Conclusions of the Agricultural Expert Panel

Recommendations to the State Water Resources Control Board pertaining to the Irrigated Lands Regulatory Program

in fulfillment of SBX 2 1 of the California Legislature

by

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Expert Panel Members

- Dr. Charles Burt, Chair
- Dr. Robert Hutmacher
- Till Angermann
- Bill Brush
- Daniel Munk
- James duBois
- Mark McKean
- Dr. Lowell Zelinski

Charges to the Expert Panel

- **Assess existing nitrate control programs**
- **Develop recommendations that are protective of groundwater quality**
- **Provide a more thorough analysis of State Water Board Water Quality Order 2013-0101**
  - **Indicators of risk**
  - **Methodologies to determine risk to GW and SW**
  - **Targets for measuring reductions in risk**
  - **Use of monitoring**
- **13 Questions Posed to the Expert Panel**

Questions Posed to the Expert Panel

1. How can risk to or vulnerability of groundwater best be determined in the context of a regulatory program such as the Irrigated Lands Regulatory Program (ILRP)?
2. Evaluate and develop recommendations for the current approaches taken to assessing risk to or vulnerability of groundwater.
3. How can risk to or vulnerability of surface water best be determined in the context of a regulatory program such as the ILRP?
4. Evaluate and develop recommendations for the current approaches taken to assessing risk to or vulnerability of surface water.
5. What management practices are expected to be implemented and under what circumstances for the control of nitrogen?
6. What management practices are recommended for consideration by growers when they are selecting practices to put in place for the control of nitrogen?

7. Evaluate and make recommendations regarding the usage of various nitrogen management and accounting practices.
8. Evaluate and make recommendations regarding the most effective methods for ensuring growers have the knowledge required for effectively implementing recommended management practices.
9. What measurements can be used to verify that the implementations of management practices for nitrogen are as effective as possible?
10. Evaluate and make recommendations regarding the usage of various verification measurements of nitrogen control.
11. Evaluate the relative merits, and make recommendations regarding the usage of, surface water measurement systems derived from either receiving water or a discharge monitoring approach to identify problem discharges.
12. Evaluate and make recommendations on how best to integrate the results of the Nitrogen Tracking and Reporting System Task Force with any above recommendation regarding management practices and verification measures.
13. Evaluate and make recommendations on the reporting requirements to report budgeting and recording of nitrogen application on a management block basis versus reporting aggregated numbers on a nitrate loading risk unit level.

Major Focus:

Nitrogen in Groundwater

The basics

- **Nitrates exist in all California groundwater.**

- **Farming contributes nitrates to groundwater.**
  - **Organic farming**
  - **Regular farming**

- **ALL sustainable farming practices leach nitrate below the crop root zone except certain conditions/times with rice.**
  - **Drip, sprinkler, flood, trees, row crops, good farmers, bad farmers**

Regulation

- **You can make this extremely complex, spend a lot of money, and accomplish very little.**

- **Or stick to the basics**
  - **This goes beyond writing tickets**
  - **This moves towards improvements.**

Back to basics

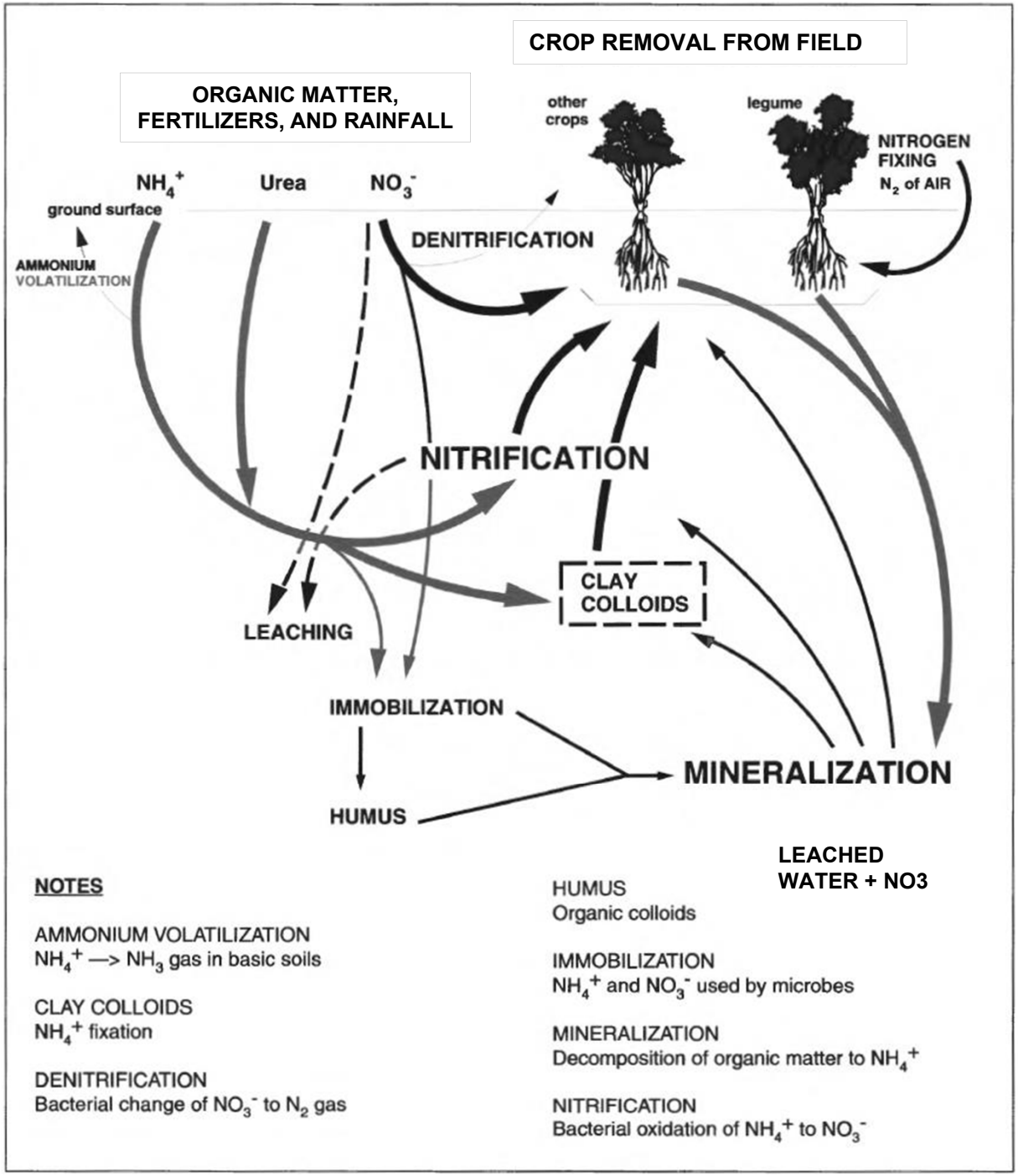
- **Nitrogen (N) is applied to farm fields**
  - **N is a major crop nutrient. Plants need N**
- **Water is applied to fields**
  - **Rainfall, or irrigation**
  - **Plants need water**
- **Some water ALWAYS moves below the root zone.**
- **Water carries NO3 (nitrate) with it.**
- **Eventually (sooner or later) the (H20 + NO3) reach the groundwater…somewhere.**

