Using Stable Isotopes to Identify Changes in Nitrogen Sources, Processes, and Uptake Over Time in the San Joaquin River and Eastern Delta

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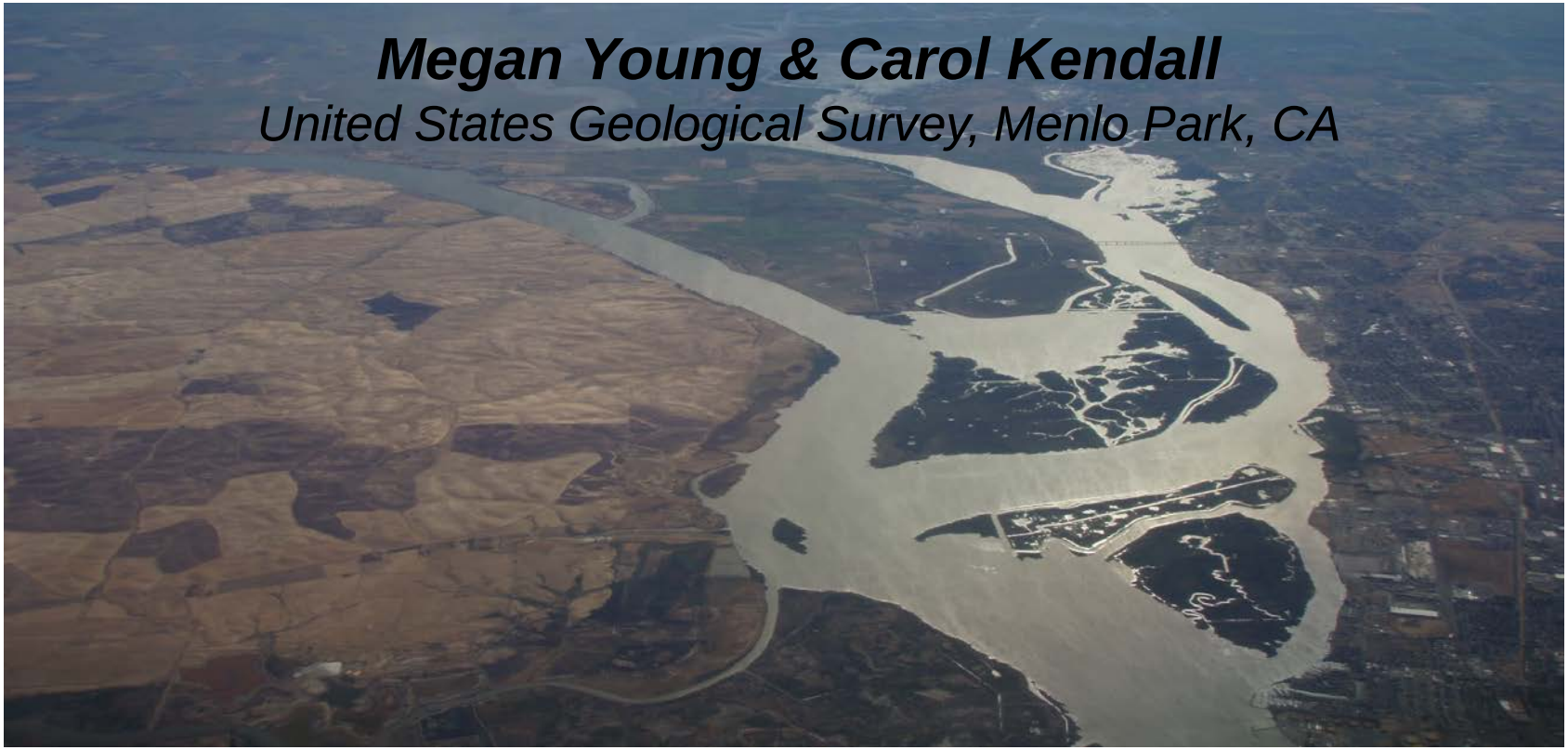

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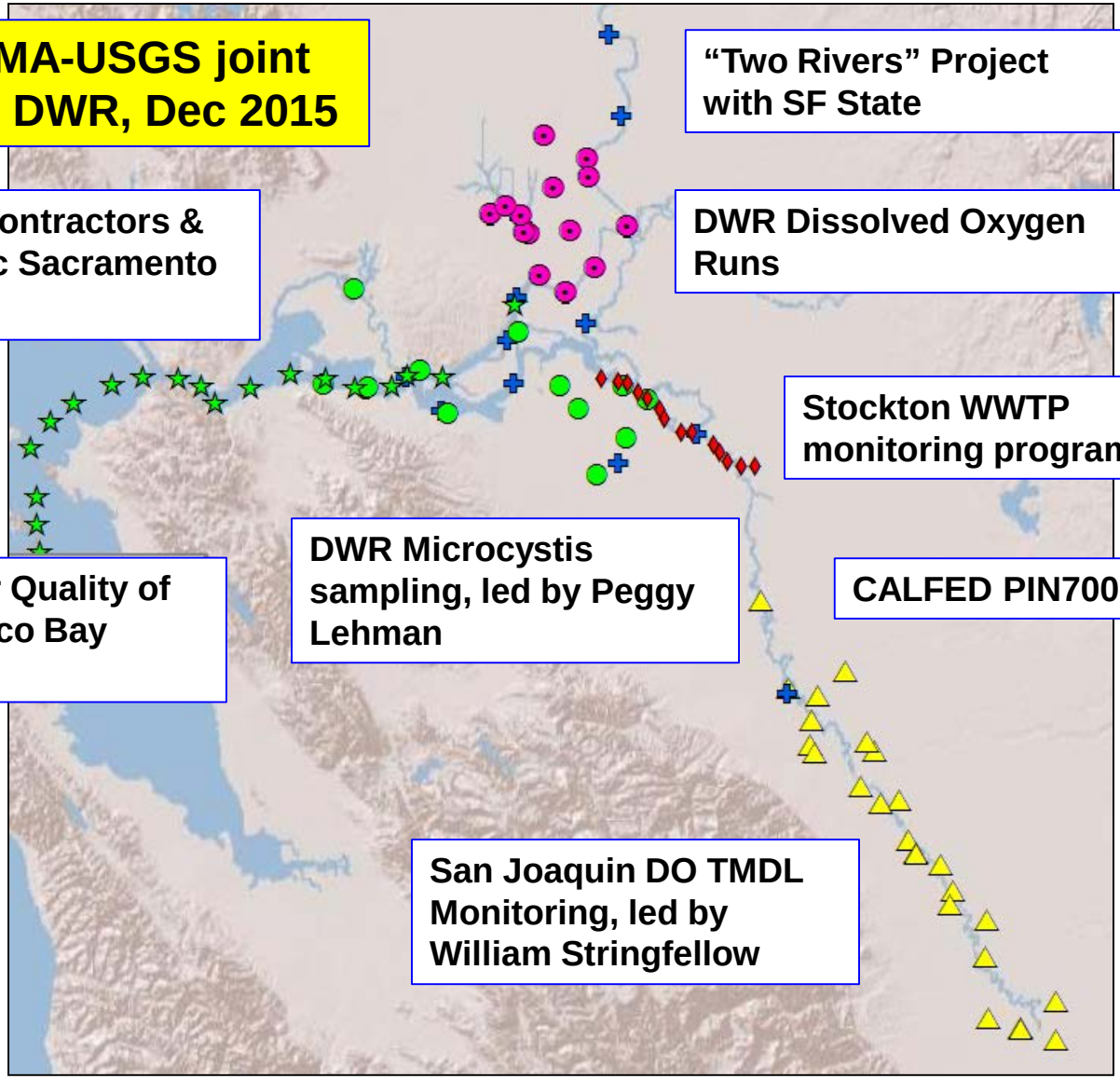
Confluence of San Joaquin & Sacramento River, photo by Dan Doctor

