Nitrate in Groundwater in the Carson Valley

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2020 Carson River Watershed Forum, March 10, 2019

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Nevada Water Science Center

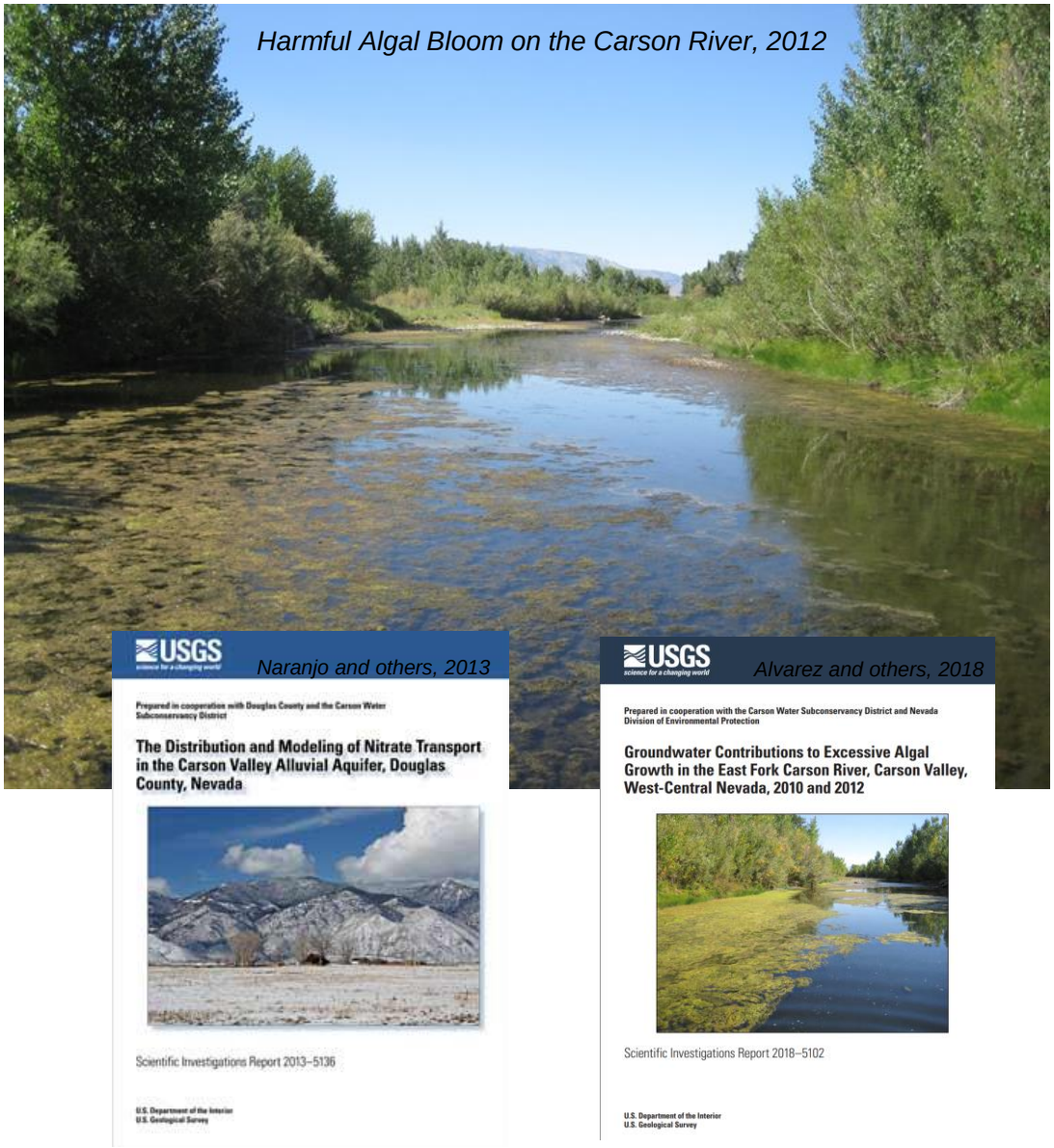
Nitrate

Health and Ecological Risks

Household waste contains bacteria, viruses, chemicals, and high levels of Nitrogen and Phosphorous (EPA, 2019)

Nitrate in drinking water more severely affects infants. Blue baby syndrome, hypertension, central nervous birth defects, diabetes and cancer. EPA MCL 10 mg/L (EPA, 2019)

Nutrient enrichment from groundwater causes stream eutrophication (Alvarez, 2018)



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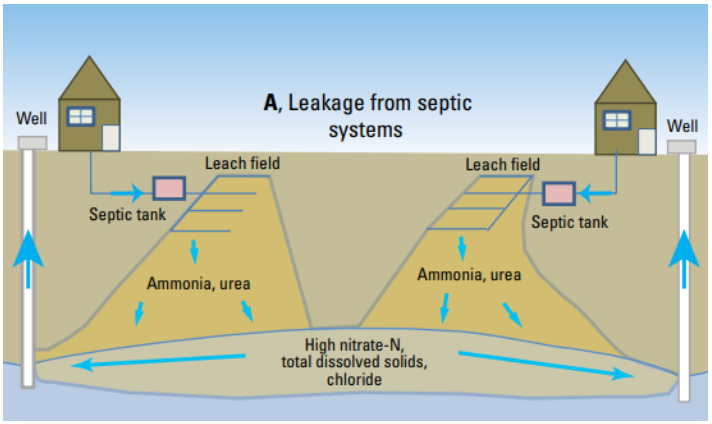
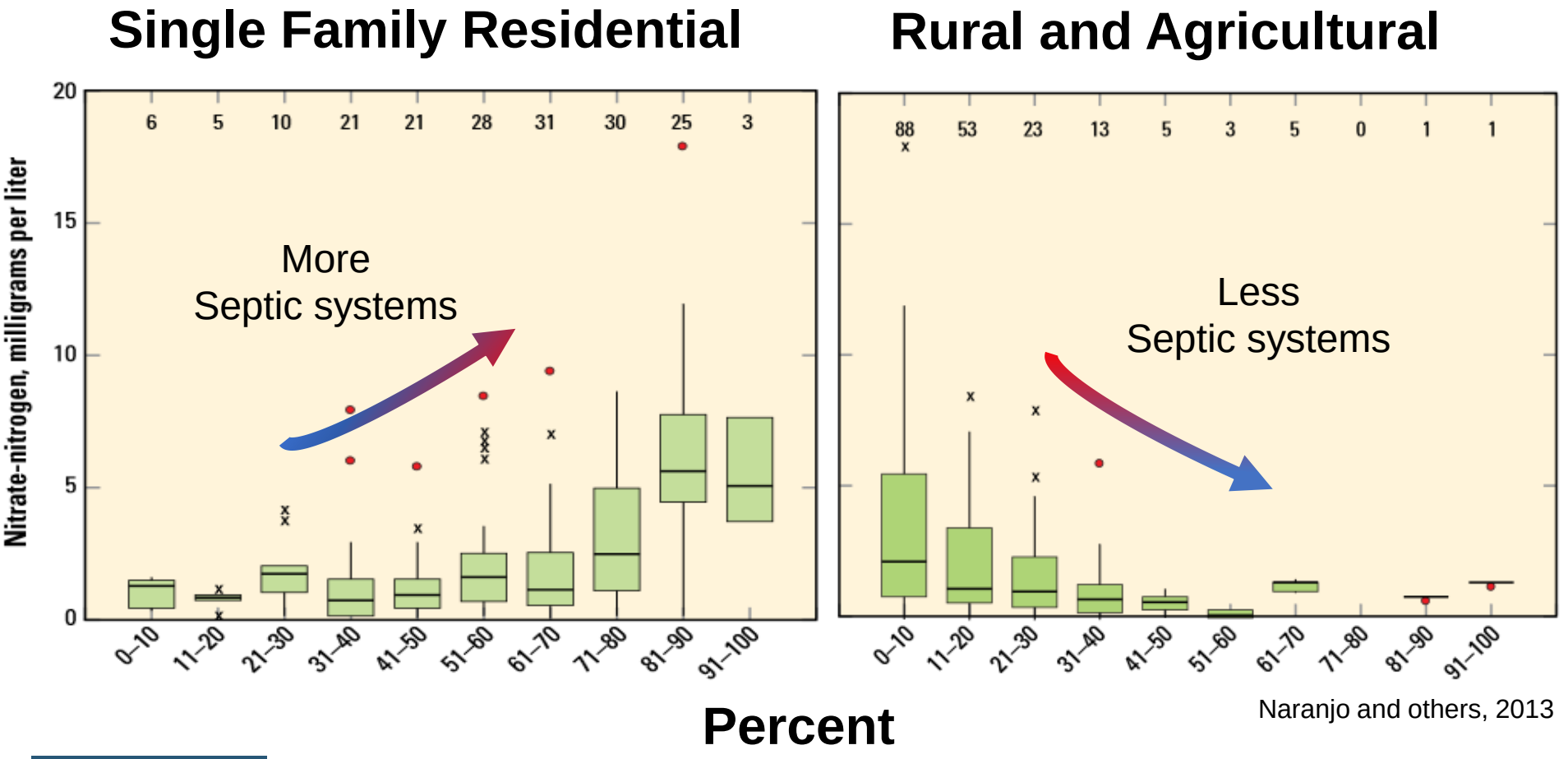
Background

