Offsetting allochthonous salinity increases, threatening irrigated agriculture, with managed recharge.

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Definition

***Allochthonous**, adj.,*

- *Materials formed or sourced elsewhere than in their present place; of foreign origin*

AGI Dictionary of Geological Terms

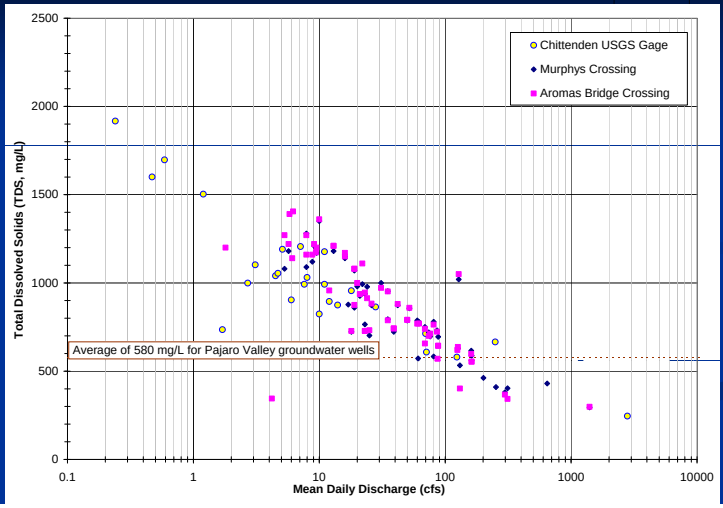
Roadmap

- Salinity is increasing over time at a given flow
- The river is the main source of recharge to the alluvial aquifer, driving groundwater salinity
- Salinity increases are detrimental to crop values and diminish crop selection
- We can offset the ongoing increase by a few proposed approaches

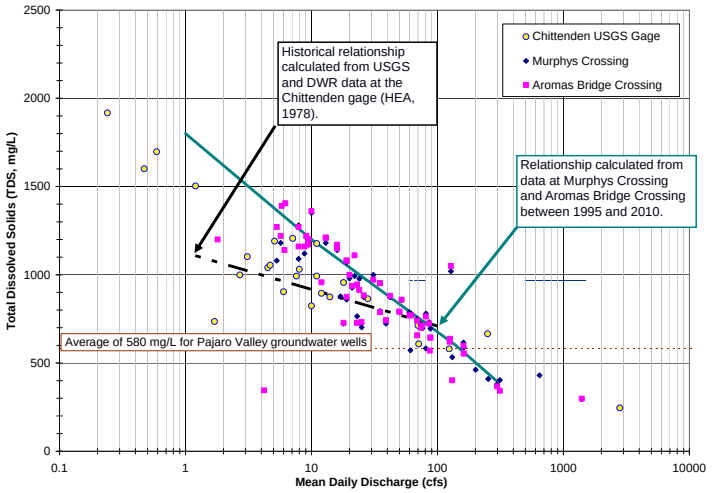
- Examples of alluvial basins with distinct upper and lower sub-basins, where allochthonous salts can increase salinity of recharge in downstream basins

