Rio Grande Canalization Project
Preliminary Water Budget Study

El Paso County, TX and Doña Ana County, New Mexico

Rio Grande Citizens Forum Meeting

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International Boundary and Water Commission
United States Section
Engineering Services Division

November 6, 2013

Project Overview

- **Purpose of the Study (Partnering with USBR)**
  - Ongoing severe drought (since Oct 2010)
  - Implications of delayed and normal irrigation releases
  - Magnitude of individual water budget components
  - Develop models for predictive capability
  - Obtain recommendations/insights on managing water releases in the years ahead

- **Consultant: Tetra Tech**

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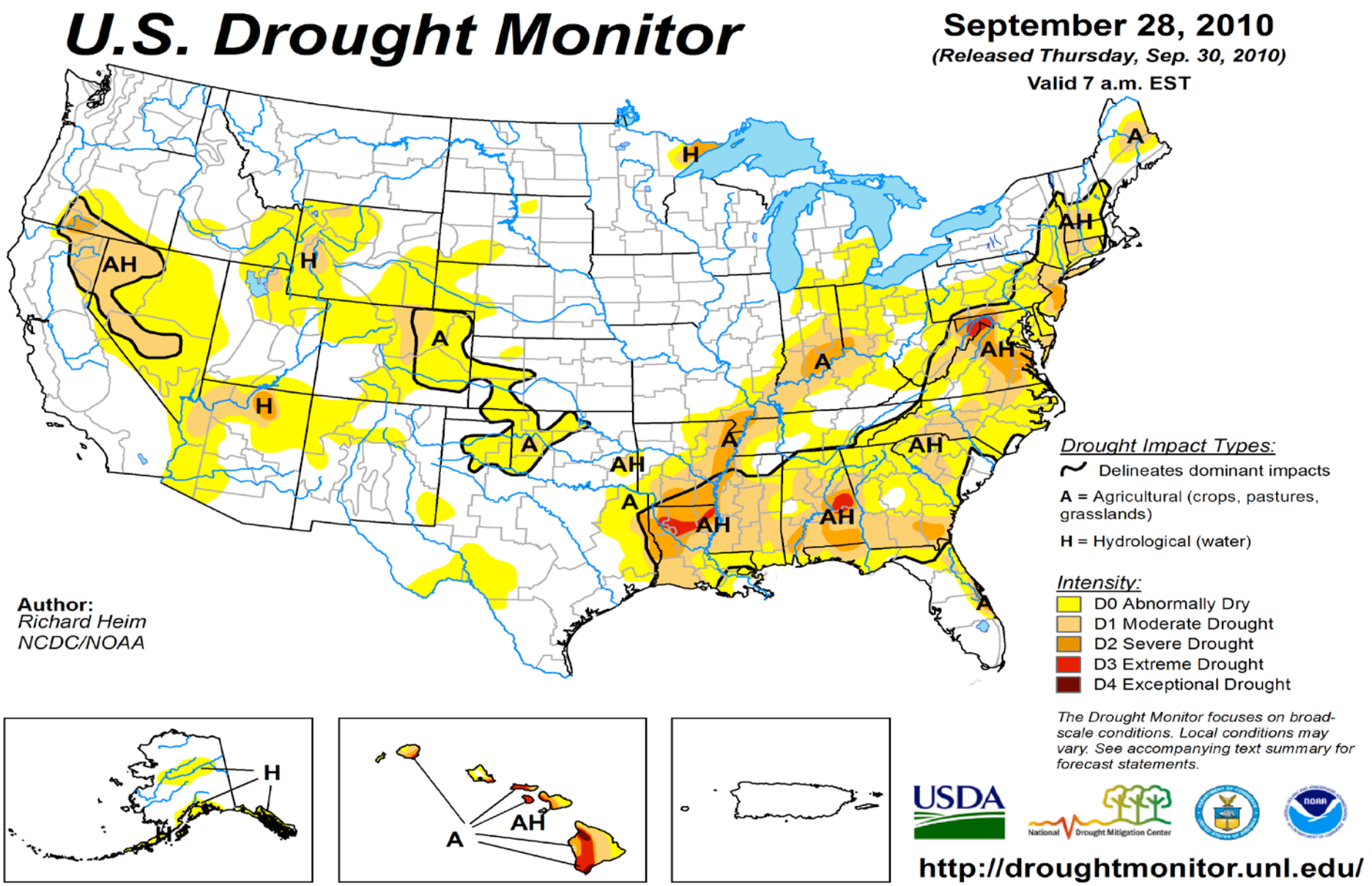
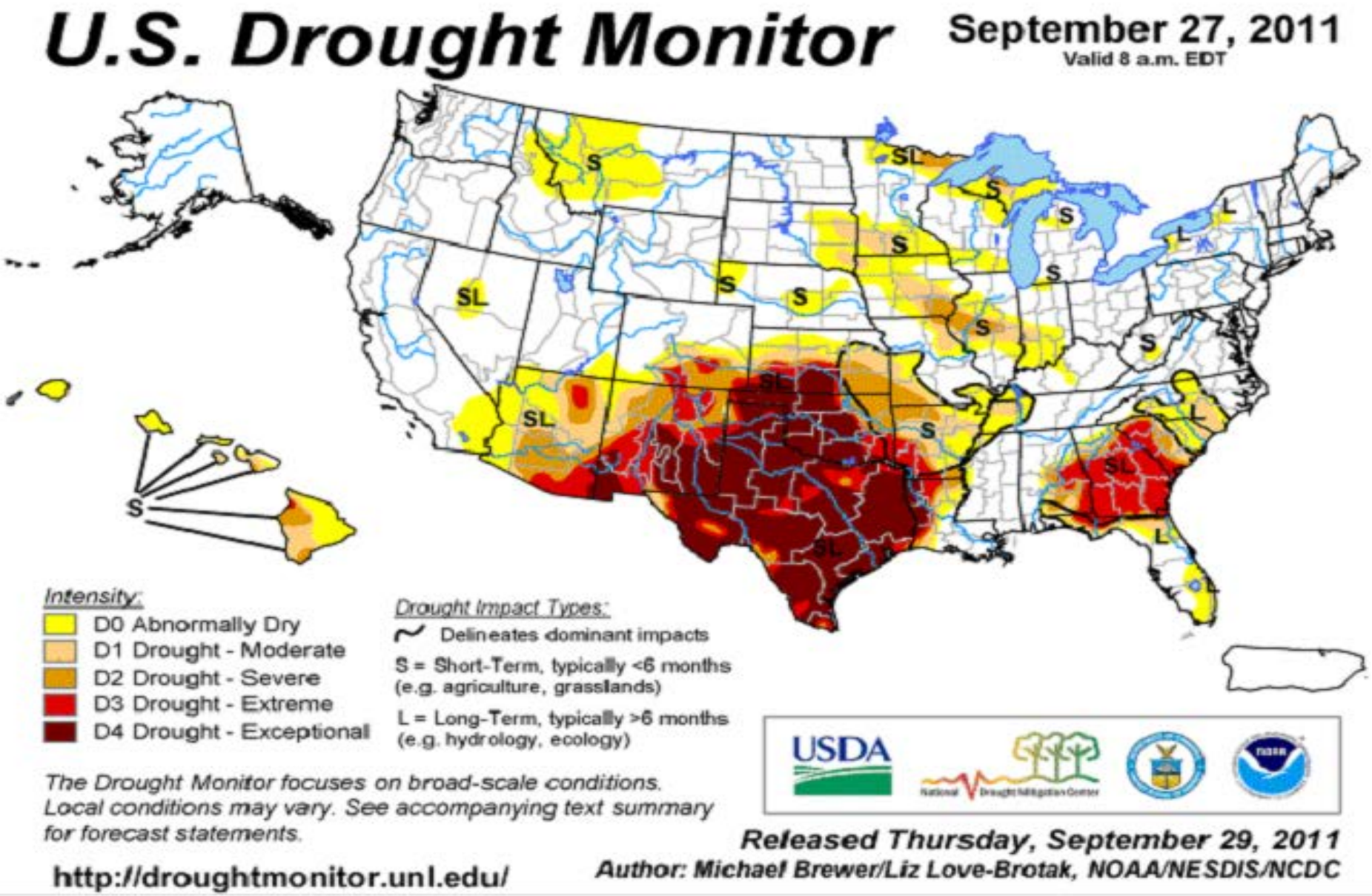
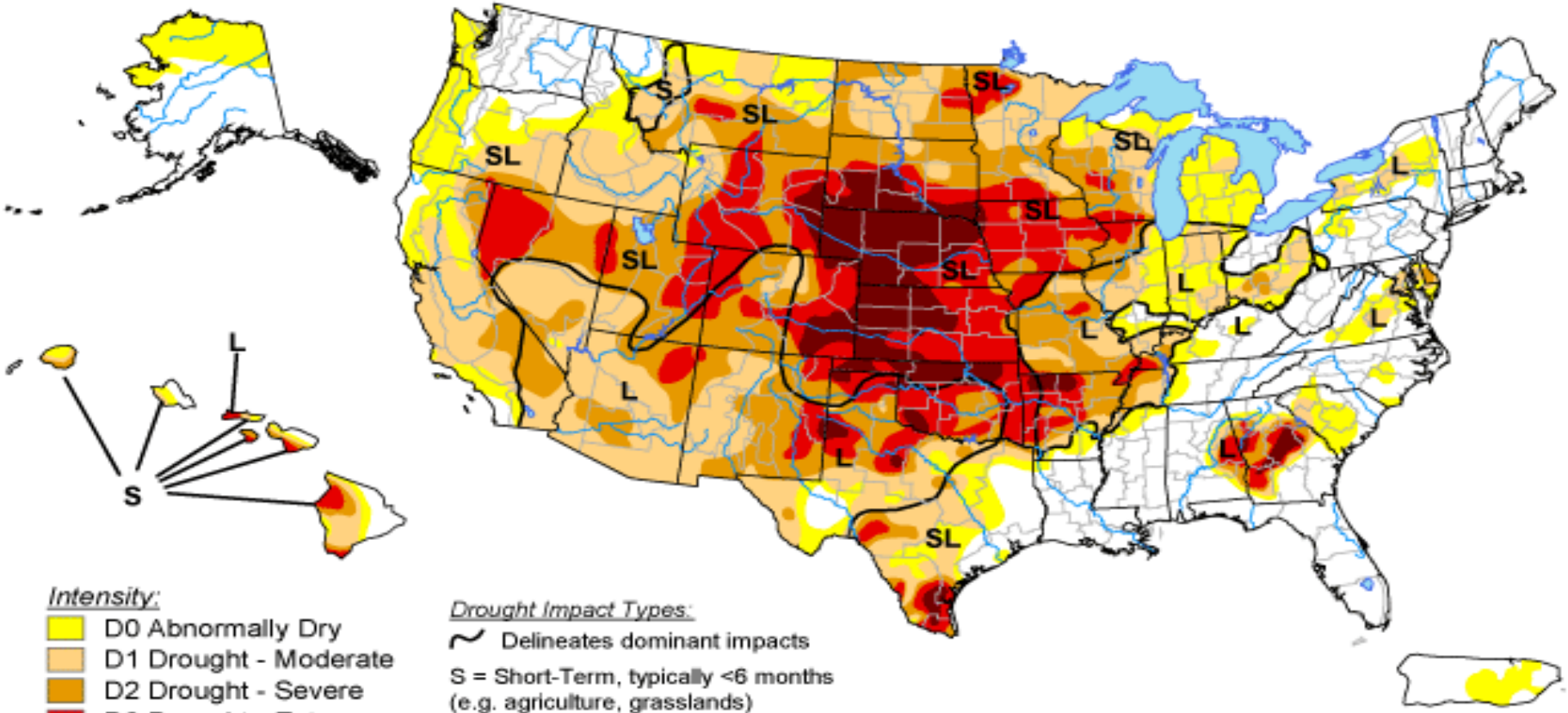