The Panel considered and discarded several commonly proposed/accepted actions:

- Modeling of root zone nitrogen activities
- Monitoring of first encountered groundwater for nitrates
- Modeling of groundwater to determine sources of NO3
- Use of proxy vulnerability indices such as the "NHI"

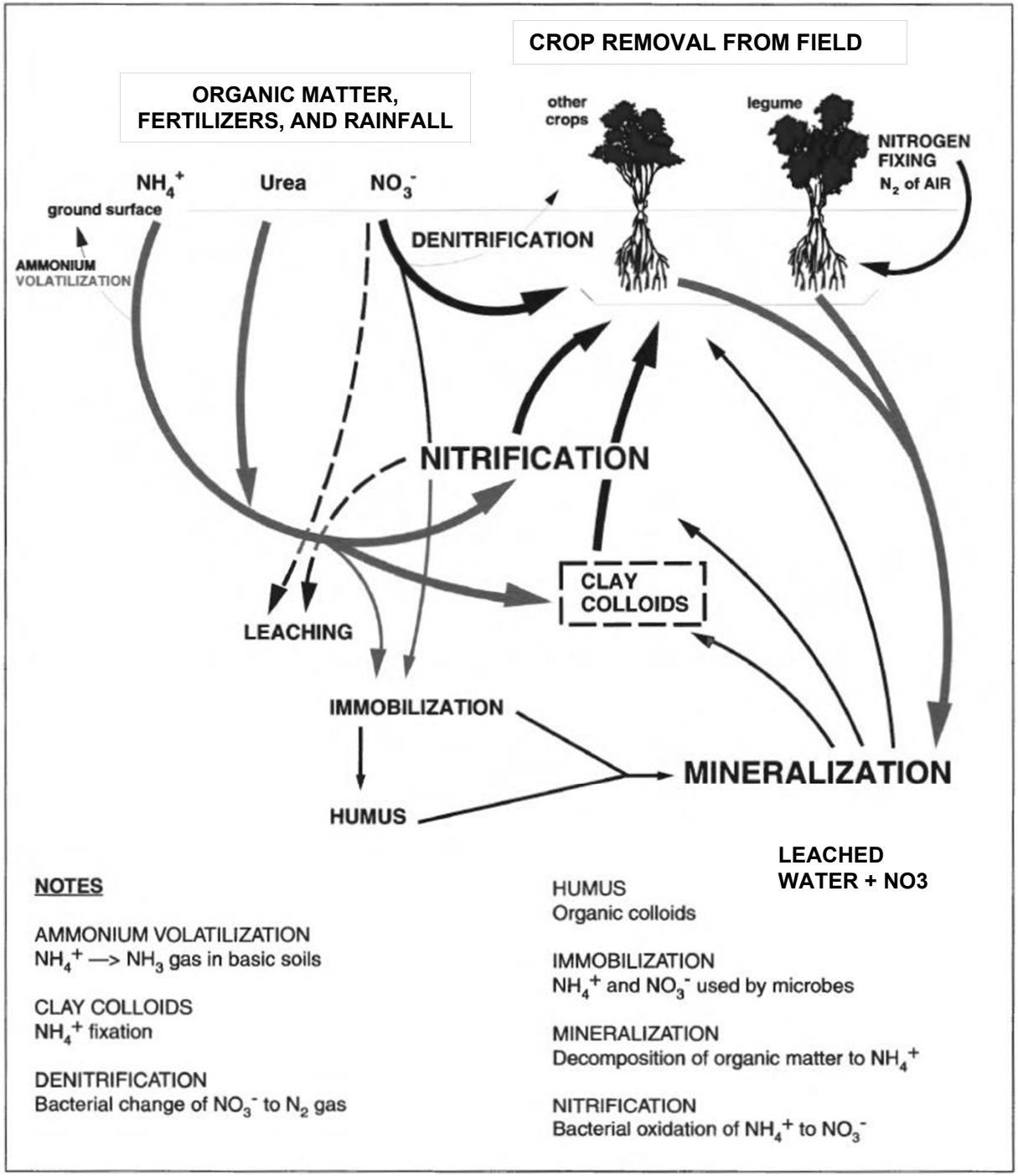
The Panel considered and rejected a need to model/report:

-The complex <u>NITROGEN CYCLE</u> in the crop root zone.