Historical increases in salinity at a given flow for the Pajaro River

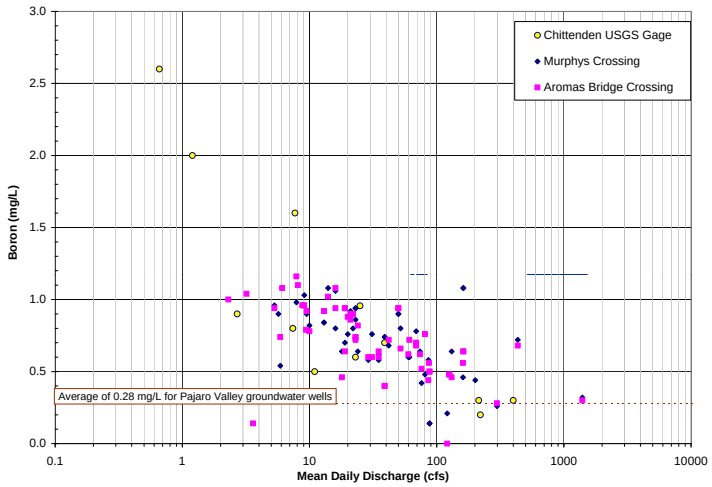
TDS from 1995-2010



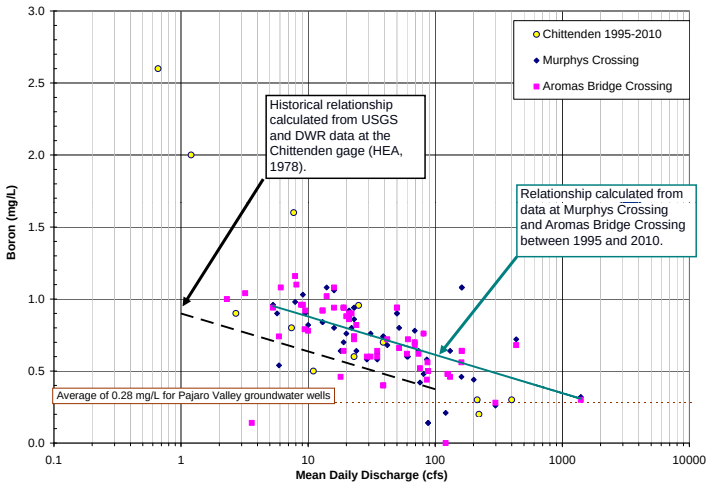
TDS from 1995-2010



Boron from 1995-2010



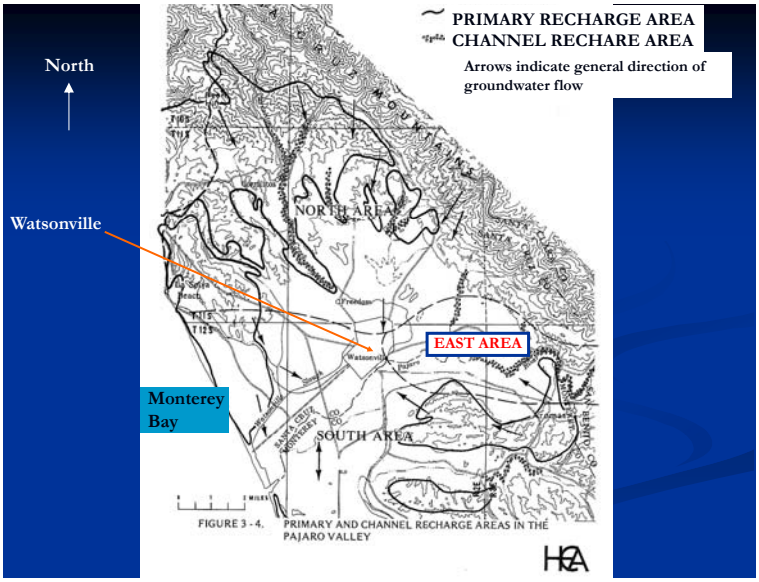
Boron from 1995-2010



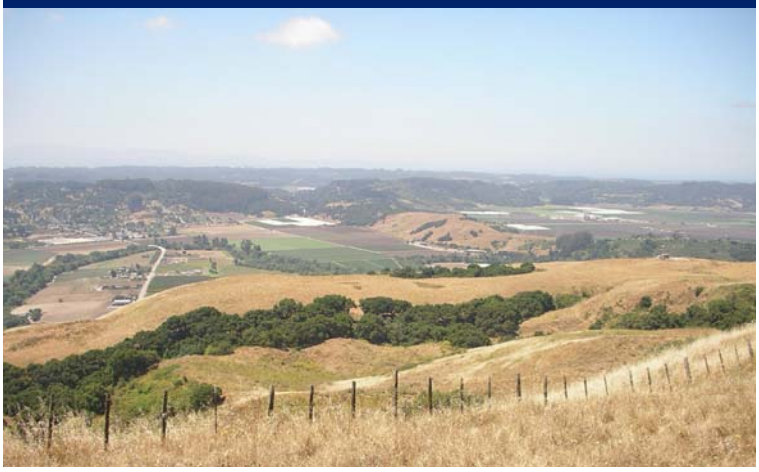
What are the causes?

- May not be identical in all basins, but often share common influences.
- The duration of low flows is sometimes being augmented by changes in land and water in the upstream basins, probably due to a combination of
  - urban activities
  - ↑ agricultural irrigation return flows,
  - ↑ volumes of treated effluent entering the riverine corridors,
  - ↑ rates of groundwater drainage as channels in upstream basins gradually incise in response to land-use change,
  - ↑ in water consumption by native vegetation along the river.