U.S. Drought Monitor
September 27, 2011
Valid 8 a.m. EDT
Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional
Drought Impact Types:
Delineates dominant impacts
S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
L = Long-Term, typically >6 months (e.g. hydrology, ecology)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
http://droughtmonitor.unl.edu/
USDA
Released Thursday, September 29, 2011
Author: Michael Brewer/Liz Love-Brotak, NOAA/NESDIS/NCDC

U.S. Drought Monitor

October 9, 2012
Valid 7 a.m. EDT



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http://droughtmonitor.unl.edu/

Released Thursday, October 11, 2012
Author: Matthew Rosencrans, NOAA/NWS/NCEP/CPC

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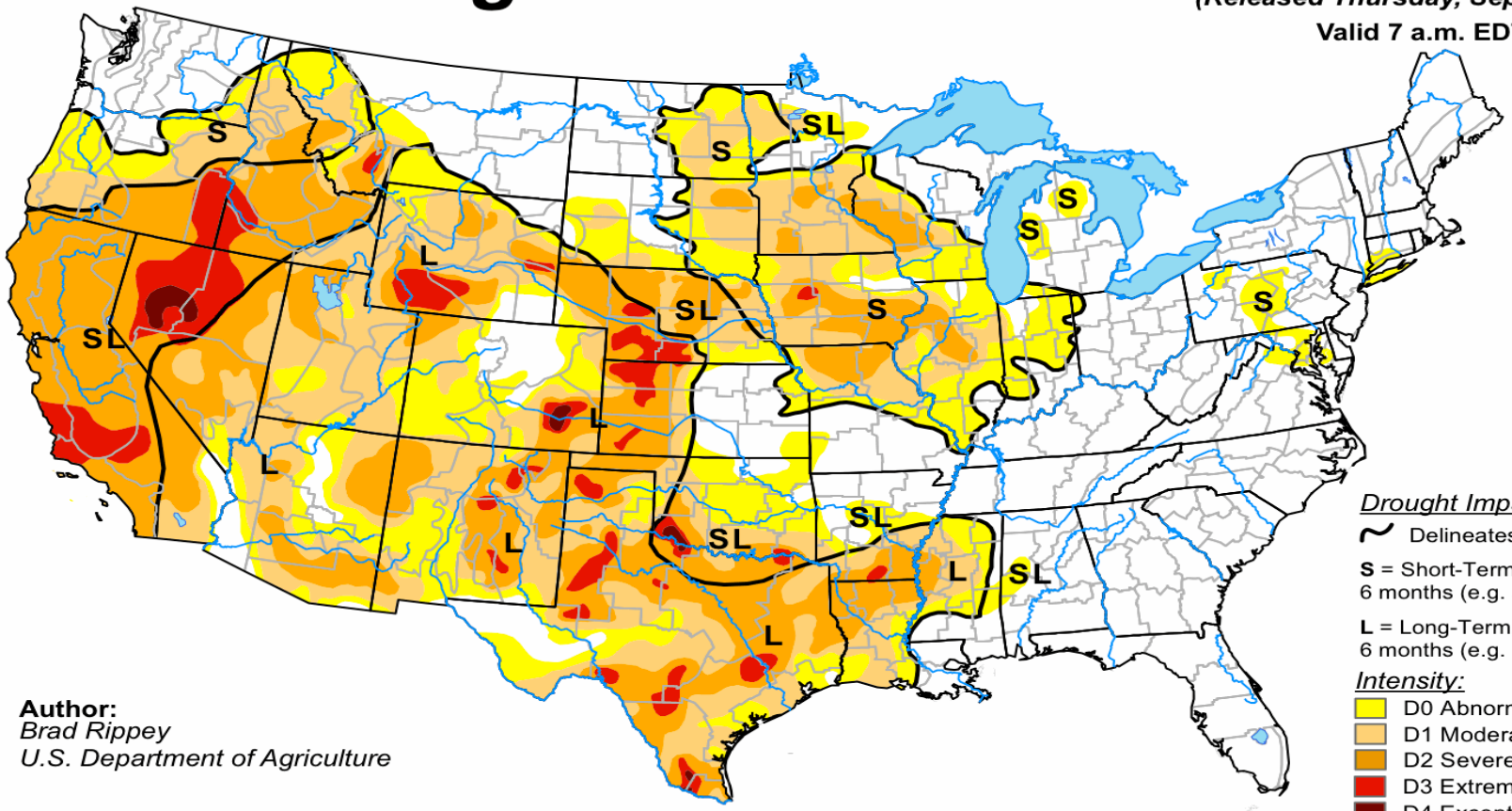
U.S. Drought Monitor

September 24, 2013

(Released Thursday, Sep. 26, 2013)

