COMMENTS ON EAST SAN JOAQUIN DRAFT ORDER

Central Valley Water Board
November 30, 2012

AGUA

California Rural Legal Assistance Foundation

Clean Water Action

Community Water Center

The Need for an Effective Groundwater Program

Nitrate contamination
in Central Valley groundwater
is widespread and increasing.

Drinking water affected by nitrate contamination

92 Drinking water systems serving over 1 million residents in San Joaquin Valley (2005-8)

~60,000 private wells used by 169,000 residents in California (2010)

Consider revising Finding #17
Nitrate health effects

Acute:

- Methemoglobinemia (children < 6 months)
- Severe gastroenteritis

Chronic:

- Cancer (thyroid, stomach, colon, others)
- Impaired *in utero* growth, pre-term birth
- Birth defects
- Pancreatitis
- Nervous system defects

CUTLER, CA

Ducor, Ca

- Town of approximately 800 people, predominantly Latino farmworkers.

- Had to drill new well because of nitrate contamination.
- Cost over $1 million and had to raise water rates.
- Now rely on aquifer with high sulfur and manganese.

EAST-OROSI , CA

MONSON, CA


MONSON MARKET
COLD BEER WINE ICE GROCERY FOUNTAIN DRINKS COLD DRINKS
HOT FOOD — POOL ROOM
OPEN 7 DAYS A WEEK

RODRIGUEZ LABOR CAMP (CA CAMP), CA

Tooleville

Tonyville, CA

- **Town of approximately 150 people, predominantly Latino farmworkers.**
- **Given well water with nitrates above legal level about 3 months out of every year.**
- **Other 9 months receives treated canal water**

Voluntary practices alone are not sufficient to protect drinking water.

State & Regional Water Boards must make tough policy decisions. We need to implement solutions in regulatory programs.

Key Components of an Effective Program

- Meaningful data collection
- Monitoring
- Transparency

Clear compliance standards

- Mitigation funding mechanism

The ILRP must protect groundwater from pesticides & degradates

- The ILRP lacks legally sufficient measures to protect groundwater from pesticides
- There continues to be a tolerance for degrading groundwater that has long since evaporated in the context of surface water
- Reliance on DPR's monitoring is legally insufficient
  - There continue to be significant gaps in DPR's monitoring program
  - The Board's responsibilities to protect groundwater from pesticides coexists with DPR's it is not replaced by nor can it replace DPR's role.
- The ILRP's inadequate treatment of pesticides violates the anti-degradation policy

Nitrogen management plans lack information on actual N loading

- Increasing summary reporting from 1 to 36 square miles makes individual enforcement on the basis of water quality impossible

- Nutrient ratio reporting is a good indication of best practice implementation, but..
  – It provides no indicator of actual groundwater impacts

- Fertilizer use reporting is needed to corroborate management practice and nitrogen management reporting and assess actual loading

Accountability

- All data goes through the coalition – no direct information to inform Water Board’s enforcement program
- Enforcement based upon threats to water quality is impossible under current monitoring and reporting program

Transparency

- Executive Officer has extraordinary powers to change key components of the order without board approval or public review.

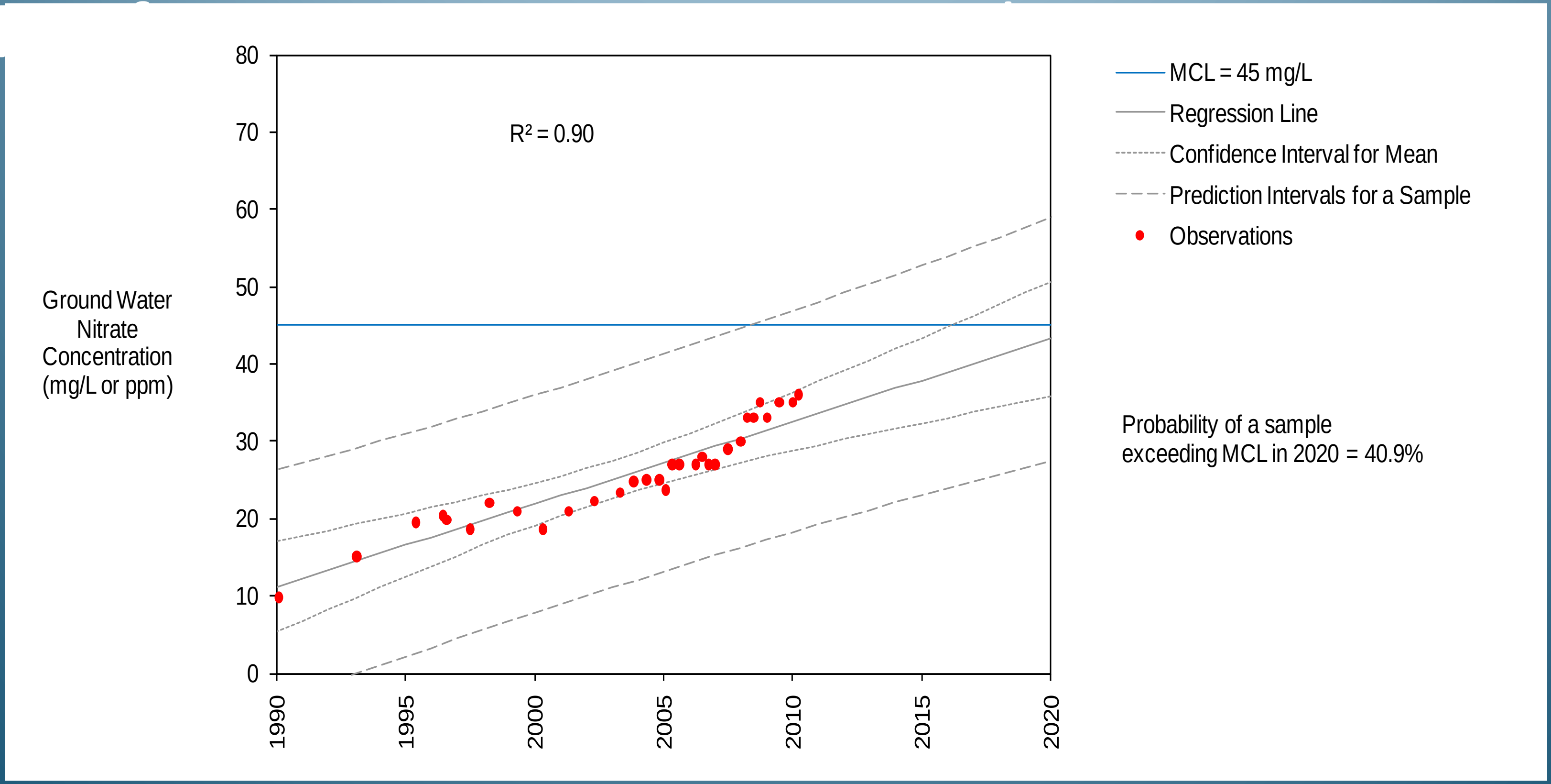
Date of Compliance is neither appropriate nor enforceable

- Does not require achievement of water quality objectives
- 10-year time frame for both surface and groundwater is arbitrary and not supported by requirements of the program
- Major components of implementation are delayed until as late as 2021

Delayed implementation allows continued degradation

- 1999 – Legislation requiring regulation of Ag discharges in passed
- 2015 – first groundwater monitoring data collected
- 2021 – first Management Practice Effectiveness reports are due
- 2024 – compliance with groundwater objectives required

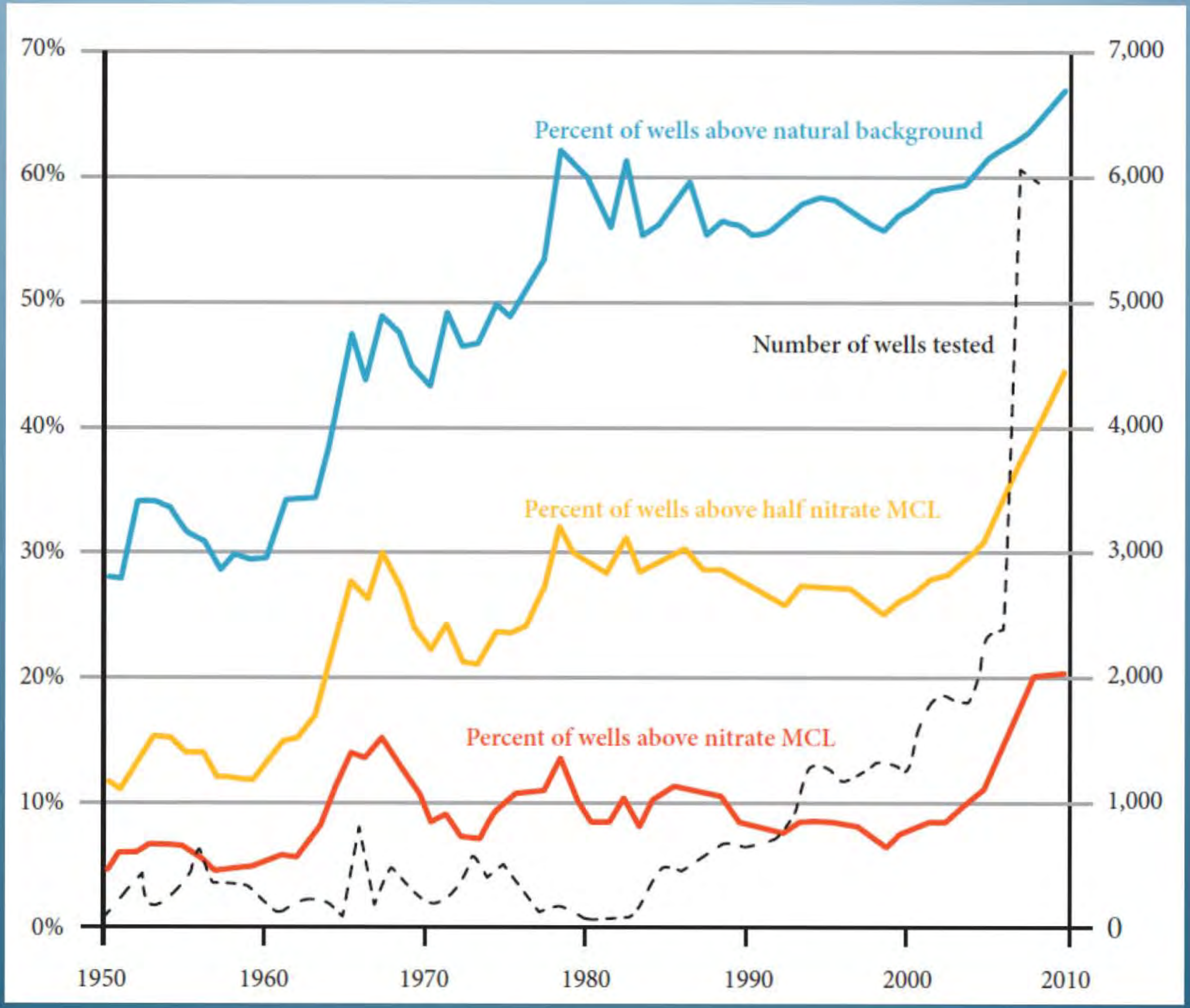
The impact of continued delay



Trend of Nitrate Levels in Monitored Wells

Kern County (1978-2010)

Pacific Institute 2010



Five-year moving average of wells for exceeding the MCL in a given year
Salinas Valley and Tulare Lake Basin
Addressing Nitrate in California's Drinking Water
UC Davis Center for Watershed Science

STATE ANTIDEGRADATION POLICY
State Water Board Resolution 68-16

Reso: 68-16 states: “highest water quality consistent with maximum benefit to the people the California”

The Water Board is being asked to approve an order that does not meet this legal requirement:
- not enforceable
- insufficient to prevent continued degradation

STATE ANTIDEGRADATION POLICY

- Requirements:
  - Sufficient information to make findings
  - Adequate mechanism to detect or identify degradation and enforce prohibitions
  - BPTC for all principal sources of degradation, for ALL high quality water

STATE ANTIDEGRADATION POLICY

Program has taken 13 years to develop and will result in continued impacts

We are willing to continue to cooperate, but we have a responsibility to the communities we represent

Agronomic Changes and Management Impacts in the Kern Sub Basin

Central Valley Regional Water Quality Control Board Workshop

Bakersfield, CA

November 30, 2012

Joel Kimmelshue, PhD

NewFields

Structure

- Nitrate Hazard Index Approach
- Past Research
- Independent Analysis
- Main Influencing Factors
  - Soil Type
  - Crop Type
  - Irrigation Method
- Conclusions

Accepted Nitrogen Impact Assessment

- Nitrate Hazard Index Approach
  - Published by the Southwestern States and Pacific Islands Regional Water Quality Program and the University of California Center for Water Resources (Universities of Arizona, California, Nevada, etc.)
  - Includes decades of research/approaches (since the 1970s)
  - National Academy of Sciences Water Science & Technology Board – Chose Hazard Index as preferred method - **"<u>It is consistent with the recommendations of the nutrient Technical Advisory Committee (TAC) appointed by the CA State Water Resources Control Board</u>."**

Plant Accumulation of Nitrogen

– Amount of N accumulated by a crop depends on:
  - Amount of N supplied by fertilizer and soil reserves
  - Genetic potential of crop to take up N
  - Growth and yield potential of crop
  - **<u>Ability to retain N in rooting zone (impacted by: soil type, crop type, irrigation method)</u>**

Mapping the Risk of Nitrate Leaching from Irrigated Fields by Use of a Nitrate Hazard Index: Case Study in the San Joaquin Valley of California

Stuart Pettygrove[1], Kristin Dzurella[1], Anna Fryjoff-Hung[2] and Allan Hollander[2],
Department of Land, Air & Water Resources[1] and Environmental Science & Policy[2], University of California, Davis, CA

Introduction

Irrigated cropland accounts for 96% of groundwater nitrate contamination in the southern San Joaquin and Salinas Valleys of California (Harter et al., 2012). Reducing nitrate leaching is primarily achieved by improving crop nitrogen use efficiency (NUE) by better matching application rates and timing of irrigation water and fertilizer to crop requirements.

The difficulty in limiting nitrate leaching from the root zone varies with the crop species, soil properties, and type of irrigation system. Under average management practices, the likelihood of high nitrate leaching loss is greater, e.g., for shallow-rooted and high-value crops that are sensitive to short-term N deficiencies; greater on highly permeable soils with low water-holding capacity; and greater under furrow irrigation compared to drip or microsprinkler irrigation.

Based on this concept, University of California scientists developed a Nitrate Groundwater Pollution Hazard Index (HI) for irrigated agriculture (Wu et al., 2005). This tool is available online to the public (see Wu et al. for web address). The HI assigns index values to crop species, soil series, and irrigation system type, which are multiplied together to produce a composite risk value.

The method allows estimation of risk severity and identification of the major factors contributing to this risk without requiring the large data set needed for more complicated assessment methods (e.g., Delgado et al., 2008, Shaffer et al., 1991). However, the HI method does not consider depth to groundwater, amount of rainfall, or the management practices in actual use on fields, such as fertilizer N rate and irrigation water applied.

In this study, we used the HI to map the risk of nitrate leaching from crop rootzones in a four-county area of the San Joaquin Valley of California. The total area analyzed was 1,318,000 ha of irrigated cropland, devoted mainly to production of grapes, deciduous tree fruits and nuts, citrus, cotton, forages, grains, and vegetables (Fig. 1).

Methods

- Crop species and irrigation type for agricultural parcels obtained from recent (1999-2006) California Department of Water Resources land use surveys for each of the four counties in the study area.
- Crop species index based on rooting depth, amount of N required, crop value, and market/product quality sensitivity to N deficiencies. Examples: Lettuce=4, alfalfa=1.
- Drip/microsprinkler with fertigation=1, without fertigation = 2, overhead sprinkler with fertigation= 2, without fertigation =3, all surface gravity systems = 4. For crops that we know are typically established with overhead sprinklers (HI=3), then switched to drip with fertigation (HI=1), we set the irrigation HI to 2.
- Soil values based on predominant soil series in SSURGO polygons. Soil index values represent the consensus of three soil scientists who considered NRCS soil series drainage and permeability characteristics, including typical pedon texture, restrictive layers and mottles (indicators of poor drainage).
- Multiply together index values for crop species, soil leaching potential, and irrigation system type to obtain composite HI value from 1 to 80 (low to high risk). Matrix is shown in Fig. 2.
- Fields with composite HI above 20 (yellow highlight in Fig. 2) are considered to be at high risk of nitrate leaching when managed with typical agronomic practices (Wu et al. 2005).
- Index values were compiled in a GIS using SSURGO polygons (soil HI values) and fields (agricultural parcels) in Department of Water Resources surveys (crop species/irrigation type HI values).

Acknowledgements

This work was funded in part by the California State Water Resources Control Board under agreement number 09-122-250. We thank Dr. John Letey and Dr. David Birkle for their helpful advice and assistance in rating soil series that were not included in the original UC Nitrate Hazard Index.

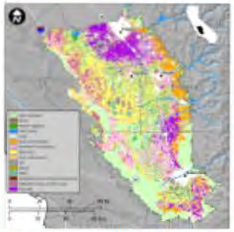


Fig. 1. Crop species in study area in southern San Joaquin Valley of California (Viers et al. 2012)

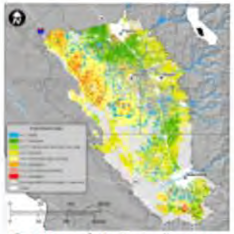


Fig. 3. Crop species by HI value. (Fresno Co., 2000; Tulare, 1999; Kings 2003; Kern 2006, Department of Water Resources surveys during summer months)

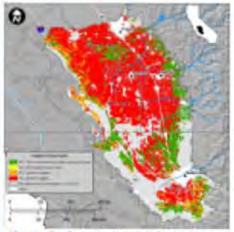


Fig. 4. Irrigation system hazard index value. Source – see Fig. 3 caption.

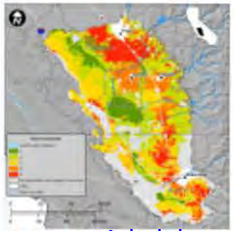


Fig. 5. Soil hazard index ... irrigated agricultural land.

Crop	Soil 1	Soil 2	Soil 3	Soil 4	Soil 5	Irrigation
1	1	2	3	4	5	1
1	2	4	6	8	10	2
1	3	6	9	12	15	3
1	4	8	12	16	20	4
2	2	4	6	8	10	1
2	4	8	12	16	20	2
2	6	12	18	24	30	3
2	8	16	24	32	40	4
3	3	6	9	12	15	1
3	6	12	18	24	30	2
3	9	18	27	36	45	3
3	12	24	36	48	60	4
4	4	8	12	16	20	1
4	8	16	24	32	40	2
4	12	24	36	48	60	3
4	16	32	48	64	80	4

Fig. 2. The University of California nitrate hazard index multiplicative matrix, with highly vulnerable situations highlighted in yellow (adapted from Wu et.al. 2005)

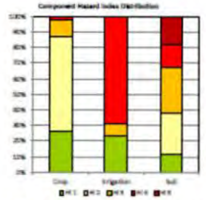


Fig. 6. Component HI values- distribution by percent of total land area in study.

