
Farm management to minimize
environmental water quality problems

California has environmental water quality problems:

- **Nitrate and phosphate in surface runoff causes 'biostimulation'**
  - **water quality goals are < 6 PPM NO_3-N and < 0.3 PPM PO_4-P**

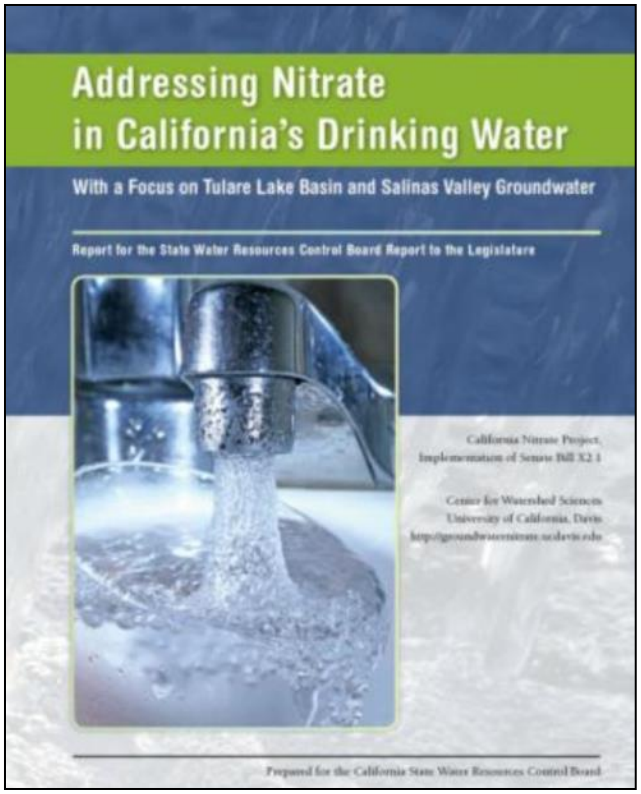
California has environmental water quality problems:

- **Nitrate in drinking water considered a human health hazard**
  - **Federal standard is 10 PPM NO_3-N**

California *agriculture* has an environmental water quality problem …

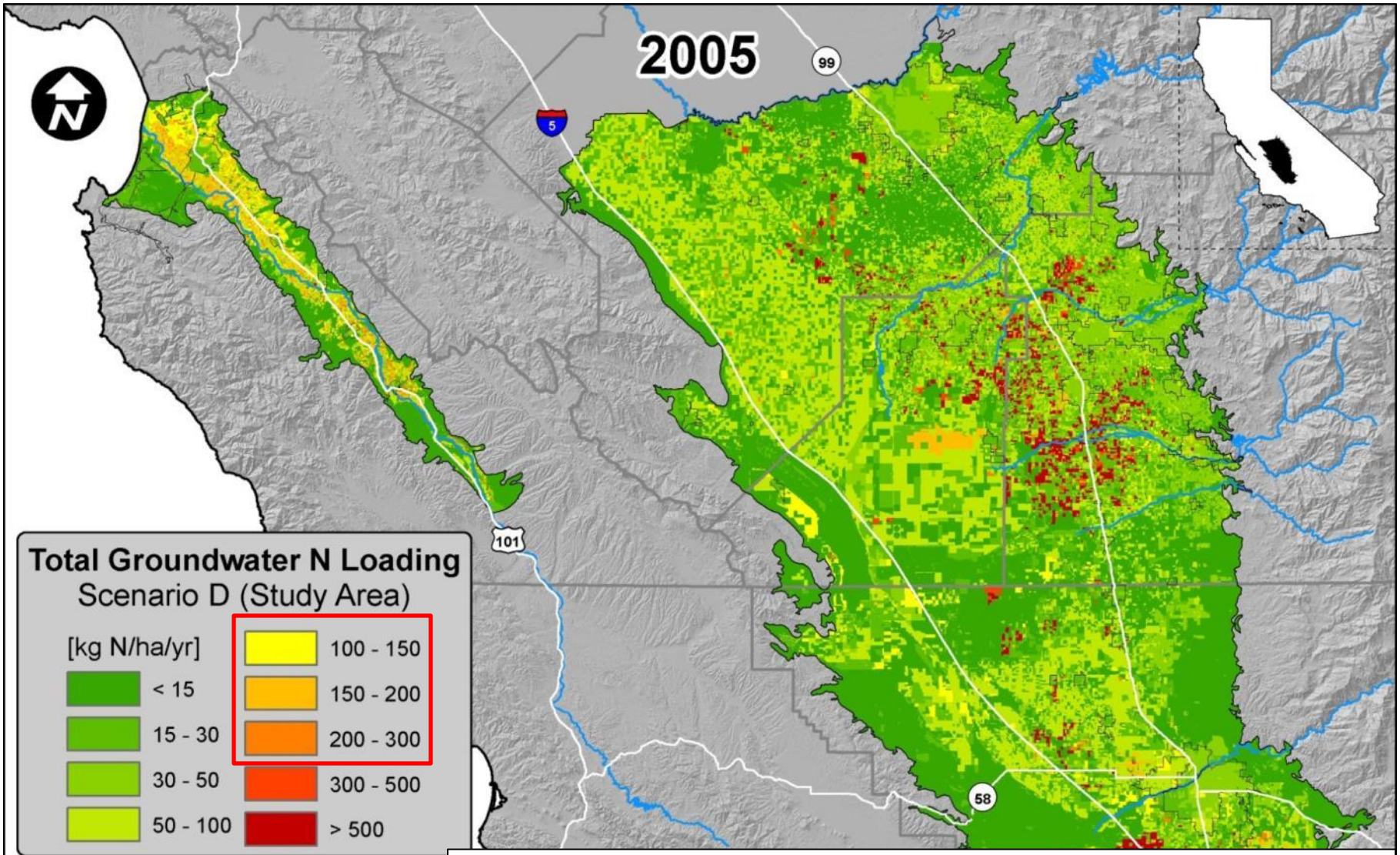
SBX21:

- **2012 special report to the legislature on nitrate in groundwater**
  (AKA the 'Harter' report)



- **Evaluated both the scale, and the source, of nitrogen losses in two regions with high groundwater nitrate levels**
  - Tulare Basin
  - Salinas Valley

Estimated nitrogen loading to groundwater:



- **Harter report suggested that a system of agricultural N use reporting would improve the estimation of a nitrogen 'mass balance' for impacted watersheds**

TIER 2/TIER 3 FARMS WITH HIGH NITRATE LOADING RISK
TOTAL NITROGEN APPLIED REPORT - RANCH / RISK UNIT

Page 1 of 1 - June 5, 2014 Version

SUBMIT ELECTRONIC FORM: Click on "Submit Form" to send completed form directly to the Water Board

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CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS - REGIONAL BOARD ORDER R3-2012-0011

By October 1, 2014 and October 1 annually thereafter, Tier 2 and Tier 3 dischargers with High Nitrate Loading Risk must report total nitrogen applied and present in the soil. *Refer to instructions on reverse.*

SECTION I: GENERAL RANCH INFORMATION

AW#: | Ranch Global ID: | Ranch Name:

High Risk Determination Name(s):

SECTION II: RECORDKEEPING AND REPORTING INFORMATION

High Risk

Reporting Year: *(select one)* ☐ 2014 ☐ 2015 ☐ 2016 ☐ 2017

Have nitrogen records been maintained for the required reporting period *(September 1 - August 30)*? ☐ YES ☐ NO

If NO, state the reporting period for which records have been maintained: _____ (MM/DD/YYYY) to _____ (MM/DD/YYYY)

SECTION III: TOTAL NITROGEN APPLIED REPORTING

Ranch / Risk Unit Reporting Name: | Ranch / Risk Unit Acres:

	Crop Type(s) Grown and Harvested During Reporting Period	Crop Type Acres	Total Nitrogen Present in the Soil *(lbs/acre)*	Total N Applied in Fertilizers & Amendments *(lbs/acre)*	O / C
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Average Nitrogen Concentration in Irrigation Water *(mg/L as NO3 -N)*

Total Nitrogen Applied with Irrigation Water *(lbs/acre)*

Identify the Basis for the Amount of Total Nitrogen that was Applied *(select all that apply)*

- ☐ University Research Data
- ☐ UCCE Information
- ☐ UC Farm Advisor Consultation
- ☐ Water Coalition
- ☐ Consultant (PCA, CCA, etc.)
- ☐ Local Info/Neighbor
- ☐ Yield Projection
- ☐ Commodity or Industry Group
- ☐ Private Research Trials
- ☐ On-Farm Research Trials
- ☐ Trade Publication
- ☐ Fertilizer Distributor/Dealer
- ☐ Grower Experience
- ☐ Laboratory Recommendation
- ☐ Site Analysis Dry Biomass
- ☐ Scientific Literature

SECTION IV: AUTHORIZATION AND CERTIFICATION

By submitting this Total Nitrogen Applied Report, in compliance with Water Code § 13267, I certify under penalty of perjury that this document was prepared by me, or under my direction or supervision, following a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. To the best of my knowledge and belief, this document is true, accurate, and complete. I am aware that there are significant penalties for submitting false information.