Valid 7 a.m. EDT



Author:
Brad Rippey
U.S. Department of Agriculture

Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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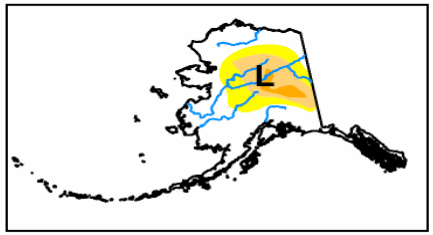
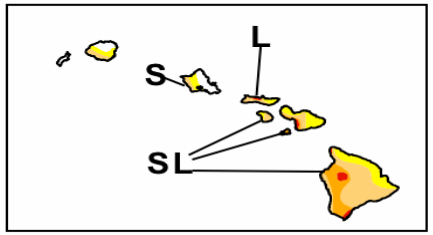
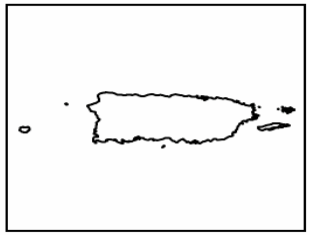






USDA National Drought Mitigation Center

http://droughtmonitor.unl.edu/

Water Budget Study Components

- **Define Study Area**

  - reservoir, watershed, river reach

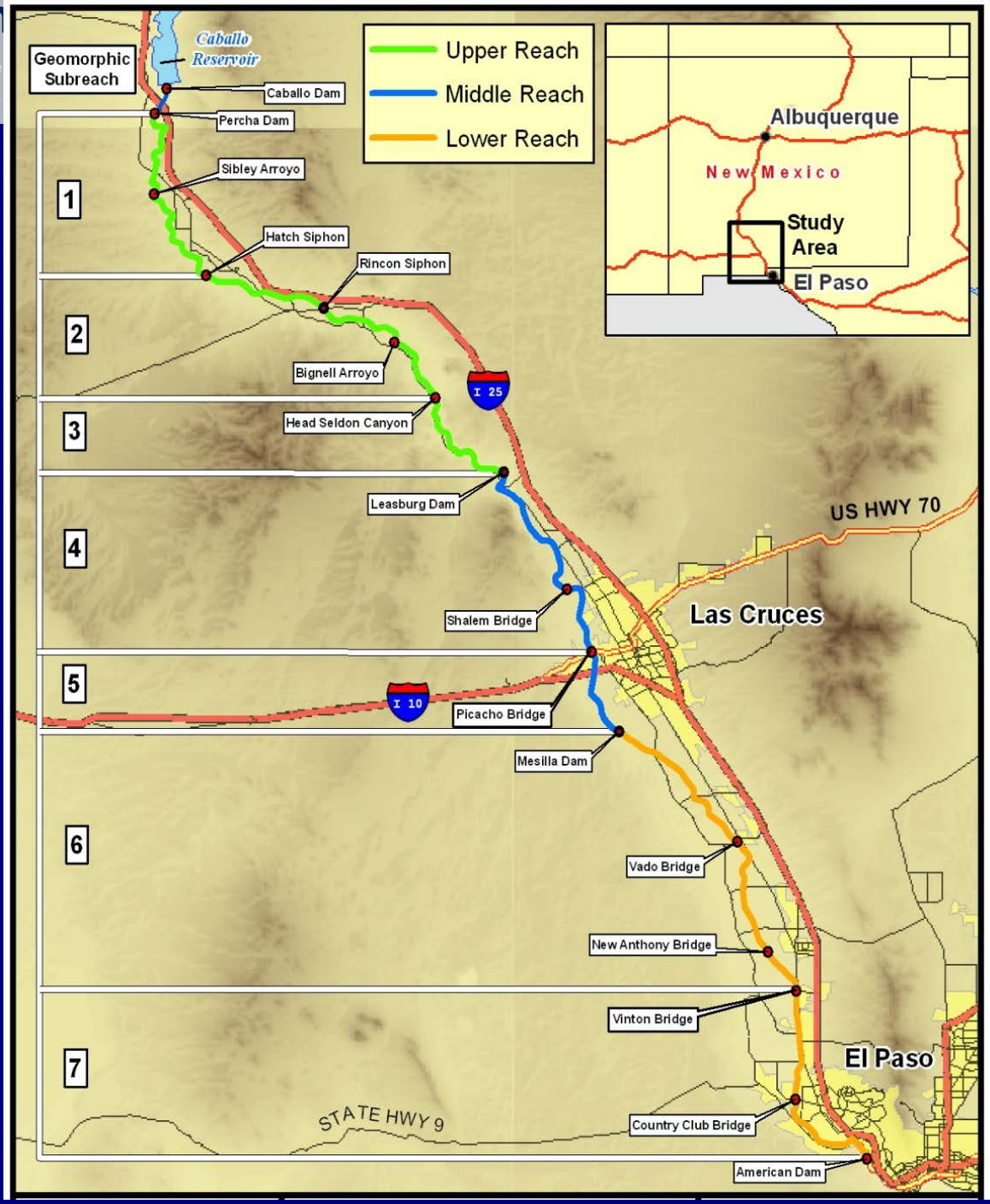
- **Select Time Step**

  - annual, monthly, weekly, daily

- **Calculations Over Each Time Step**

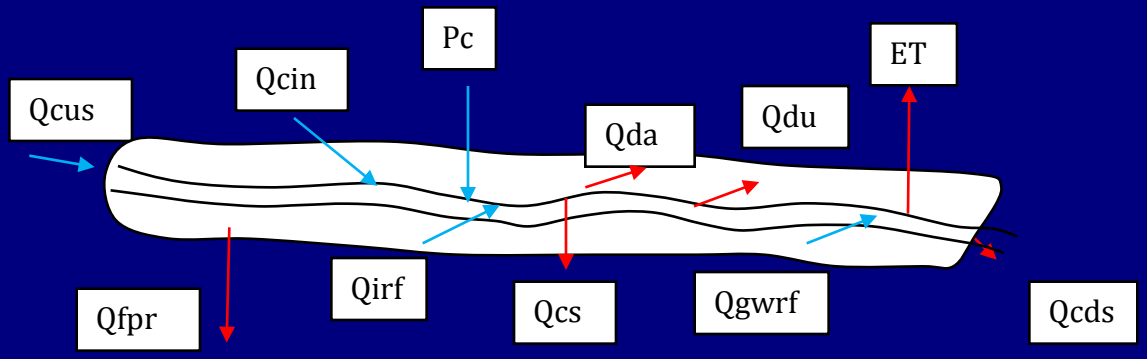
  INFLOW – OUTFLOW = CHANGE IN STORAGE

Study Area


Geomorphic Subreach
Caballo Reservoir
Upper Reach
Middle Reach
Lower Reach
Albuquerque
New Mexico
Study Area
El Paso
Caballo Dam
Percha Dam