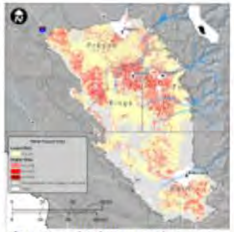


Fig. 7. Composite nitrate hazard index map.

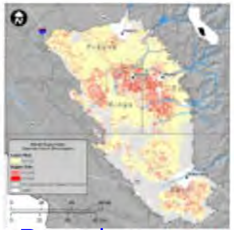


Fig. 8. ... map assuming all orchards, vineyards, and vegetable crop fields converted to drip or microsprinkler irrigation with fertigation.

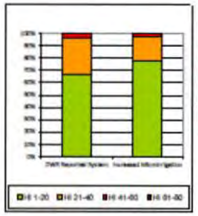


Fig. 9. Decrease in land area with high nitrate leaching risk due to conversion to drip/microsprinkler irrigation (see caption Fig. 8)

Results and Discussion

- One third (33%, 435,372 ha of 1,317,906 ha) of the basin has a composite HI > 20 and therefore is vulnerable to significant nitrate leaching if not properly managed (Fig. 7).
- Much of the study area is cropped to lower risk crop species (Fig. 3), but prevalence of higher risk surface irrigation (Fig. 4) and well-drained soils (Fig. 5) contribute to the overall 33% of area at risk (Fig. 6).
- Corn (mainly for silage) and vegetable production, as well as surface irrigated trees and field crops grown on high-risk soils account for the majority of this area.
- Conversion of fruit, nut, and vegetable crops to drip or microsprinkler irrigation from the earlier (1999-2006) adoption levels would decrease the area vulnerable from 33% to 22% of the area analyzed (Figs. 8 and 9).
- Significant conversion of cropland to drip/microsprinkler irrigation has occurred since the surveys used in this study were conducted in 1999-2006, and therefore the actual situation in 2012 falls between the two maps shown in Figs. 7 and 8.
- A large proportion of the cropped area remaining at risk of nitrate leaching loss after such a conversion is used to produce silage corn and other forages, which typically receive applications of dairy manure and are irrigated by furrow or border methods. We note that in Tulare Co. (east-center of study area), dairy farmers milked approximately 500,000 cows (2010), which produced more milk than any other county in the US.

References

Delgado, J.A., M. Shaffer et al. 2008. An index approach to assess nitrogen losses to the environment. Ecological Engineering 32: 108–120.

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Shaffer, M.J., A.D. Halvorson, and F.J. Pierce. 1991. Nitrate leaching and economic analysis package (NLEAP): Model description and application. p. 285-322 In R.F. Follett, D.R. Keeney, and R.M. Cruse (ed.) Managing nitrogen for groundwater quality and farm profitability. ASA, CSSA, and SSSA, Madison. WI, pp. 285–322.

Viers, J.H., D. Liptzin, et al. 2012. Nitrogen sources and loading to groundwater. Technical Report 2 In Addressing nitrate in California's drinking water with a focus on Tulare Lake Basin and Salinas Valley groundwater. Report for the State Water Resources Control Board Report to the Legislature. Center for Watershed Sciences, University of California, Davis. http://groundwaternitrate.ucdavis.edu

Wu, L., J. Letey, C. French, Y. Wood, and D. Birkle. 2005. Nitrate leaching hazard index developed for irrigated agriculture. J Soil Water Conservation 60(4): 90–95. Online version of UC nitrate hazard index: http://ucanr.edu/sites/wrc/Programs/Water_Quality/Nitrate_Groundwater_Pollution_Hazard_Index/

Southern San Joaquin Valley Nitrate Hazard Index Approach

Soil, Crop and Irrigation Methods approach used to create relative Nitrate Hazard Index

Spatial Data Sources: DWR Crop Mapping - (Fresno Co., 2000; Tulare, 1999; Kings 2003; Kern 2006)

Crop	Soil 1	Soil 2	Soil 3	Soil 4	Soil 5	Irrigation
1	1	2	3	4	5	1
1	2	4	6	8	10	2
1	3	6	9	12	15	3
1	4	8	12	16	20	4
2	2	4	6	8	10	1
2	4	8	12	16	20	2
2	6	12	18	24	30	3
2	8	16	24	32	40	4
3	3	6	9	12	15	1
3	6	12	18	24	30	2
3	9	18	27	36	45	3
3	12	24	36	48	60	4
4	4	8	12	16	20	1
4	8	16	24	32	40	2
4	12	24	36	48	60	3
4	16	32	48	64	80	4

Pettygrove, et al, 2012

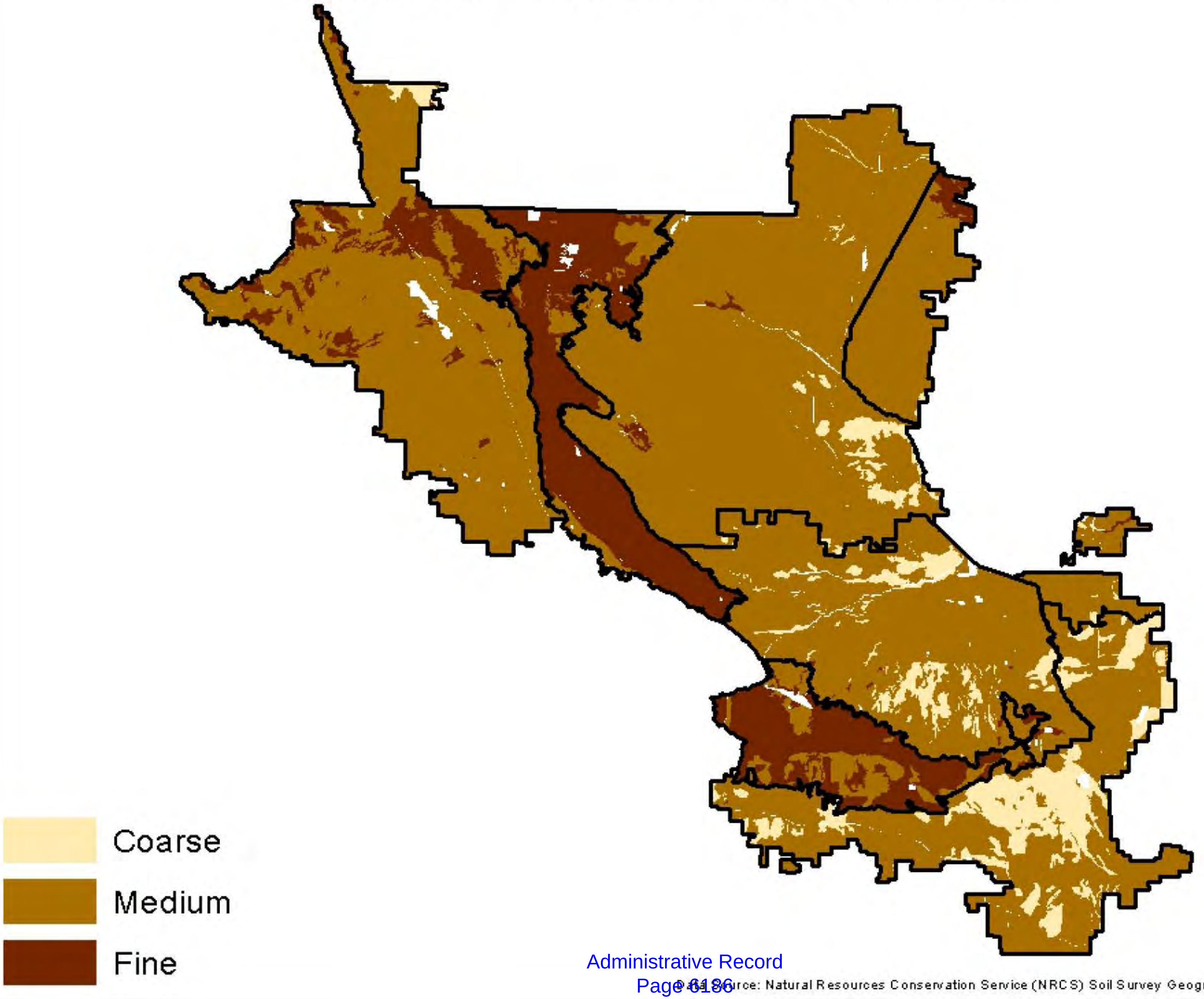
Southern San Joaquin Valley Nitrate Hazard Index Conclusions - Pettygrove, et al, 2012

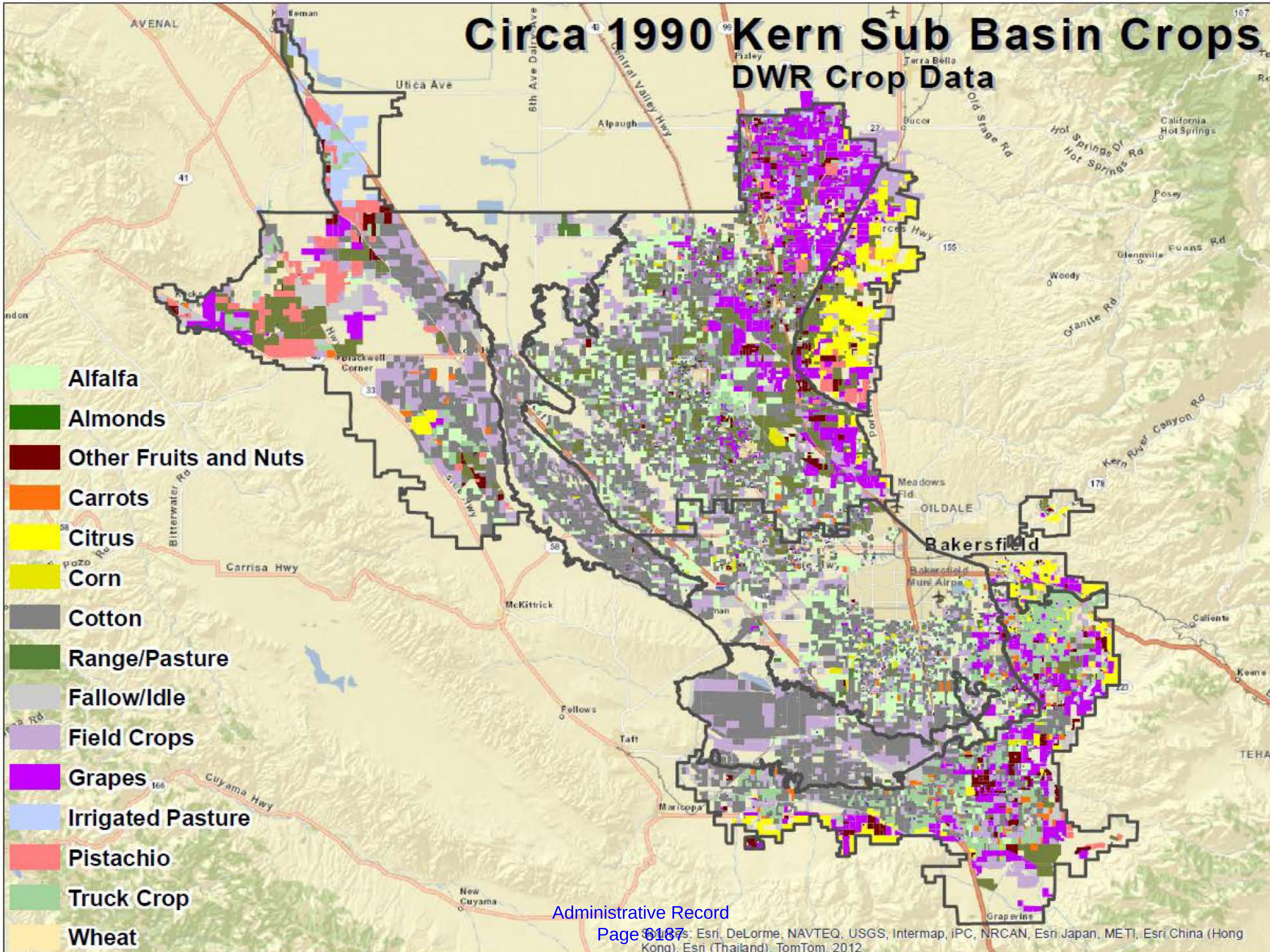
- 33% of basin has a significant N leaching potential
- That 33% is driven by gravity/surface irrigation practices on various crops and well-drained soils
- Conversion to drip/micro systems would result in a low leaching potential (Nitrate Hazard Index) for certain crops
- Significant conversion to these systems has occurred since the DWR 1999-2006 base layers (crop type and irrigation methods) were used.
- Following conversion, a large area remaining at risk is silage corn and other forages, receiving dairy manure applications via furrow or border-check methods.

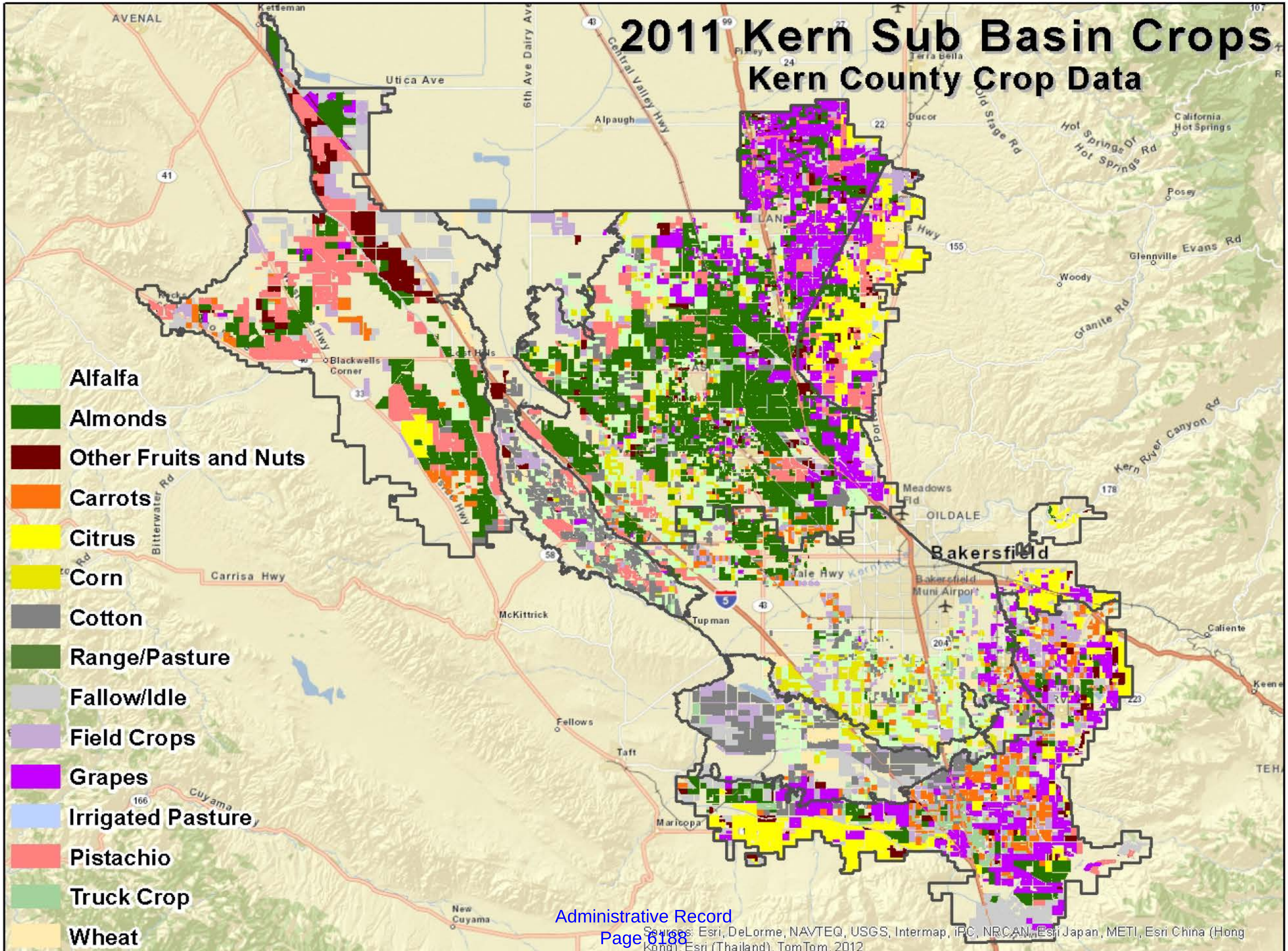
Independent Analysis

- Focuses on Kern Sub Basin area only
- Uses Kern Sub Basin specific information
  - recent (2011) Kern County crop coverage
  - local climatic conditions
  - local irrigation methods
  - local agronomic knowledge specific to the Kern Sub Basin obtained from Blake Sanden and others
- Performed analysis for representative scenarios in the Kern Sub Basin area
- Our analysis aligns well in approach and enhances conclusions of Pettygrove, et al. 2012 and other researchers

Kern Sub Basin Generalized Soil Textures




Circa 1990 Kern Sub Basin Crops
DWR Crop Data
Alfalfa
Almonds
Other Fruits and Nuts
Carrots
Citrus
Corn
Cotton
Range/Pasture
Fallow/Idle
Field Crops
Grapes
Irrigated Pasture
Pistachio
Truck Crop
Wheat
AVENAL
Utica Ave
Alpaugh
Central Valley Hwy
Pixley
Terra Bella
Ducor
Old Stage Rd
Hot Springs Dr
Hot Springs Rd
California Hot Springs
Posey
Glennville
Woody
Granite Rd
Kern River Canyon Rd
Meadows Fld
OILDALE
Bakersfield
Caliente
Keene
Carrisa Hwy
Bitterwater Rd
McKittrick
Fellows
Taft
Maricopa
Cuyama Hwy
New Cuyama
Grapevine
Blackwell Corner
Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012