Data from multiple projects and funding sources



SFEI-RMA-USGS joint report to DWR, Dec 2015

“Two Rivers” Project with SF State

State Water Contractors & Bureau of Rec Sacramento River studies

DWR Dissolved Oxygen Runs

Stockton WWTP monitoring program

USGS Water Quality of San Francisco Bay (ongoing)

DWR Microcystis sampling, led by Peggy Lehman

CALFED PIN700 Project

San Joaquin DO TMDL Monitoring, led by William Stringfellow

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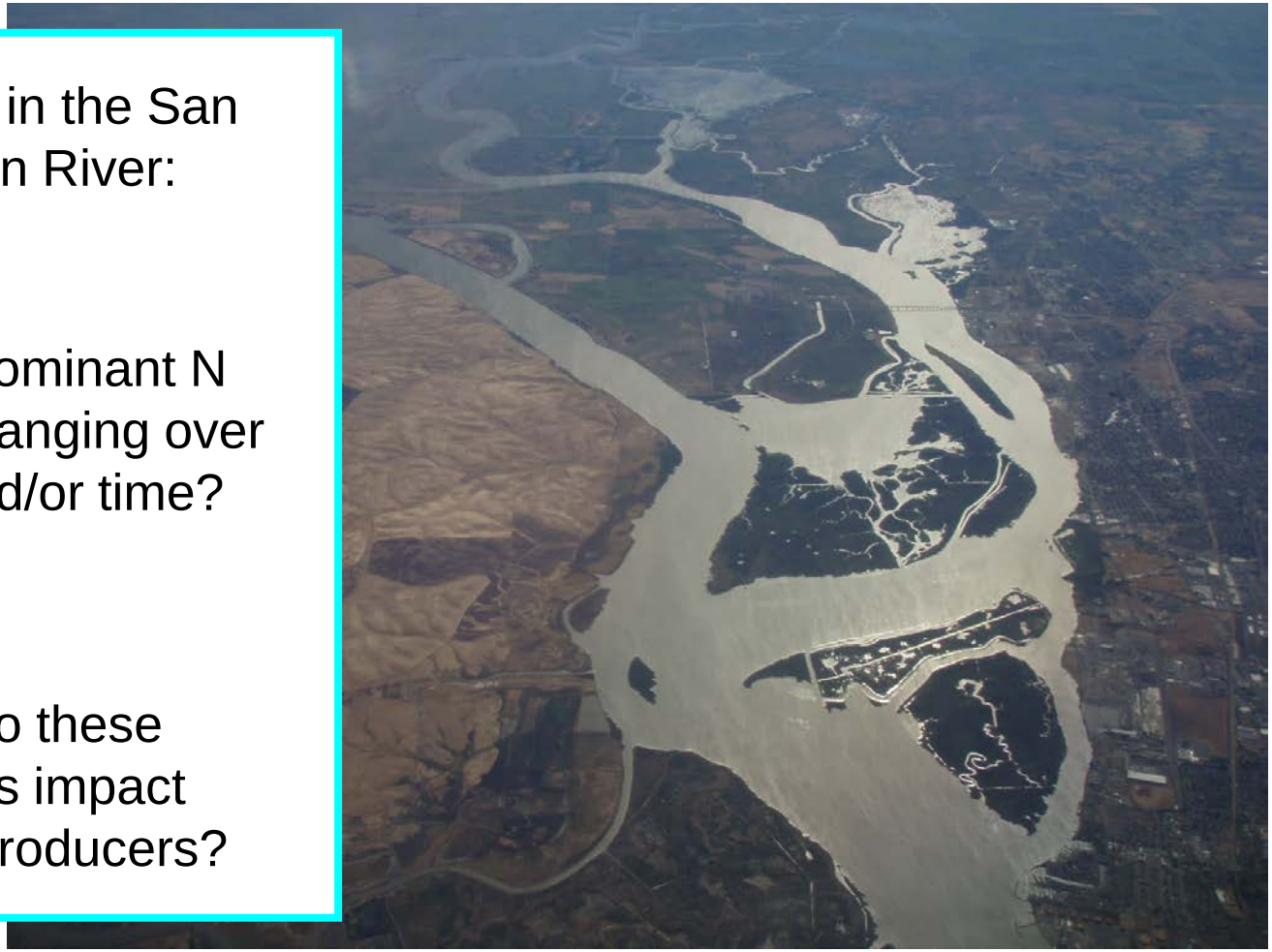
Rivers are important sources of nutrients & organic matter to coastal areas

Nutrients in the San Joaquin River:

Are the dominant N sources changing over space and/or time?

How do these changes impact primary producers?



Confluence of San Joaquin & Sacramento River, photo by Dan Doctor

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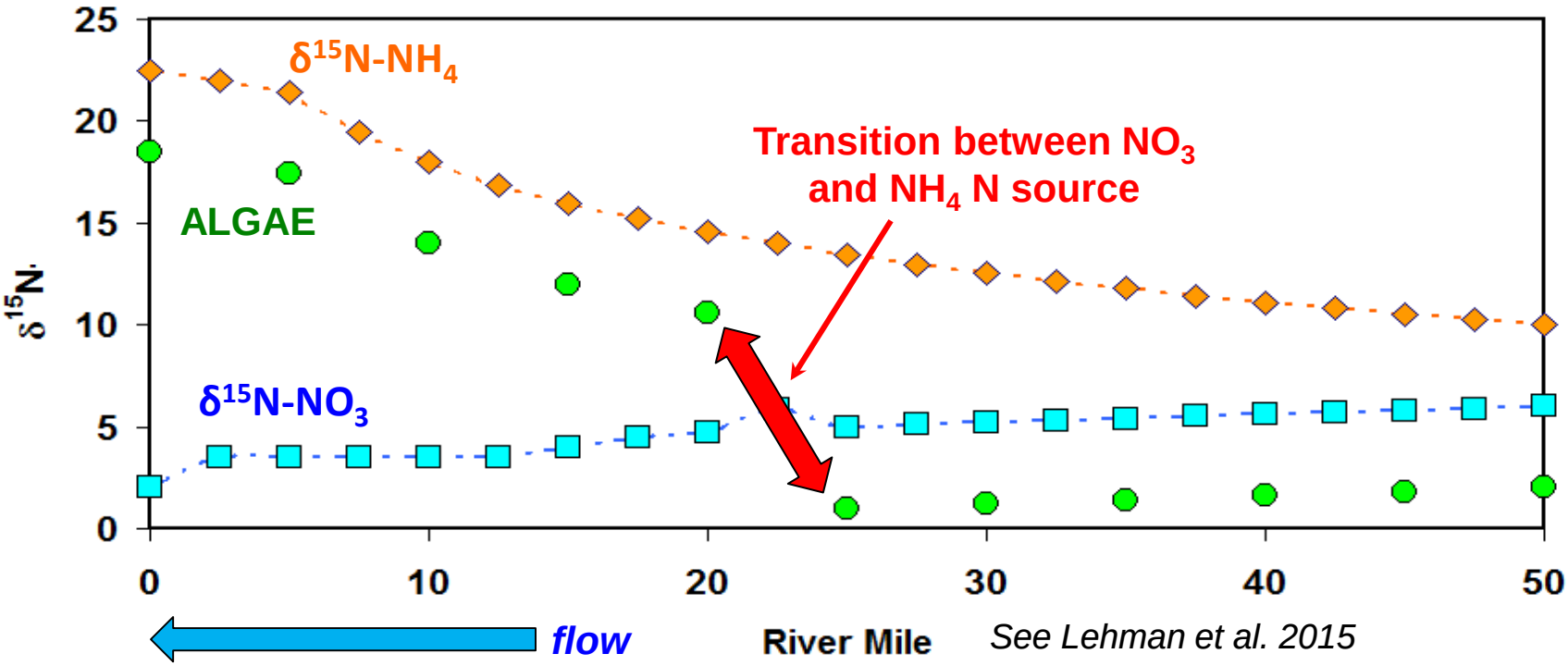
The isotopic composition of primary producers is controlled by their nutrient source