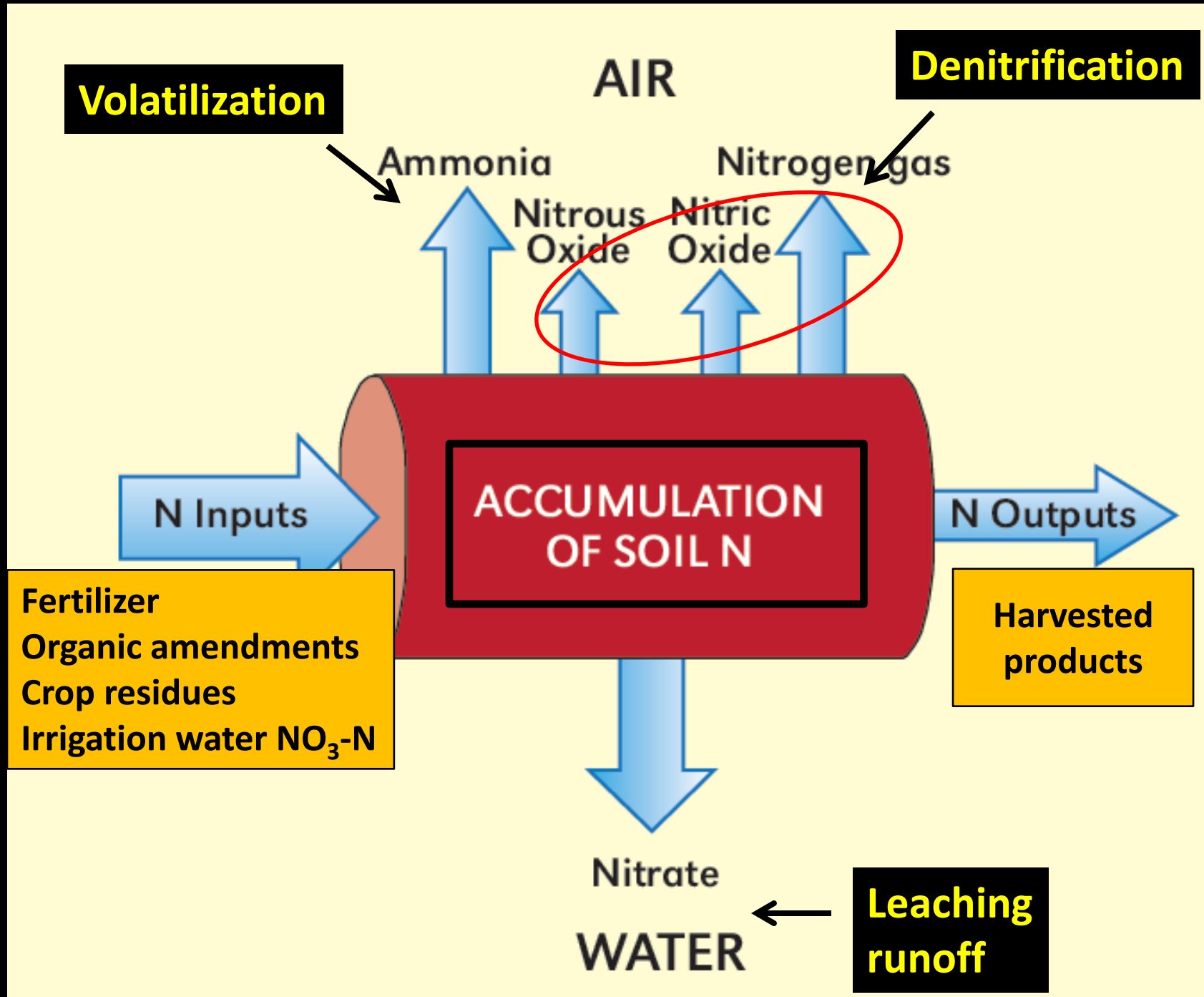
Does this form contain information related to trade secrets or secret processes? ☐ YES ☐ NO

Preparer Name: | Date Prepared: | Operator/RP Name:

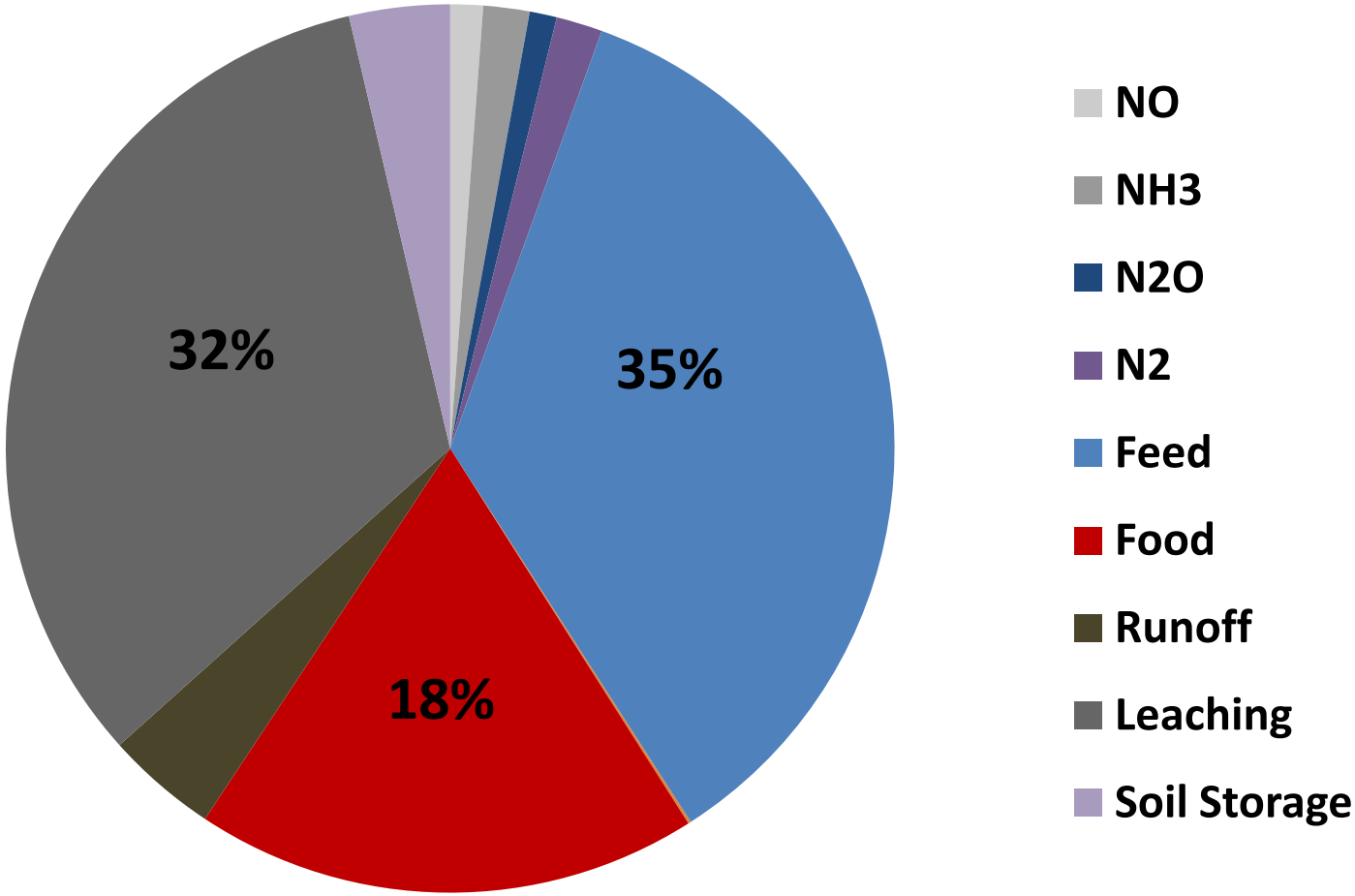
Nitrogen use reporting starts in October, 2014 on the coast

Basic assumption of a nitrogen ‘mass balance’ approach: :

- **N applied to a field but not removed in harvested products is at risk of *eventually* leaving the field in gaseous or liquid form**


AIR
Volatilization
Denitrification
Ammonia
Nitrogen gas
Nitrous Oxide
Nitric Oxide
N Inputs
ACCUMULATION OF SOIL N
N Outputs
Fertilizer
Organic amendments
Crop residues
Irrigation water NO_3-N
Harvested products
Nitrate
WATER
Leaching runoff