Administrative Record
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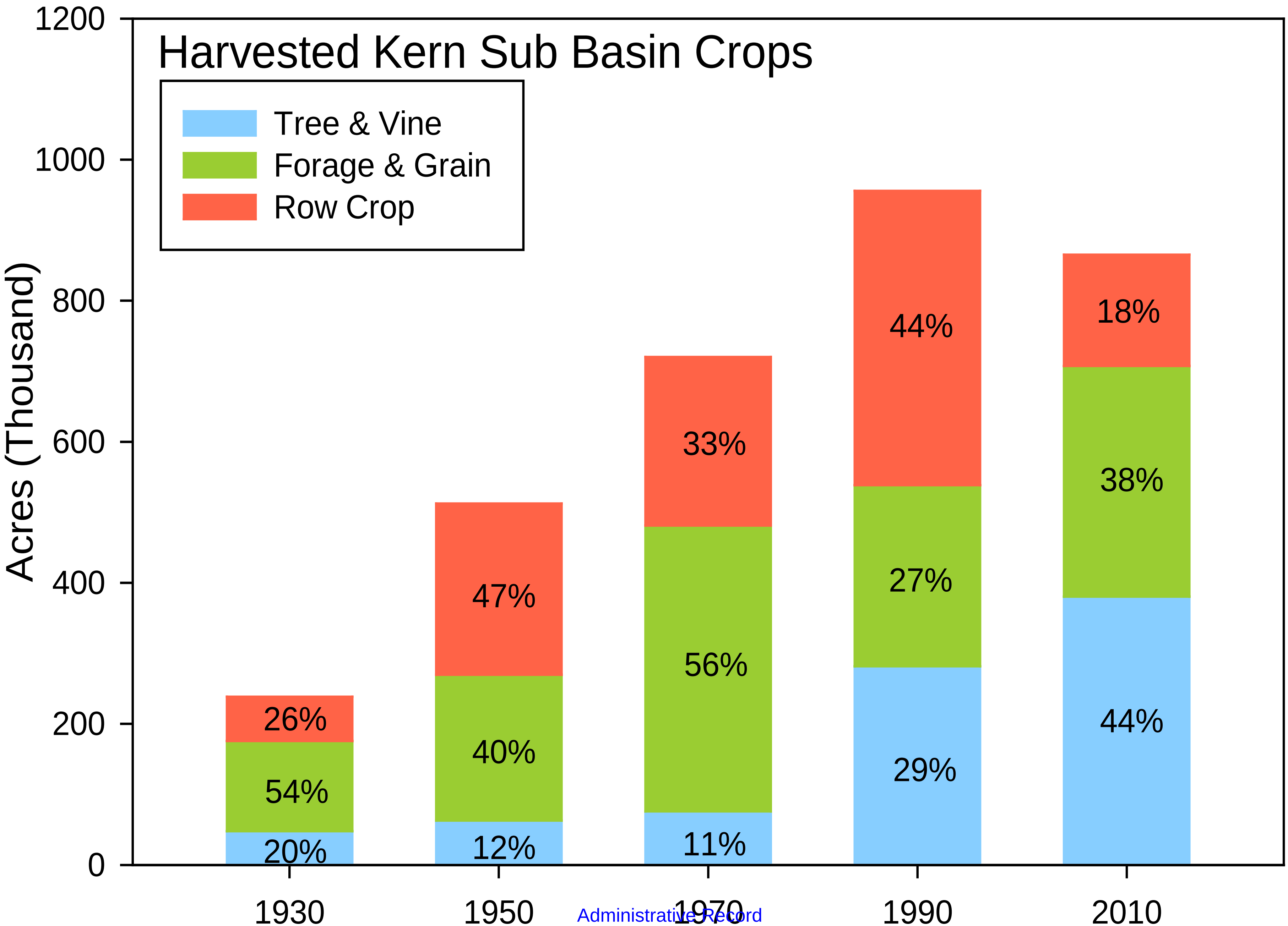
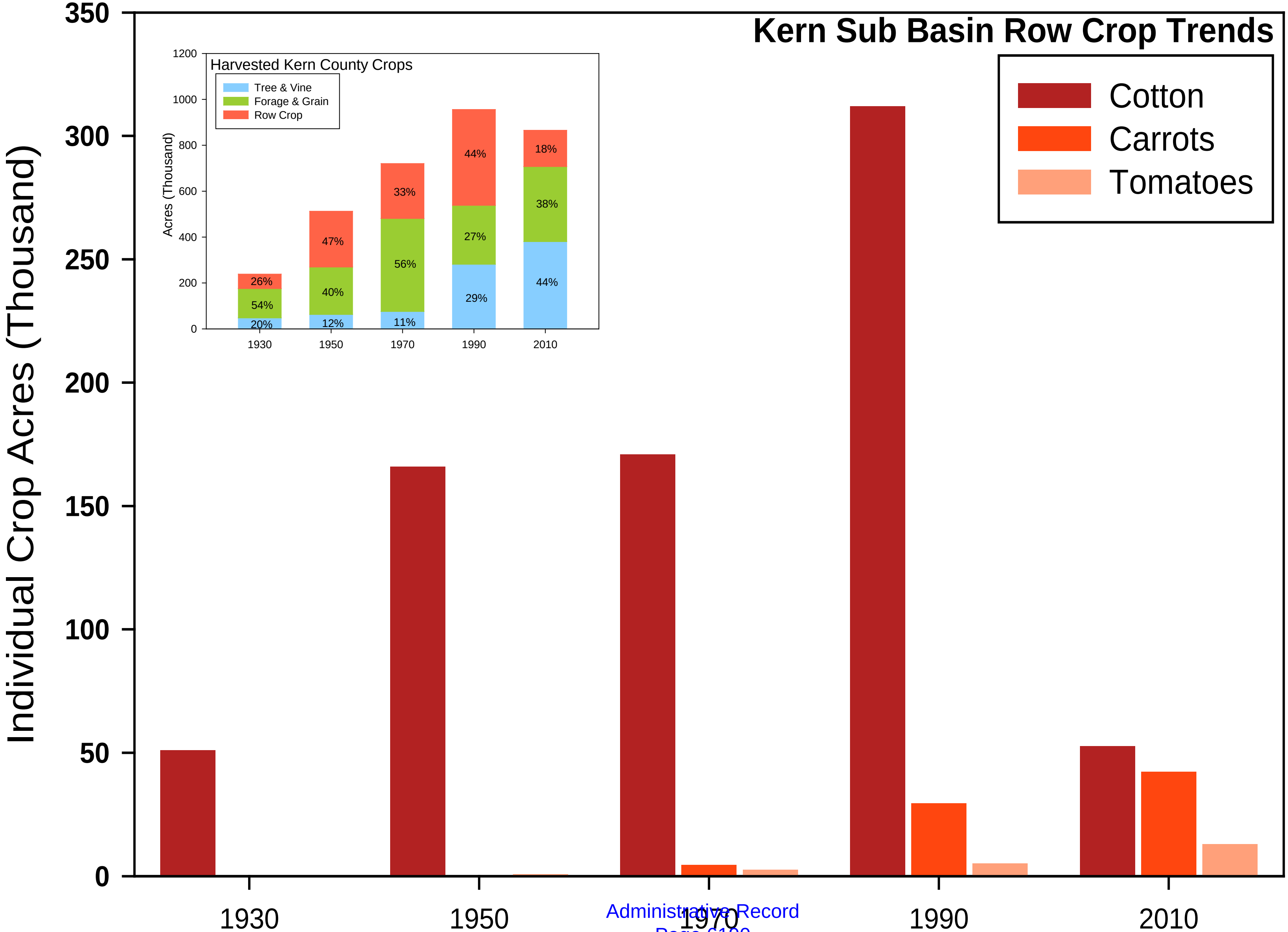
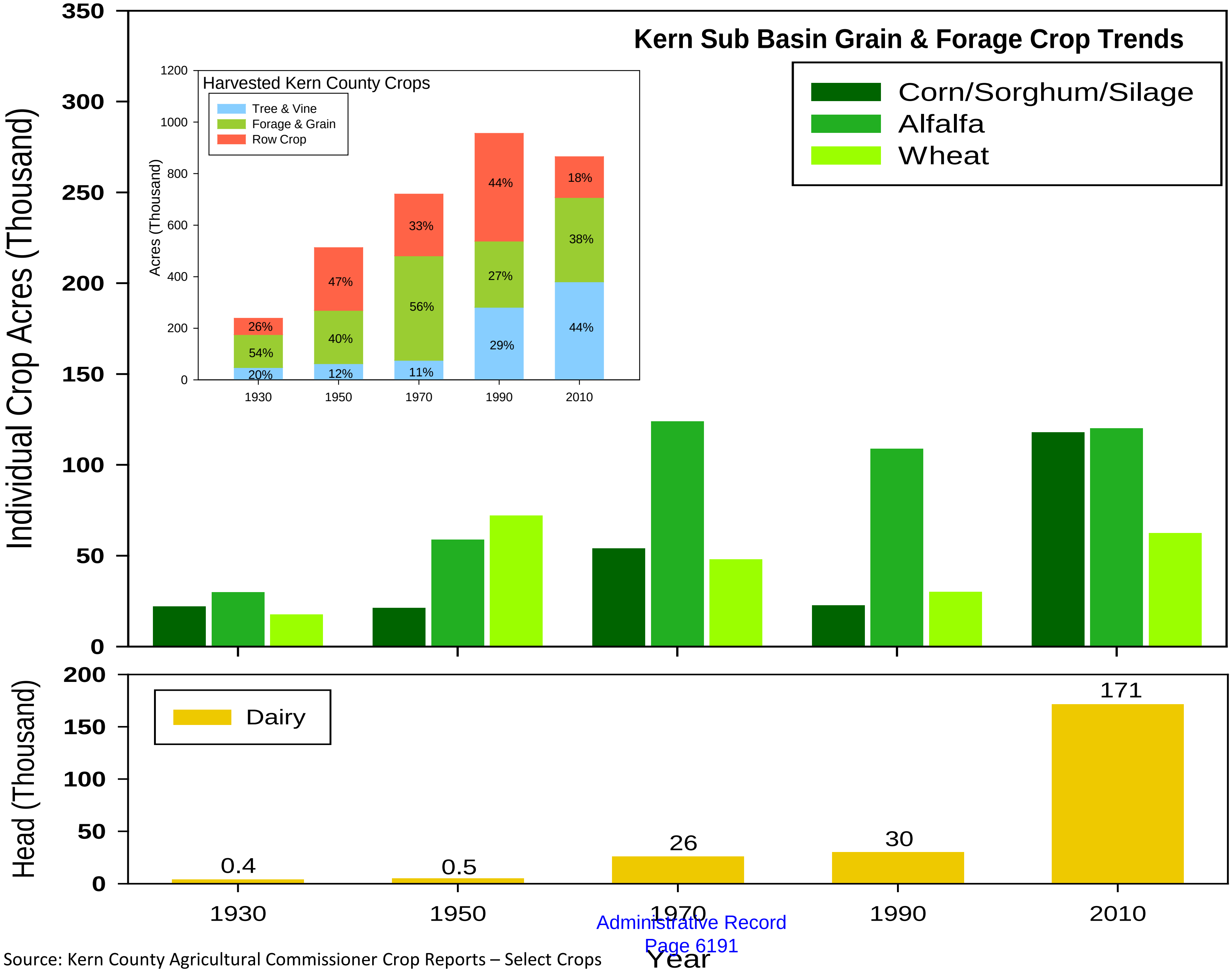


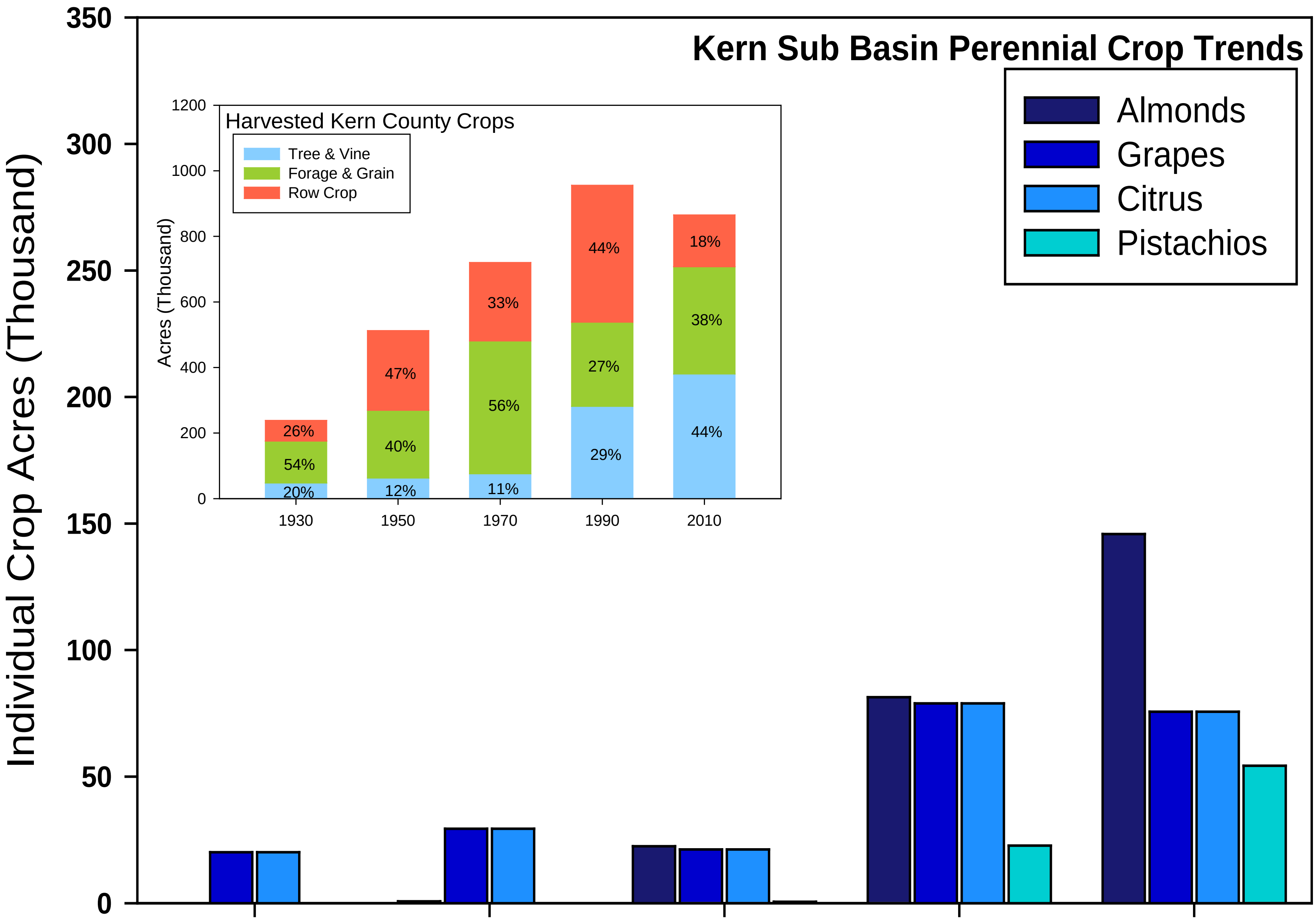
Source: Kern County Agricultural Commissioner Crop Reports – Does not include fallow land,1st leaf orchards and is Kern County only



Source: Kern County Agricultural Commissioner Crop Reports – Select Crops

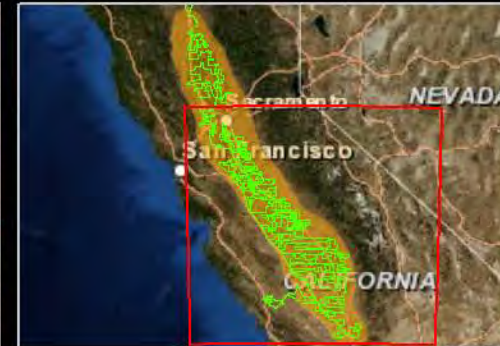


Source: Kern County Agricultural Commissioner Crop Reports – Select Crops



Source: Kern County Agricultural Commissioner Crop Reports – Select Crops

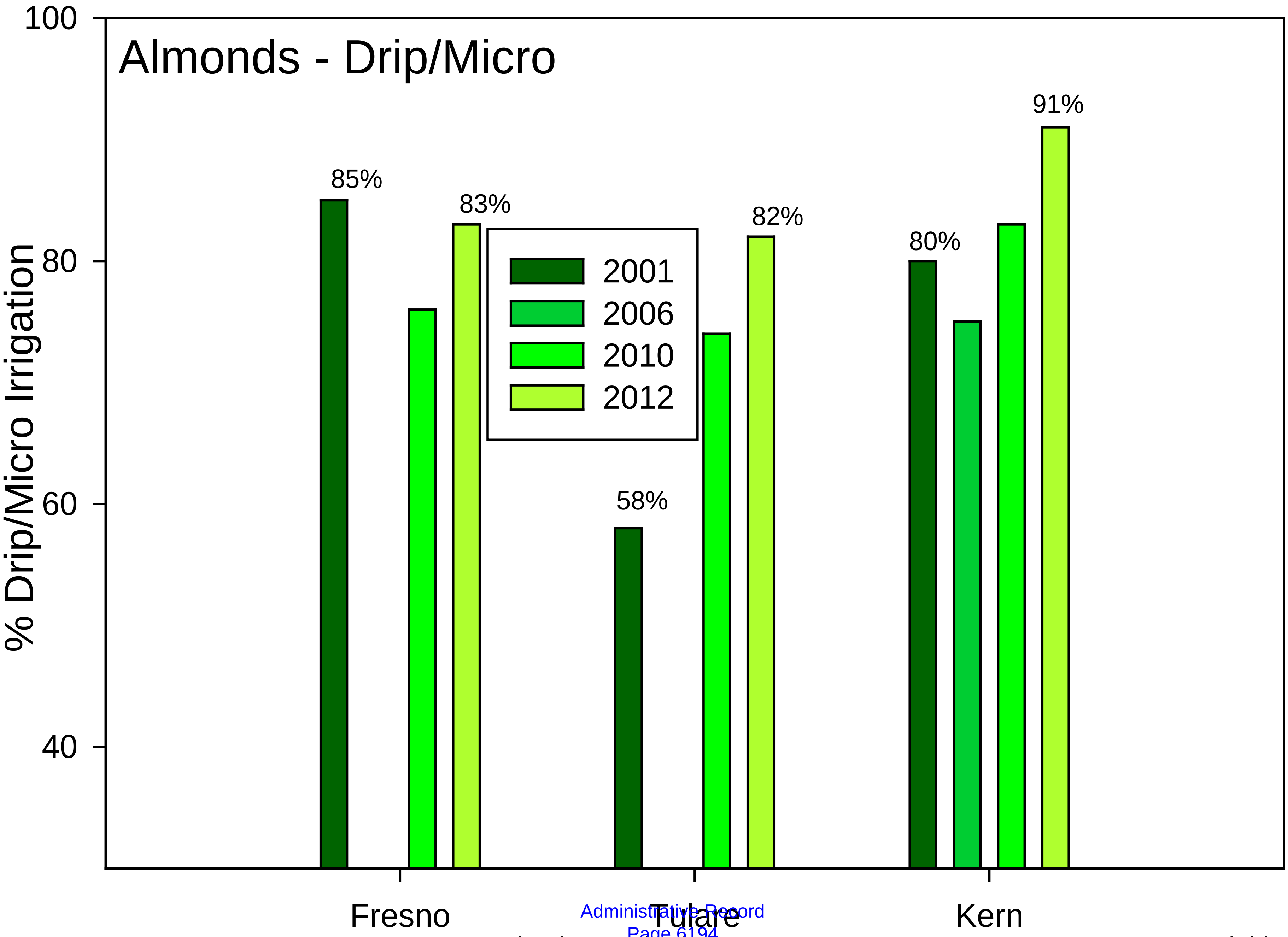
Central Valley - Spatial and Spectral Crop Library (2012)