We understand the general process.

But QUANTIFYING each step and defining the TIMINGs is difficult even for researchers in controlled conditions.



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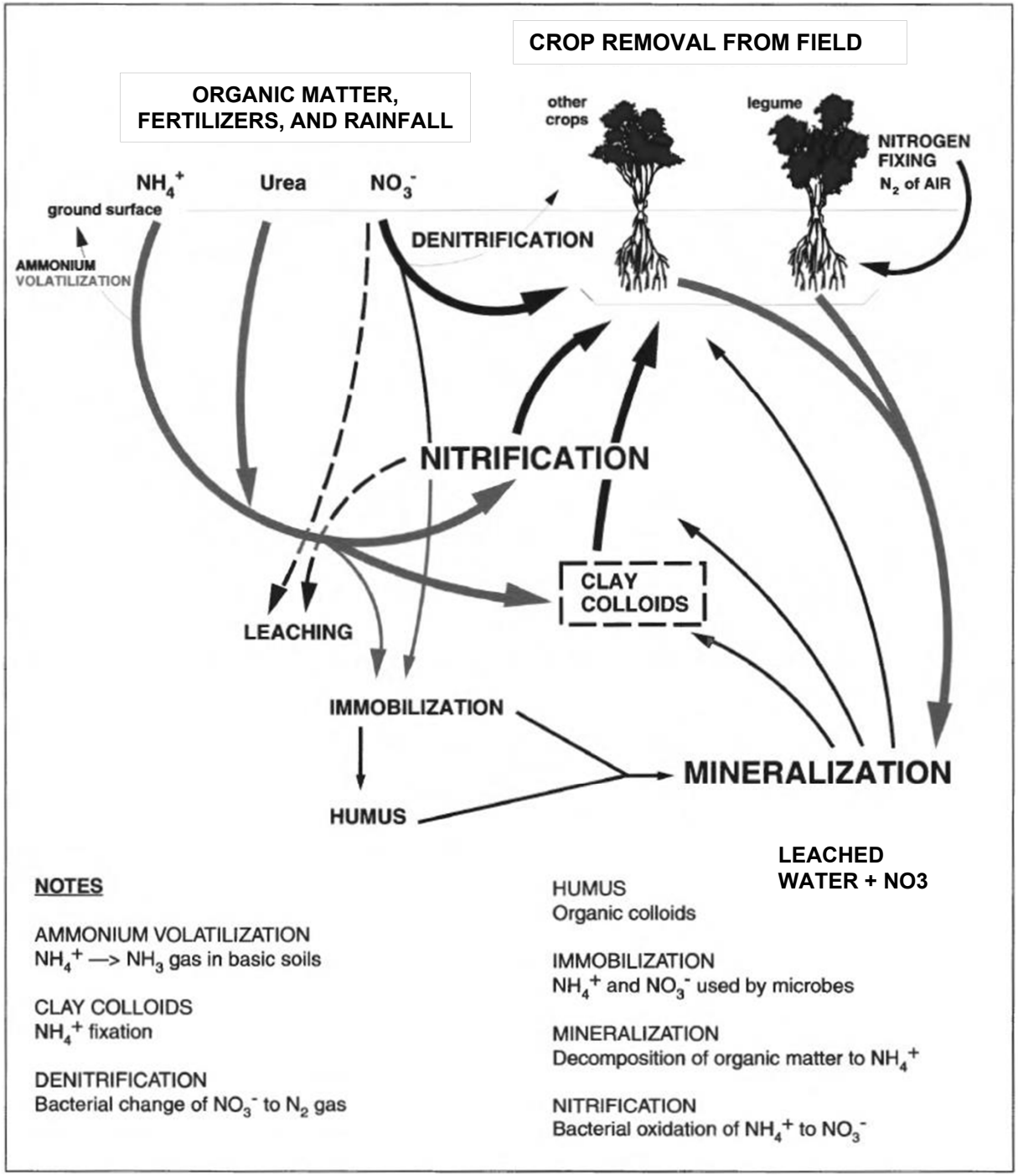
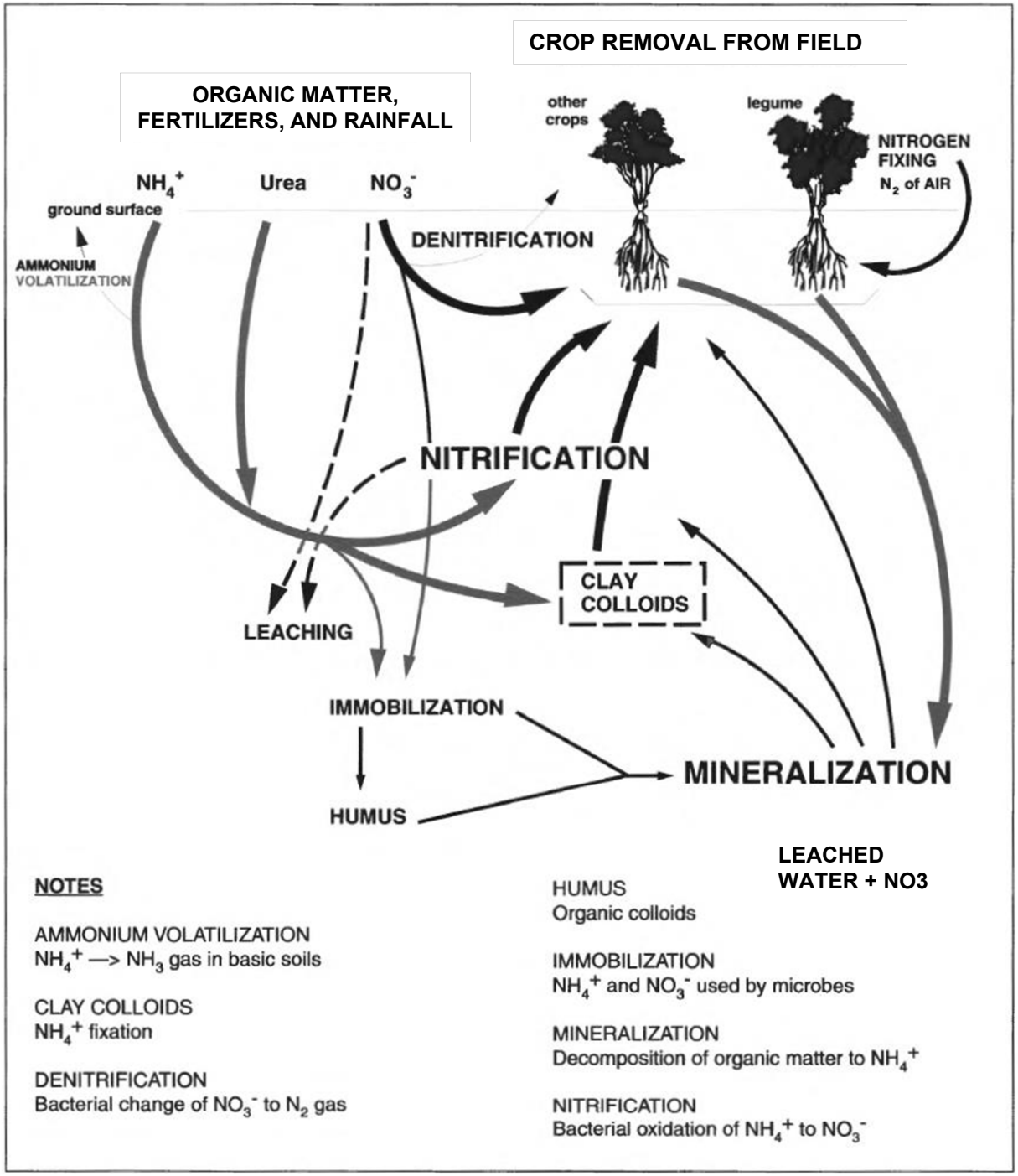
CONCLUSION:

A REGULATORY PROGRAM SHOULD NOT REQUIRE MEASUREMENT AND REPORTING ALL THE DETAILS OF THE PROCESS



Second Conclusion:

Regulatory programs should not be based on understanding and reporting processes that have so many arrows.



SECOND KEY QUESTION
for the Expert Panel

The nitrate problem is in the groundwater. So should the regulatory process focus on understanding the details of groundwater NO3 movement?

Movement of Nitrates to and within groundwater can be modeled…….BUT…

We can't accurately define the

*** Boundary conditions**

*** Soil characteristics**

*** Deep percolation amounts**

*** Leached nitrate amounts**

etc., etc.

Movement of Nitrates to and within groundwater cannot be modeled accurately…….

But even if it could be modeled perfectly,

"Why do it"?

Groundwater Modeling

We don't need a groundwater model to tell us we have high nitrates, or what the cause/solution is.

And models are certainly incapable of tying individual fields to groundwater NO3 problems.

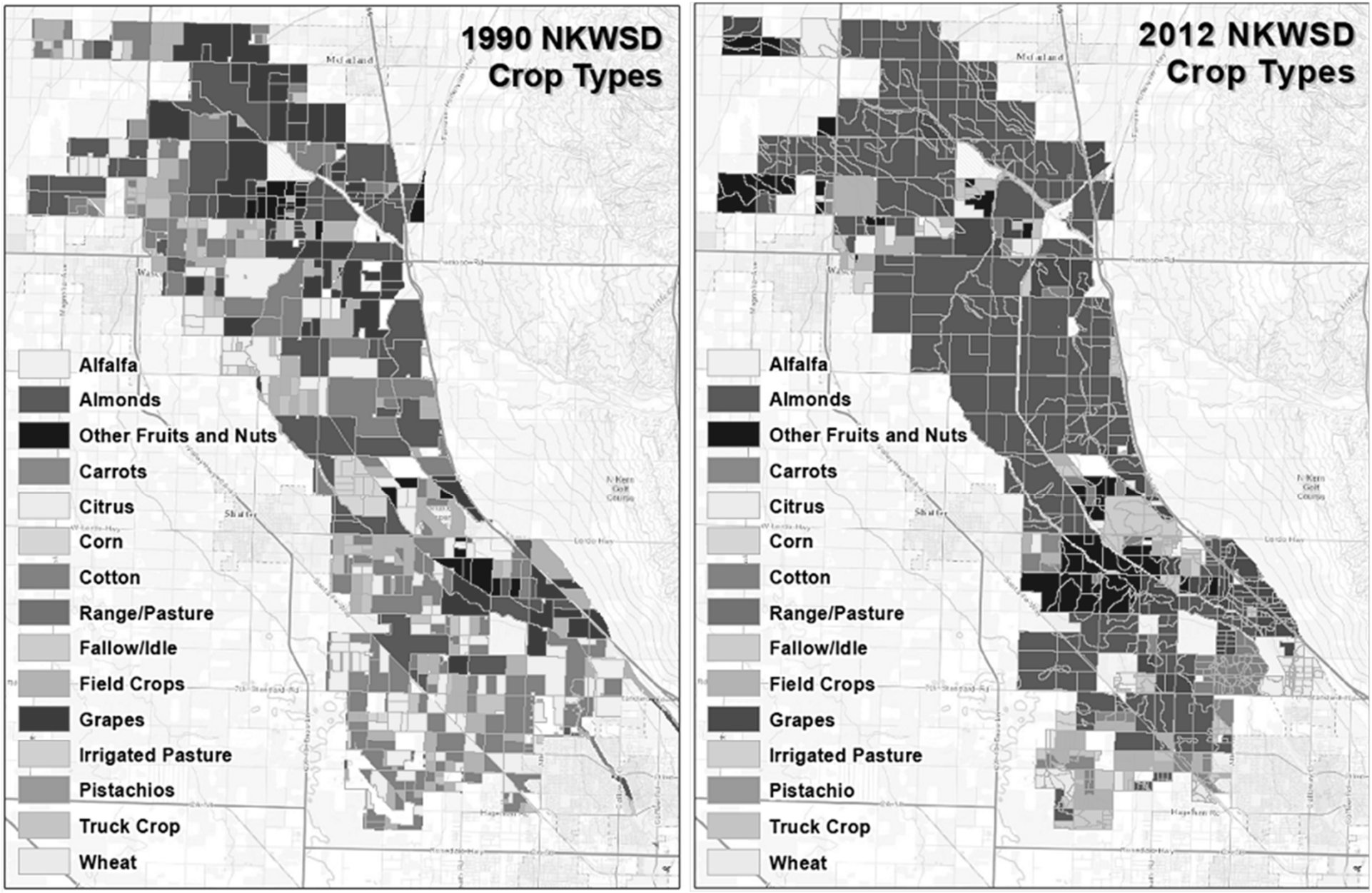
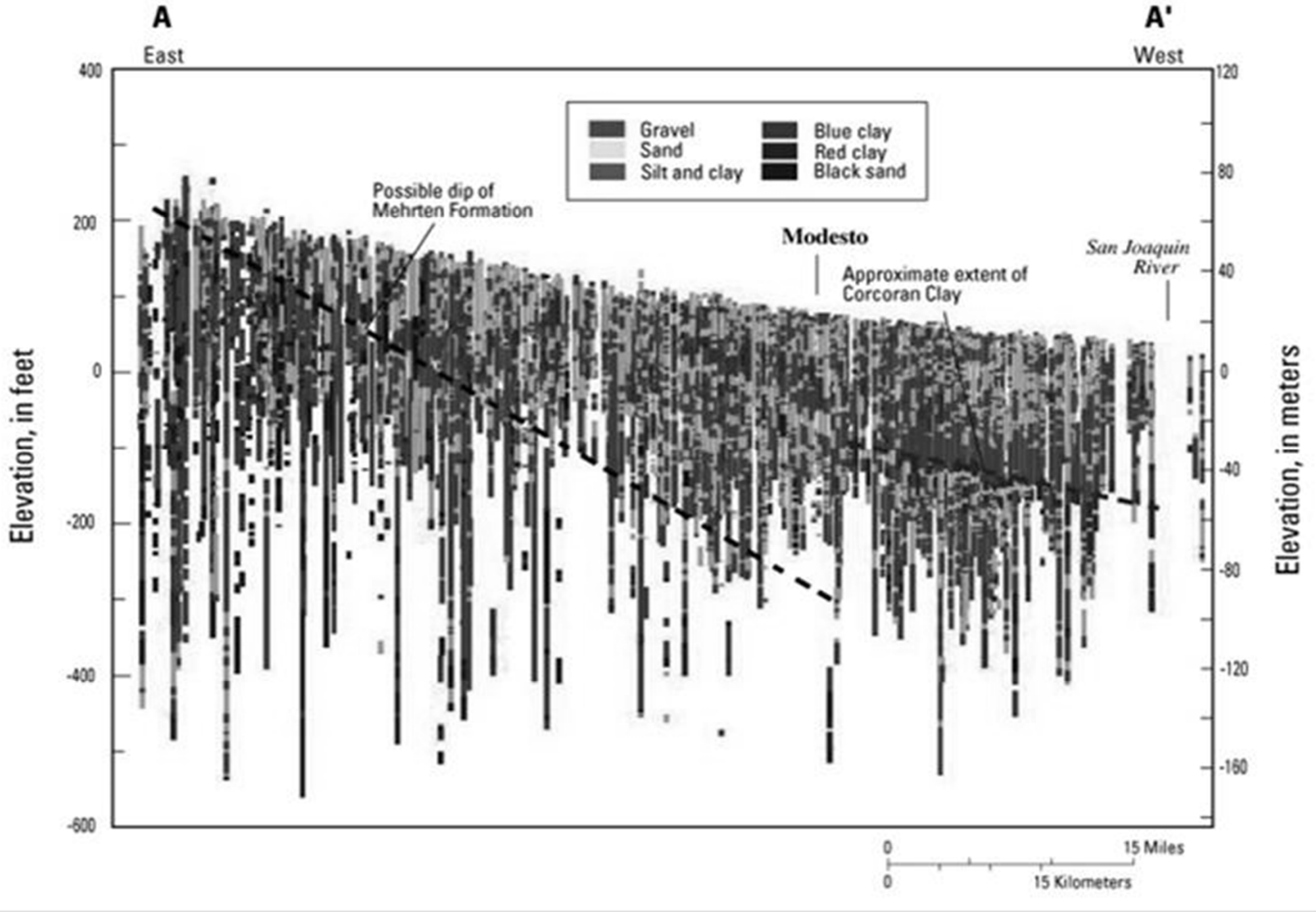


Figure 1. Crop type maps of North Kern Water Storage District, 1990 and 2012. Provided by Dr. Joel Kimmelshue


A
East
A'
West
Gravel
Sand
Silt and clay
Blue clay
Red clay
Black sand
Possible dip of
Mehrten Formation
Modesto
Approximate extent of
Corcoran Clay
San Joaquin
River
Elevation, in feet
Elevation, in meters
400
200
0
-200
-400
-600
120
80
40
0
-40
-80
-120
-160
0
15 Miles
0
15 Kilometers

Another idea:
Reporting nitrates in
"first encountered groundwater"

- Very expensive
- This doesn't really tell us anything in most cases.
- It doesn't solve any problems.
- High concentrations may indicate excellent mgmt.