Algae & bacteria will utilize the lighter isotopic fraction first- in the SJR, algae-N tends to be ~4‰ lighter than NO_3-N

Idealized downstream transect data



See Lehman et al. 2015

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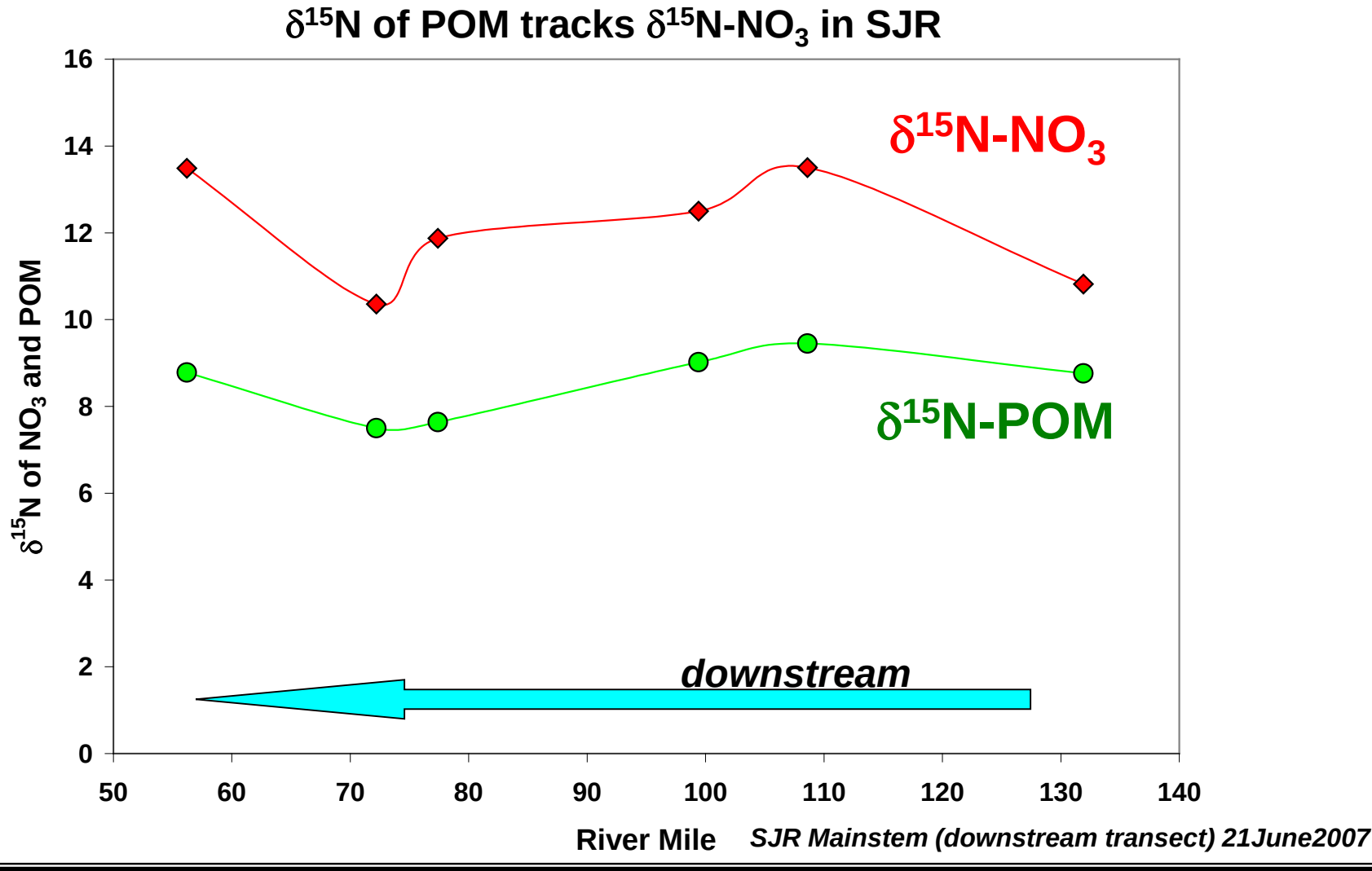
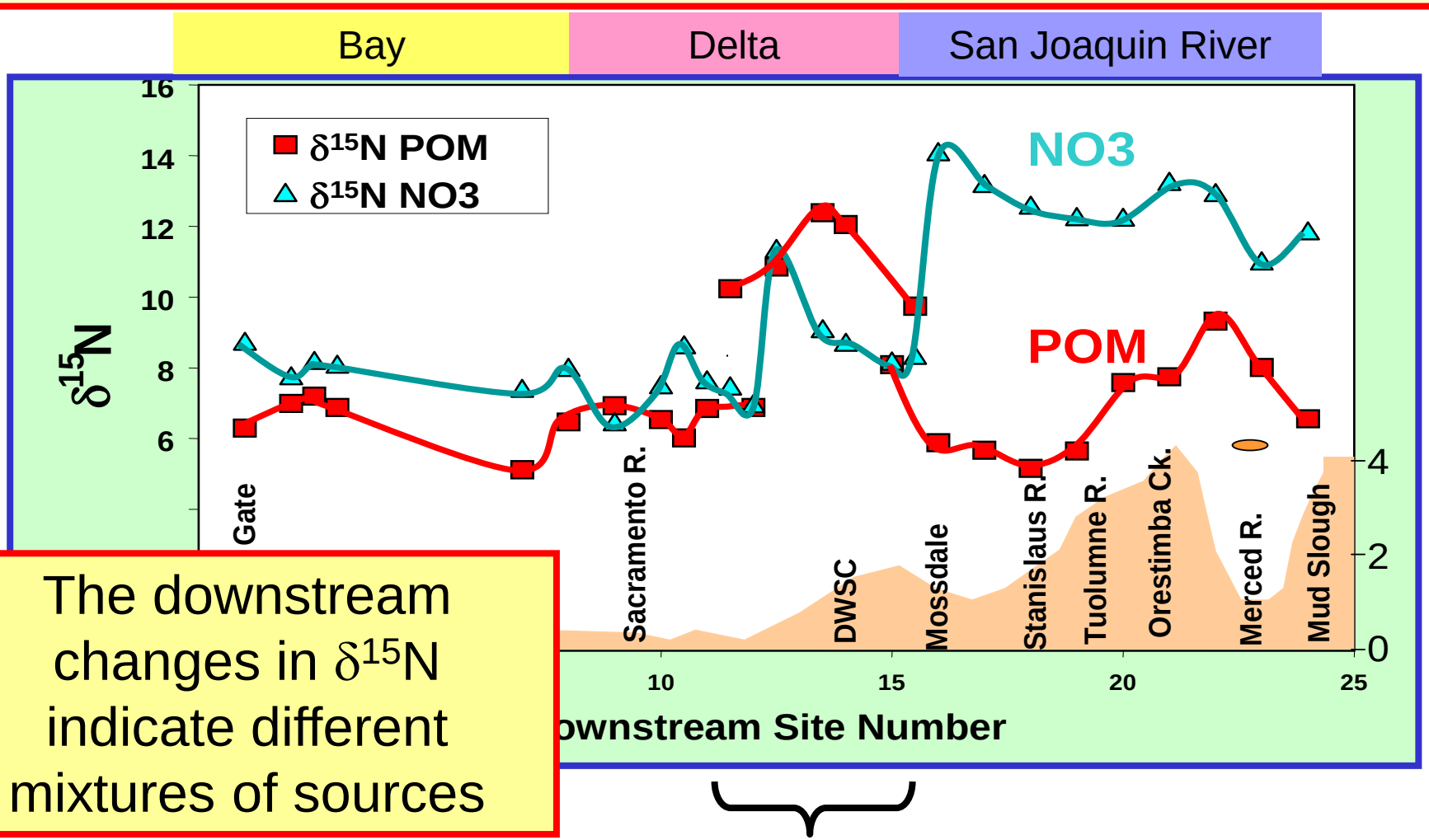
Nitrate is the primary N source for algae in the San Joaquin River



Transect showing changes in the $\delta^{15}N$ of NO_3 and POM caused by downstream changes in nitrate sources (August 2004).