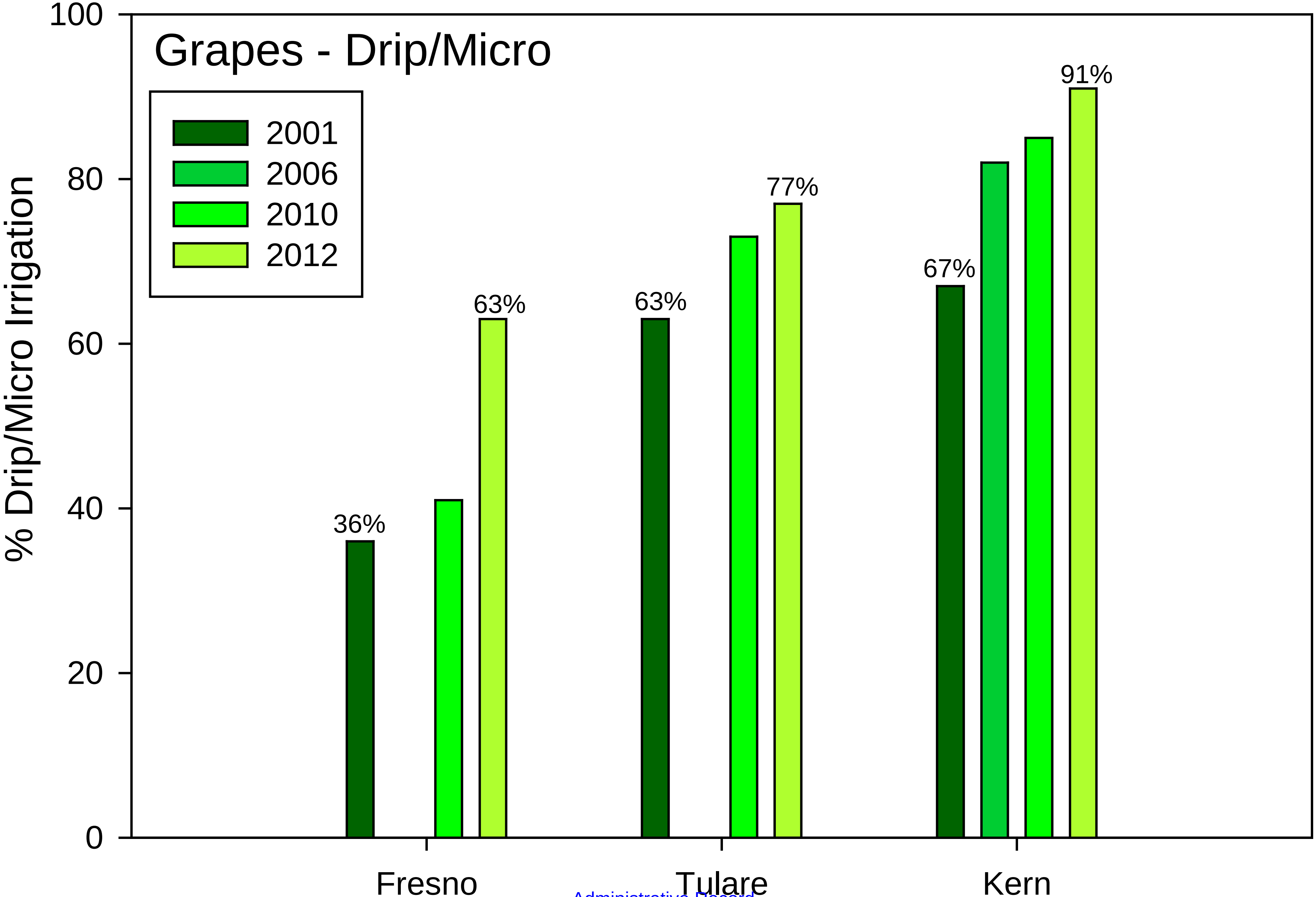
Map Legend

- 2012 Crop Library Locations
- Crop Ground Truth Route
- Central Valley Extent

Crop Attributes



Data Source: 2001, 2010 DWR Irrigation Method Surveys, 2006 DWR Crop Survey, 2012 NewFields



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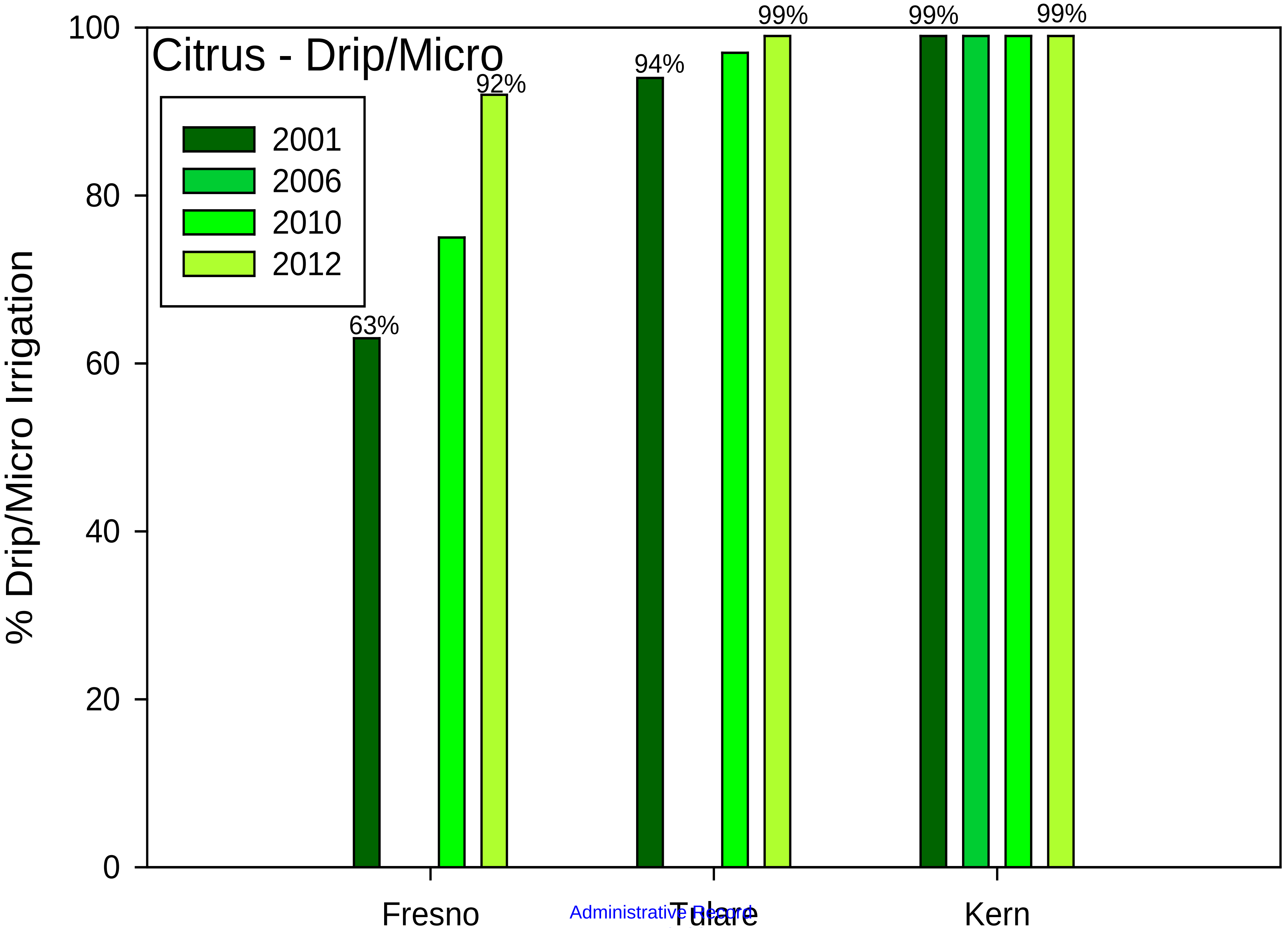
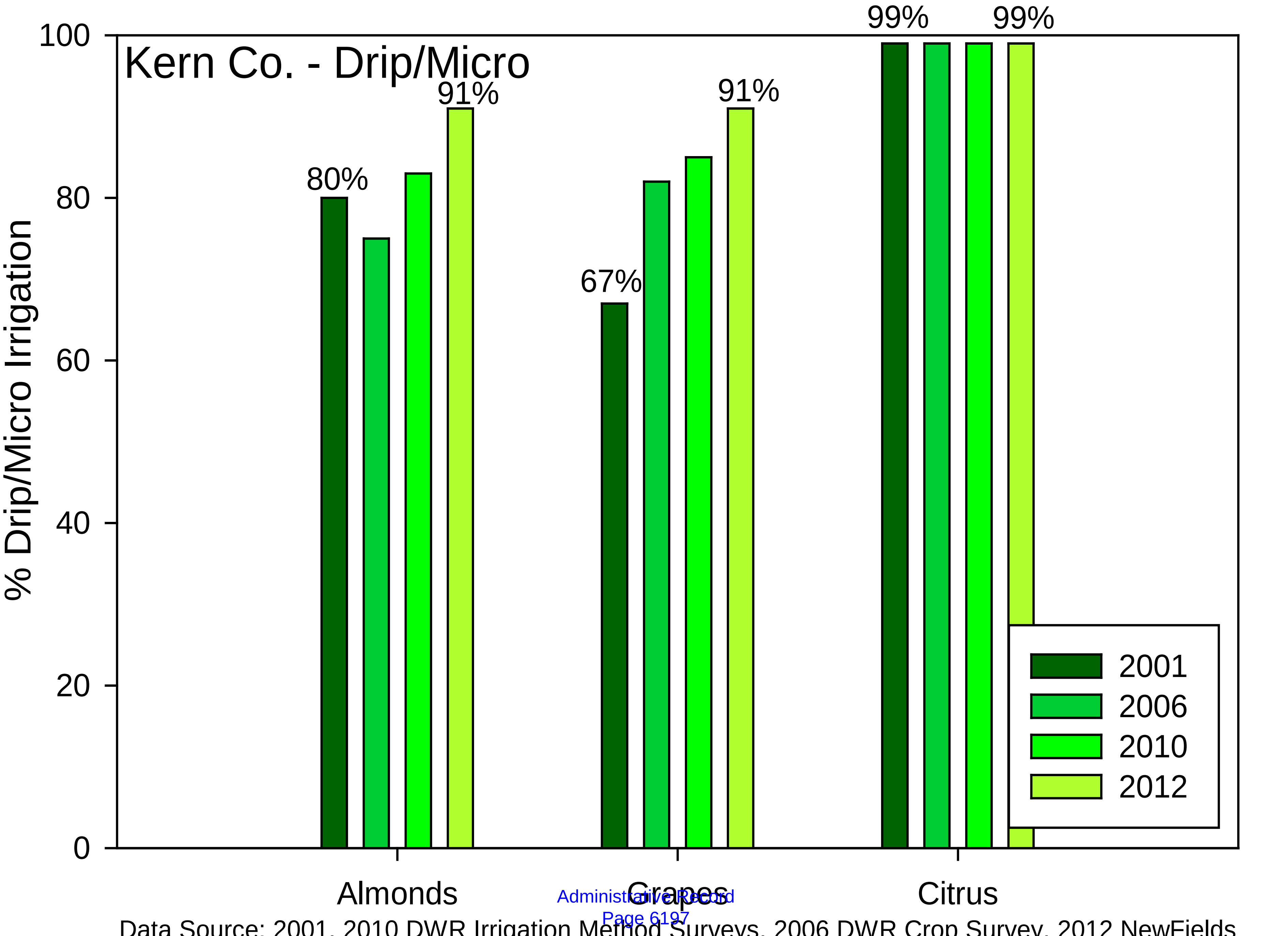


Data Source: 2001, 2010 DWR Irrigation Method Surveys, 2006 DWR Crop Survey, 2012 NewFields


Kern Co. - Drip/Micro
% Drip/Micro Irrigation
100
80
60
40
20
0
80%
91%
67%
91%
99%
99%
Almonds
Grapes
Citrus
2001
2006
2010
2012
Data Source: 2001, 2010 DWR Irrigation Method Surveys, 2006 DWR Crop Survey, 2012 NewFields

Conclusions of Analysis

- Nitrate Hazard Index Approach
  - Universally accepted as qualitative method to estimate nitrate leaching hazard
  - Work performed recently by UC Davis (e.g. Pettygrove, et al, 2012) was unable to use current (2011/2012) land use and irrigation practices
  - It was not the purpose of this work to review historic trends/future projections
- Increase in Permanent Crops
  - Deep rooted permanent crops account for approximately 45-50% of the crop mix within the Kern Sub-Basin as of 2011 and continue to increase in plantings
  - Of these crops (almonds, pistachios, grapes, citrus, pomegranates, etc.), over 90% are irrigated with drip/micro systems and result in limited return flow to groundwater.
  - These changes have resulted in a significant reduction in the nitrate leaching hazard to groundwater over time
  - Similar conclusions were reached by other researchers

Conclusions of Analysis

- Increase in Dairy
  - Approximately one-third (30-35%) of remaining acreage is mostly associated with dairies (corn silage, alfalfa, sorghum, sudan grass, etc.)
  - This land base/crop type is separately regulated
- Decrease in Non-Dairy Related Field and Row Crops
  - Over the past 20+ years, perennial fruit and nut crops, along with dairies have significantly replaced field and row crops.
  - The remaining crops (15-25%) consist of cotton, carrots, potatoes, truck crops and other field and row crops
- Irrigation and N Use Efficiencies in Kern Sub Basin are likely the highest in the Central Valley
- Conditions in Kern Sub Basin are different than other areas of the Valley and it would appear to warrant consideration of a different regulatory approach

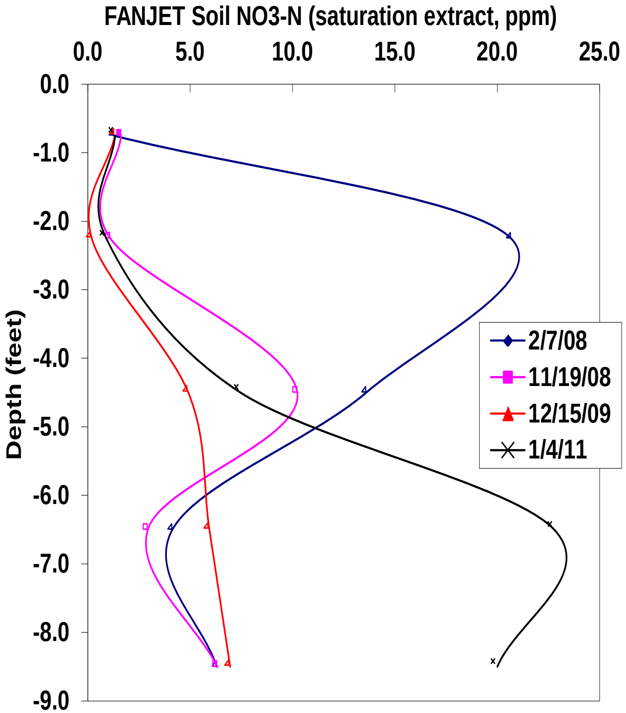
CVRWQCB Workshop on ILRP
Bakersfield 11/30/12

Blake Sanden – Irrigation Advisor, Kern County

UCCE 1031 S. Mt. Vernon Ave, Bakersfield CA 93307

blsanden@ucdavis.edu

http://cekern.ucdavis.edu/Irrigation_Management/



Nitrogen use efficiency (NUE) in 5 year Kern almond trial:
1) Efficiency of N retained in soil

LEACHING FRACTION ESTIMATE (from Cl concentration at depth)				Estimated Nitrogen Use Efficiency, NUE (Sanden)			
2/7/08	11/19/08	12/15/09	1/4/11	2/7/08	11/19/08	12/15/09	1/4/11
0.50	0.36	0.24	0.76	97%	97%	99%	96%
0.12	0.16	0.13	0.60	89%	99%	100%	98%
0.07	**0.05**	**0.07**	0.08	**96%**	**98%**	**98%**	97%
0.23	0.18	0.11	**0.07**	96%	98%	97%	**93%**
0.28	0.28	0.27	0.17	92%	92%	92%	85%
(Average Cl_{irrig} concentration = 2.2 meq/l. Total Cl @ 950 lb/yr)							

Nitrogen use efficiency (NUE) in 5 year almond trial:
2) NUE by crop export

3 Year Average Kernel Yield (2009-11): 3,743 lb/ac

Annual N Fertilizer Application: 275 lb/ac

Annual N Export from Crop: 246 lb/ac

3 Year Average NUE: 89.6%

Paramount Farming Company ranch-wide average applied water and soil NO3-N concentrations from 2008-12 (Note: applied water is for the whole year and less than CIMIS calculated ET for almonds)

	Almond Mature	Almond Dvlpt
EASTSIDE		
[1]Avg Applied Water	43.0	25.8
Acres	13,582	835
[2]0-4 ft Avg Soil NO3-N	5.7	--
[3]No. of samples	324	
WESTSIDE		
Avg Applied Water	48.2	0.0
Acres	22,960	0
0-4 ft Avg Soil NO3-N	4.0	--
No. of samples	700	
ALL PFC		
Avg Applied Water	**46.3**	**25.8**
Acres	**36,542**	**835**
0-4 ft Avg Soil NO3-N	**4.5**	**--**
No. of samples	**1,024**	

[1]Weighted 2008-2012 average annual applied water by PFC division

[2]Not all fields sampled. Some fields sampled in more than one location. Mature or development (immature) status not designated. All locations sampled in 12" increments to 4 feet. Thus, total number of field locations = No. of samples/4.

[3]Total number of samples in one foot increments from either 2011 or 2012 when the most number of samples were taken.

THE SOURCE GROUP, INC.

COMMENTS ON HYDROGEOLOGIC POINTS OF CONCERN FOR THE KRWCA AREA

IRRIGATED LANDS REGULATORY PROGRAM

November 30, 2012

Robert M. Gailey, P.G., C.HG.