Examined and discarded:

Using a “Proxy” formula/metric to look at fields from a distance and decide risk/vulnerability?

The “proxy” of the moment: Nitrogen Hazard Leaching Index (NHI)

There is a lot of vested interest in this!!

NHI allows people to make maps and say “here is where the biggest source problem is”

Ideas of NHI:

- **Three variables influence nitrate leaching:**
  - **Soil type**
  - **Irrigation method**
  - **Crop type**

Crop: 1-4
Soil: 1-5
Irrigation: 1-4

Multiply together.

Crop	Soil 1	2	3	4	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

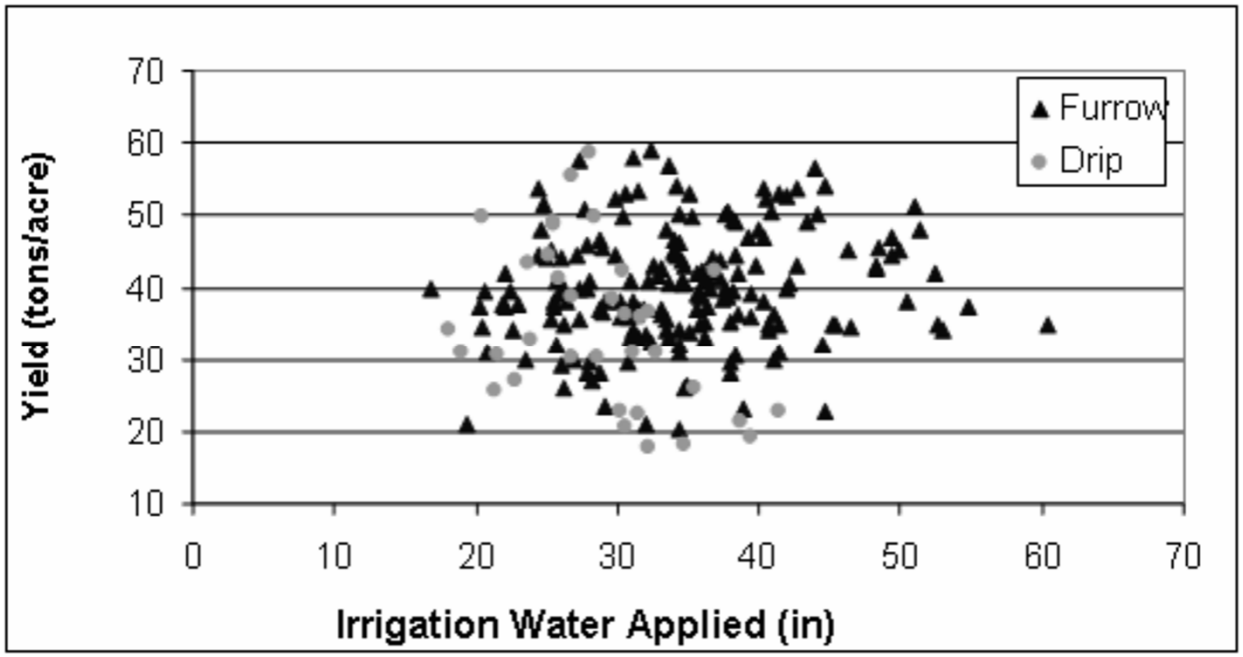
Why not add the numbers instead of multiplying?

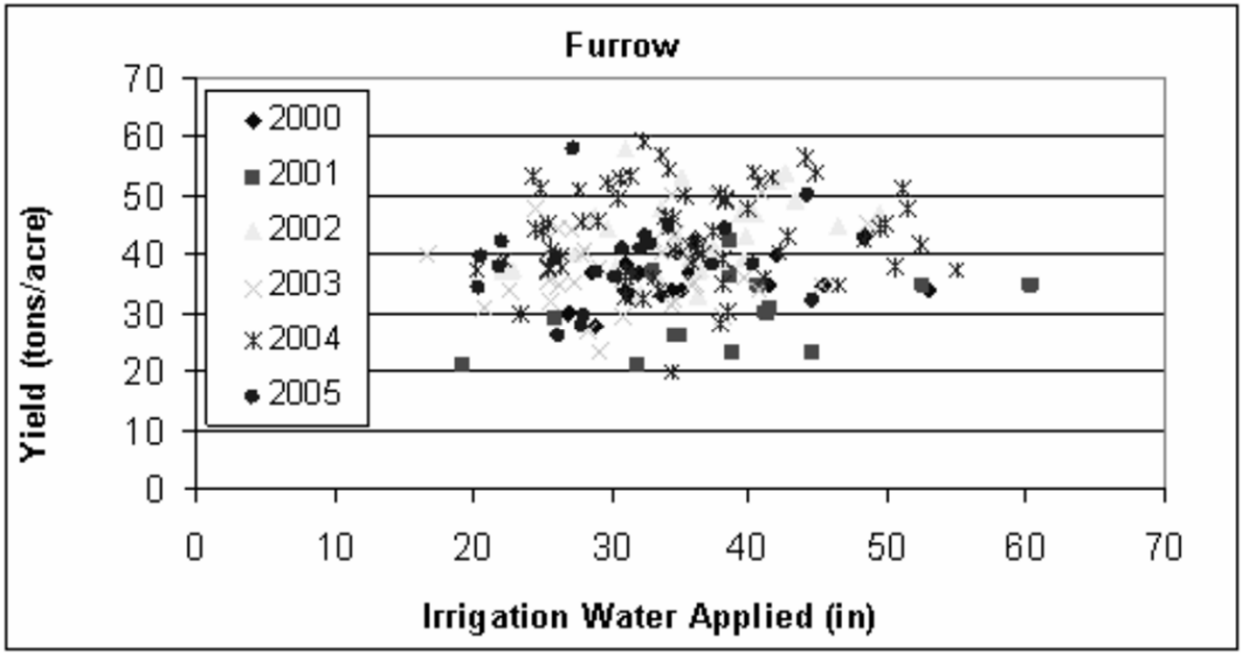
Does soil type really make a difference with microspray?