Wells with elevated Nitrate are in areas with highest septic density

Low nitrates in agricultural areas except for areas near development



Nitrate vs Land Use



Naranjo and others, 2013

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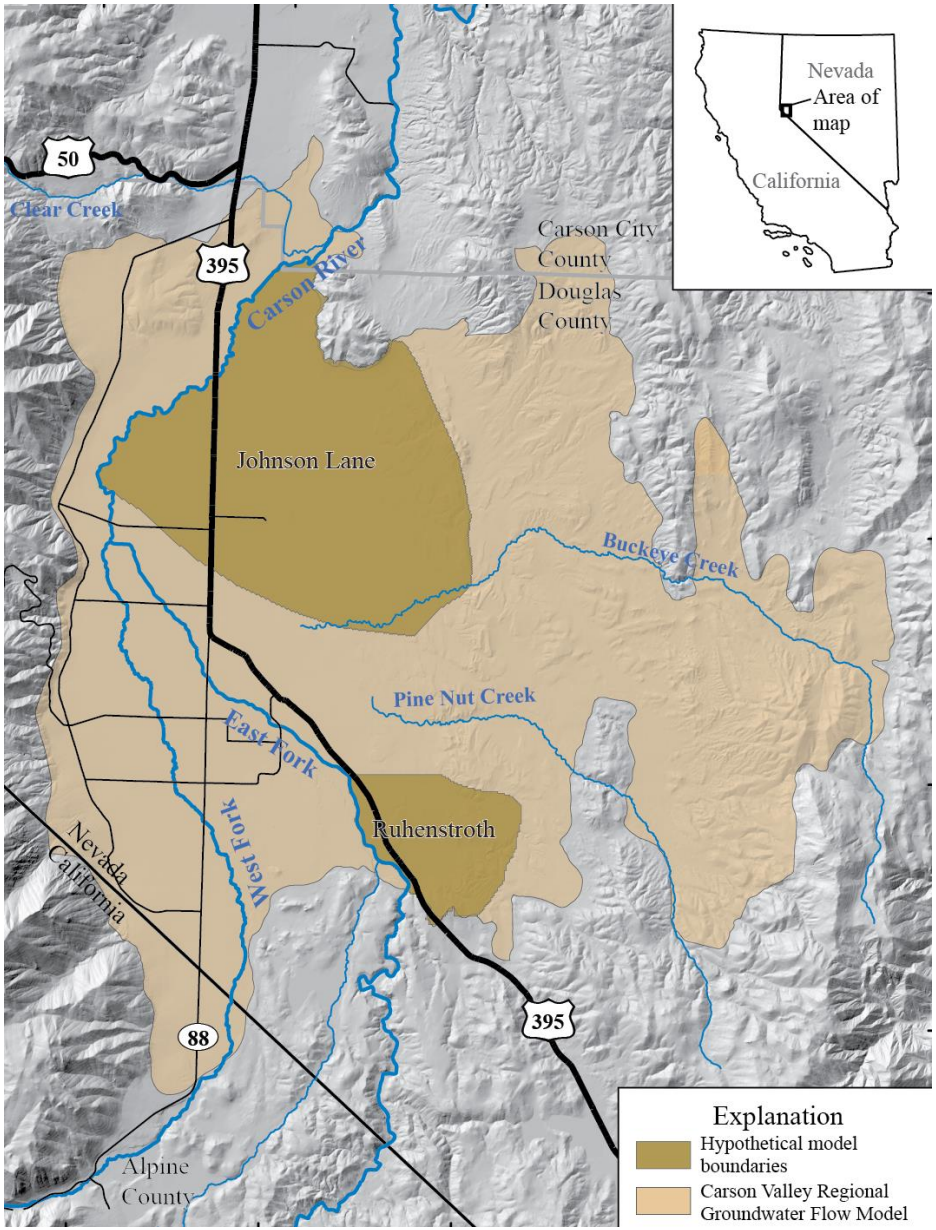
Transport Study Areas

- Johnson Lane
  - 62 mi²
  - 1,433 septic tanks
  - 23 septics / mi²
  - 2,627 wells

- Ruhenstroth
  - 14 mi²
  - 500 septic tanks
  - 36 septics / mi²
  - 511 wells



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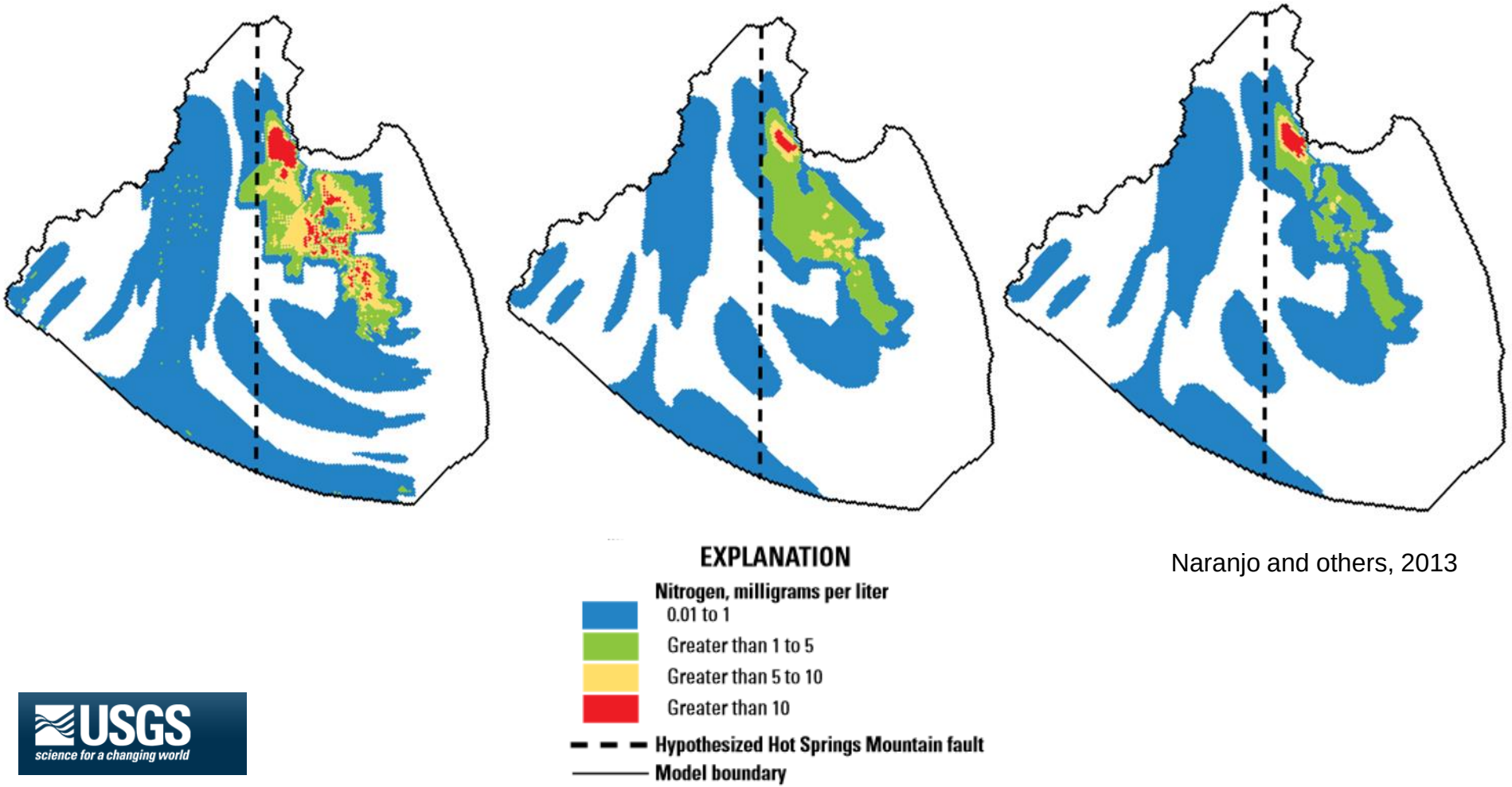
Simulated Results - Johnson Lane (2059)