PRESENTATION OUTLINE

- UNIQUE ASPECTS OF THE KRWCA AREA
- SUMMARY OF POINTS REGARDING DRAFT ORDER GROUNDWATER MONITORING PROGRAM
- DETAILS OF SELECTED TECHNICAL POINTS

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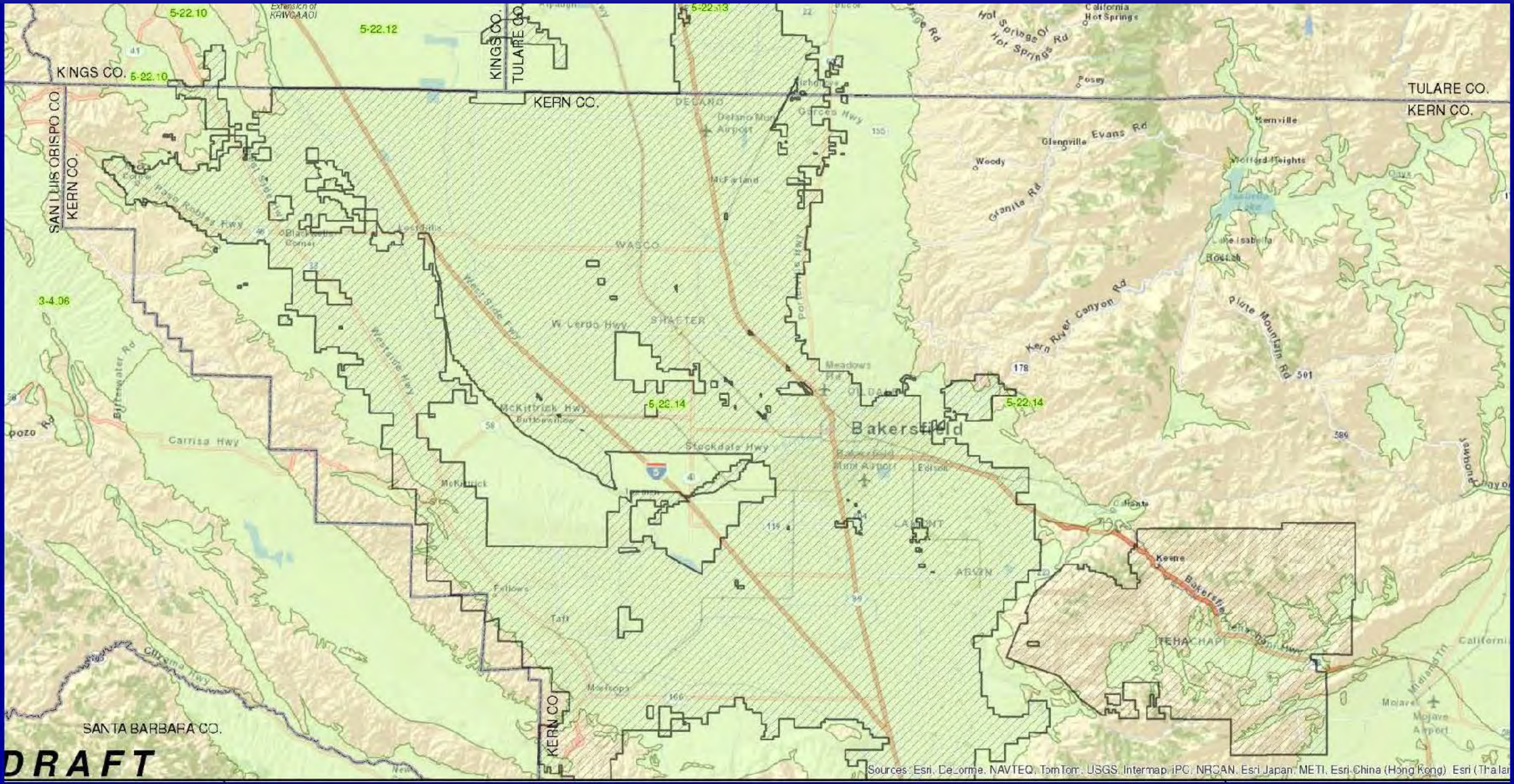
KRWCA AREA



KINGS CO.
KERN CO.
TULARE CO.
KINGS CO.
TULARE CO.
KERN CO.
SAN LUIS OBISPO CO.
KERN CO.
SANTA BARBARA CO.
KERN CO.
5-22.10
5-22.12
5-22.13
5-22.14
3-4.06
Bakersfield
DRAFT
Sources: Esri, DeLorme, NAVTEQ, TomTom, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand)

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
- Significant Depth to Water
- Nitrate Impact Less Pronounced

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
  - Water quality impacts from nitrogen accumulate unless denitrification occurs
  - Impacts from both past and present activities
  - Impacts from all industries – not just crop agriculture

- Groundwater Use and Management Operations

- Significant Depth to Water

- Nitrate Impact Less Pronounced

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
  - Extraction from water supply wells
  - Significant recharge operations
  - Potential to move water around subbasin
- Significant Depth to Water
- Nitrate Impact Less Pronounced

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
- Significant Depth to Water
  - Depth varies across area
  - Areas where depth is greater than to north
- Nitrate Impact Less Pronounced

AVERAGE DEPTH TO GROUNDWATER

- Analysis of DWR Data from North to South

• East San Joaquin Watershed	88 feet
• Kings Subbasin	87 feet
• Kaweah Subbasin	102 feet
• Tulare Lake Subbasin	77 feet
• Tule Subbasin	159 feet
• Kern Subbasin	219 feet

Note: Calculation of averages included data declustering at the township-range level

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
- Significant Depth to Water
- Nitrate Impact Less Pronounced
  - Quality of first-encountered groundwater
  - Appears better than to north

UC DAVIS NITRATE STUDY
ASSESSMENT OF NITRATE IMPACTS

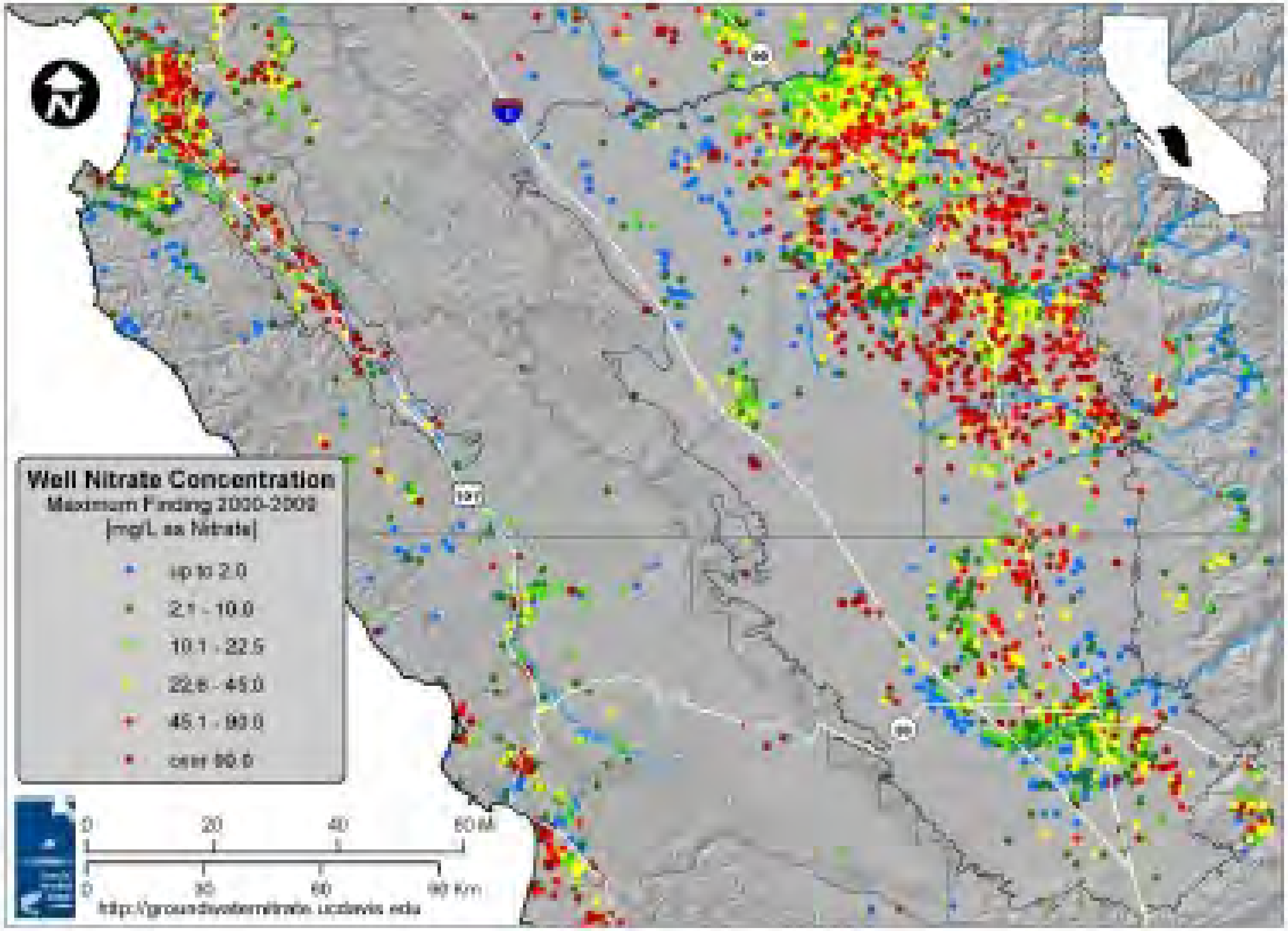
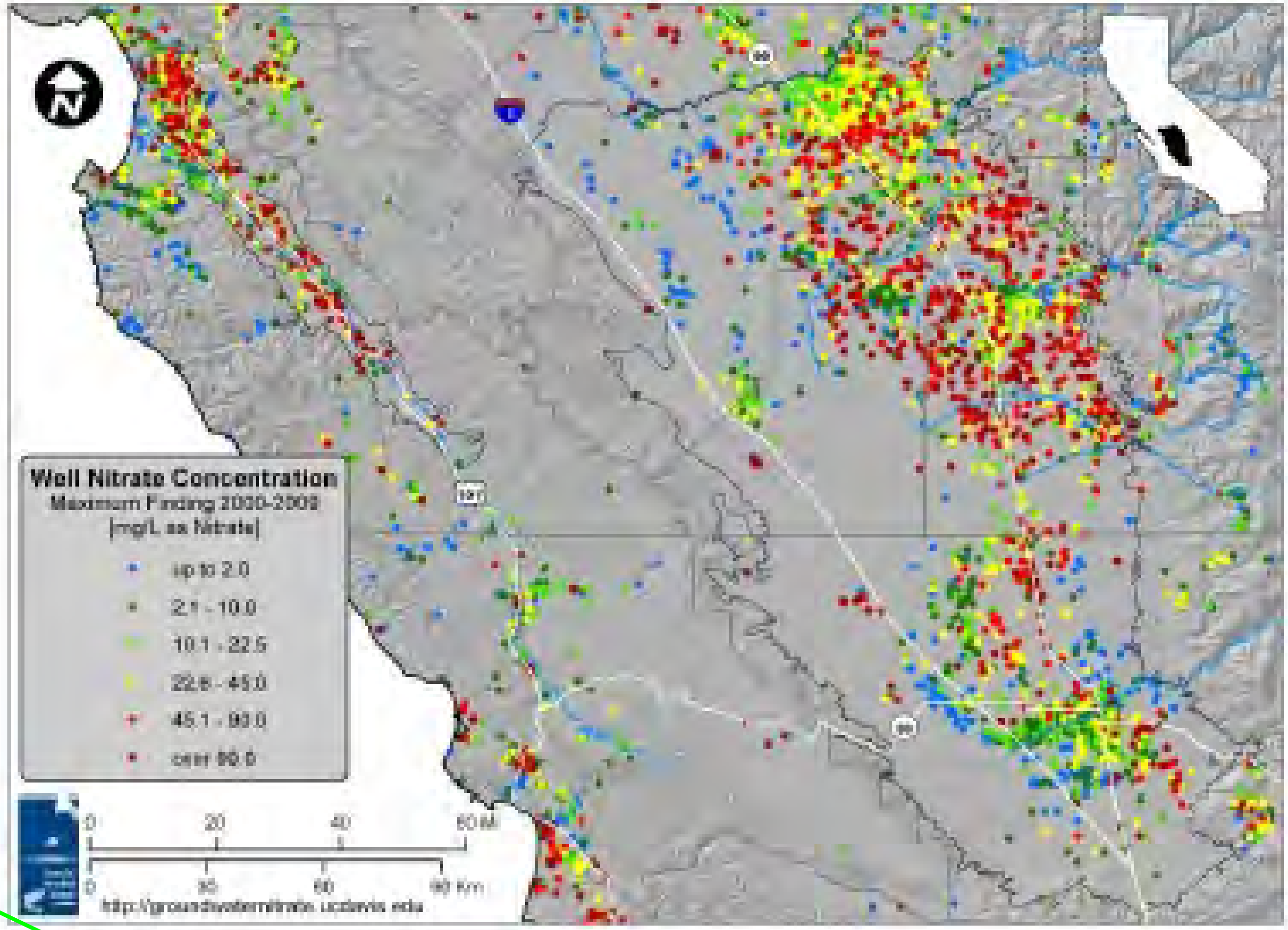


Figure 42. Maximum concentration of nitrate in wells with at least one sample during the decade 2000 to 2010

UC DAVIS NITRATE STUDY
ASSESSMENT OF NITRATE IMPACTS



Worst Case

Figure 42. Maximum concentration of nitrate in wells with at least one sample during the decade 2000 to 2010

PRESENTATION OUTLINE

- UNIQUE ASPECTS OF THE KRWCA AREA
- SUMMARY OF POINTS REGARDING DRAFT ORDER GROUNDWATER MONITORING PROGRAM
- DETAILS OF SELECTED TECHNICAL POINTS

SUMMARY OF POINTS

Preliminary Findings

- There are likely to be complexities (i.e. time lags) associated with interpreting groundwater quality data in the KRWCA area.

- Implementing a large-scale monitoring program before the complexities are explored could result in significant unnecessary costs.

- Further study or an interim regulatory step would increase the likelihood that the monitoring will meet the intent of the order.

PRESENTATION OUTLINE

- UNIQUE ASPECTS OF THE KRWCA AREA
- SUMMARY OF POINTS REGARDING DRAFT ORDER GROUNDWATER MONITORING PROGRAM
- DETAILS OF SELECTED TECHNICAL POINTS

SELECTED POINTS

1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.

2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface.

3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

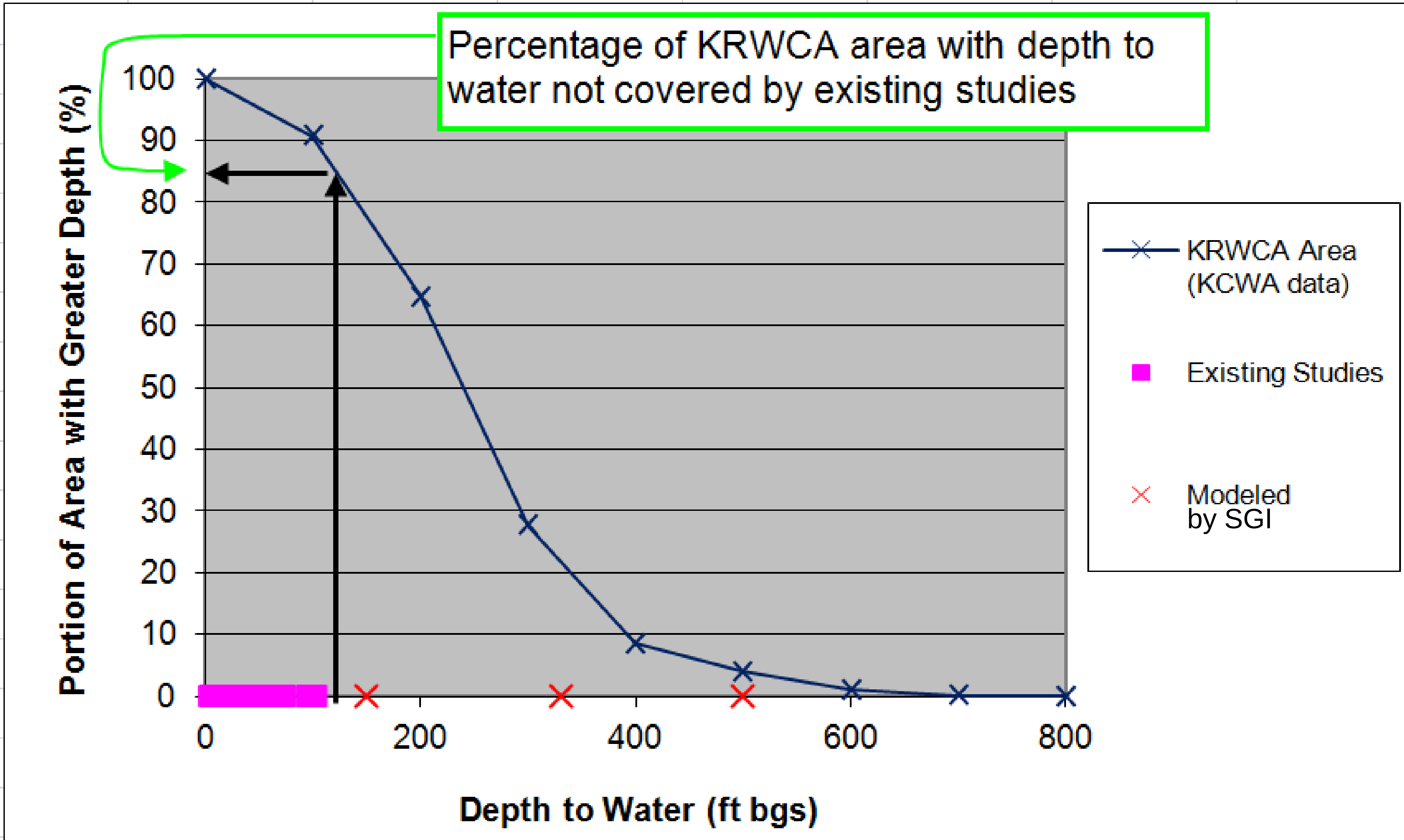
SELECTED POINTS

1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.

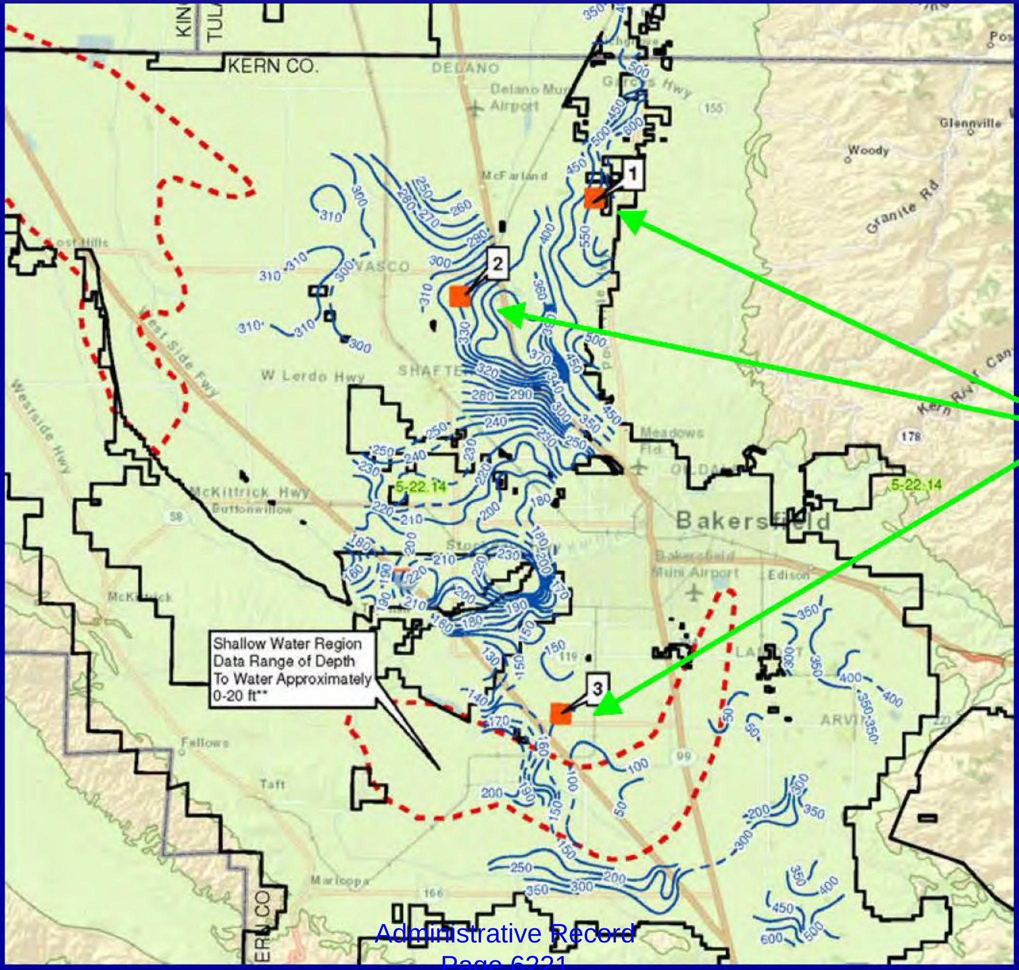
2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface.