Sibley Arroyo
Hatch Siphon
Rincon Siphon
Bignell Arroyo
Head Seldon Canyon
Leasburg Dam
Shalem Bridge
Picacho Bridge
Mesilla Dam
Vado Bridge
New Anthony Bridge
Vinton Bridge
Country Club Bridge
American Dam
I 25
I 10
US HWY 70
STATE HWY 9
Las Cruces
El Paso
1
2
3
4
5
6
7

RGCP Scale Water Budget

Jan 1, 2010 to November 30, 2012; Time Step = Daily



Upper Reach (Caballo to Leasburg metering stations)
Middle Reach (Leasburg to Mesilla metering stations)
Lower Reach Mesilla to Anthony metering station
Lower Reach Anthony to American Dam

Summary of Available Information

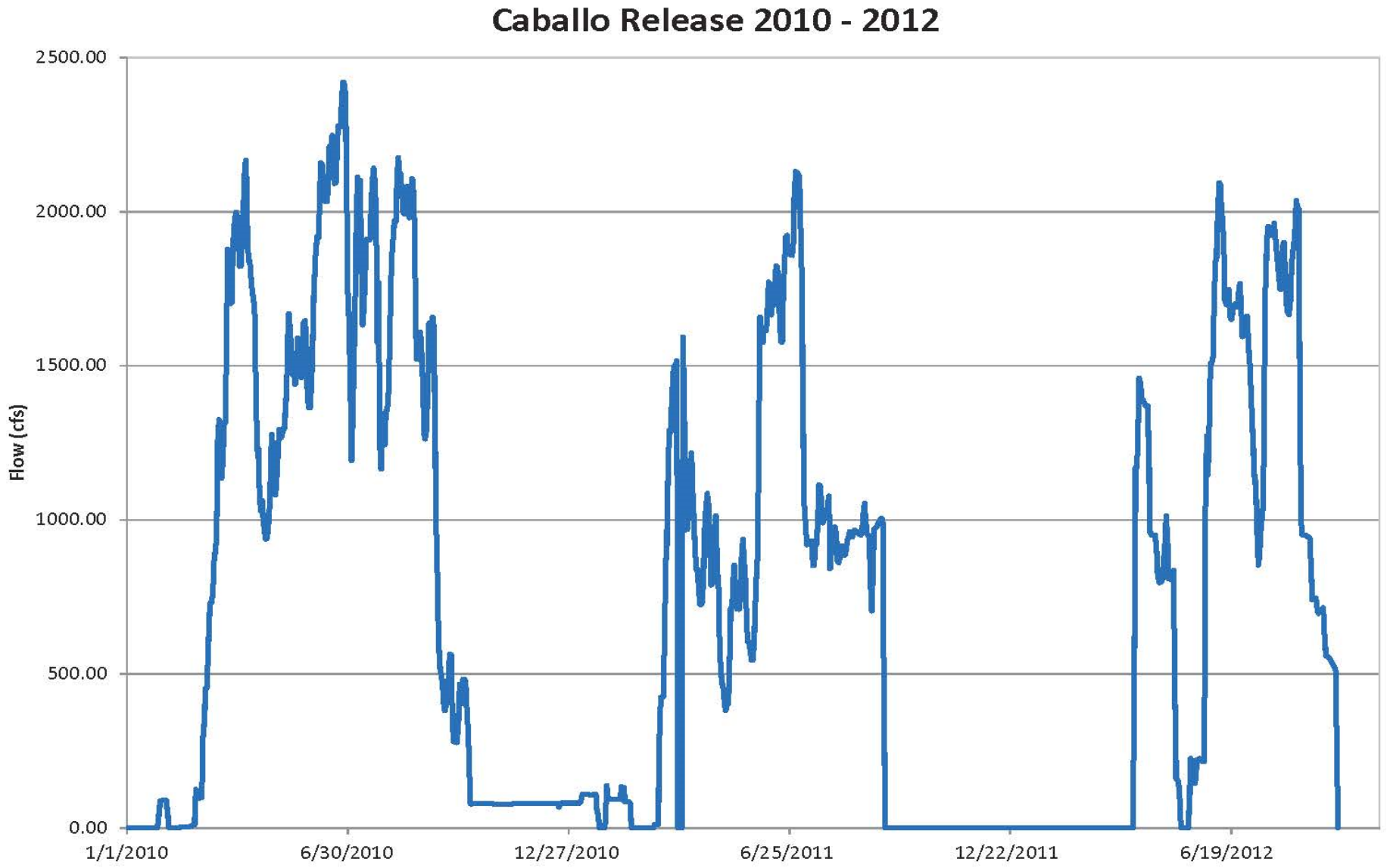
- **Measured Data**

  Topographic Data – Based on 2010 LiDAR
  Surface Water Data
    Reservoir Outflow Data
    Diversion Data
    Irrigation Return Flow
    Pumping Data
  Precipitation and Runoff Data
  USGS Groundwater Data
  GIS Data