The $\delta^{15}N$ of the river POM (mostly algal) tracks the $\delta^{15}N$ of nitrate.



The downstream changes in $\delta^{15}N$ indicate different mixtures of sources

$\delta^{15}N$ data indicate considerable nitrification of ammonium here.

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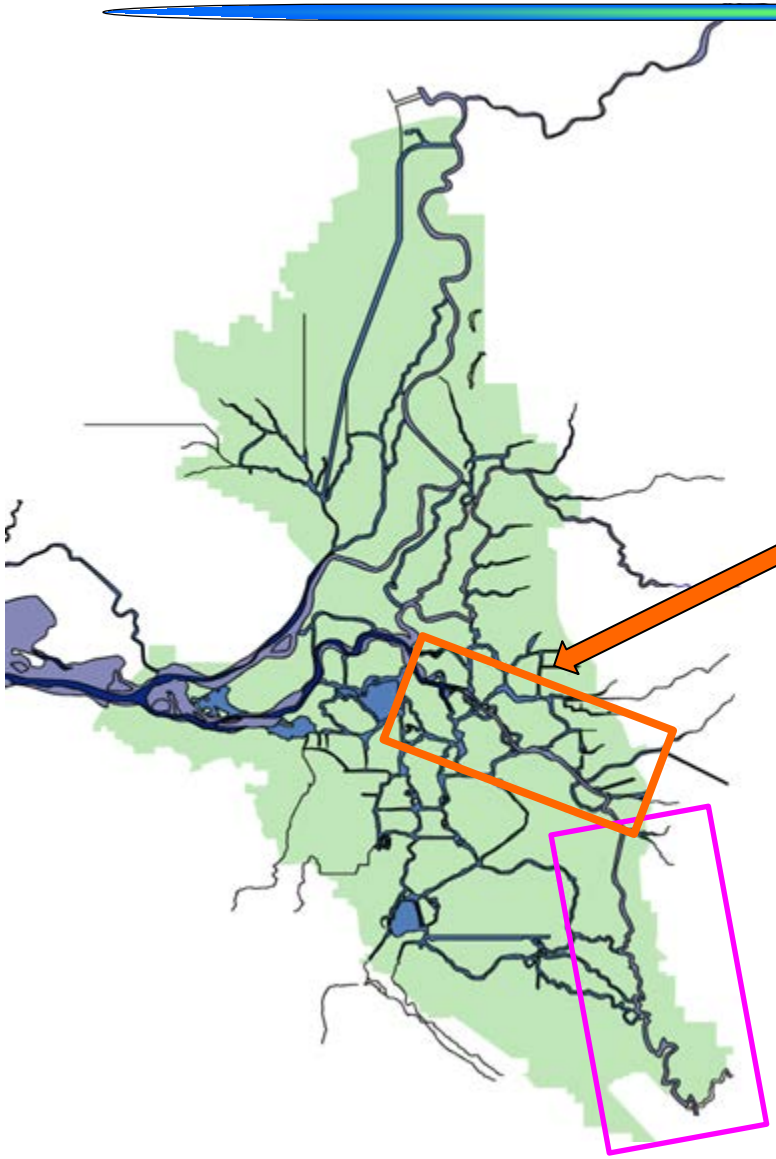
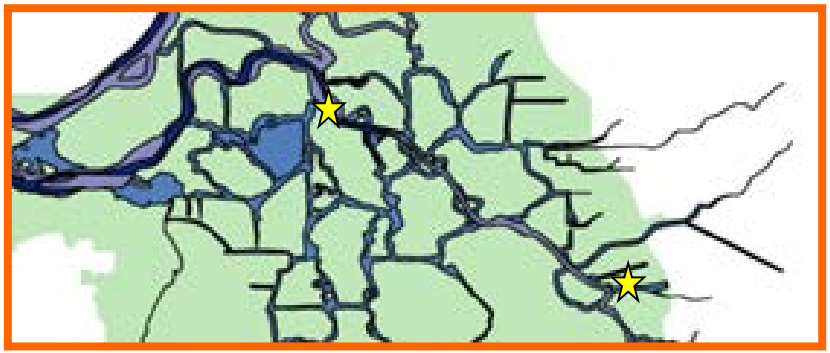
Slide from Carol Kendall

Identifying different Delta NO_3 sources



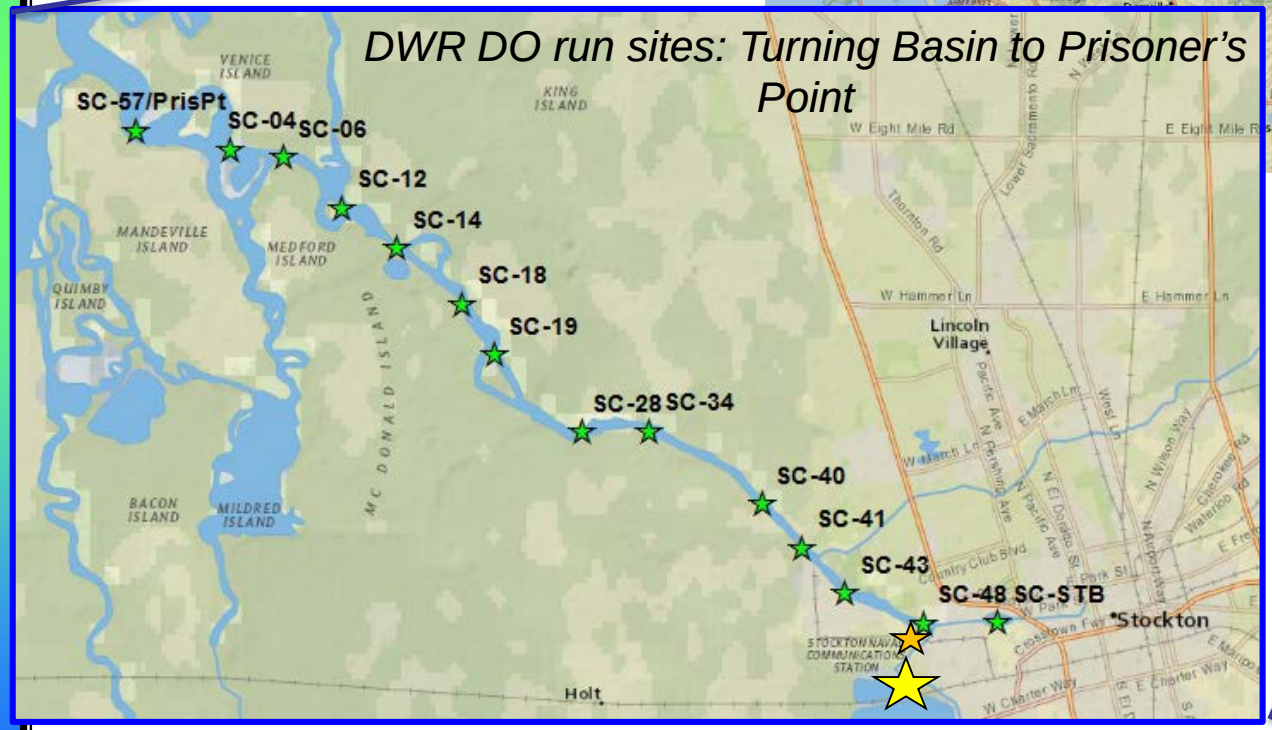
Stockton Deep Water Ship Channel (SJR)