Isn't it true that in many areas there is tremendous under-irrigation with furrows and border strips?

Crop	Soil 1	2	3	4	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

2006 report by ITRC to Westlands WD and Panoche WD regarding Drainage reduction.





The point: Cherished assumptions are not always valid.

The Expert Panel believes that it is futile and expensive, from a regulatory standpoint, to:

- **Extensively MODEL surface/groundwater NO3 interactions.**
- **Monitor/report first encountered groundwater.**
- **Model root zone nitrogen process**
- **“Guess” using a proxy indicator such as NHI….no matter how many people like it.**

We explained in detail why the NO3 problem is vastly different from typical point-source discharge problems

.....and why the NO3 problem requires a different approach.

The NO3 problem involves

- **Numerous processes**
- **Social/behavioral components**
- **Diffuse, non-point source and distribution characteristics**
- **Many uncontrolled variables**

It is <u>not</u> like a leaky gasoline tank

We developed a list of solid and positive recommendations that will

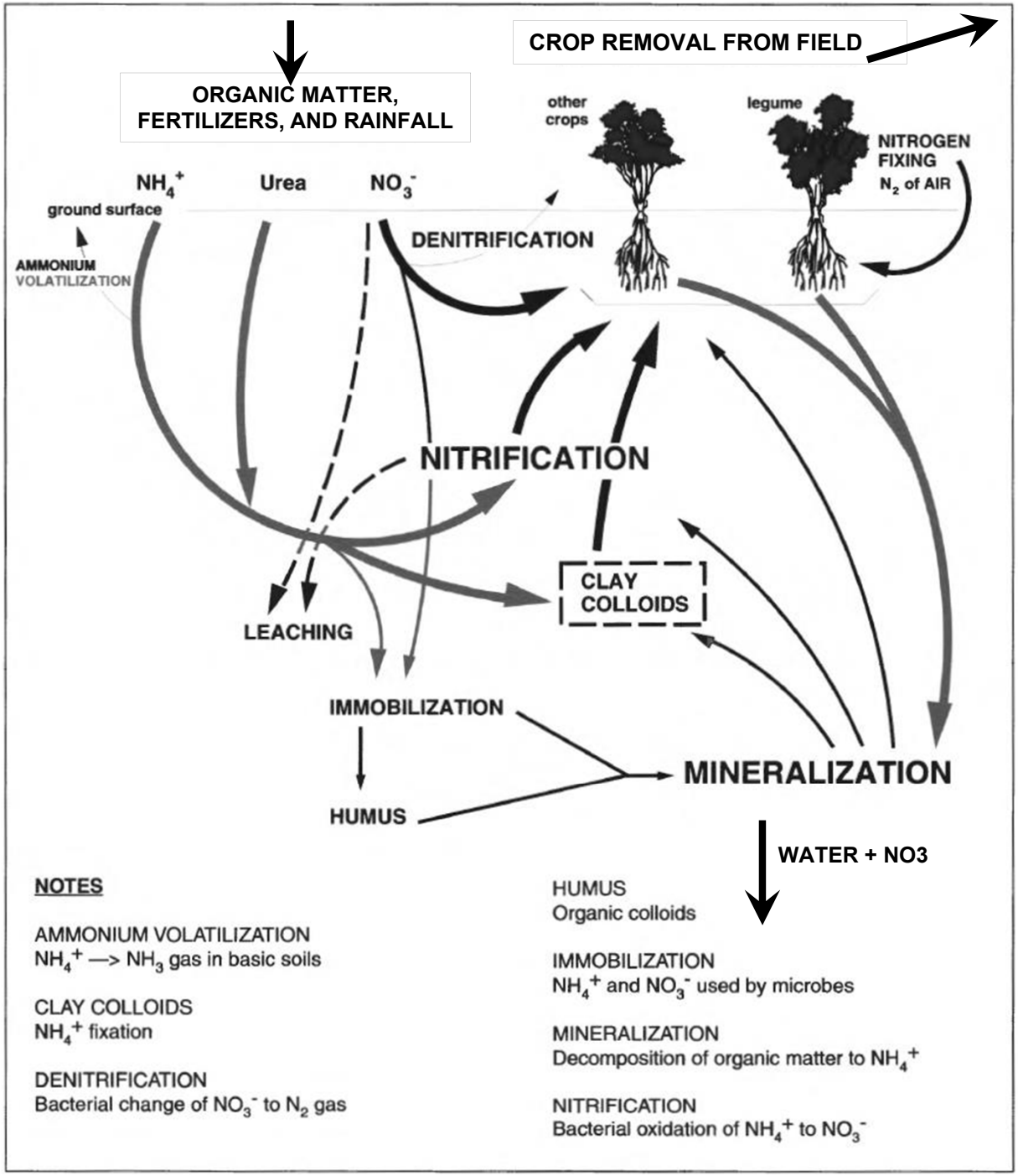
- **Reduce NO3 leaching to groundwater.**
- **Utilize long-term groundwater monitoring.**
- **Allow regulators to know the true status of the problem at the source.**

Bottom line: Go to the source in a pragmatic manner

Focus on the 2 arrows we can measure.