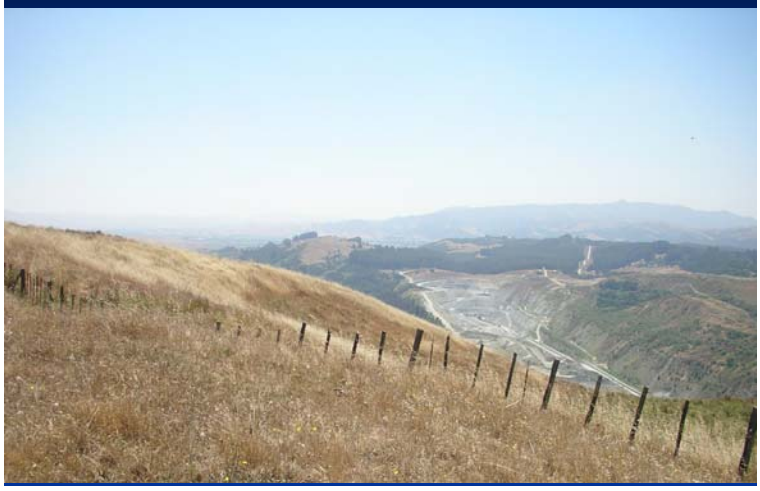
Salinity in the river drives salinity in the aquifer

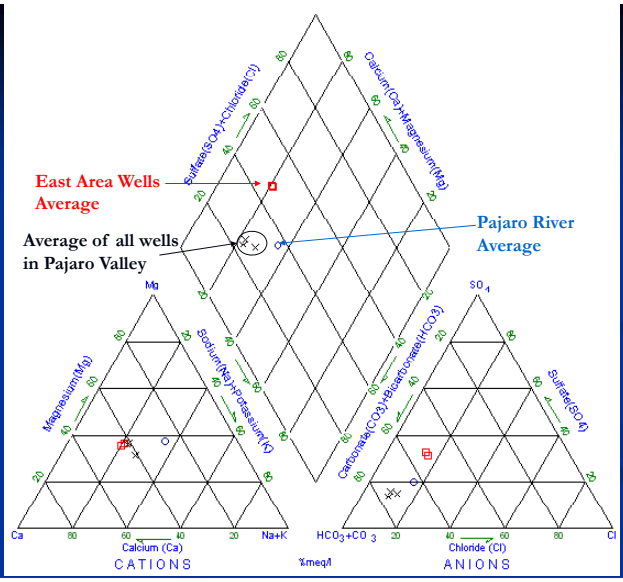


East Area overview

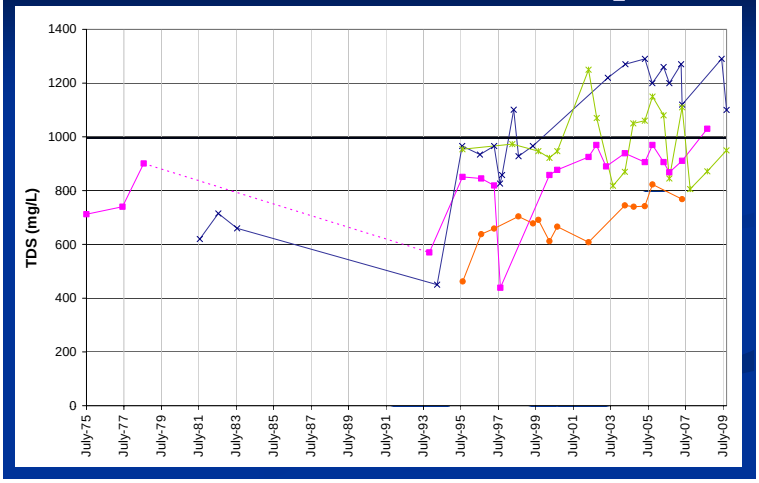


Large quarry





Historical trend in East Area aquifer



How quickly will the salinity of the alluvial aquifer increase in response to increases in the river?