Baseline Prediction
Continue Septics and Pumping

H1
No Septics, Continue Domestic Pumping

H2
Septics Removed in 2030, No Domestic Pumping



Naranjo and others, 2013

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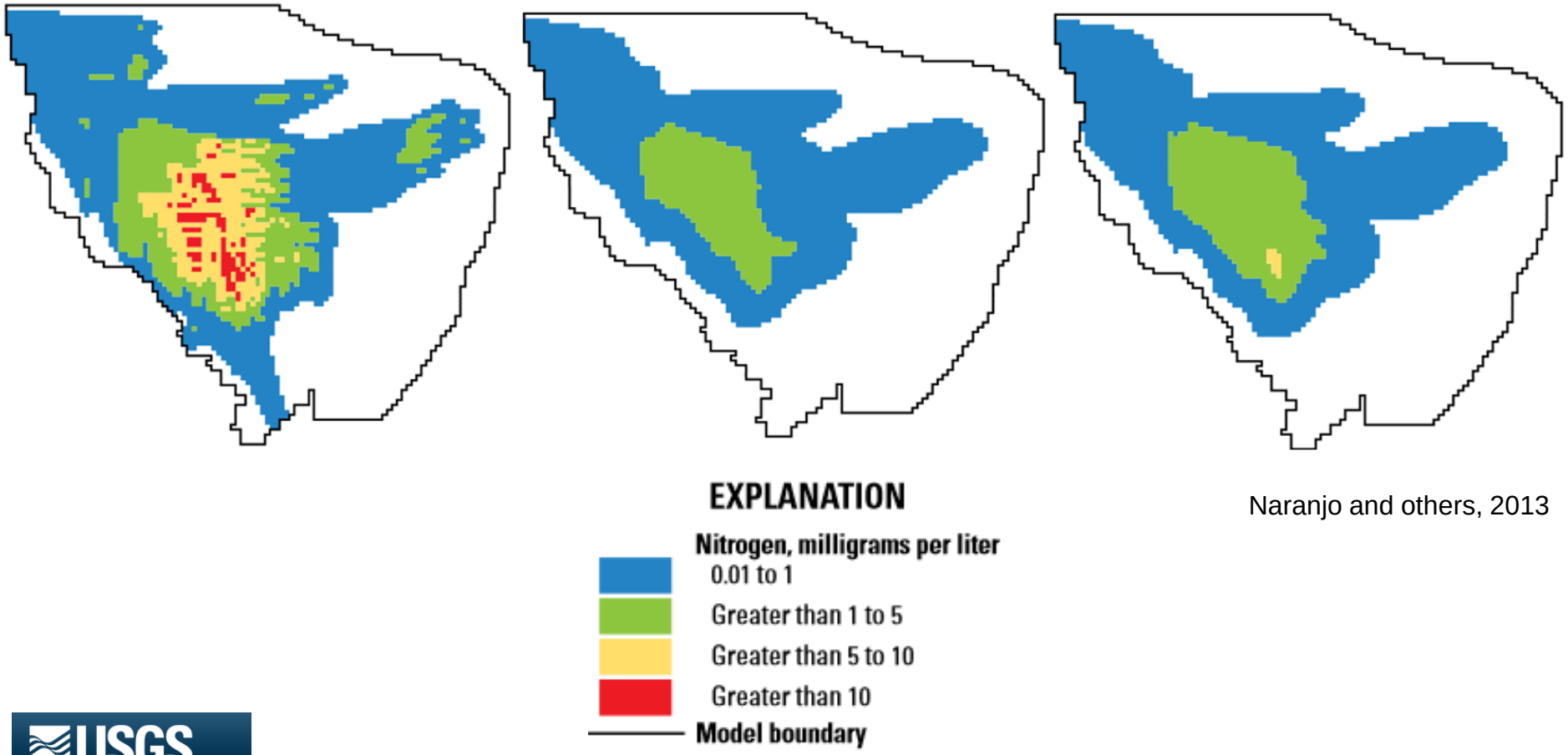

Naranjo and others, 2013

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Summary of Scenario Results

		2059		
	2009	Prediction	H1	H2
Johnson Lane				
Maximum (mg/L)	18	30	20	19
Percent change in maximum[1]	-	69	-34	-39
Acres > MCL (10 mg/L)	156	373	92	48
Percent change in area[1]	-	139	-75	-87
Ruhenstroth				
Maximum (mg/L)	12	19	4	5
Percent change in maximum[1]	-	62	-79	-72
Acres > MCL (10 mg/L)	13	112	0	0
Percent change in area[1]	-	769	-100	-100

[1] *calculated as a percentage from prediction at 2059*

Naranjo and others, 2013

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Summary of Report Findings

Septic tank systems contribute main source of Nitrate

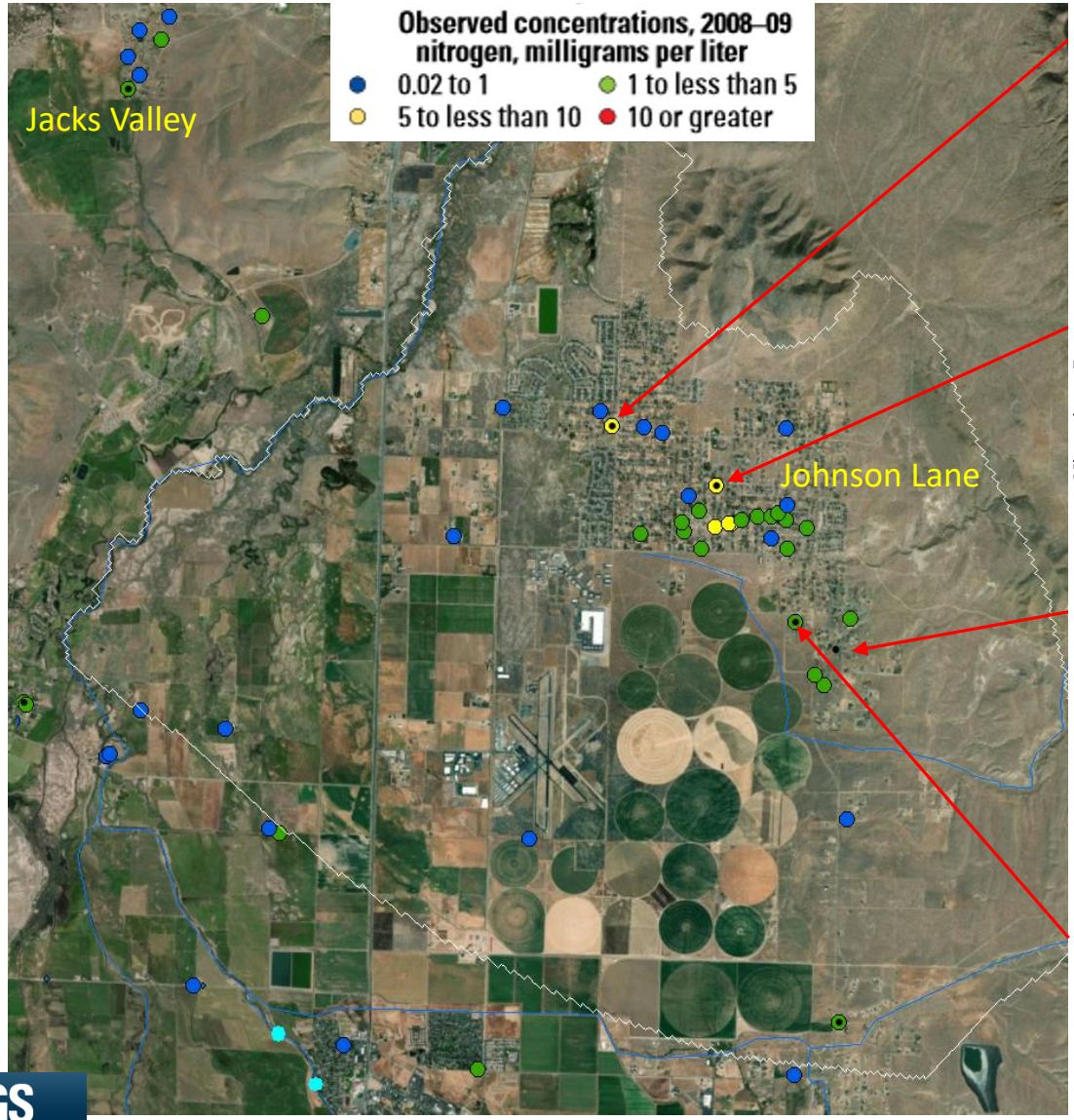
Nitrate concentrations are dependent on well depth, septic tank density, age, and proximity to up-gradient septic systems.

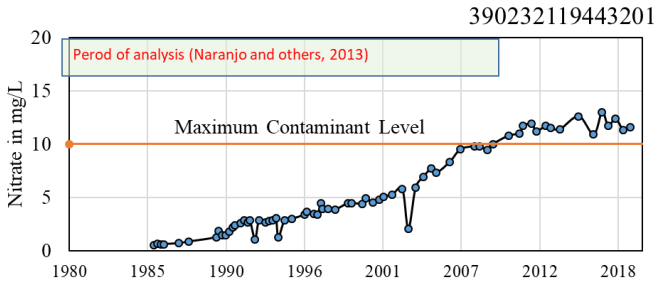
The ability of the aquifer to dilute the leachate concentration has been reduced due to high use of septic systems (i.e. Ruhenstroth)

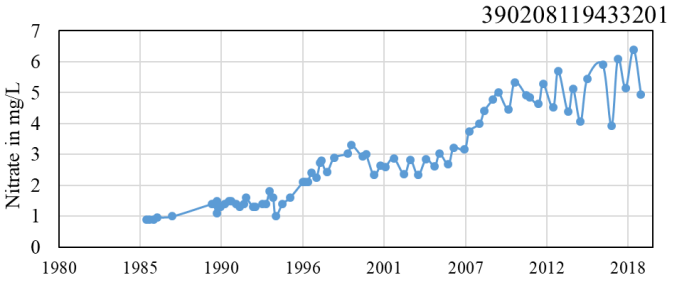
Concentrations reduce rapidly when septic tanks are removed and domestic wells continued to pump.

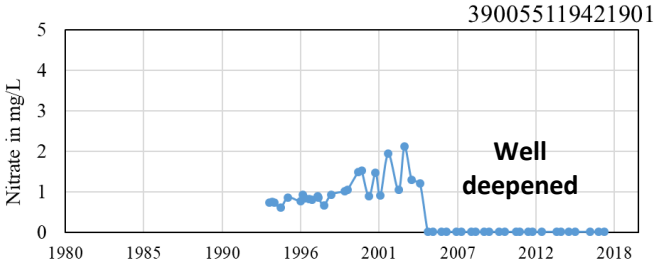
If no action is taken, nitrate will eventually increase above the USEPA's MCL.