<u>The 3rd (leaching)</u>

<u>is the remainder.</u>



RECOMMENDED REGULATORY PROGRAM

The key elements of the recommended regulatory program are:

1. Establishment of coalitions to serve as the intermediate body between farmers and the Regional Boards.

2. Adoption of the A/R ratio as the primary metric for evaluating progress on source control, with eventual impact on the groundwater quality. [Q9]

$$A/R = \frac{\text{Nitrogen Applied}}{(\text{Nitrogen Removed via harvest}) + (\text{Nitrogen sequestered in the permanent wood of perennial crops})}$$

3. Development of a very strong, comprehensive, and sustained educational and outreach program. Such a program will require different materials and presentation techniques for different audiences, such as individuals who may need certification, managers of irrigation/nutrient plans, irrigators, and farmers/managers. [Q8]

RECOMMENDED REGULATORY PROGRAM

4. Creation and implementation of nitrogen/water management plans that are truly plans rather than just a listing of best management practices. These must be customized by features such as crop and locale. [Q5][Q6]
5. Reporting of key values (i.e., crop type, acreage, total nitrogen applied, and total nitrogen removed) by farms to the coalitions. [Q9]
6. Trend monitoring of groundwater nitrate concentrations to track general aquifer conditions over multiple years. [Q9]
7. Targeted research that will directly help the agricultural community to maintain and/or improve yields while simultaneously decreasing the A/R ratio on individual fields.
8. Use of multi-year reported values and monitored trends by the coalitions to inform the agricultural community of progress, to improve understanding of what is reasonable to attain and expect, and to sharpen improvement efforts. [Q9]

Recommendation: Coalitions

Section 4.1

- **Grower Coalitions should be encouraged by Regional Water Boards**
  - **Administration provided by local third-party**

- **Coalitions in Region 5 have been valuable**

Recommendation: A/R Ratio

Section 4.2

- **Irrigation and or rainfall deep percolation moves nitrate beyond the crop root zone**

- **Management practices minimize water deep percolation and match plant nitrogen needs**

$$A/R = \frac{\text{Nitrogen Applied}}{(\text{Nitrogen removed via harvest}) + (\text{Nitrogen sequestered in the permanent wood of perennial crops})}$$

Recommendation: Education and Outreach

Section 4.3

Growers/farmers must develop and implement good irrigation and nitrogen management plans.

Recommendation: Education and Outreach

Section 4.3

- **Key: Growers/farmers must develop and implement good irrigation and nitrogen management plans**

- **Not enough qualified consultants or individual farmers at present to develop such plans**

- **Educational programs address two groups:**
  1. **Individual farmers or farm managers who make water/nitrogen decisions**
  2. **Persons who develop irrigation and nitrogen water management plans**

Recommendation: Education and Outreach (continued)

Section 4.3

- **Critical Educational Components include:**
  - **Water and nitrogen needs specific to particular crops**
  - **Creating and implementing irrigation schedule**
  - **Irrigation distribution uniformity**
  - **Correct timing of nitrogen applications**
  - **Fertigation principles**
  - **Nitrogen management considerations with crop rotations**

- **Achieving this is described in further detail in the report**

Recommendation: Nitrogen Management Plans for each farm UNIT

Section 4.4

Instead of BMPs Focus on 4 Items:

1. **Creation of irrigation and nitrogen management plans specific to each grower and similar management unit**
2. **Awareness/education programs**
3. **Implementation of management plans**
4. **Internal (on-farm) review and assessment of the impacts**

Recommendation: Nitrogen Management Plans for each farm UNIT

Section 4.4

- **Instead of BMPs Focus on 4 Items:**
  1. **Creation of irrigation and nitrogen management plans specific to each grower and similar management unit**
  2. **Awareness/education programs**
  3. **Implementation of management plans**
  4. **Internal (on-farm) review and assessment of the impacts**

- **1-3 years for Coalitions to just develop the collection and organization process of management plans**

- **Plan details are for management, not for reporting. But subject to audit**

- **Updated annually**

Recommendation: Data to be reported to the Coalitions

Section 4.5

5 basic items

The 5 values that are REPORTED for each farming UNIT

- **Location of the reporting unit.**
- **Crop (e.g., lettuce, wheat, almond)**
- **Crop acreage (acres)**
- **Nitrogen applications for each crop (lbs./acre) including organic applications (e.g., manure, compost), synthetic fertilizer applications, and nitrogen in irrigation water [**
- **Nitrogen removed by harvest or sequestered in permanent wood.**

Recommendation: Verification/Monitoring

Section 4.8

- **Measuring <u>progress on source control</u>**

- **A/R Ratios will be used for long-term trend analysis**
  - **Provide a baseline**
  - **Indication of long-term progress**
  - **Viewed individually or regionally**

- **Groundwater nitrate concentrations trend monitoring**

Recommendation: Targeted Research

Section 4.7

- **Pragmatic research is needed to identify items such as:**
  - **Crop nitrogen uptake rates and timing**
  - **Crop removal rates and timing**
  - **Sampling intervals**
  - **Sampling Density**

Recommendation: Surface Water Discharges

Section 4.9

- **Individual field monitoring is problematic**
- **Use a third-party effort**
- **For surface water issues, monitor receiving water instead of discharge points**
- **No uniform sampling density and frequency recommendations because they depend on:**
  - **Size and complexity of watershed**
  - **Current sample results**

Questions?