3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

DEPTH TO WATER OVER KRWCA

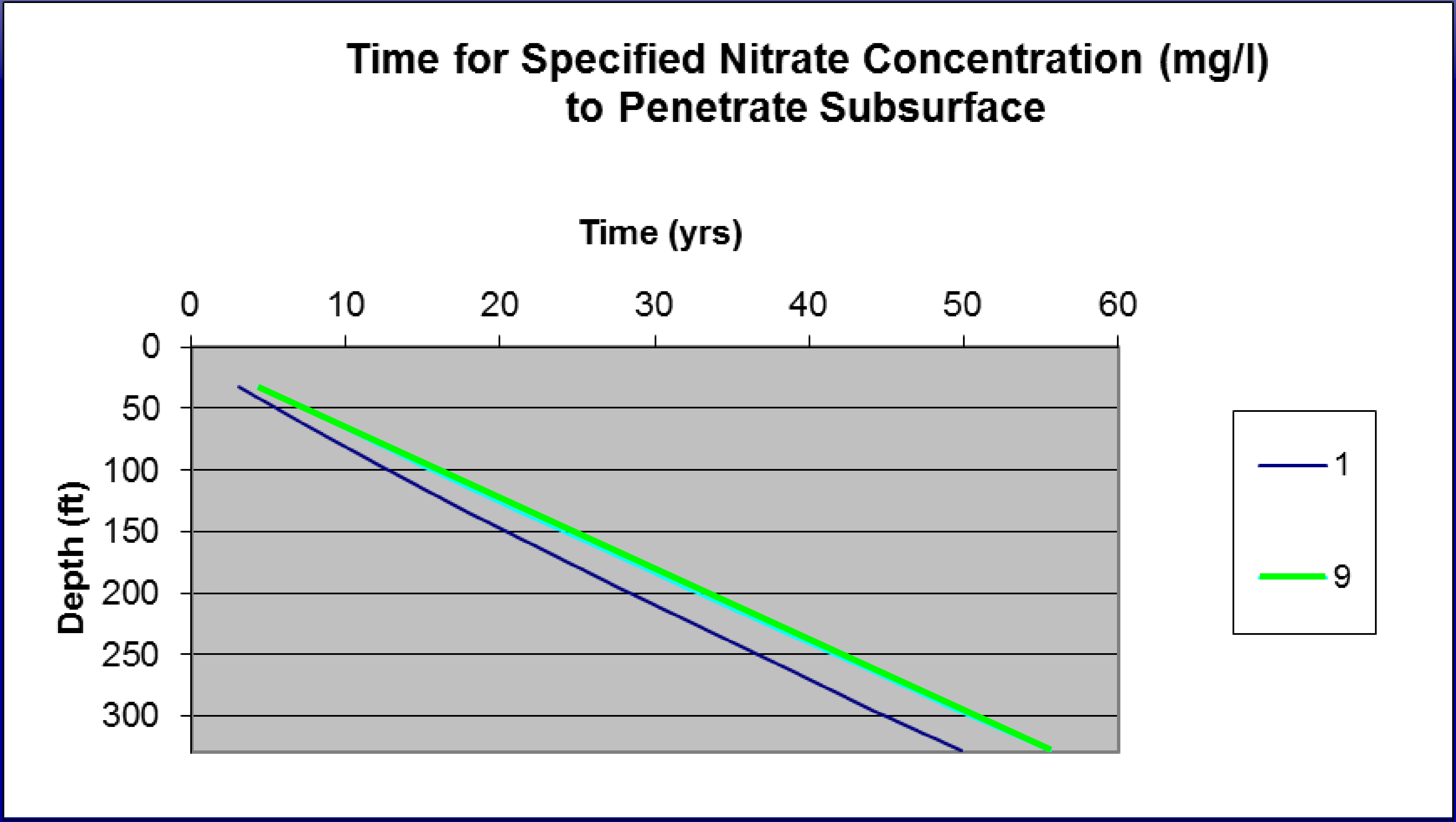


REPRESENTATIVE SITES MODELED



Preliminary modeling performed by SGI includes site-specific unsaturated zone stratigraphy.

MODELING RESULTS (Middle Depth - 330’)



Almonds, Drip/Micro, Coarse Soil, Interlayed Clay & Sand

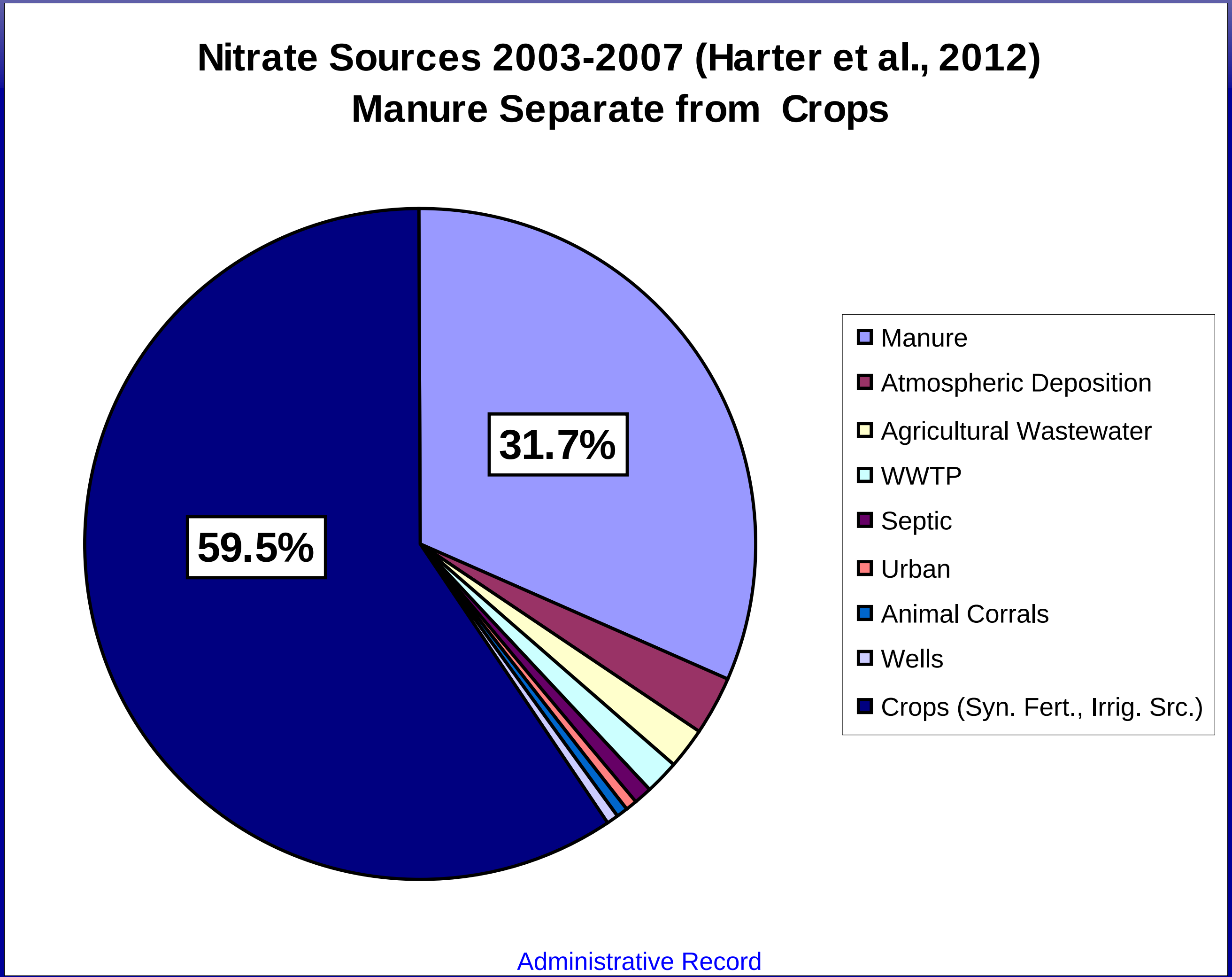
SELECTED POINTS

1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.

2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface. <u>Thus, addressing current farming practices through this proposed regulation will have little affect on this legacy issue.</u>

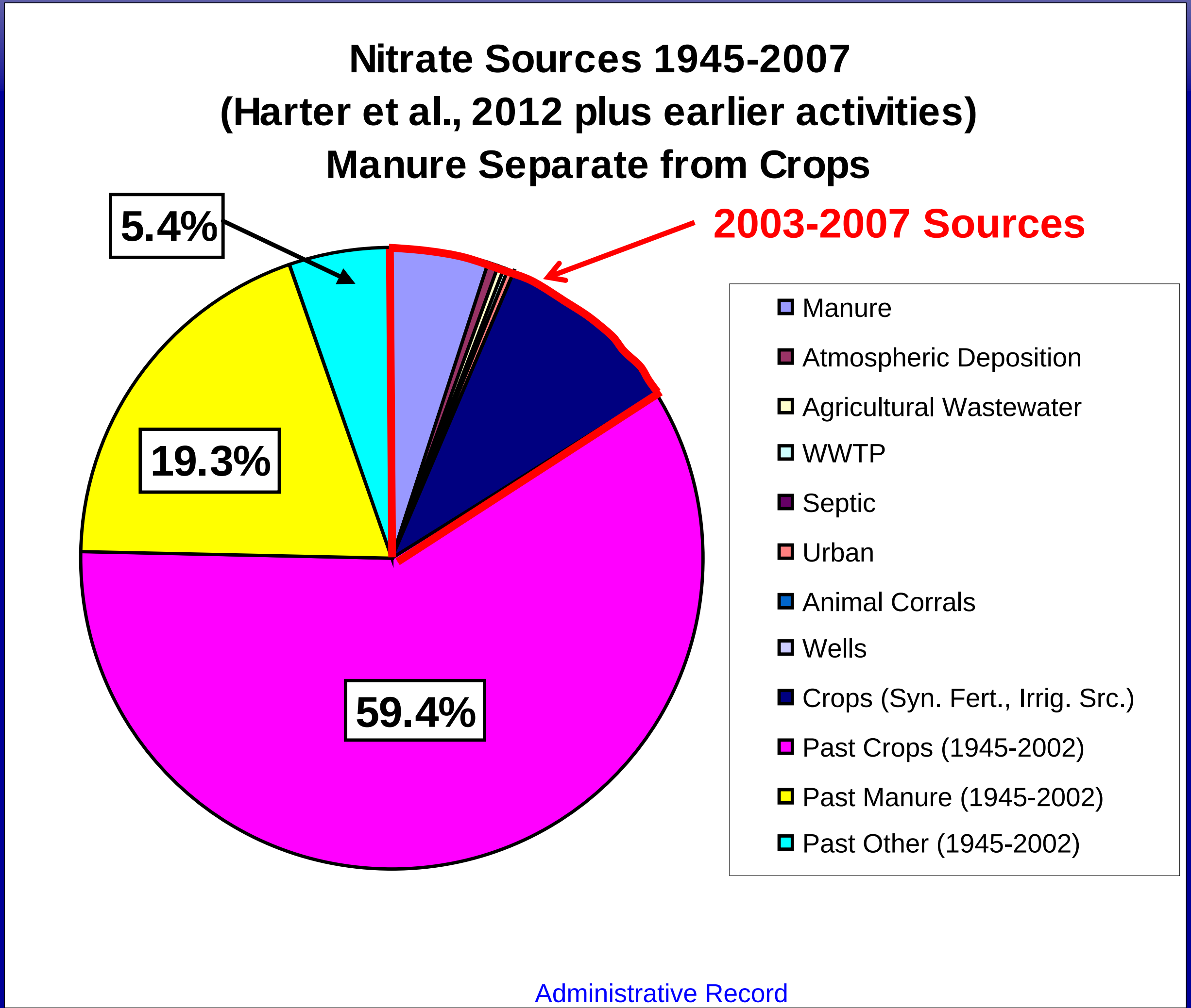
3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

UC DAVIS ASSESSMENT OF NITRATE LOADING TO GROUNDWATER

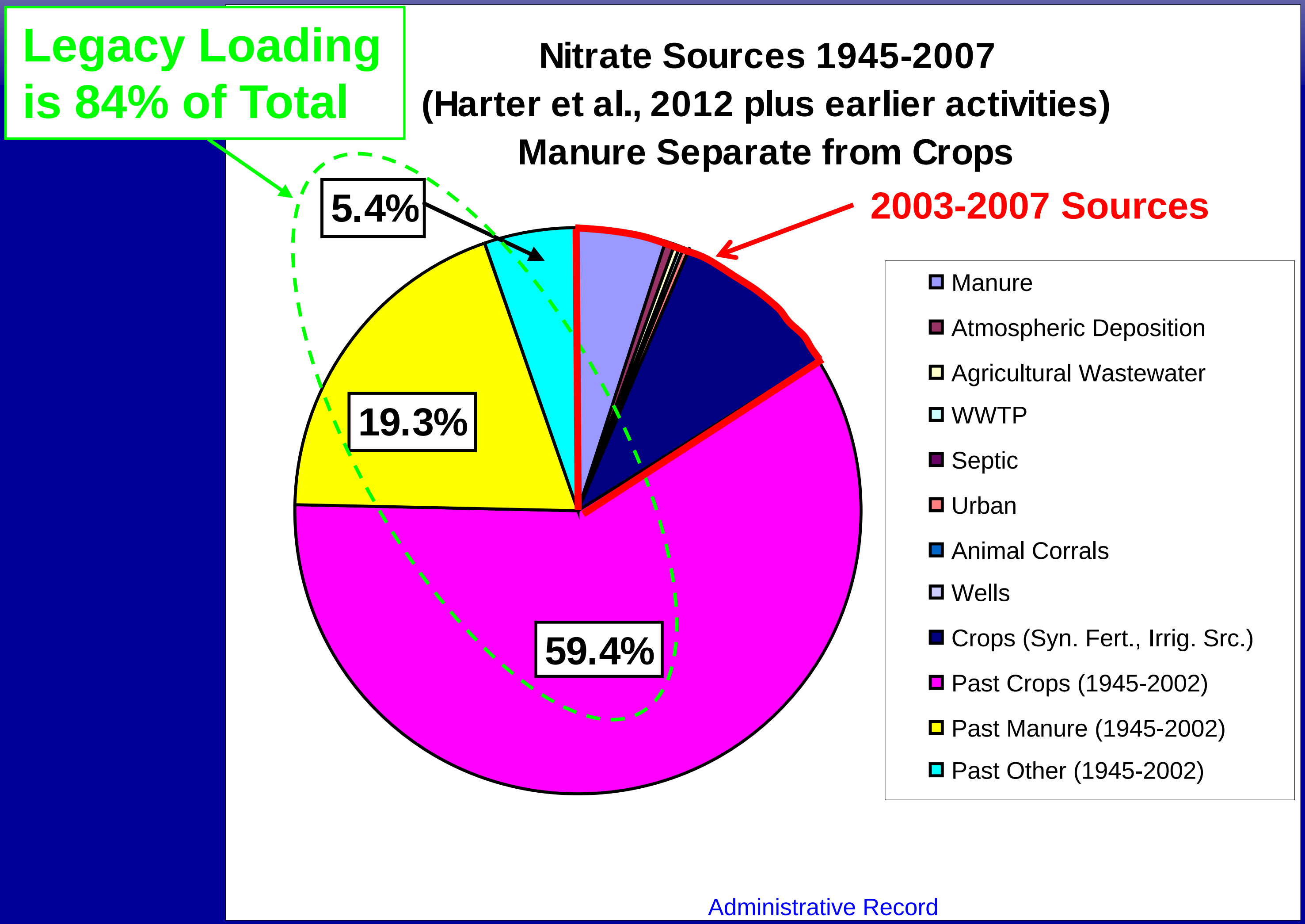


Presented only for the purposes of discussion. The details of this analysis have not been reviewed.