Summary of Available Information

- **Relevant Studies and Literature Review**
  - Channel Seepage Studies
  - Evaporation/ET Studies (Classify Land Use, Crops)
  - Evaporation (Caballo and Elephant Butte)
  - Soil Evaporation

- **Models**
  - HEC-RAS Model (USACE)
  - FLO-2D Models (2005, 2007, 2009)
  - USGS MODFLOW Groundwater Model (2007)


Caballo Release 2010 - 2012
Flow (cfs)
2500.00
2000.00
1500.00
1000.00
500.00
0.00
1/1/2010
6/30/2010
12/27/2010
6/25/2011
12/22/2011
6/19/2012

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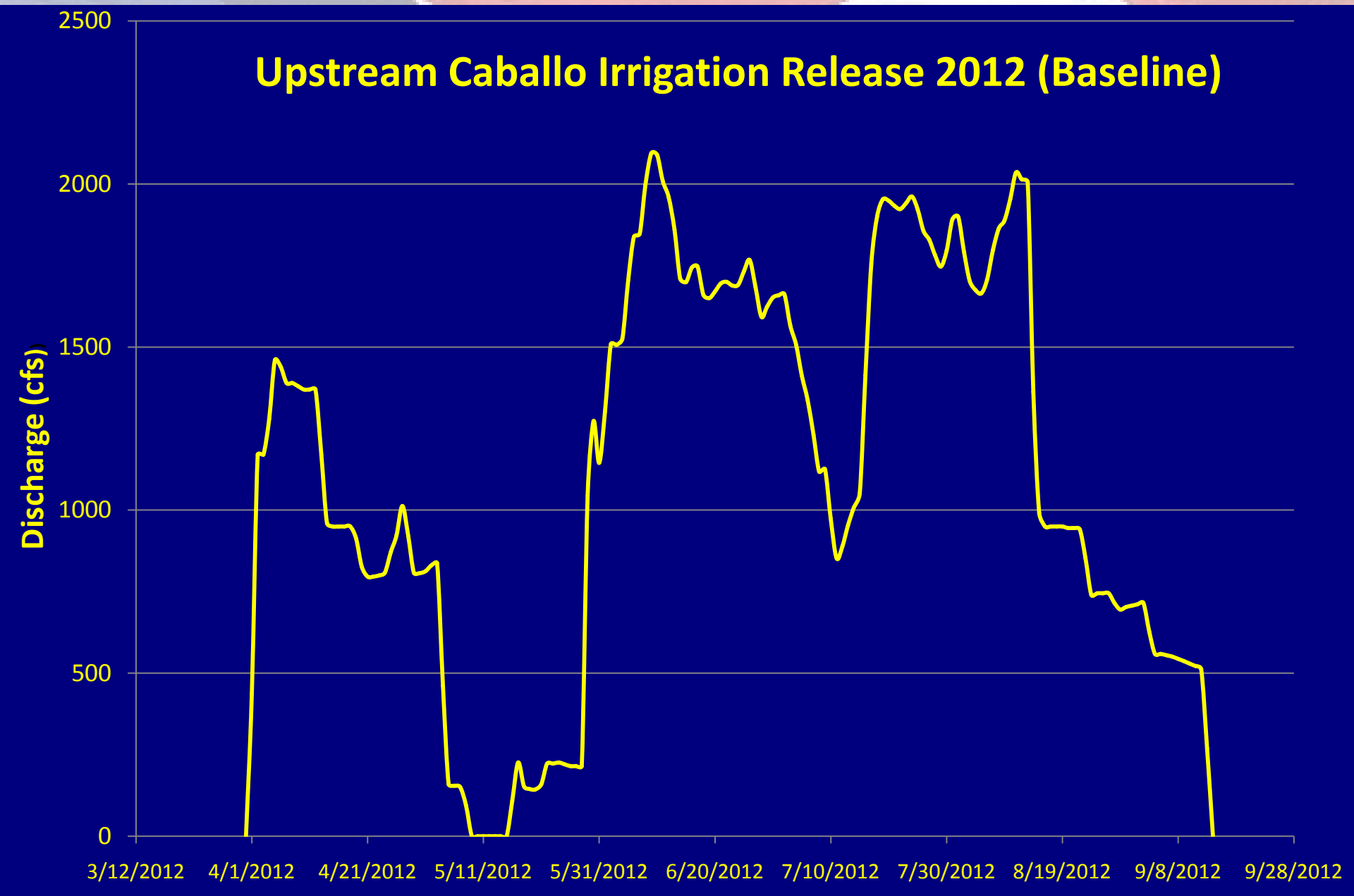

