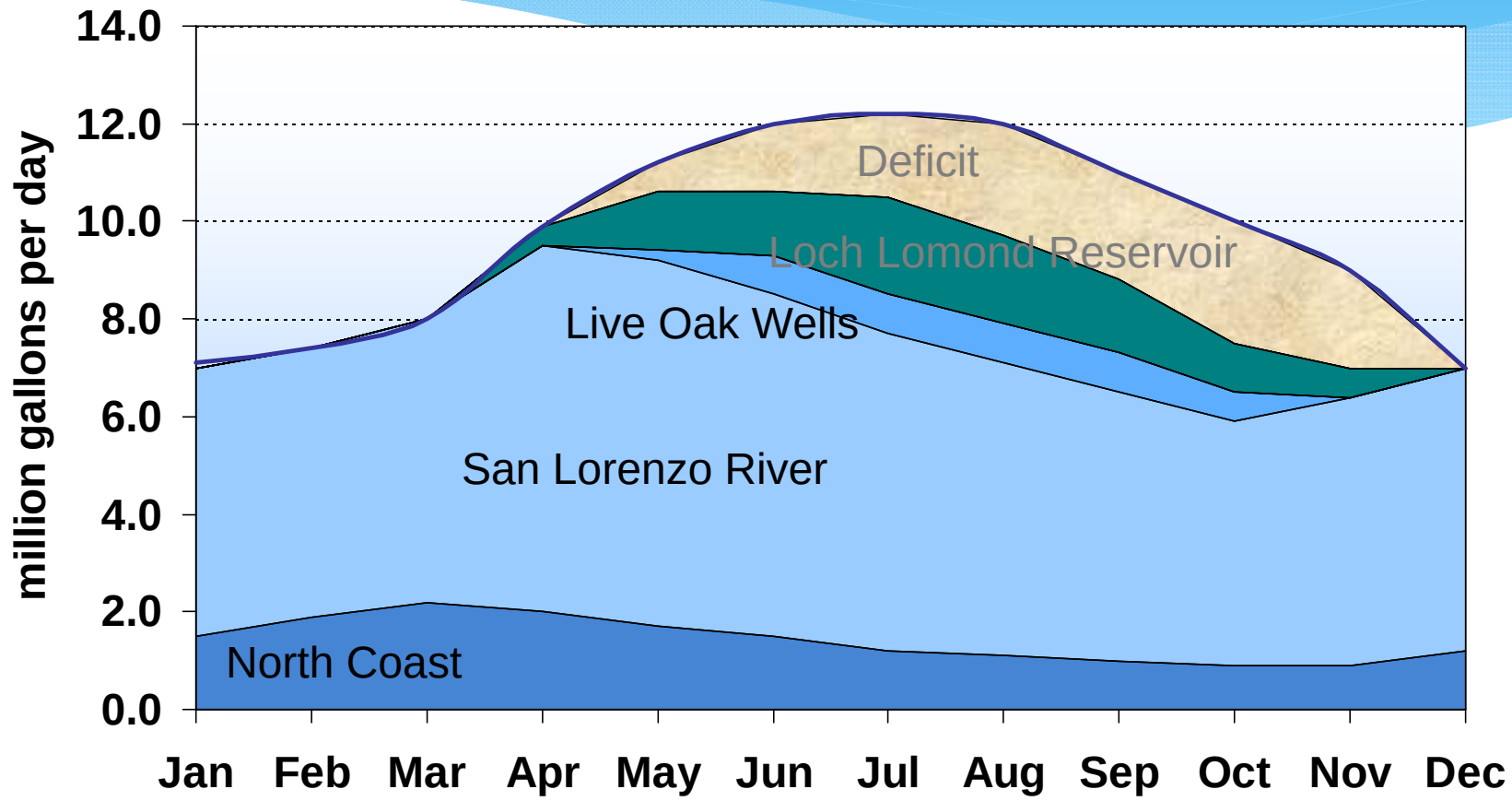

3-Step Process to Determine Shortfall

1. Develop a monthly forecast of supply available from flowing sources and wells
2. Estimate withdrawals/drawdown of Loch Lomond Reservoir and evaluate end of season storage for different scenarios and levels of demand
3. Decide how much reservoir water is available for use in the current year and how much should be "banked" as a safeguard against the possibility of another dry year

Tradeoffs of Alternative Allocations from Loch Lomond Reservoir

Allocation	Frequency	Revenue Impact	Consequence
Large	Shortages occur less frequently	Less impact on water sales and revenue	• Draw down reservoir faster • Require more draconian cutbacks if drought persists
Small	Shortages occur more frequently	Lower sales and reduced revenue	• Deeper cutbacks in current year • Withstand more prolonged drought before running out of water

Overarching Goals

1. To conserve the water supply of the City for the greatest public benefit;
2. To mitigate the effects of a water supply shortage on public health and safety, economic activity, and customer lifestyle;
3. **To budget water use so that the supply will be available for the most essential purposes for the entire duration of the shortage**

Key Considerations

* Ideally, the carryover storage amount will be enough , along with other sources, to meet the essential health and safety needs of the community if the subsequent winter is as dry as the driest year on record.
* **Planning is geared toward next year, not just the immediate situation at hand**

5-Stage Demand Reduction Program

Stage	Magnitude of Water Shortage	Stage Title
1	0-5%	Water Shortage Alert
2	5-15%	Water Shortage Warning
3	15-25%	Water Shortage Emergency
4	25-35%	Severe Water Shortage Emergency
5	35-50%	Critical Water Shortage Emergency

Set of regulations that apply at each stage become increasingly stringent as the magnitude of the water shortage increases

Percent Shortage

Supply Deficiency (mg):	387
Unrestricted Demand (mg):	÷2,562
Water Shortage:	= 0.15 or **15%**

Spreadsheet Model Demo

More Information

Written description and example provided in City's Water Shortage Contingency Plan:

http://www.cityofsantacruz.com/departments/water/conservation/more-information/water-shortage-contingency-plan