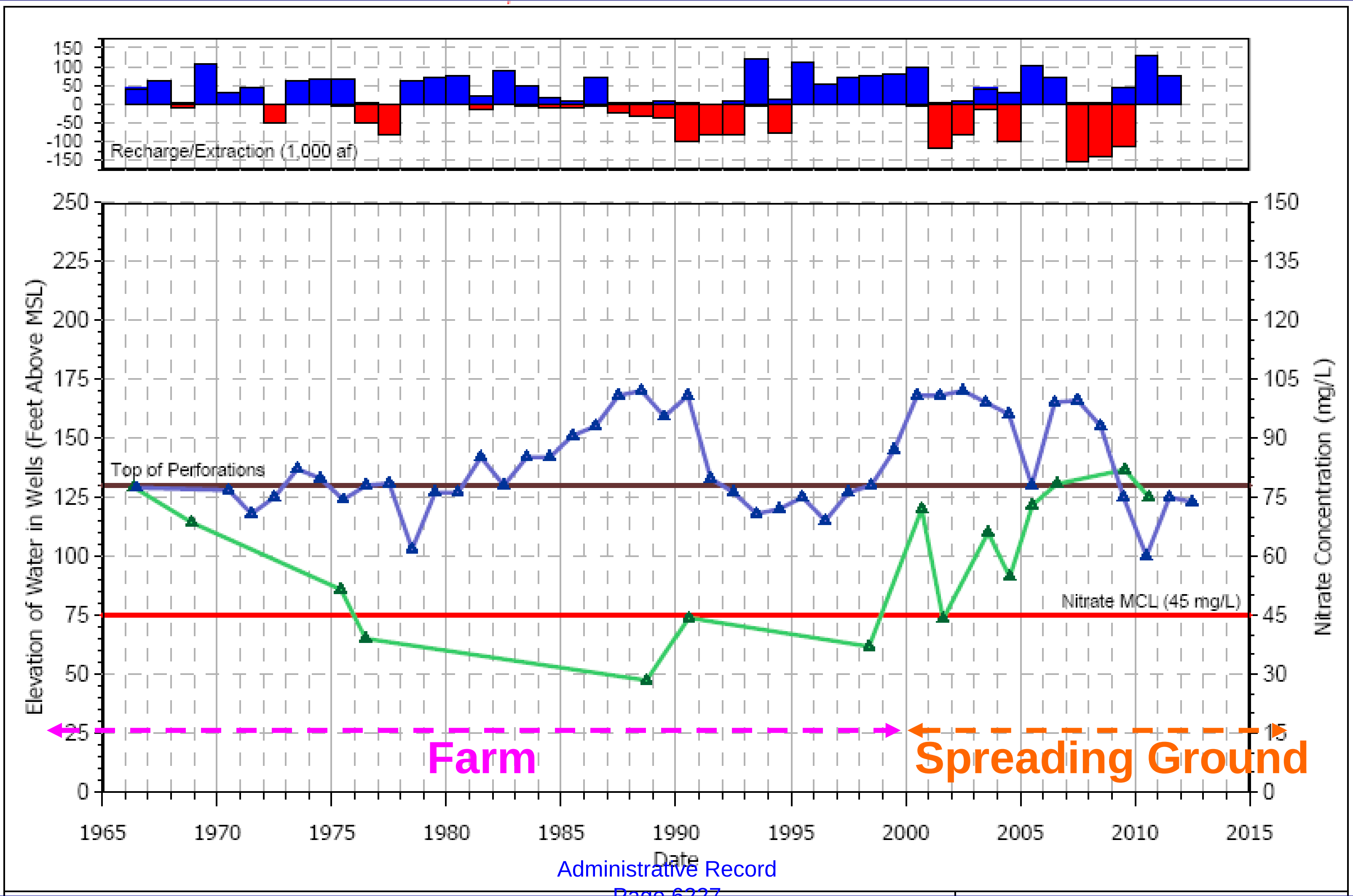
EXTENSION OF UC DAVIS NITRATE ASSESSMENT BACK IN TIME



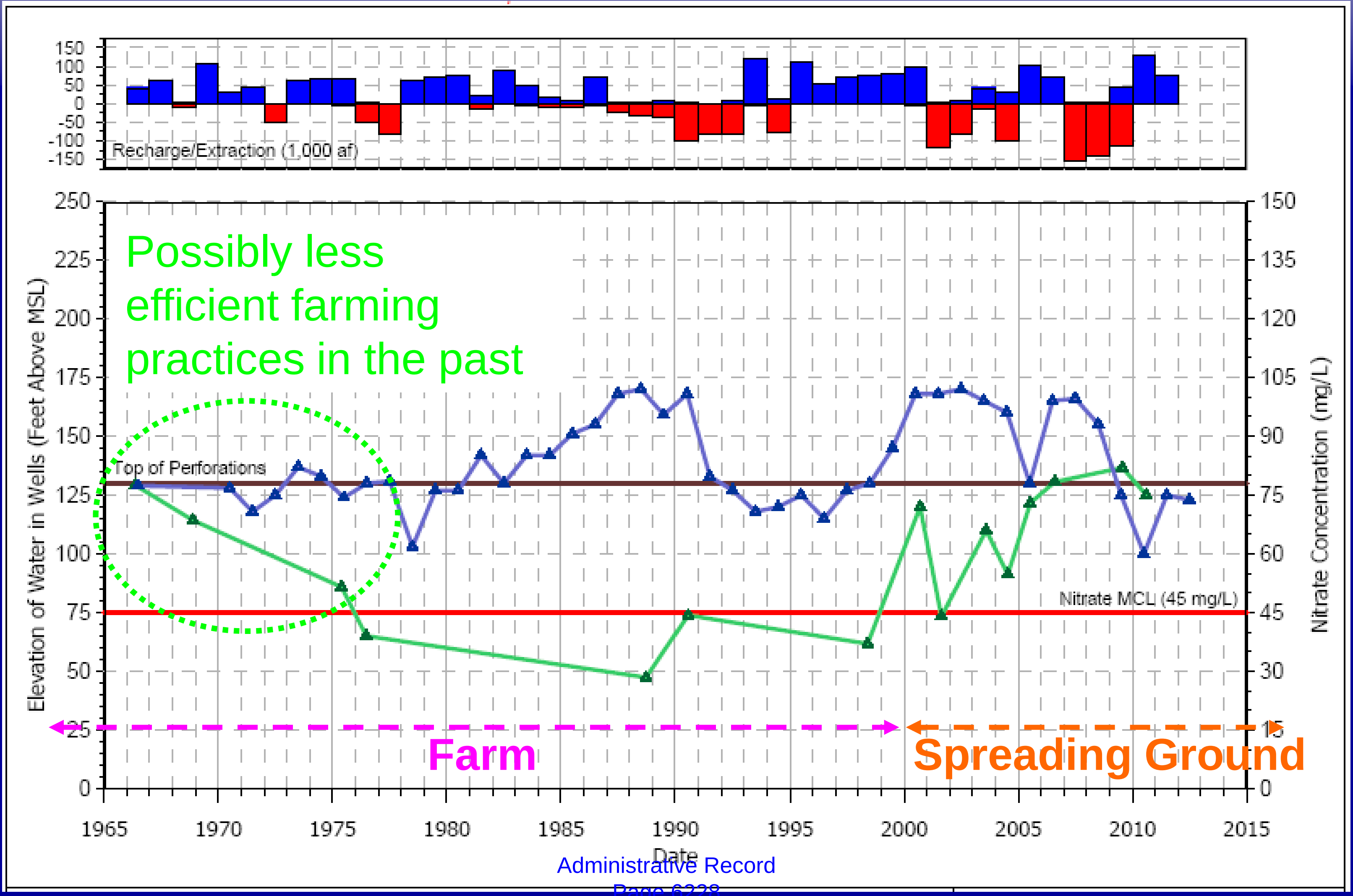
EXTENSION OF UC DAVIS NITRATE ASSESSMENT BACK IN TIME



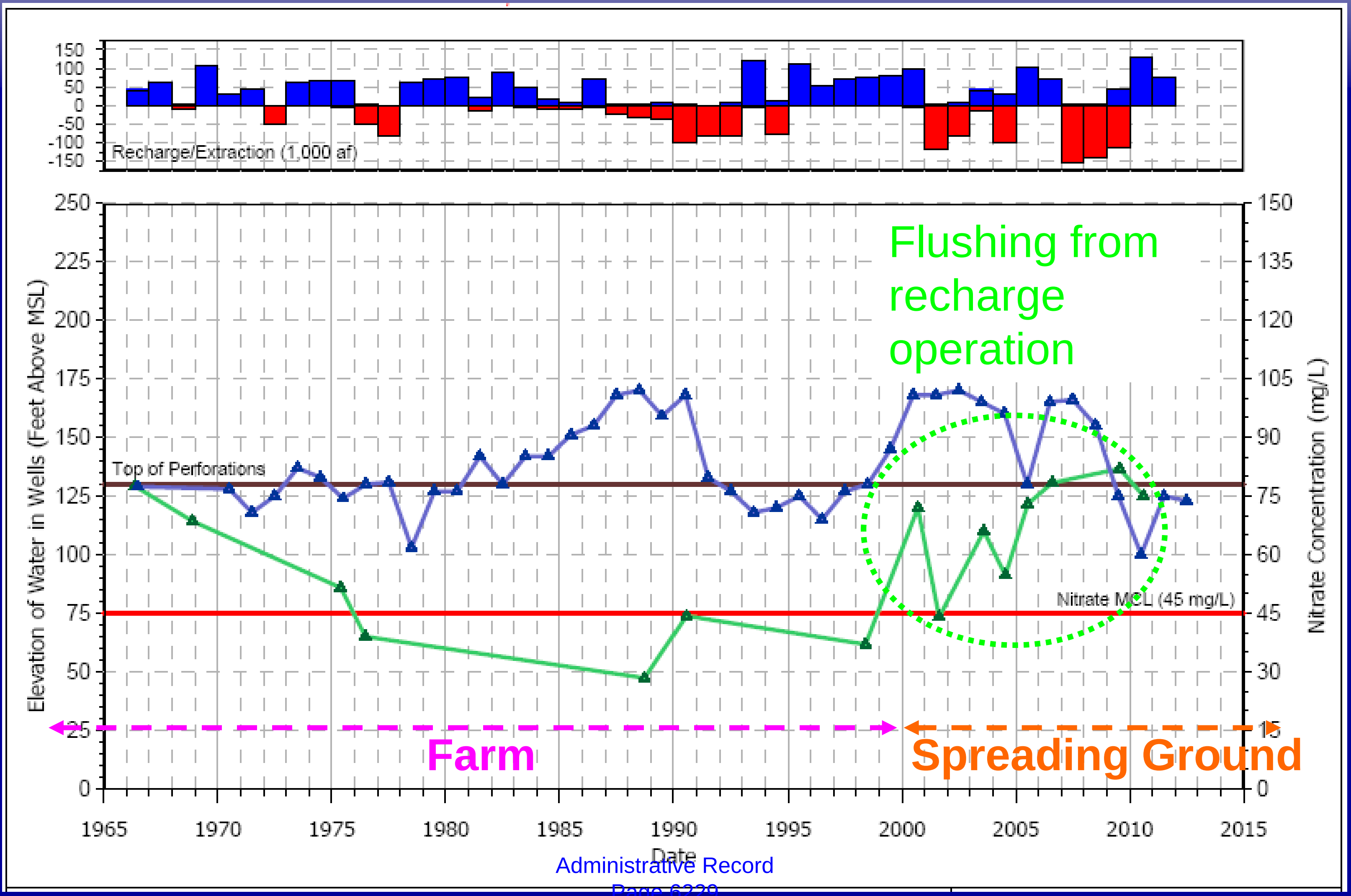
NITRATE FLUSHING FROM THE UNSATURATED ZONE



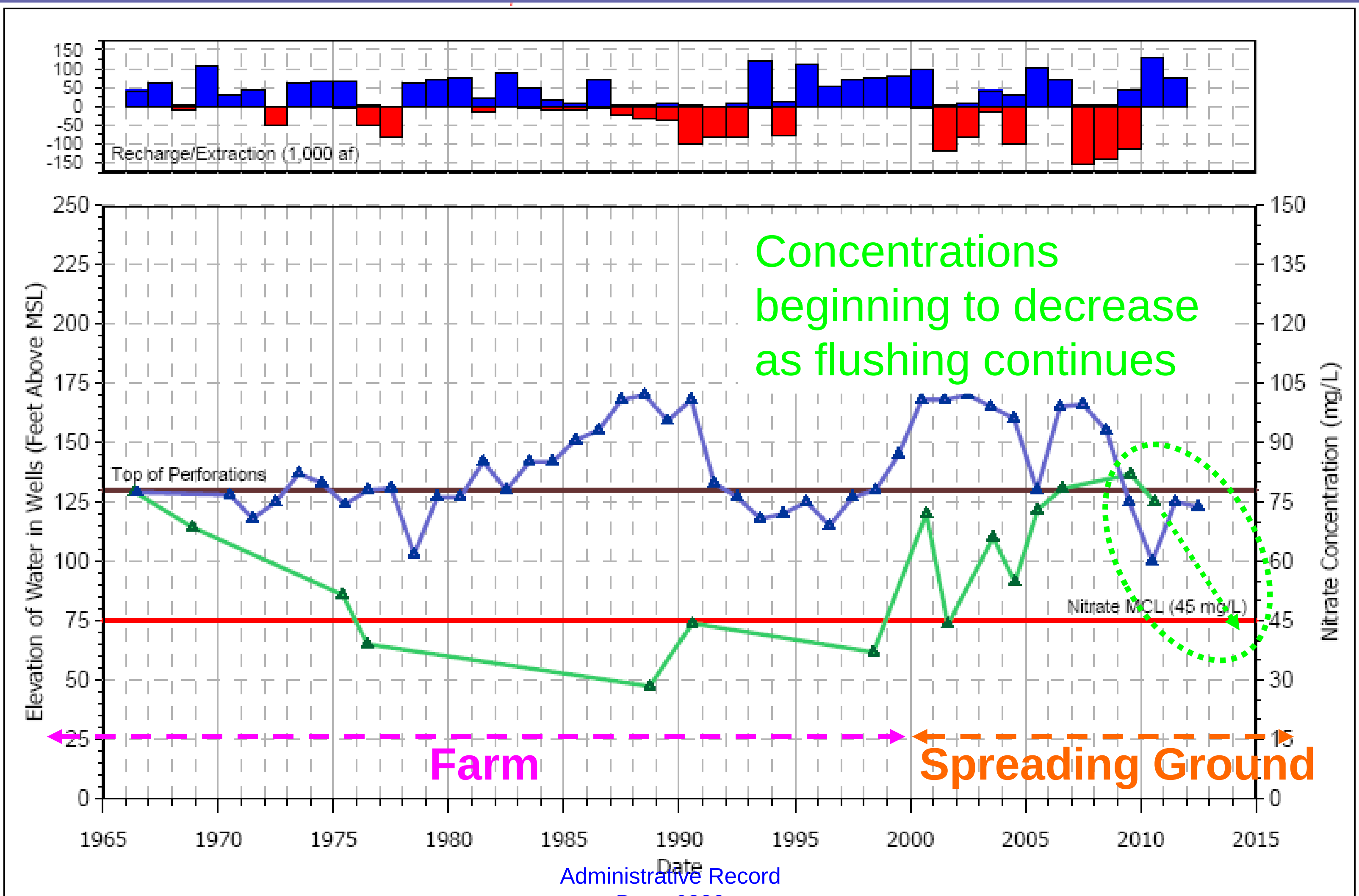
NITRATE FLUSHING FROM THE UNSATURATED ZONE



NITRATE FLUSHING FROM THE UNSATURATED ZONE



NITRATE FLUSHING FROM THE UNSATURATED ZONE



SELECTED POINTS

1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.

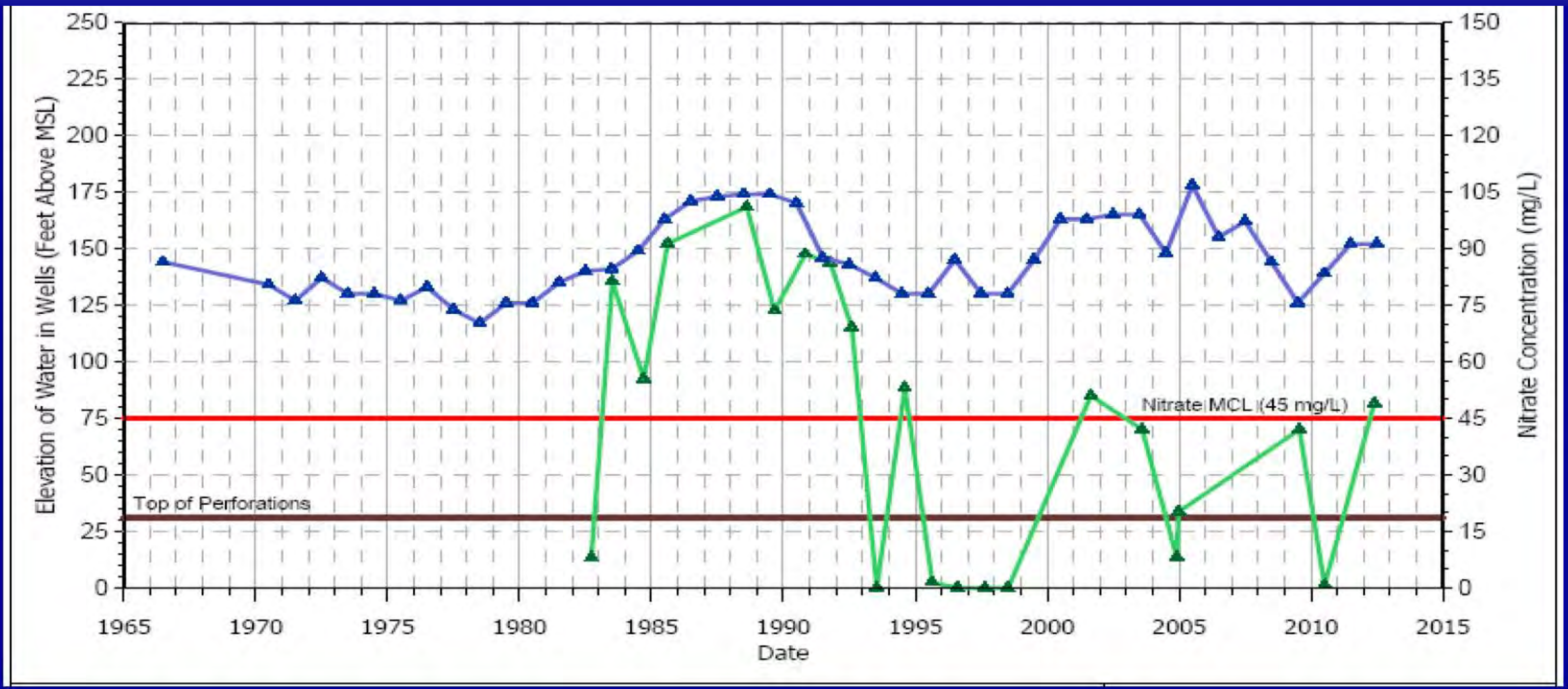
2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface.

3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

POTENTIAL COSTS

- Implementation of Large Groundwater Monitoring Program as Presented in Draft Order
- Impacts to Farming Practices Required Based Upon Unclear Monitoring Results

DATA FROM THE KRWCA AREA



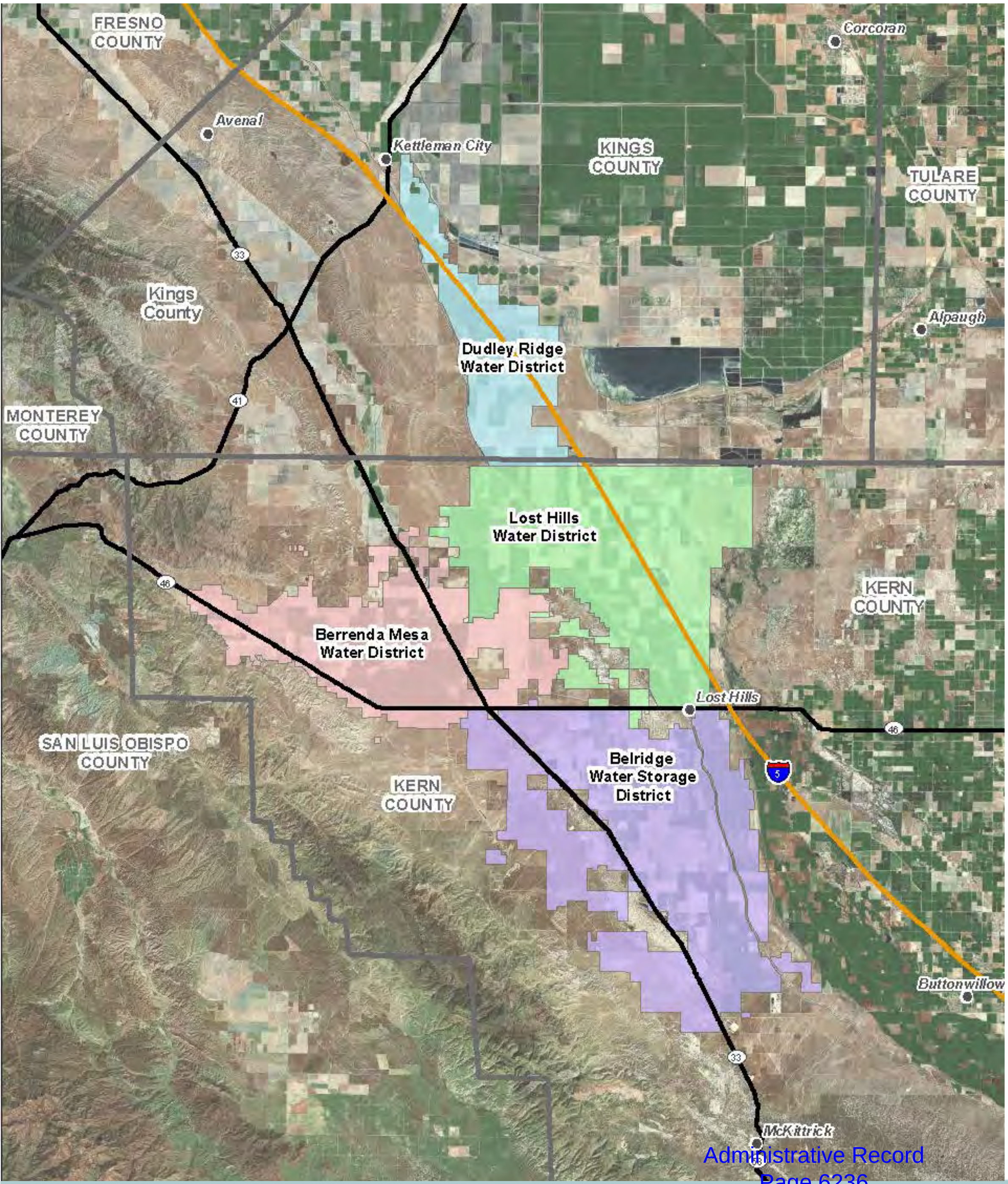
What would we conclude from these data?