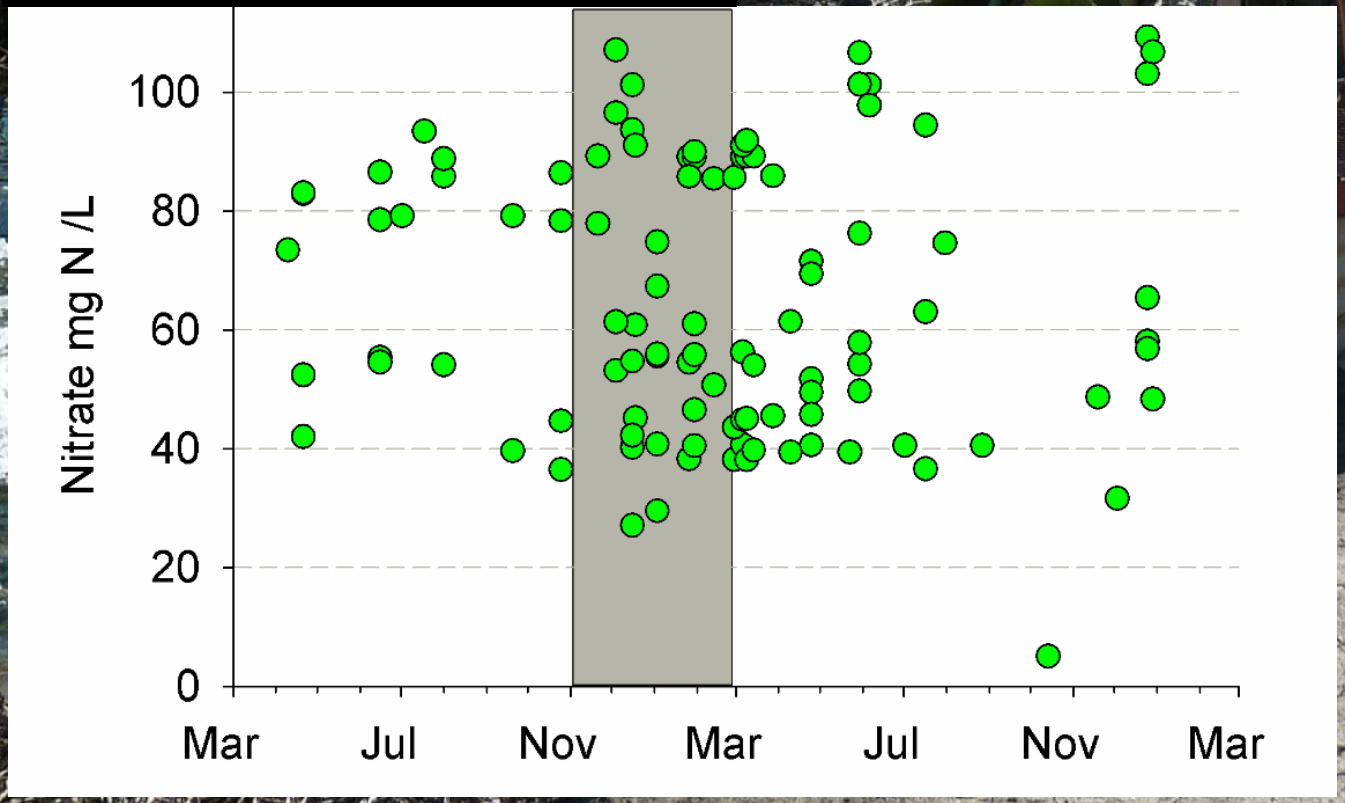
Cropland nitrogen outputs and storage



Source: California Nitrogen Assessment

Is there direct evidence of NO_3-N leaching from vegetable fields?

Coastal tile drain effluent:



Why is the Salinas Valley a hot spot for water quality problems ?

- Agriculture dominates the landscape; low population, little industry
- Multiple crops per year the norm, high crop value leads to high N rates
- Low annual rainfall (minimal dilution of agricultural emissions)

Simplified N balance for coastal vegetable production :

	lb N/acre		
Inputs	Spring lettuce	Summer lettuce	Summer broccoli
Fertilizer	170	130	180
Irrigation water NO_3-N	30	30	40
Total input	200	160	220

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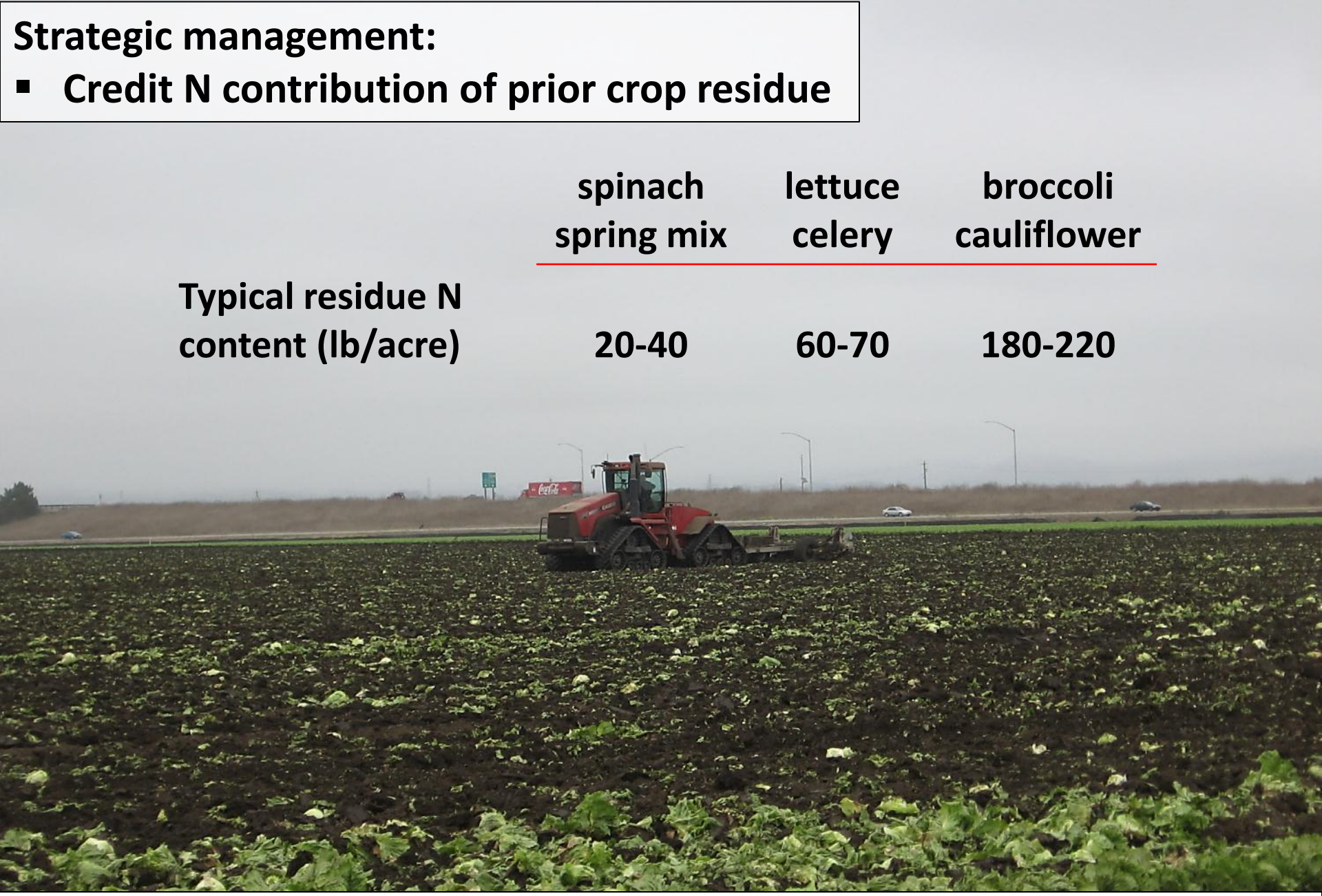
Balance (N removal basis)	130	90	120