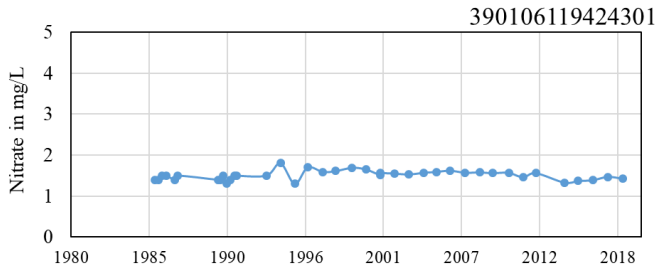
Trends in Nitrate











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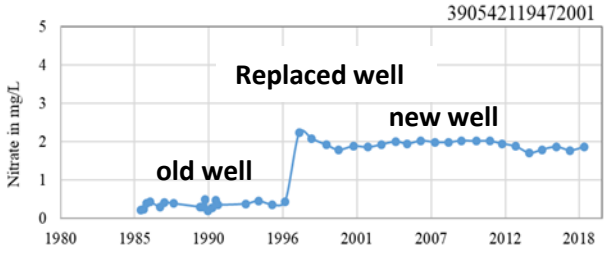
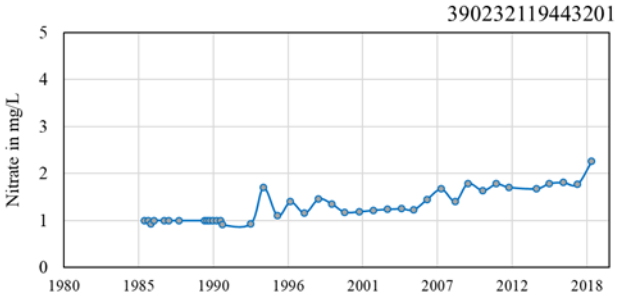
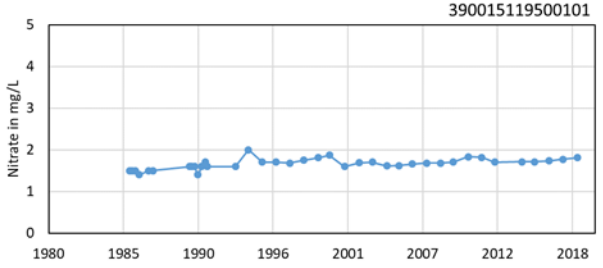
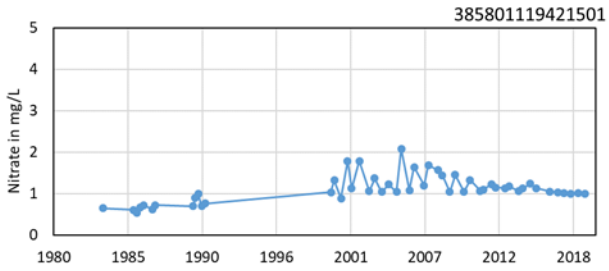
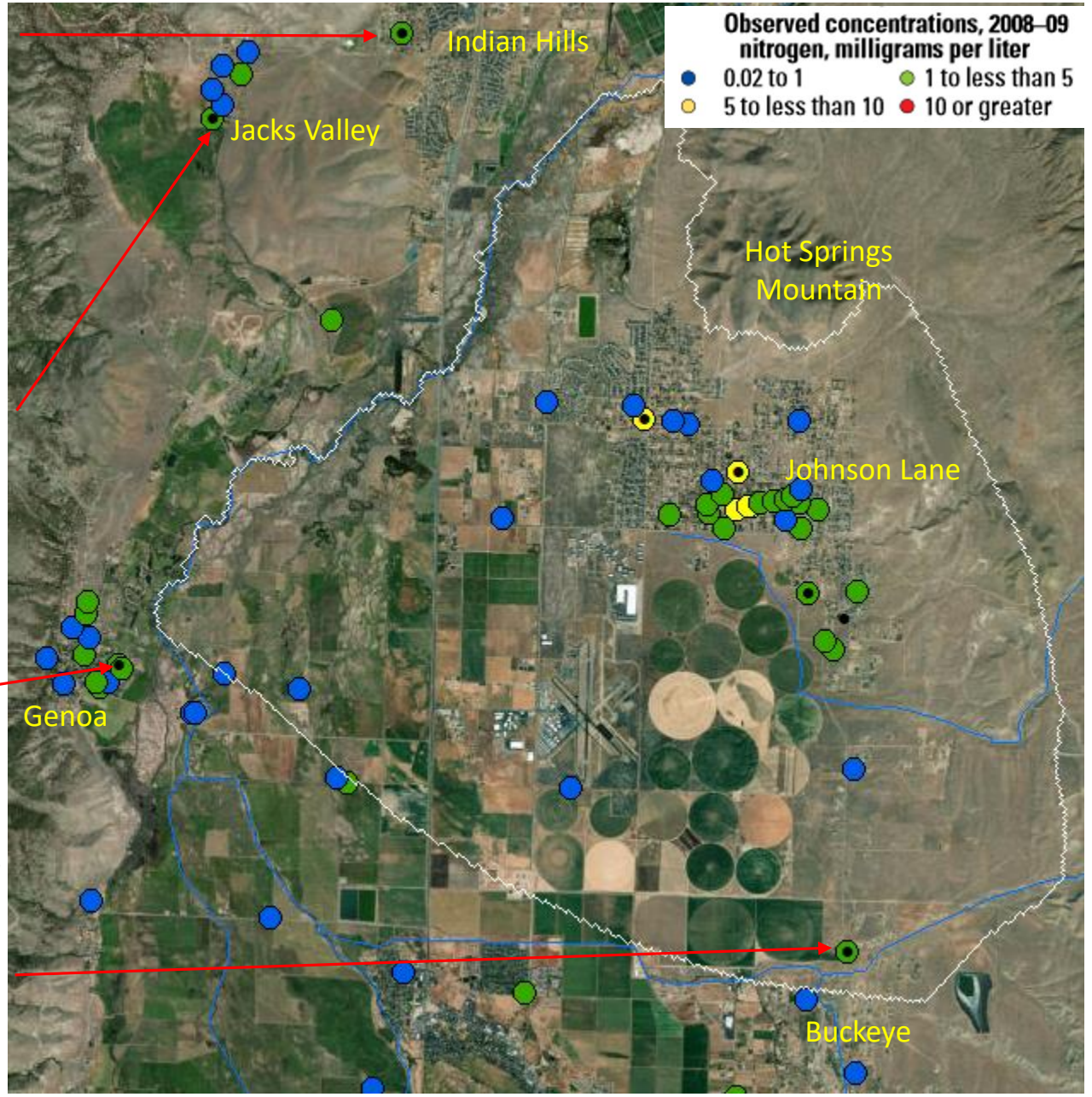
Trends in Nitrate











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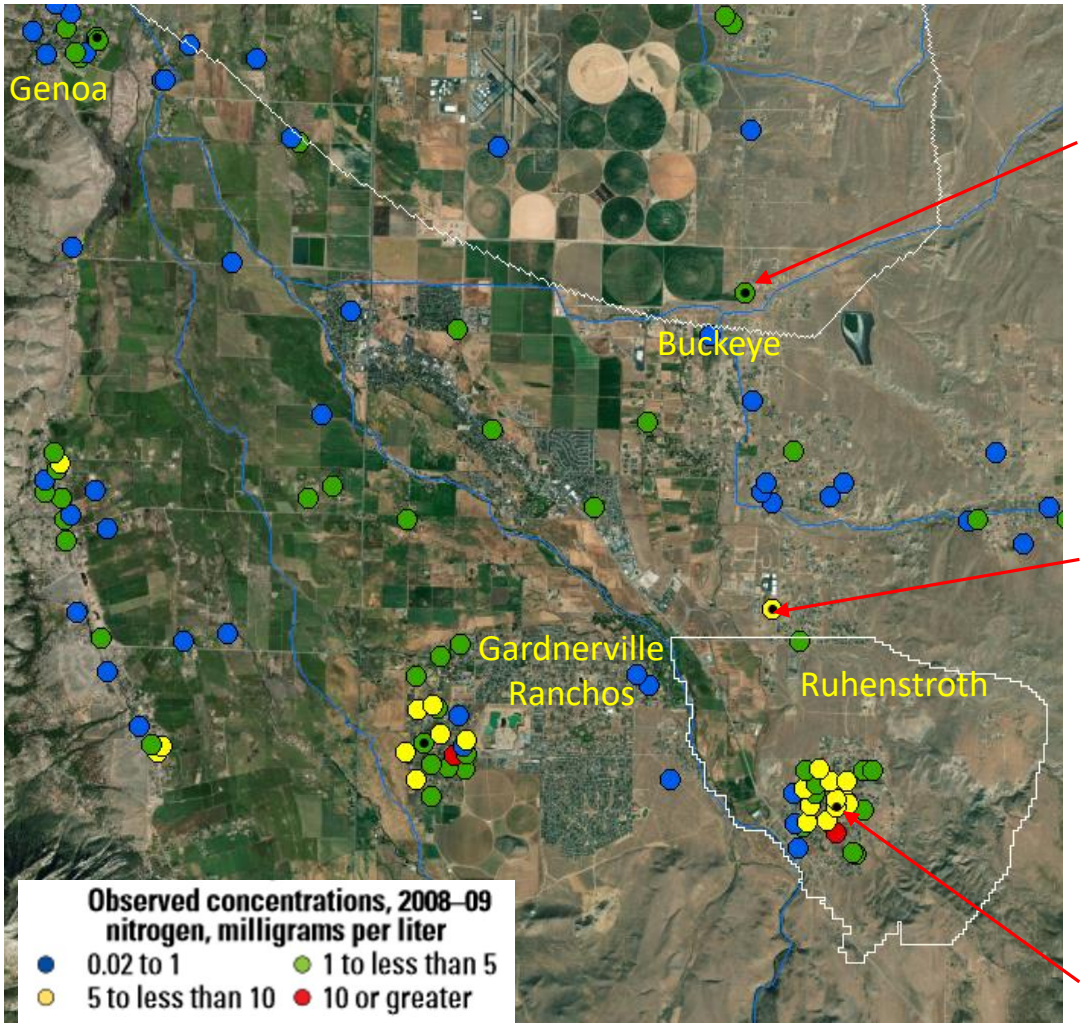