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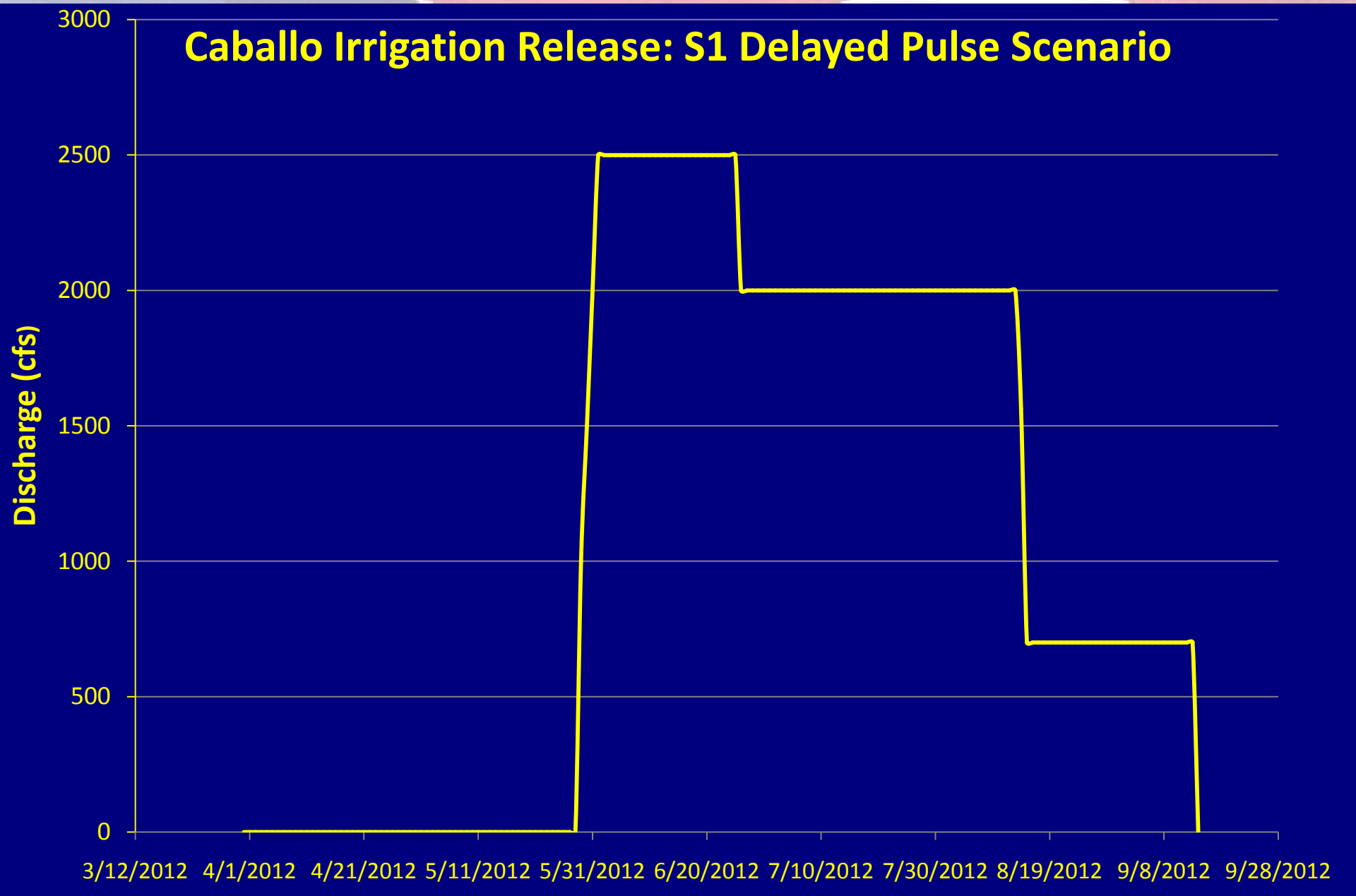

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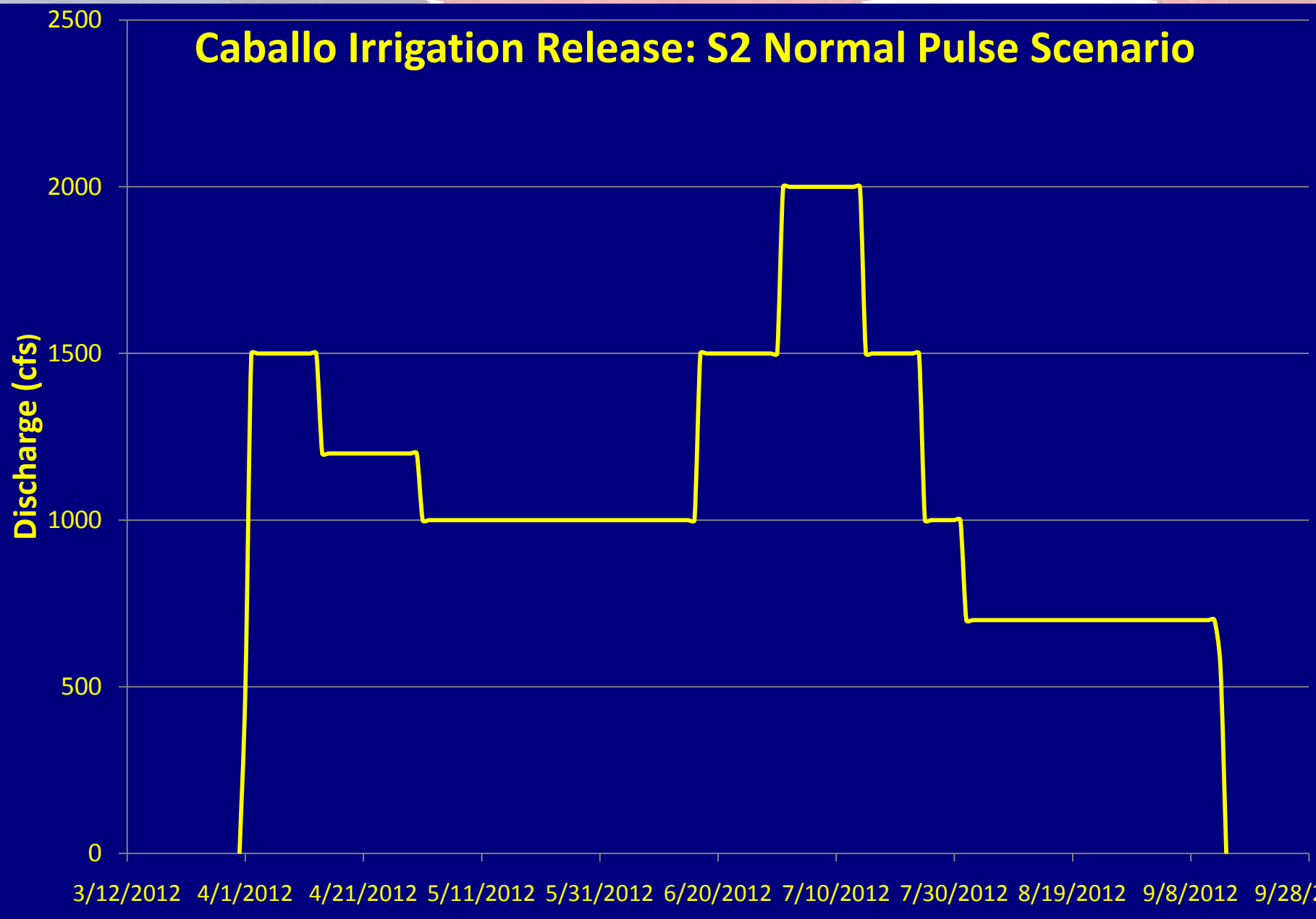