Improvement requires ‘strategic’ N management, not just a fertilizer ‘program’

Strategic management:

- Credit N contribution of prior crop residue

	spinach spring mix	lettuce celery	broccoli cauliflower
Typical residue N content (lb/acre)	20-40	60-70	180-220

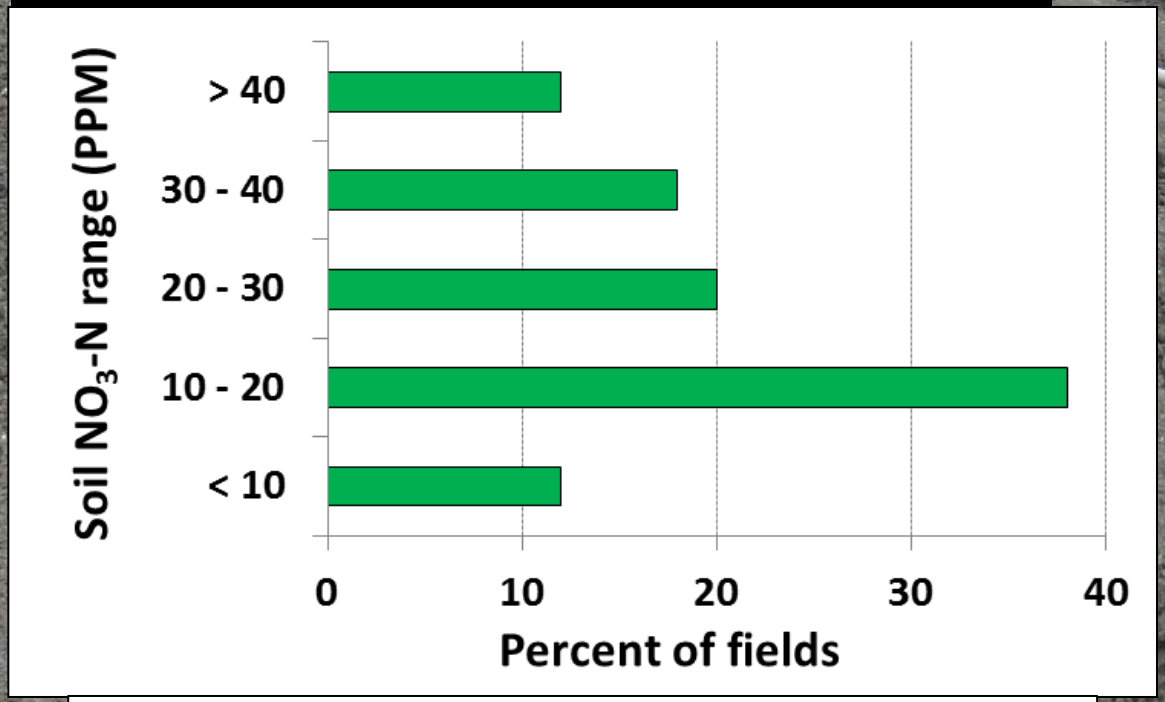


At least 60% of vegetable residue N likely to become plant-available for the next crop

Strategic management:

- Credit residual soil NO_3-N

Survey of 50 lettuce and cauliflower fields :



PPM x 4 = approximate pounds of NO_3-N per acre

Strategic management:

- **Credit irrigation water N**

Irrigation water NO_3-N x 2.7 = lb N per acre·foot

Castroville reuse water is ≈ 35 PPM mineral N

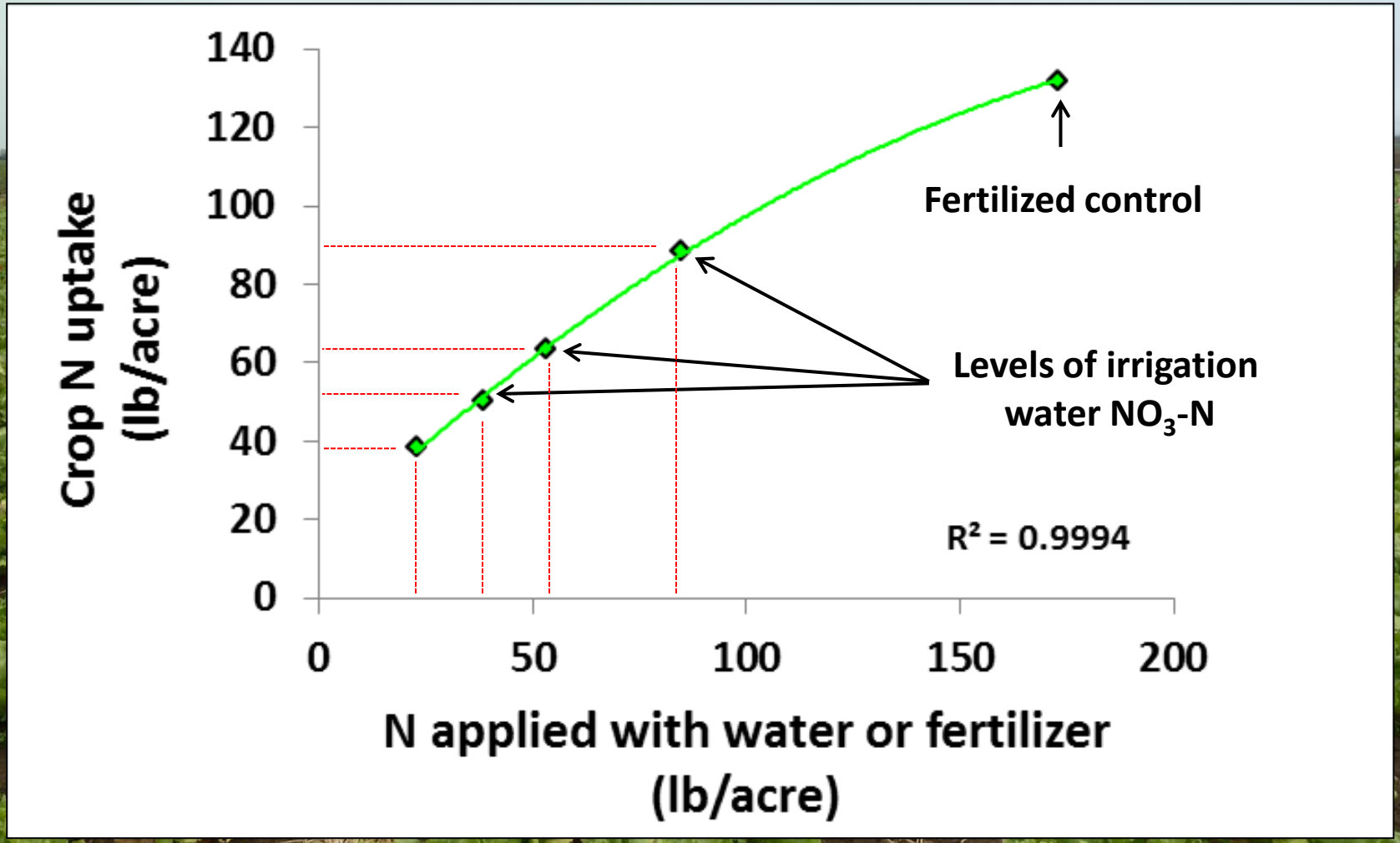
- **each foot of irrigation water adds 95 lb N/acre**

How effectively do crops utilize irrigation water NO_3-N ?

2013 irrigation water NO_3-N uptake efficiency trial

- continuously injected varying levels of NO_3-N from 0-40 PPM
- measured lettuce biomass N at harvest