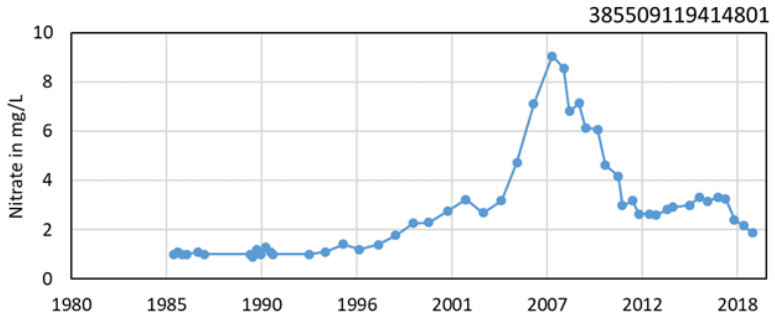

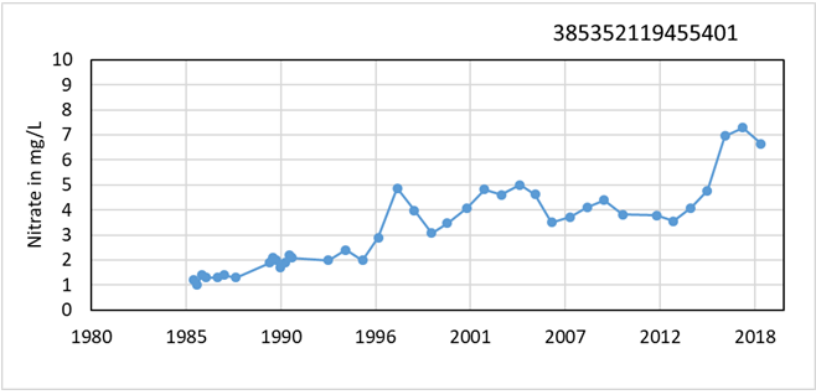

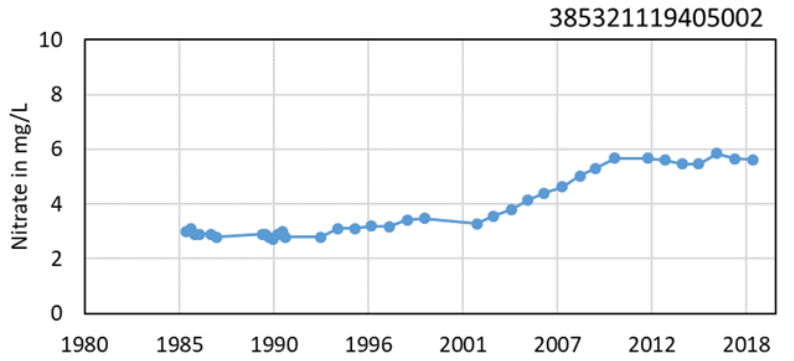

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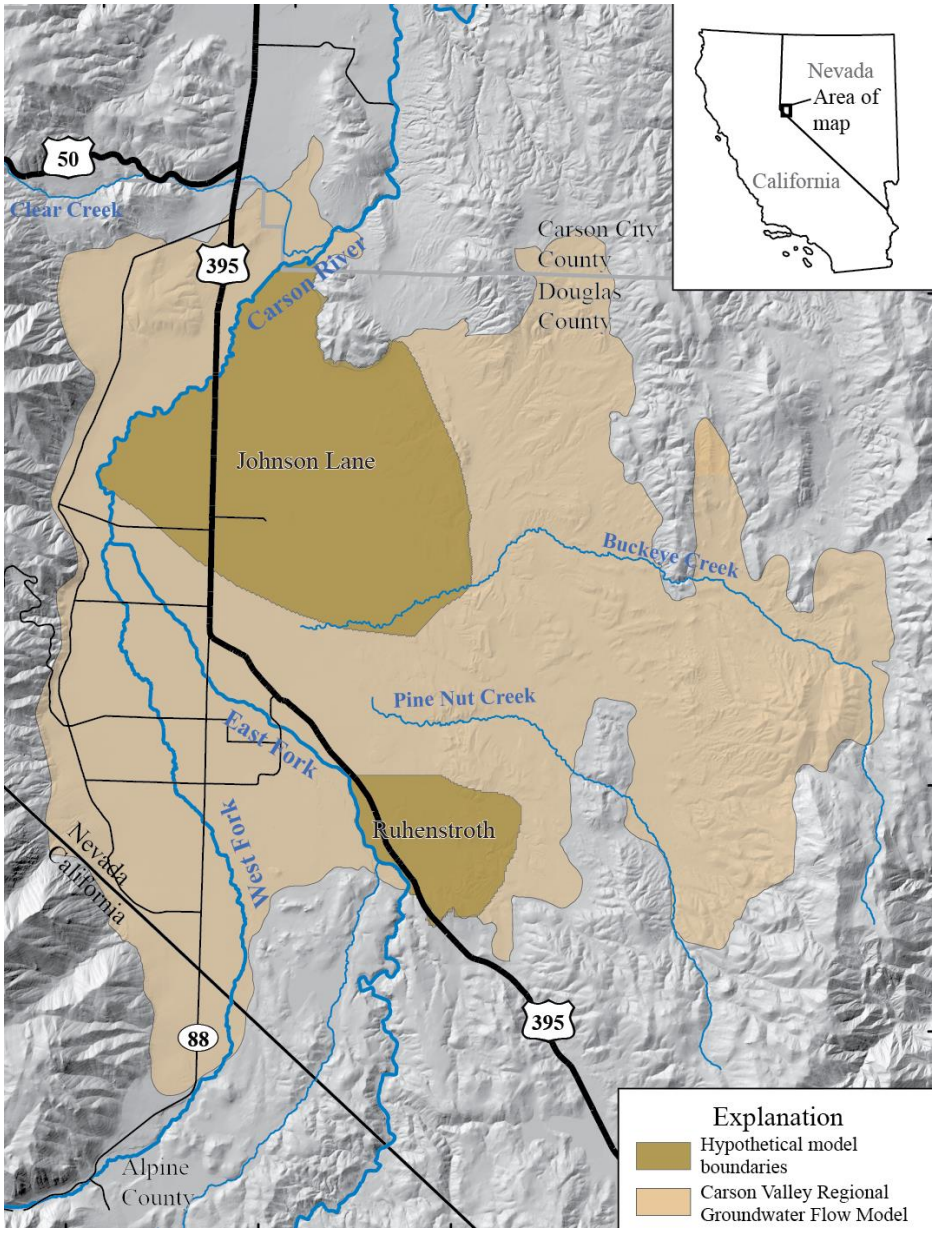
Application of Nitrate Transport Model

Naranjo and others, 2013

How have concentrations changed in since 2009?