DWR DO run sites: Turning Basin to Prisoner's Point

Upstream SJR (mostly above tidal influence)

Sampling sites in the Stockton Deep Water Ship Channel



Stockton WWTP discharge site & downstream monitoring station

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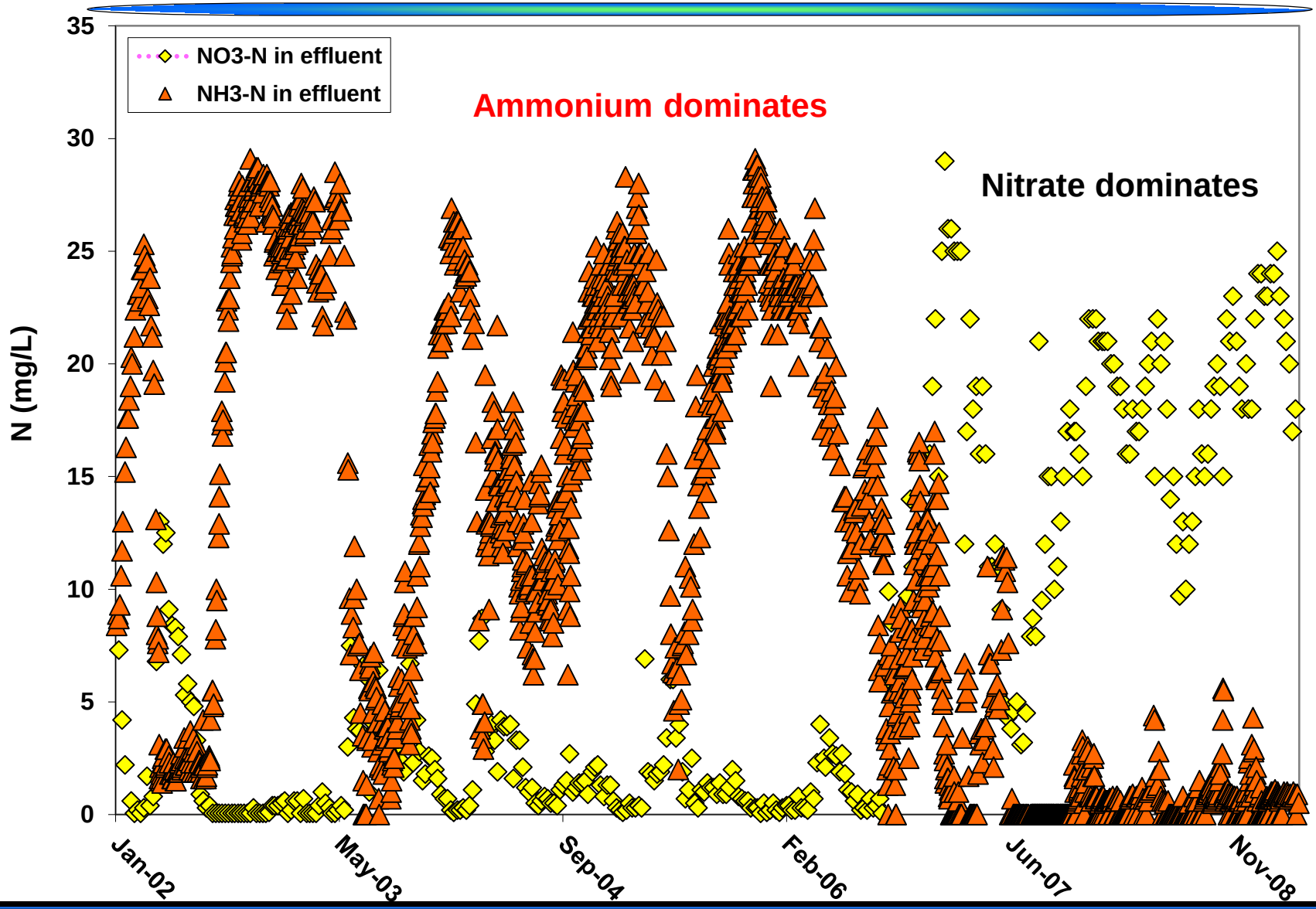
Stockton WWTP upgrades cause change in nitrogen forms



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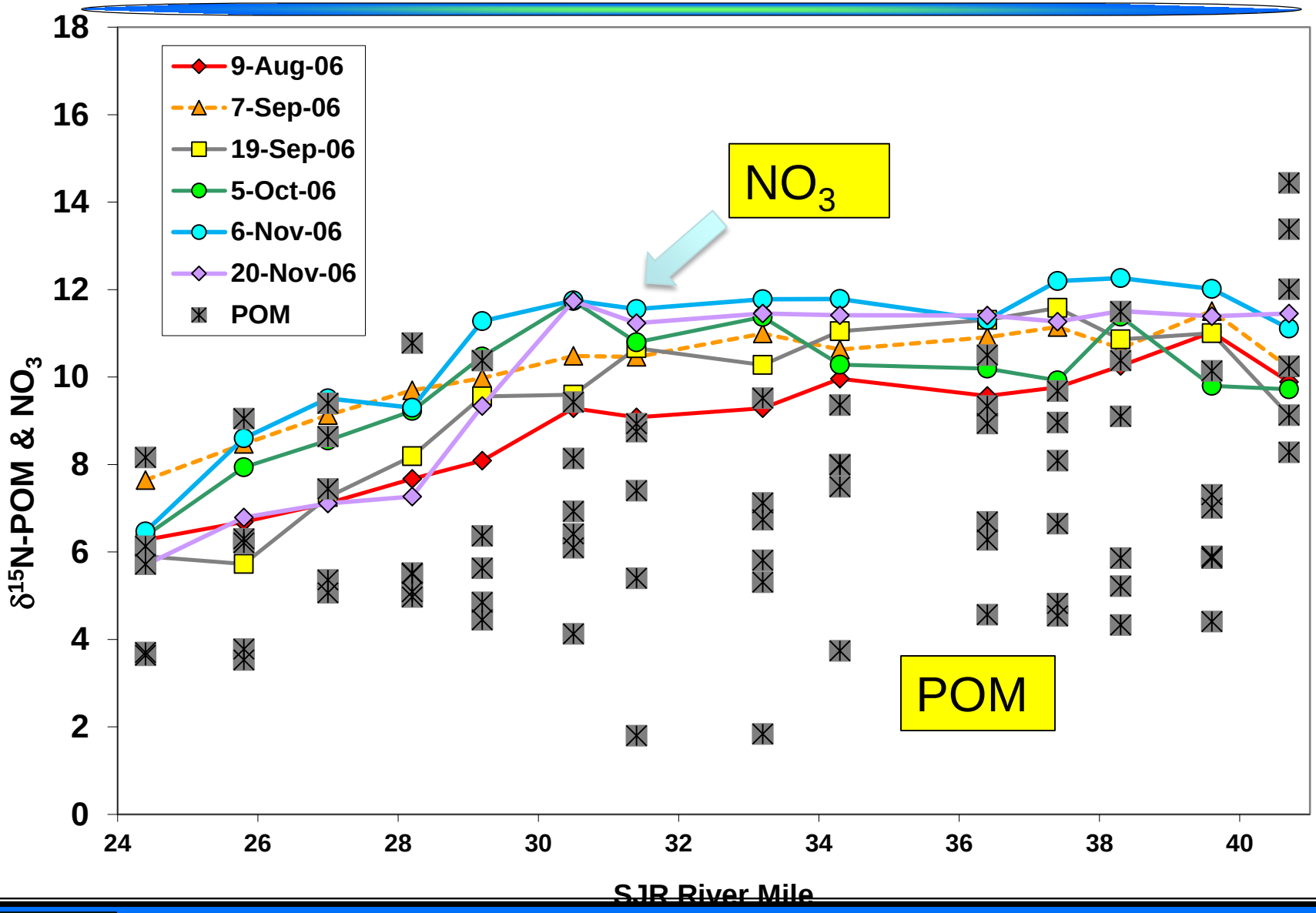
By Fall 2006- Isotopic composition of POM consistent with nitrate source of N