CONCLUSION

Per the information provided above, the KRWCA area is unique, groundwater quality monitoring data interpretation is expected to be complex, area-wide monitoring will be expensive, and a one-size-fits-all groundwater monitoring approach is not appropriate.

Westside Water Districts Preliminary Water Quality Report

Timothy G. Souther and Gary L. Kramer
AMEC Environment & Infrastructure, Inc.



Belridge Water Storage District

Berrenda Mesa Water District

Dudley Ridge Water District

Lost Hills Water District

Groundwater Quality (USGS, 1959)

District *Criterion*	**TDS (mg/L)**	**Boron (mg/L)**
Belridge Water Storage District	2,848 to 6,500	0.4 to 9.5
Berrenda Mesa Water District	1,250 to 6,800	0.3 to 11.0
Dudley Ridge Water District	584 to 4,971	0.9 to 4.9
Lost Hills Water District	2,200 to 6,660	3.4 to 10.0
MUN (SMCL)	*500 to 1,500*	---
AGR (WQA)	*450 to 2,000*	*0.7 to 3.0*

SMCL = Secondary Maximum Contaminant Level (64449, Title 22, CCR) .

<500 mg/L TDS is Recommended

<1,500 mg/L TDS is Short-Term Use Only

WQA = Water Quality for Agriculture, FAO Drainage Paper 29, 1994.

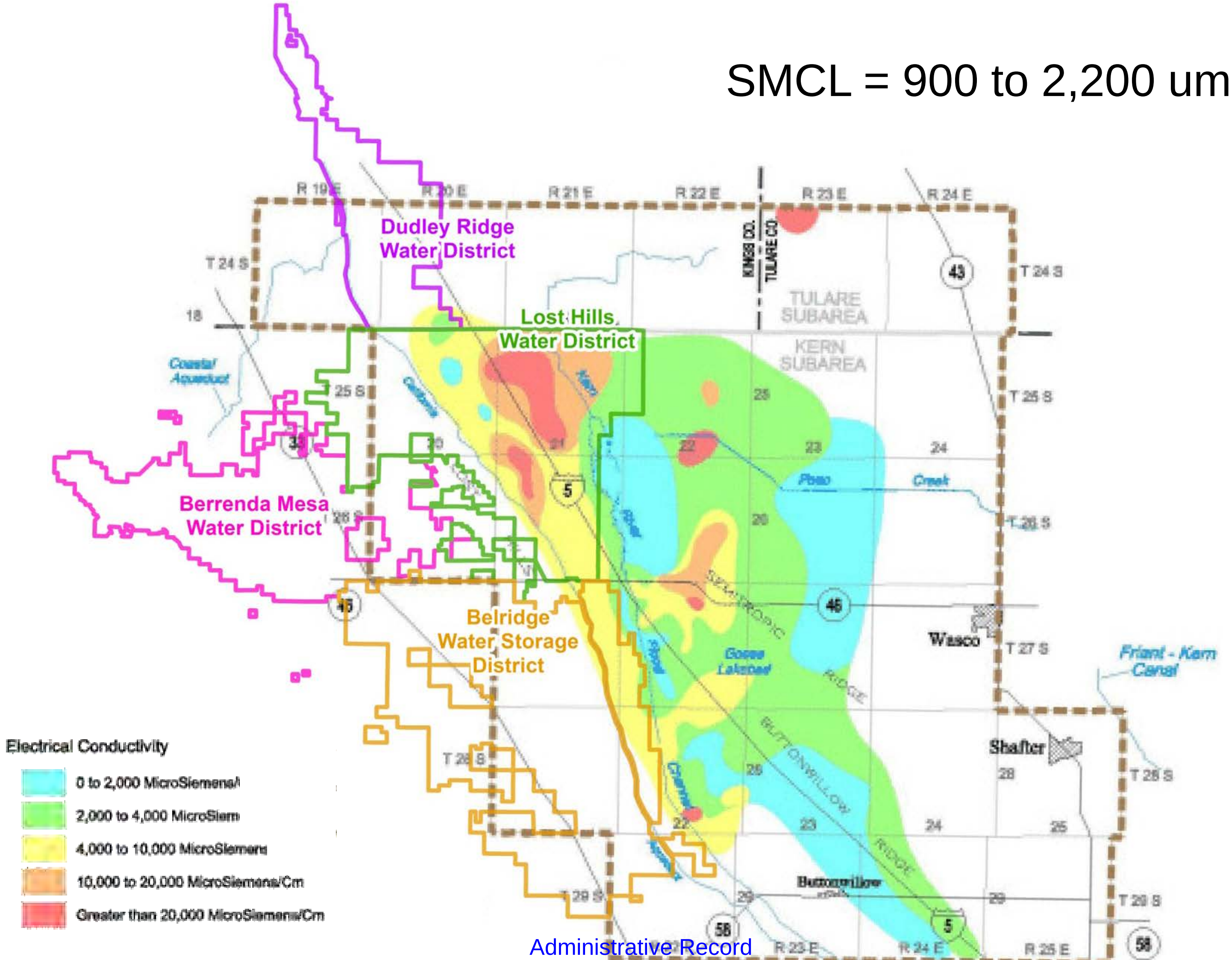
<450 mg/L TDS and <0.7 mg/L Boron is No Restriction

>2,000 mg/L TDS and >3 mg/L Boron is Severe Restriction

Perched Groundwater Quality Electrical Conductance (DWR, 2001)

amec

SMCL = 900 to 2,200 umhos/cm



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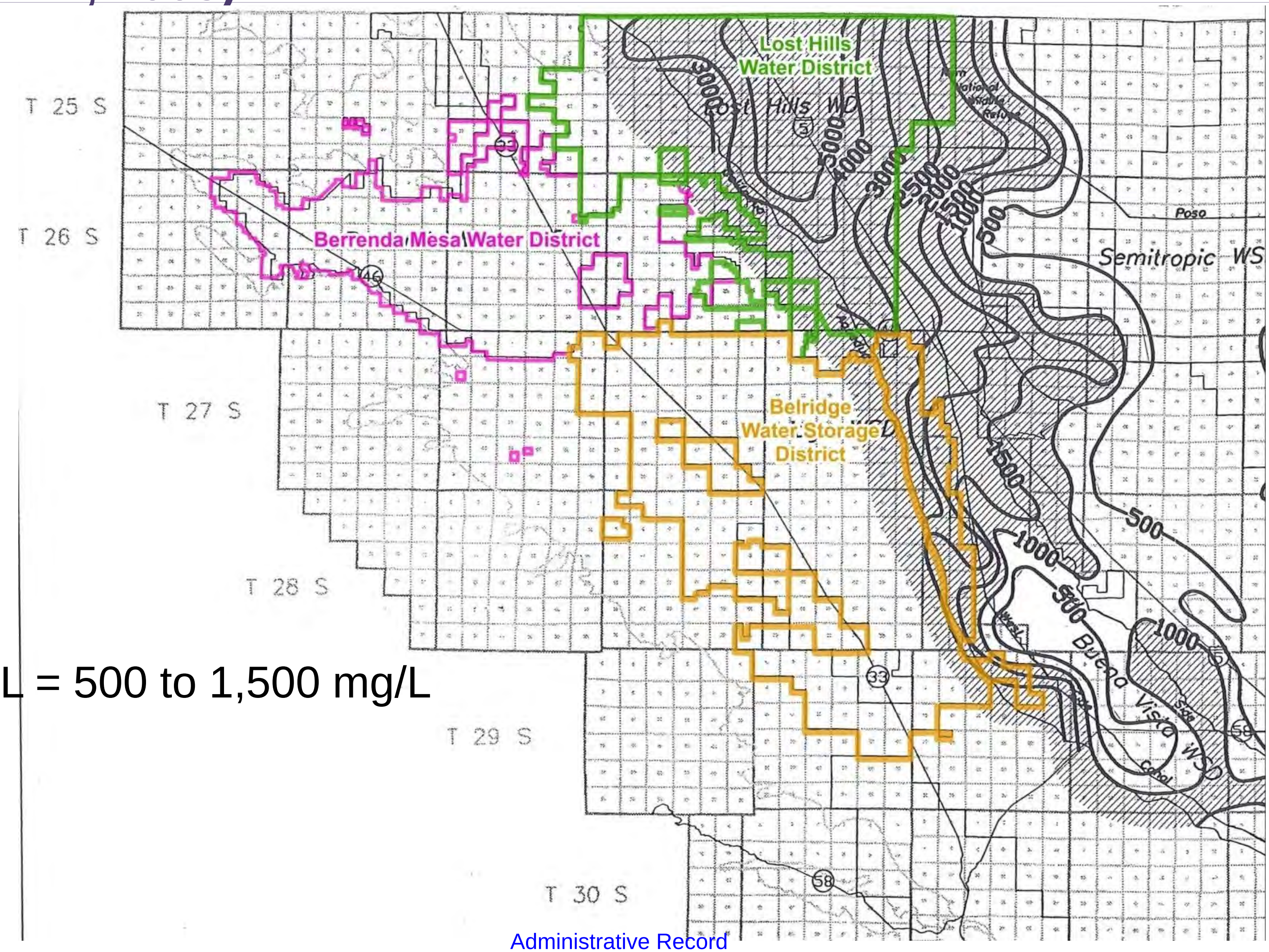
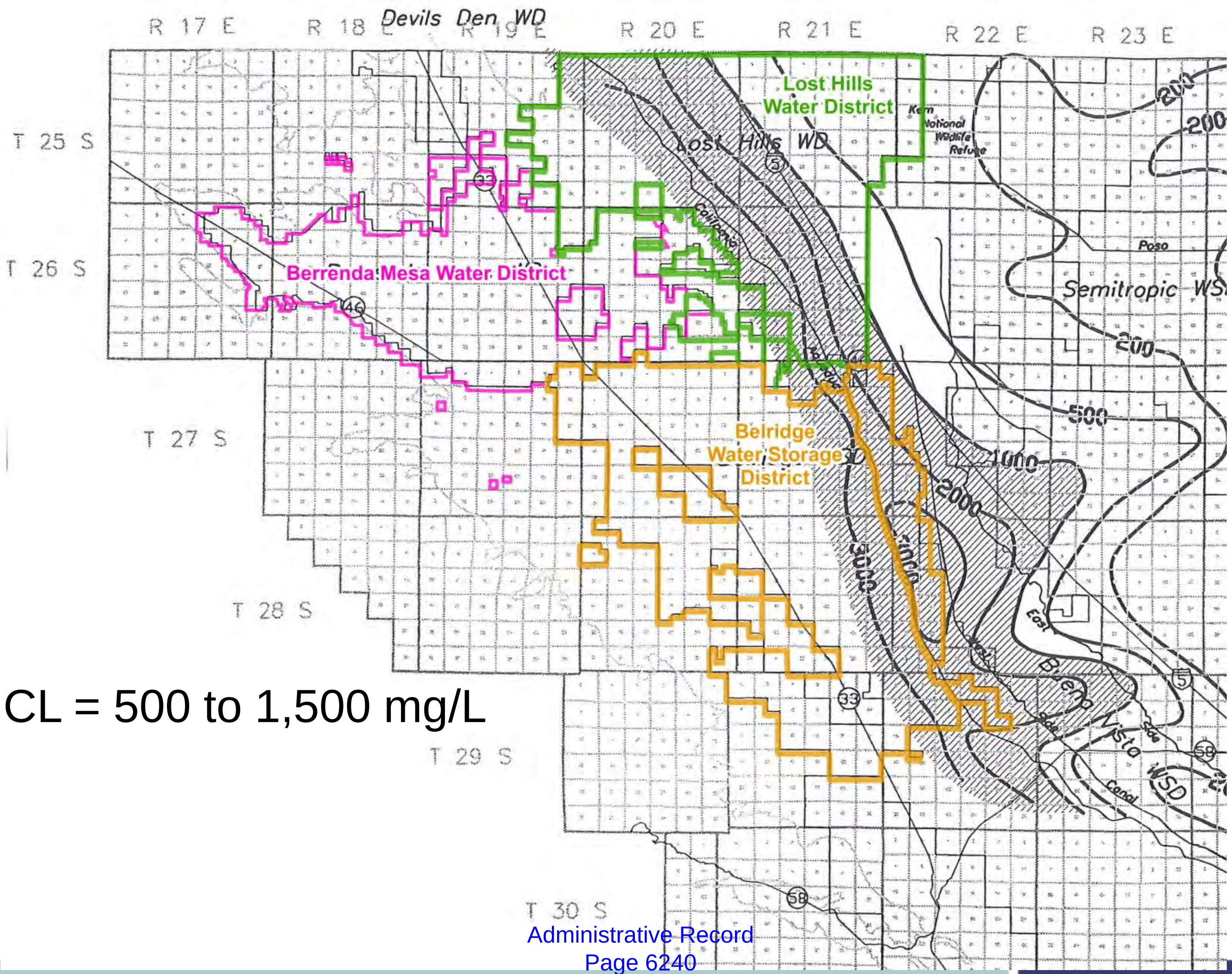
Unconfined Groundwater Quality Total Dissolved Solids (mg/L) (KCWA, 2005)



SMCL = 500 to 1,500 mg/L

Confined Groundwater Quality Total Dissolved Solids (mg/L) (KCWA, 2005)



SMCL = 500 to 1,500 mg/L

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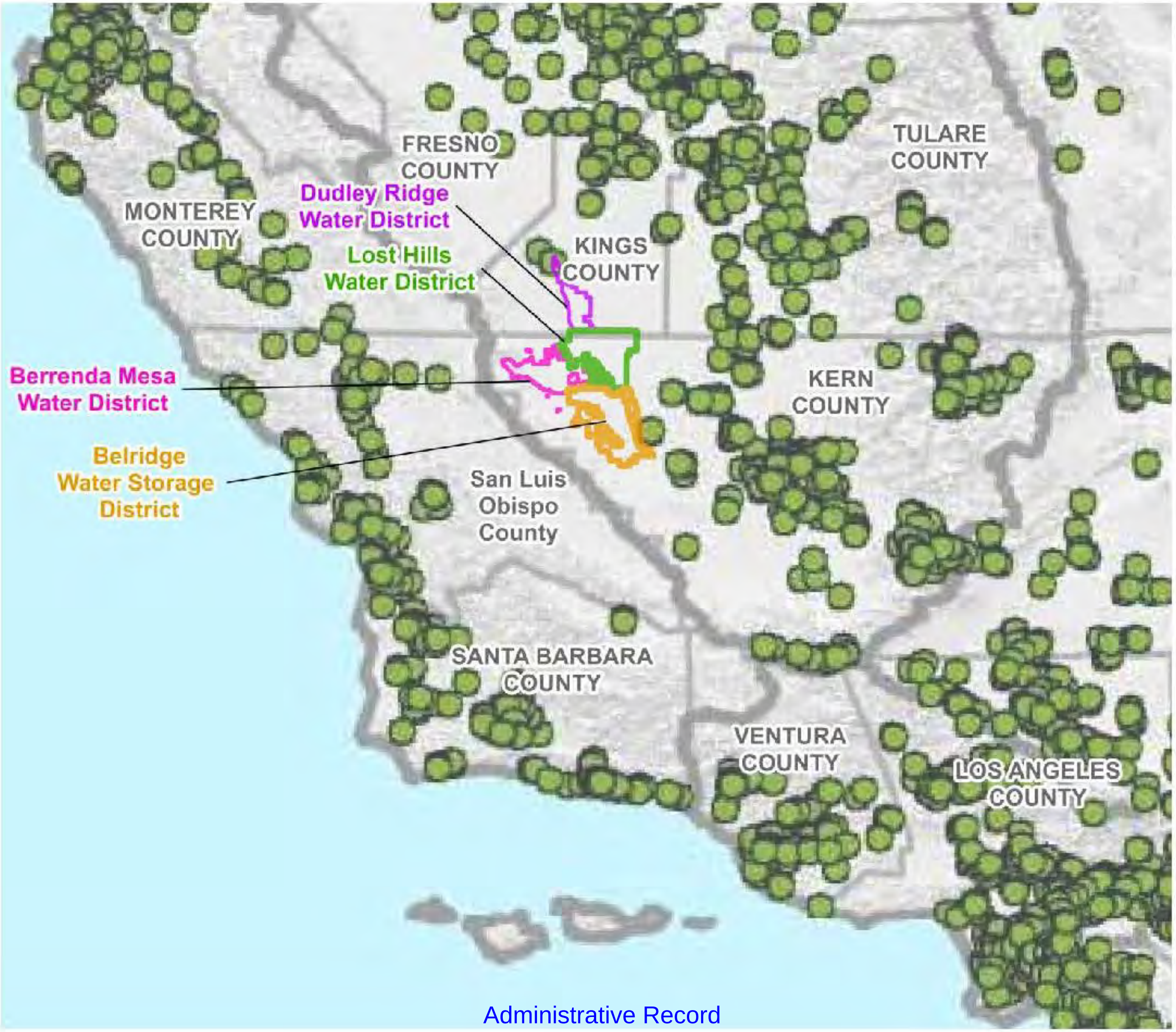
Currently Active Community Water Systems Relying on Groundwater (SWRCB, 2012)



Preliminary Findings

MUN - Groundwater within the Districts is generally of poor mineral quality (generally >2,000 mg/L TDS) and contains other mineral constituents (arsenic) that have prevented its use for drinking water. Groundwater within the Districts, except near the far northern part of DRWD (Kettleman City), is not used for municipal water supply.

AGR - The poor mineral quality of groundwater (TDS, and boron) has prevented its use for agricultural irrigation. Based on the poor quality of groundwater within the Districts, they have obtained irrigation water supply from the California Aqueduct.