Project Analysis

- **Kickoff Meeting on July 17, 2012**
- **Data Collection Completed**

- **Modeling (Channel Seepage)**
  - HEC-RAS and FLO-2D Updates with latest LiDAR
  - FLO-2D Pro Software and Updates
  - Model Calibrations; Runs 2010-2012, S1, S2

- **Water Budget Calculations**
- **60%, 75%, 90% Reports Completed**
- **Final Report is Being Completed**

Results from HEC-RAS: Baseline 2012
Significance of Water Budget Components

- Sum of Inflows = 100%
- Upstream Caballo Release = 83%

- Irrigation Diversions Authorized = 37%
- Downstream Channel Outflow = 36%
- Channel Seepage = 18%
- Treated Effluent Return Flow = 6%
- Evapotranspiration = 5%
- Stormwater Return Flow = 5%
- Irrigation Return Flow = 3%

Results from FLO-2D: Baseline 2012
Significance of Water Budget Components

- Sum of Inflows = 100%
- Upstream Caballo Release = 85%

- Irrigation Diversions Authorized = 38%
- Downstream Channel Outflow = 26%
- Channel Seepage = 25%
- Treated Effluent Return Flow = 6%
- Evapotranspiration = 6%
- Irrigation Return Flow = 3%
- Stormwater Return Flow = 2%

Implications of Delayed Release
Results from HEC-RAS Modeling

Irrigation Release Scenario	Total Seepage (acre-feet)	Caballo Release (acre-feet)	Seepage as % of Caballo	Seepage as % of Baseline
Baseline 2012	76,923	372,028	20.7%	100.0%
S1 Delayed Release	66,786	372,028	18.0%	86.8%
S2 Normal Release	74,087	372,028	19.9%	96.3%

Decrease in S1 Seepage = 76,923 - 66,786 = 10,137 acre-feet
Percent Decrease in Seepage = (10,137/372,028)*100 = 2.72%

Implications of Delayed Release
Results from FLO-2D Modeling

Irrigation Release Scenario	Total Seepage (acre-feet)	Caballo Release (acre-feet)	Seepage as % of Caballo	Seepage as % of Baseline
Baseline 2012	104,546	372,028	28.1%	100.0%
S1 Delayed Release	84,066	372,028	22.6%	80.4%
S2 Normal Release	104,684	372,028	28.1%	100.1%

Decrease in S1 Seepage = 104,546 - 84,066 = 20,480 acre-feet
Percent Decrease in Seepage = (20,480/372,028)*100 = 5.50%

Summary

- Irrigation releases were mostly accounted for by irrigation diversions, downstream outflow and seepage.
- Channel seepage varied between 18% and 25% of total inflows.
- A delayed irrigation release decreased channel seepage by 2.7% to 5.5% of Caballo 2012 release. However, the resulting increase in pumping may increase initial seepage and decrease these percentages.
- Study provides a good foundation for future water budget studies and water management along the RGCP.

Recommendations

- Delayed releases and/or shortened releases may be the only option in ongoing drought years with depleted upstream reservoir storages. Such releases may provide some decrease in channel seepage.

- Improvements in data collection: at unreliable river gages, diversions and significant return flows; pumping data; detailed groundwater levels along the RGCP.

- An integrated surface water and groundwater evaluation is required. The USGS 2007 groundwater model needs to be updated for subsequent years.

Recommendations (contd)

- Need improved understanding of processes controlling river-groundwater exchanges. Identify and document processes, and gaining and losing reaches under normal and drought flow conditions. Calibrate models to represent these hydrologic processes.

- Extend the water budget study downstream to Fort Quitman to include El Paso water use.

- Explore alternate software for better quantification of channel seepage and groundwater return flows. Include these estimates in the water budget calculations.

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