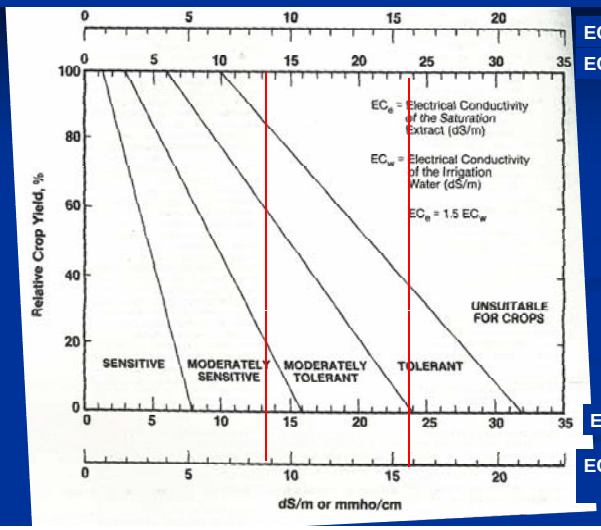
- The river recharges about 4400 af/yr
- More than 85% of the East Area recharge originates from the river (5000 af/yr total)
- Using gage data and chemical/heat tracers
- Exchange ratio is about 1:18

We assume that the aquifer responds with a delay averaging 15 to 20 years

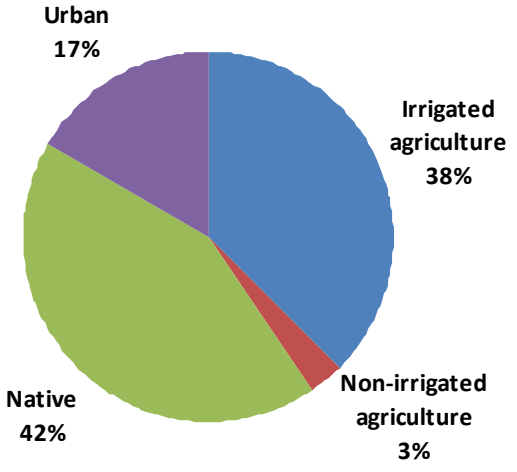
Management Implication: **It will take somewhat longer for the salinity increases to manifest in the aquifer than in the river, but it will be harder to reverse them in the years to come.**

Salinity increases are detrimental to crop values and diminish crop yield and selection