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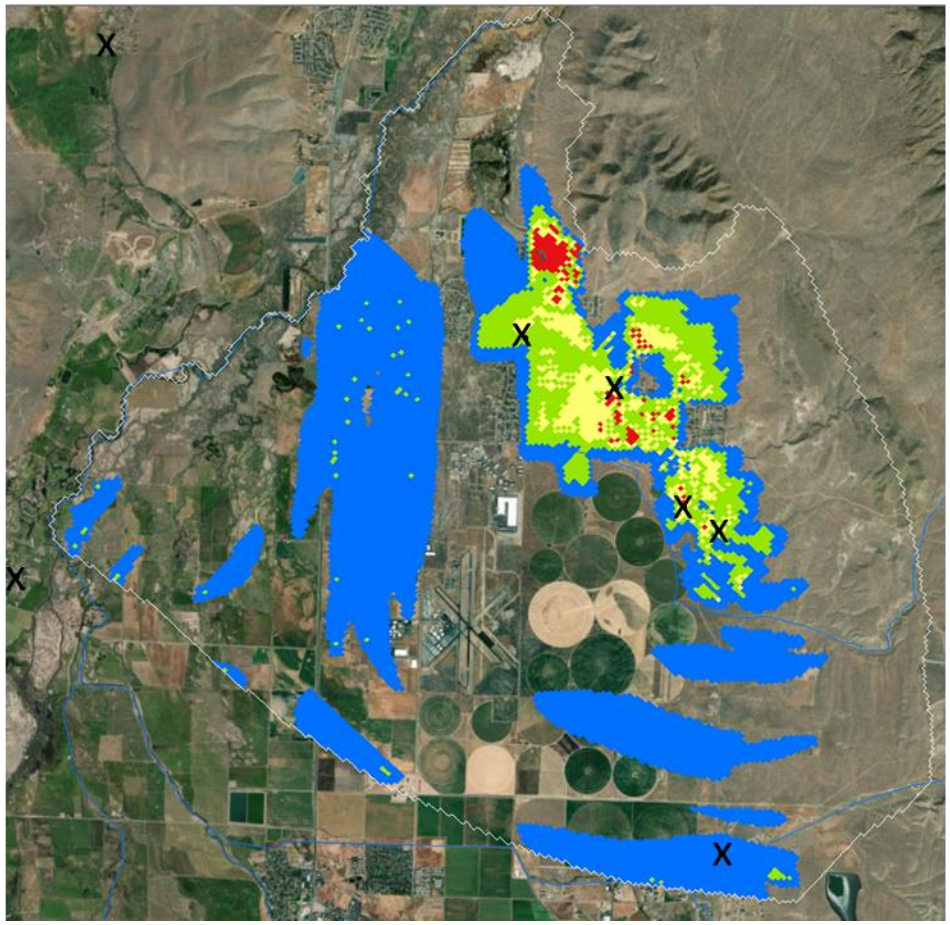
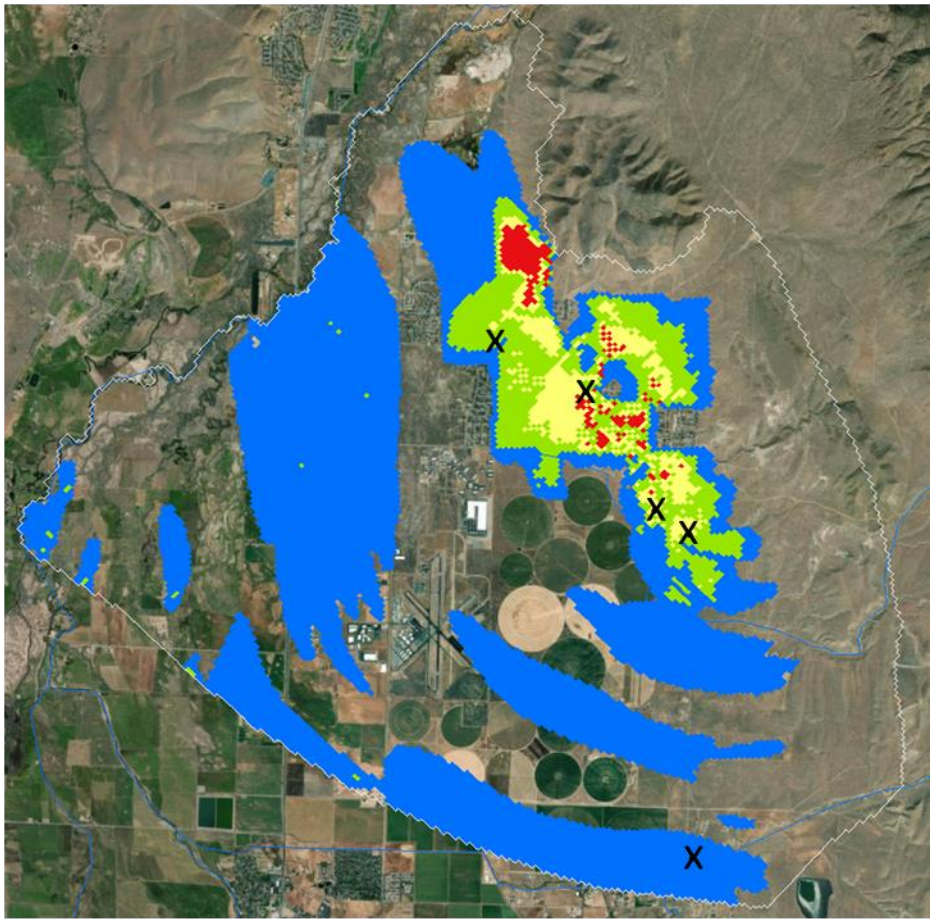
Simulated Change in Concentration –
Johnson Lane

2009

2019





0.01 to 1
Greater than 1 to 5
Greater than 5 to 10
Greater than 10

X are active monitoring wells

Information for 2019 is preliminary and subject to revision

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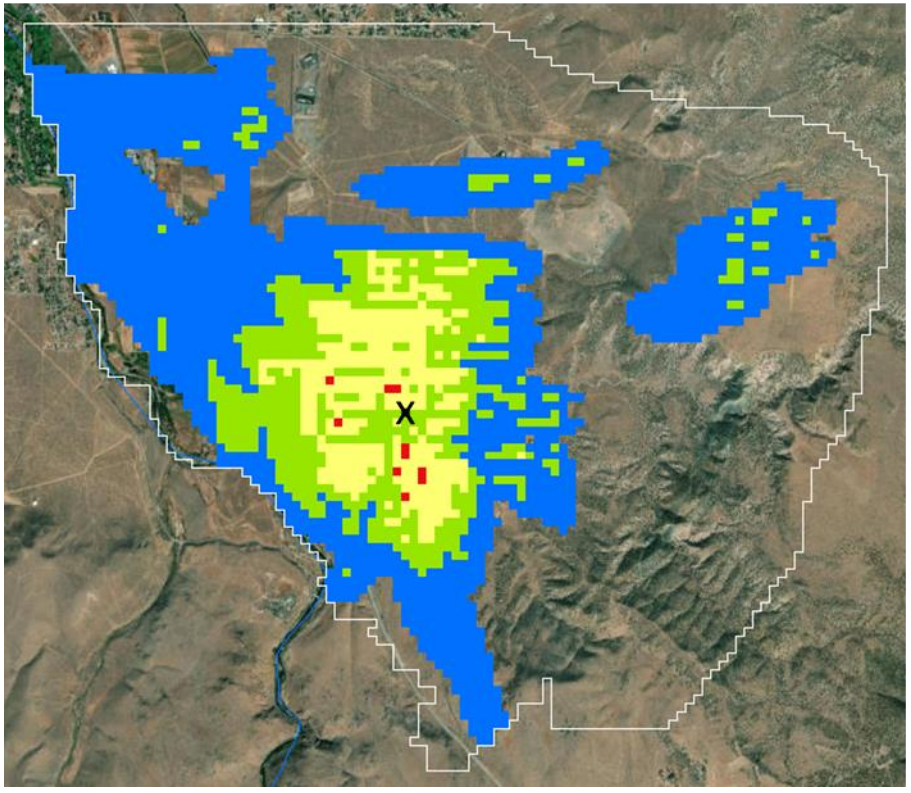
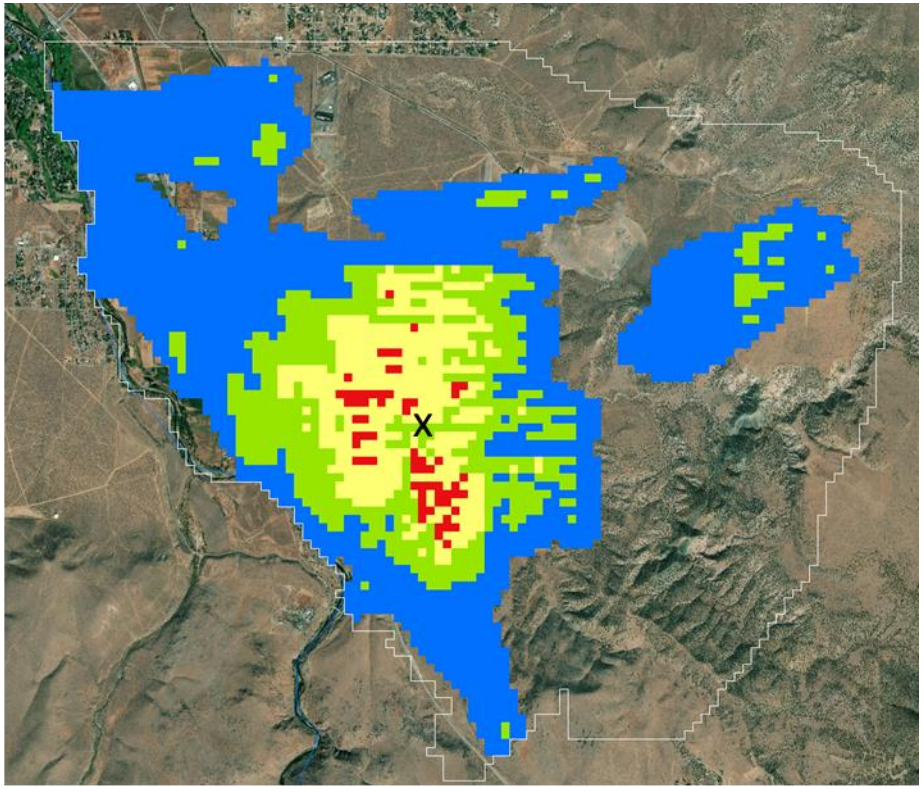
Simulated Change in Concentration - Ruhenstroth

2009



2019



0.01 to 1
Greater than 1 to 5
Greater than 5 to 10
Greater than 10

X is active monitoring well

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Simulated Increase in Acres > MCL
2009 to 2019