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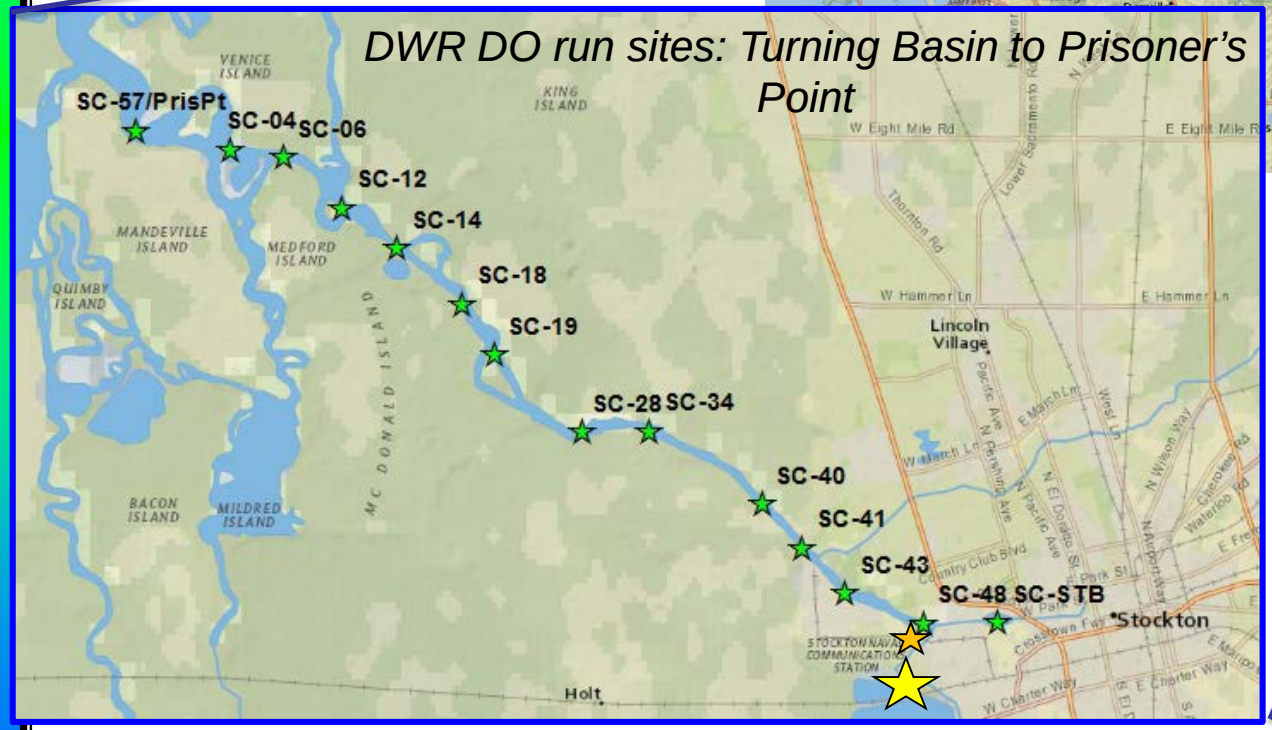
Where is the nitrate coming from?



Stockton WWTP discharge site & downstream monitoring station

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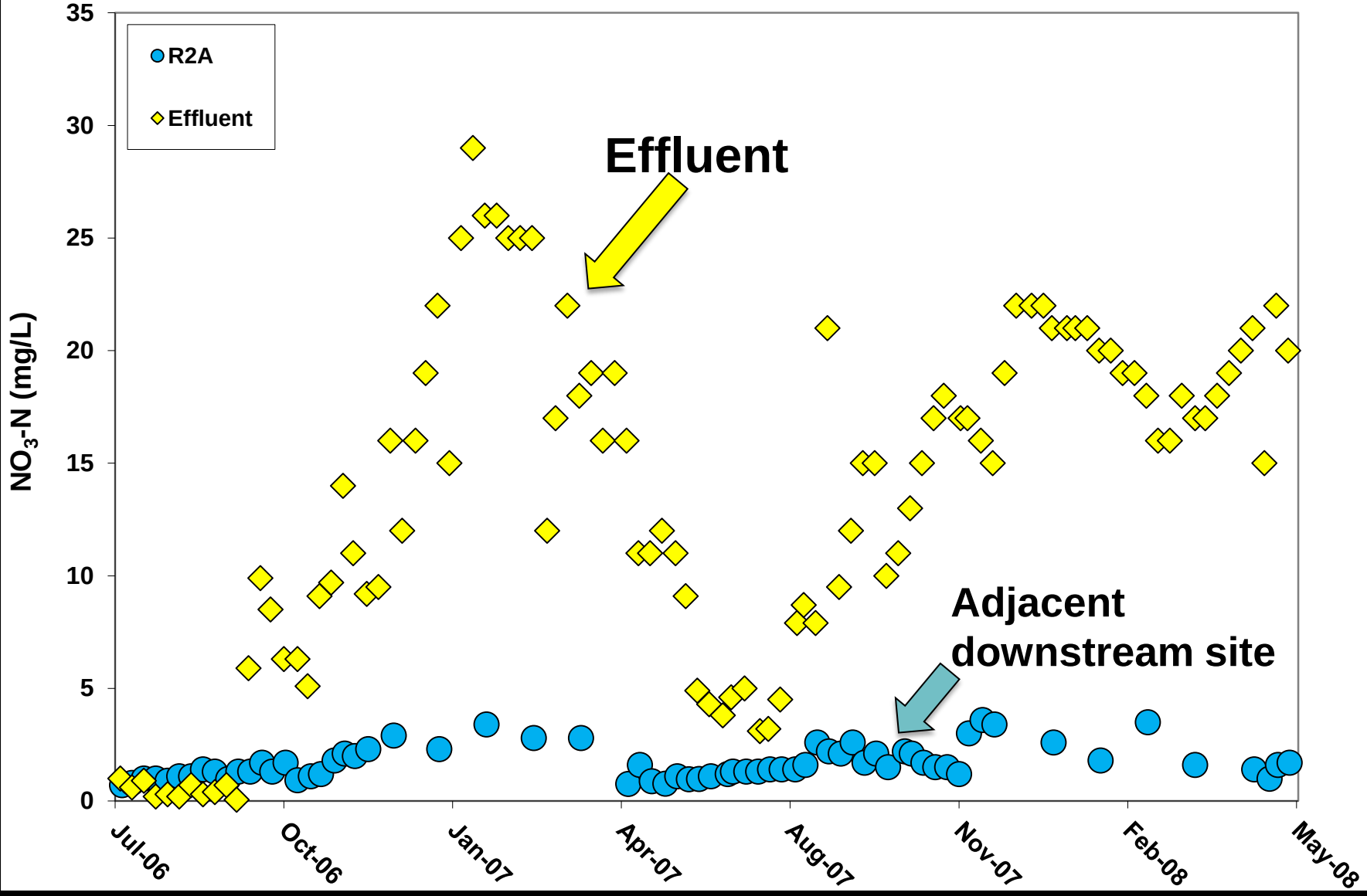
Effluent has high nitrate concentrations, but low load