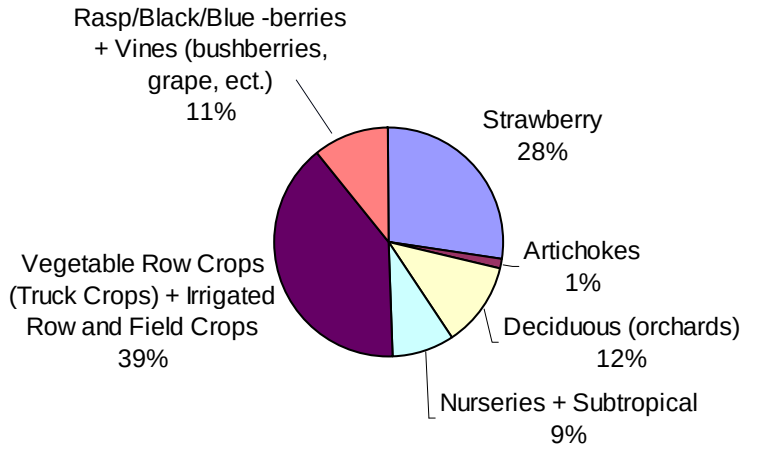
Relative salt tolerances



Pajaro Valley Land Use



Data from 2005



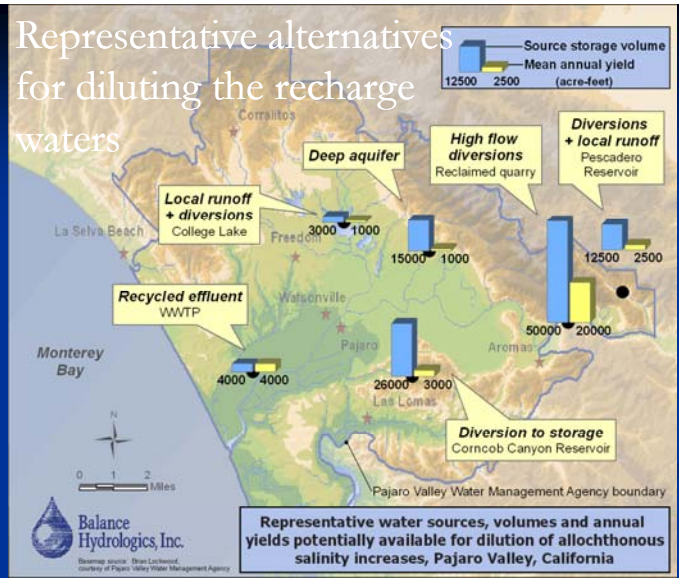
Data from 2005

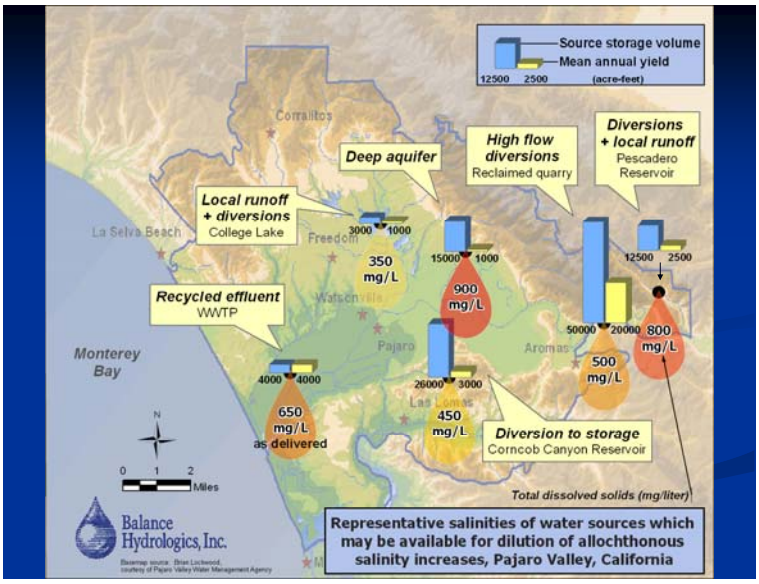
We can offset the ongoing salinity increase by a few proposed approaches

Options for decreasing salinity

- Local Conditions Enable Dilution
  - Low salinity storm runoff captured in reservoirs and in recharge facilities, such as former quarries
  - Deeper groundwater of lower salinity, typically available from clastic continental deposits of Pleistocene or recent age
  - Treated effluent, which often is of substantially lower salinity in subarid California than is the master stream, due to water imports or selection of lower-salinity local sources for drinking water quality

Representative alternatives for diluting the recharge waters





Recycled Water Effluent

"I'd take that water in a minute" –leading Salinas Valley grower

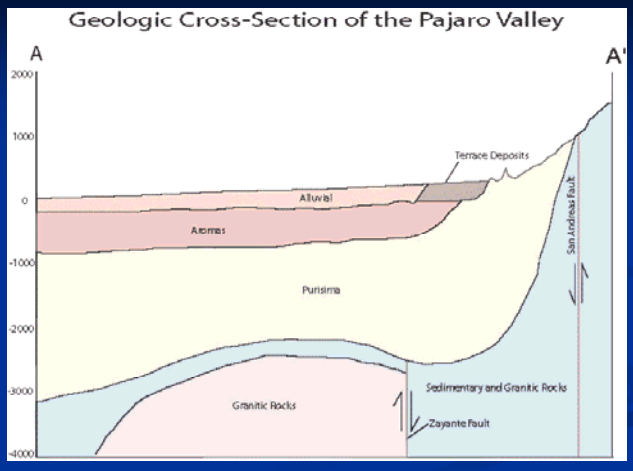
Conclusions

- Allochthonous salinity increases in low flows are an important aspect of basin-wide salinity management.
- Increases in river salinities lead to increases in aquifer salinities that can restrict yields or choices of crops.
- Groundwater management should include evaluating and implementing one of more of these strategies in basins where salinity increases are being observed.
- In the Pajaro Valley, the imposed changes in salinity are at a rate and magnitude which warrant active management.

Policy implications

- Salinity increases threaten agricultural/potable supplies, economic implications-policy needs to address the increase.
- To sustain agriculture, particularly in light of other economic pressures, salinity management at heads of valleys will become progressively important.
- There are real costs to ignoring increases in allochthonous salinity
  - Need to be addressed in a management time frame of 15-20 years
- Alternative solutions are available.
- While overdraft-which increases salt load to aquifer- is being addressed, other increases to salt loading is being overlooked.

end



Salinity

- Salinities of master streams in Central California are increasing
  - *Many streams are major recharge sources*
- Salinity increases can adversely effect agricultural production
- Salinity is already managed in some agricultural basins in central and southern California
  - *Including the Pajaro Valley*