	2009	2019	2059
Johnson Lane			
Maximum (mg/L)	18	20	30
Percent change in maximum[1]	-	12	38
Acres > MCL (10 mg/L)	156	227	373
Percent change in area[1]	-	46	139
Ruhenstroth			
Maximum (mg/L)	12	17	19
Percent change in maximum[1]	-	42	62
Acres > MCL (10 mg/L)	13	71	112
Percent change in area[1]	-	450	769

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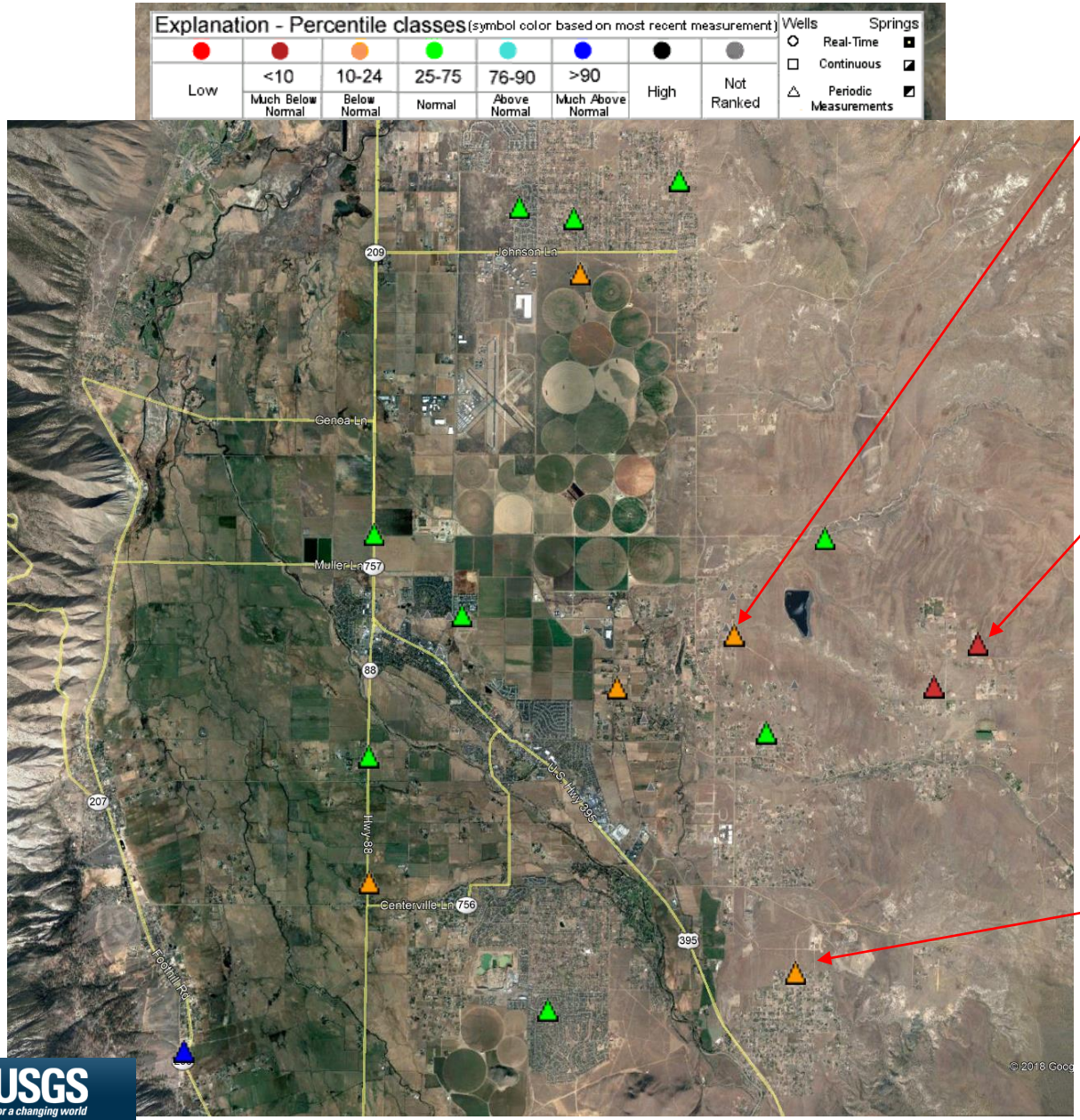
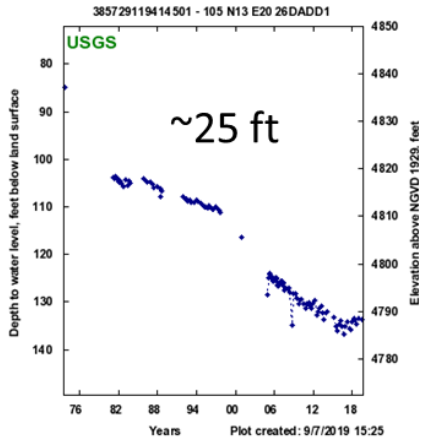
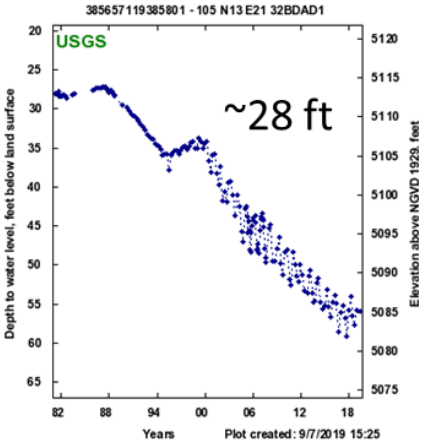
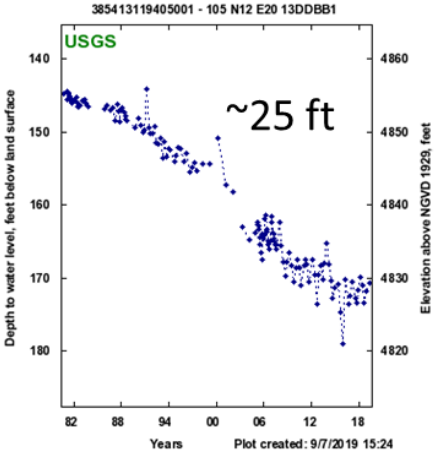
Trends in Water Levels

- **Declining at ~1 ft/yr on East side of Carson Valley**









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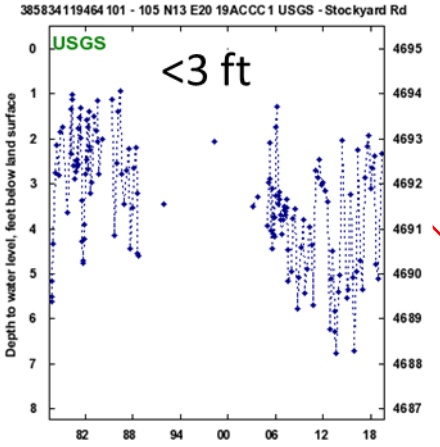
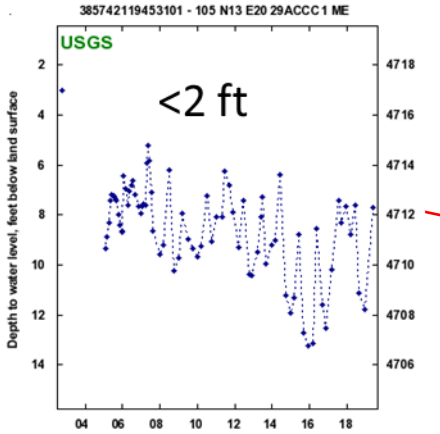
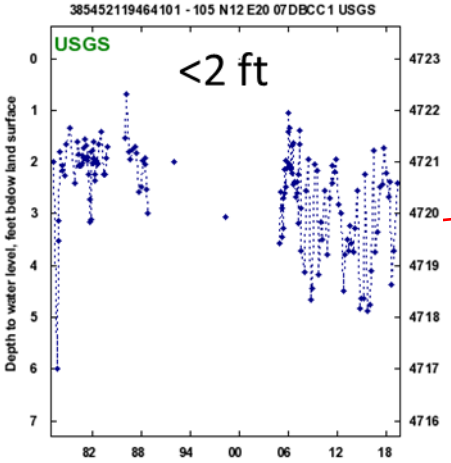
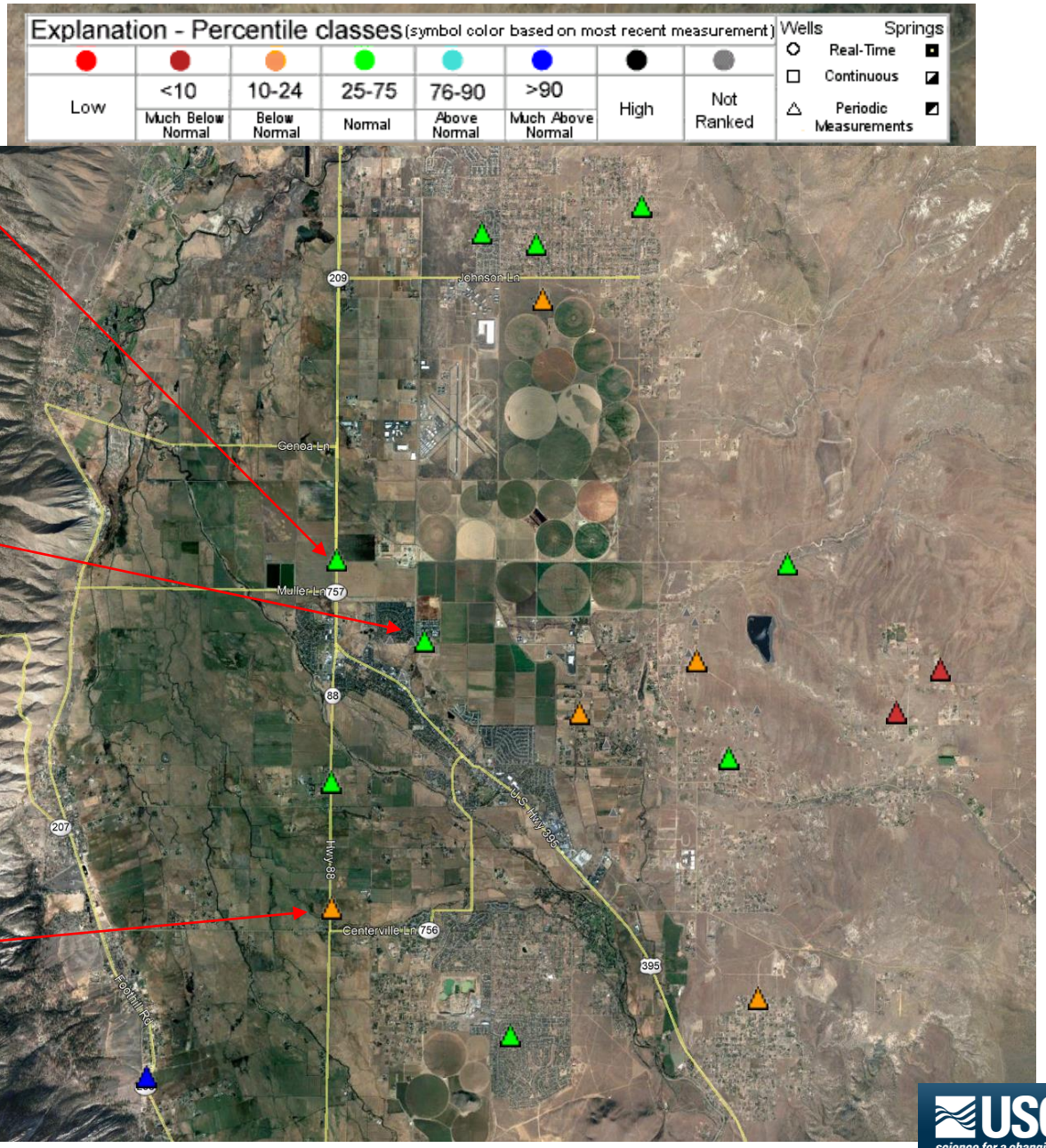
Trends in Water Levels