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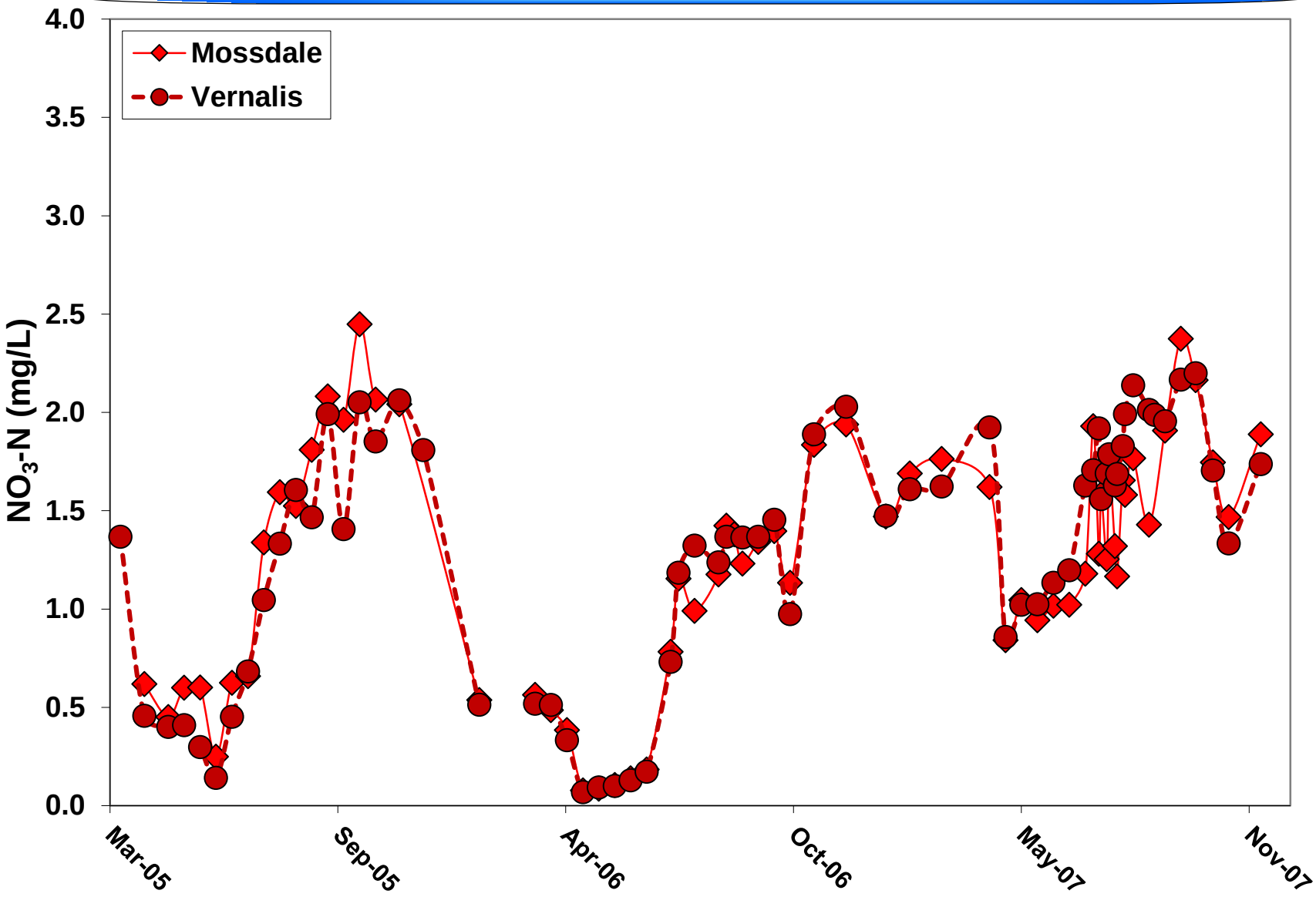
Data provided by Stockton WWTP

Nitrate in the SJR upstream of the WWTP



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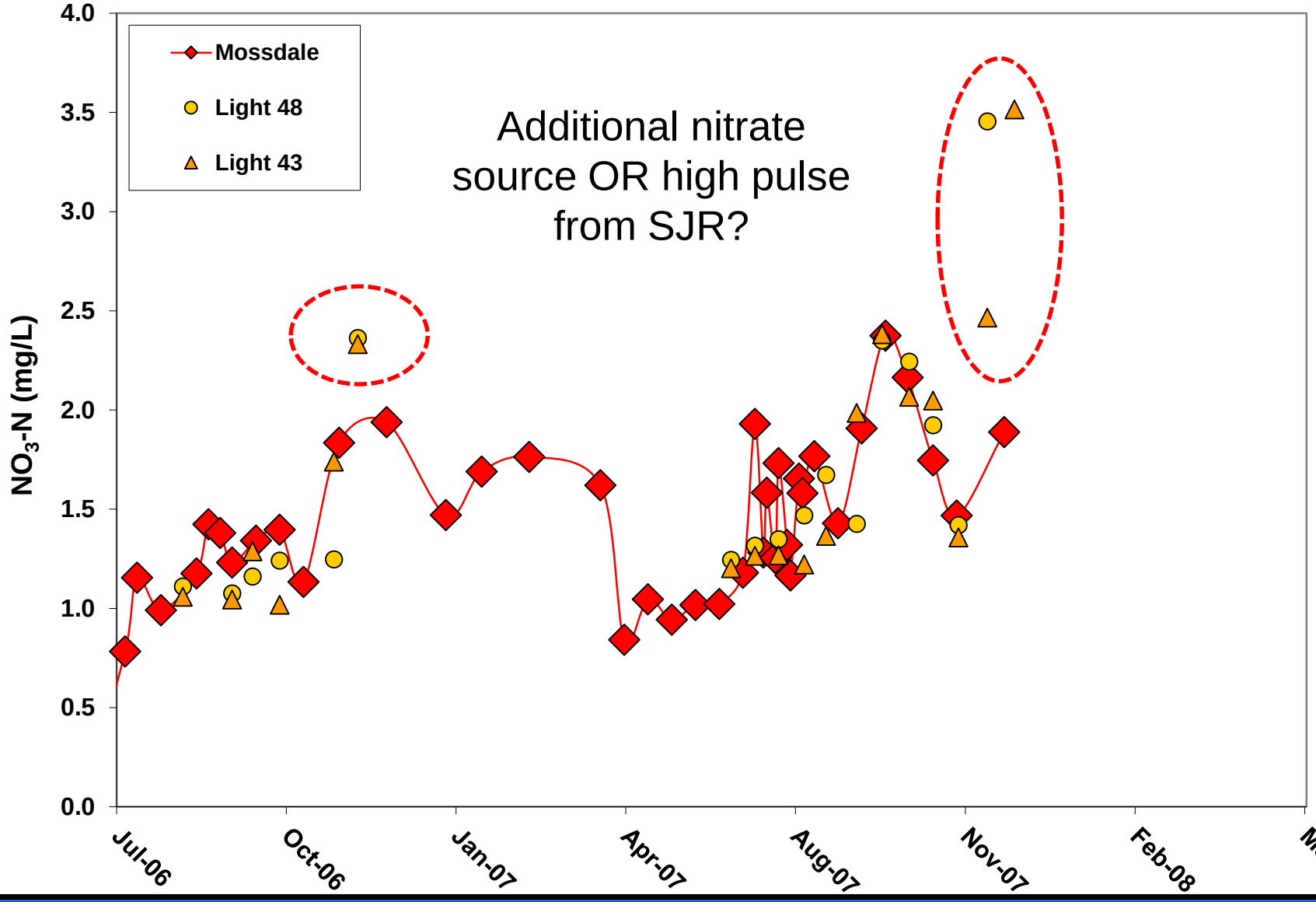
Downstream sites mostly follow SJR nitrate pattern



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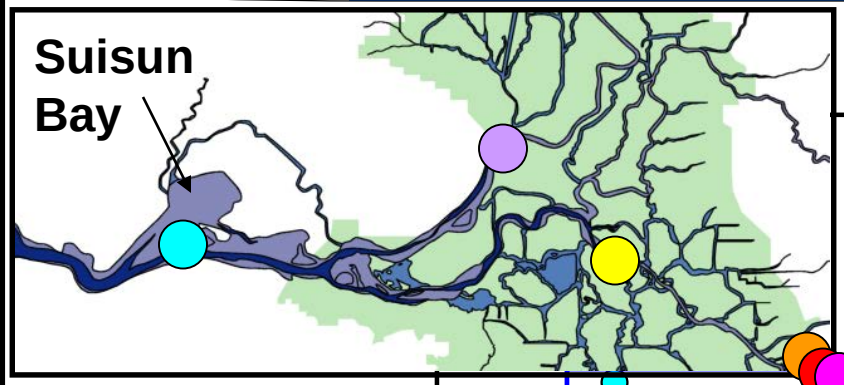
Nitrate isotope compositions are distinct