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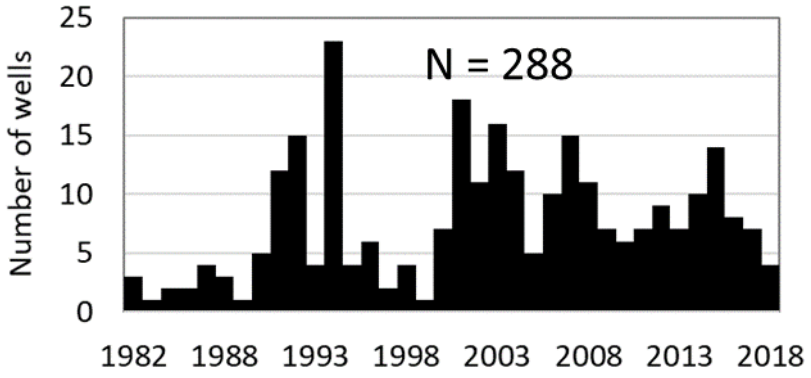
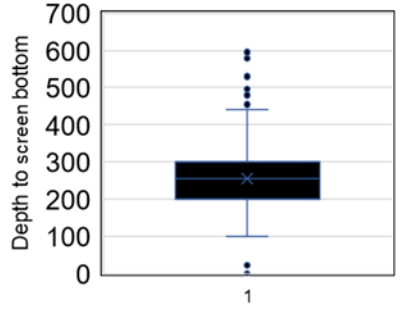
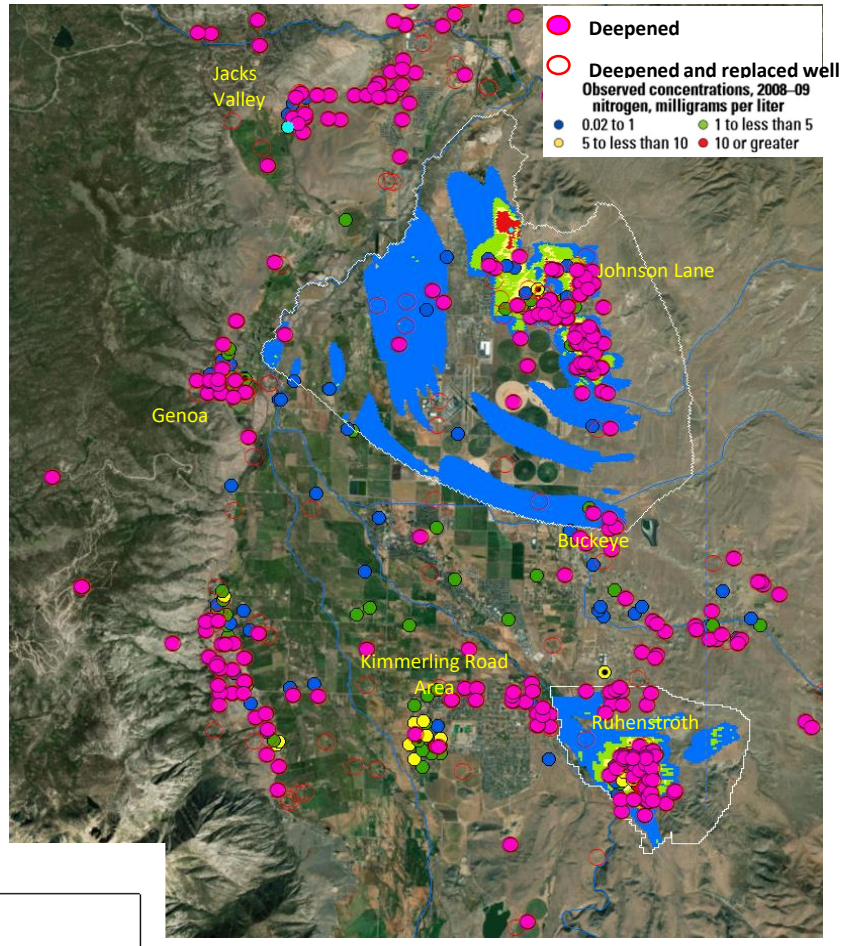
Wells Deepened and Replaced in the Carson Valley

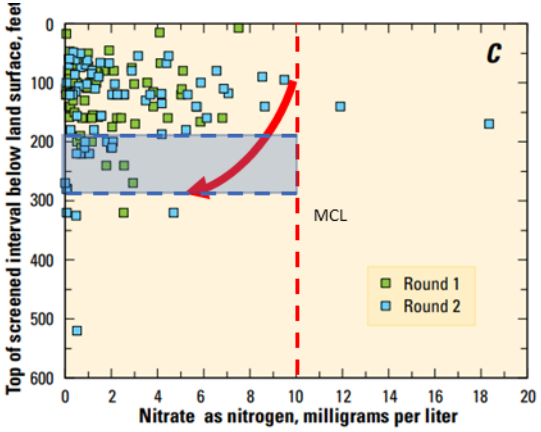
Source: Nevada State Engineers Database

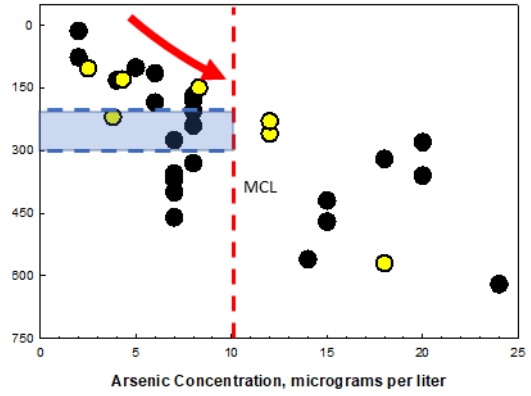


Average depth 260 ft









Information is preliminary and subject to revision

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Summary of Monitoring Data

- Nitrates are increasing in 8 of 11 monitoring wells.
- Since 2007, well in Johnson Lane area has nitrate concentrations greater than MCL of 10 mg/L
- Are monitoring well locations appropriate? Should wells be added in high risk areas (domestic use wells) and include arsenic?
- Are we collecting enough data to evaluate risk to domestic wells, municipal wells, and Carson River?

Summary of Nitrate Transport

- Transport model indicates an 1.5 (Johnson Lane) and 5.5 (Ruhenstroth) fold increase in acres with concentrations greater than 10 mg/L since last reported in 2009 (Naranjo and others, 2013).

- It has been 10 years since comprehensive sampling of rural areas in Douglas County. New data could be used to evaluate hotspots, changes in concentrations, and evaluate transport predictions.

- Develop transport models of other hot spot areas and evaluate risk to municipal wells and Carson River.