San Joaquin River sites

Lower channel, Sac. River, & Suisun Bay

$\delta^{18}O\text{-}NO_3$

5
0
-5
-10

0
5
10
15
20

$\delta^{15}N\text{-}NO_3$

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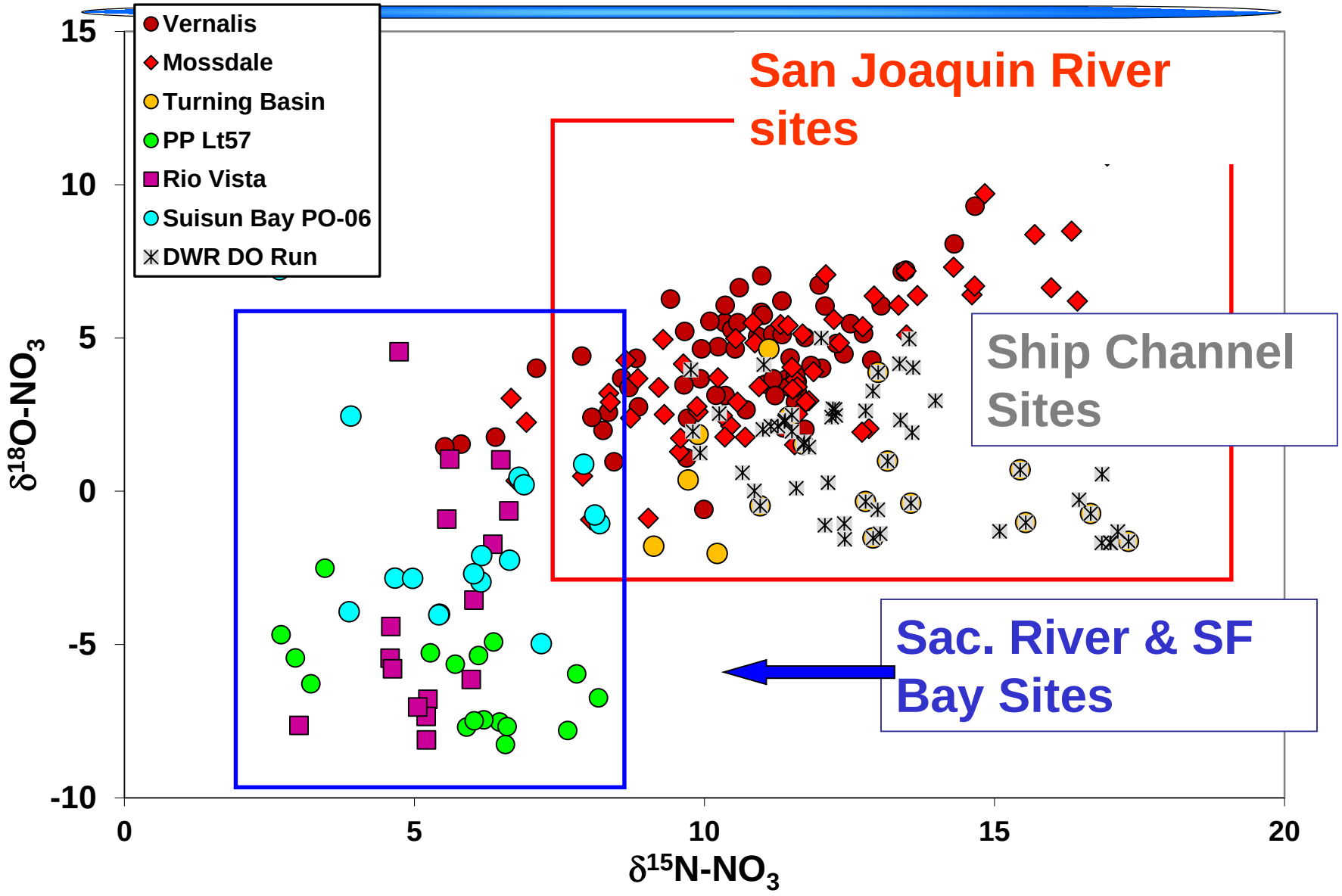
δ^{15}N-NO_3 in Ship Channel is consistent with SJR nitrate



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SUMMARY

- In 2004, $\delta^{15}N$ of nitrate and POM suggested that WWTP ammonium was a significant N source for primary producers
- When a new study started in Fall 2006 (during the WWTP transition period), nitrate appeared to be the dominant N source
- Nitrate concentrations in the Stockton DWSC are primarily controlled by nitrate loads from the upstream SJR, although other sources (or high pulses missed by SJR monitoring programs) are sometimes significant.

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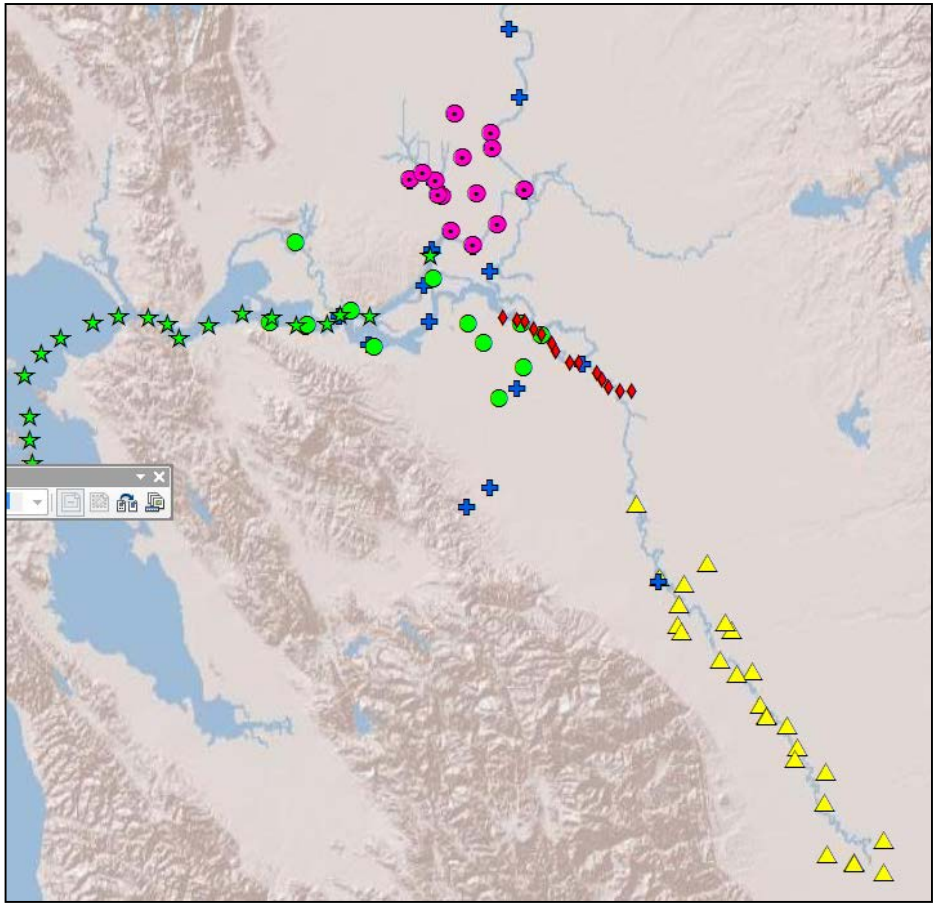

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