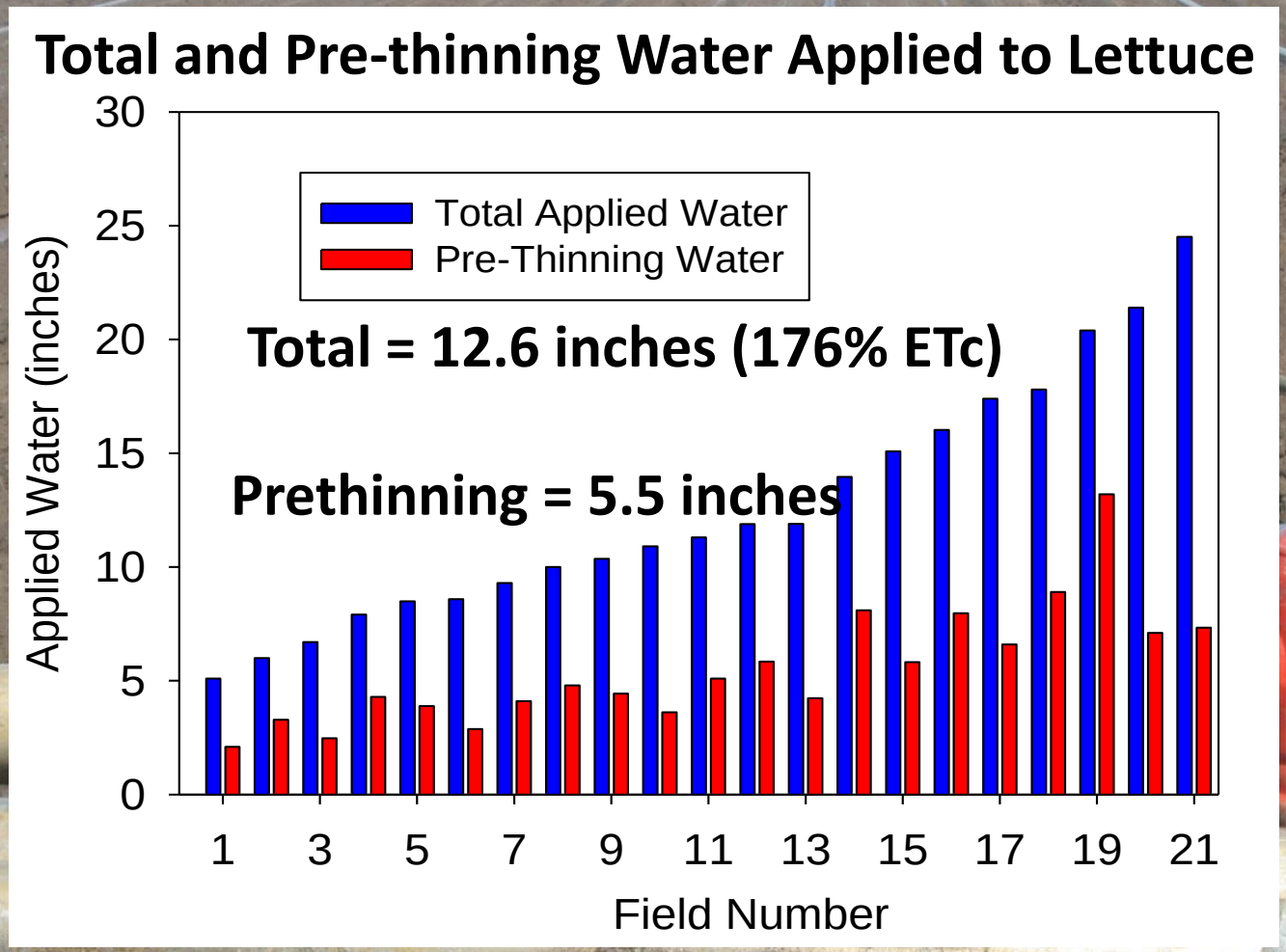
Results:



Bottom line: NO_3-N in irrigation water behaves like fertilizer

Strategic management:

- **Control irrigation**



Data from Mike Cahn, Monterey County UCCE

CropManage:

- a web-based tool for irrigation and nitrogen management

CropManage Overview: A web application for managing water and nitrogen fertilizer in lettuce

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Author: Michael D Cahn **Published on: October 15, 2012**

Cool season vegetable production requires significant inputs of water and nitrogen (N) fertilizer to maximize yield and quality. Proposed changes in water quality regulations on the Central Coast and higher fertilizer prices in recent years have prompted grower interest in increasing efficiency of nitrogen fertilizer use in lettuce. By improving water management and matching nitrogen applications to the uptake pattern of the crop, growers could potentially reduce fertilizer use and address water quality concerns.

Two tools available, the quick nitrate soil test and weather-based irrigation scheduling, have been shown to help lettuce producers better manage water and fertilizer nitrogen. Trials we conducted in commercial fields have demonstrated that soil nitrate concentrations greater than 20 ppm NO_3-N, are sufficient to maximize crop production. In addition, we have shown that evapotranspiration data available from the California Irrigation Management and Information system (CIMIS), can be used to accurately estimate the appropriate volume of water to apply to meet crop needs and minimize potential leaching losses of nitrate-N.

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- Entering a new soil nitrate test value for a planting
- Upcoming Irrigation and Nutrient Management Meetings

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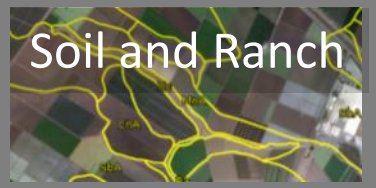
- April 2014

Integrate information from multiple sources



Database Driven Web Application

Crop ET model

Crop N model

Some nitrogen discharge is inevitable …

Are there remediation options ?

Nitrate removal with anion resin technology

Lessons from municipal wastewater treatment

Ag applications of ‘managed denitrification’ :

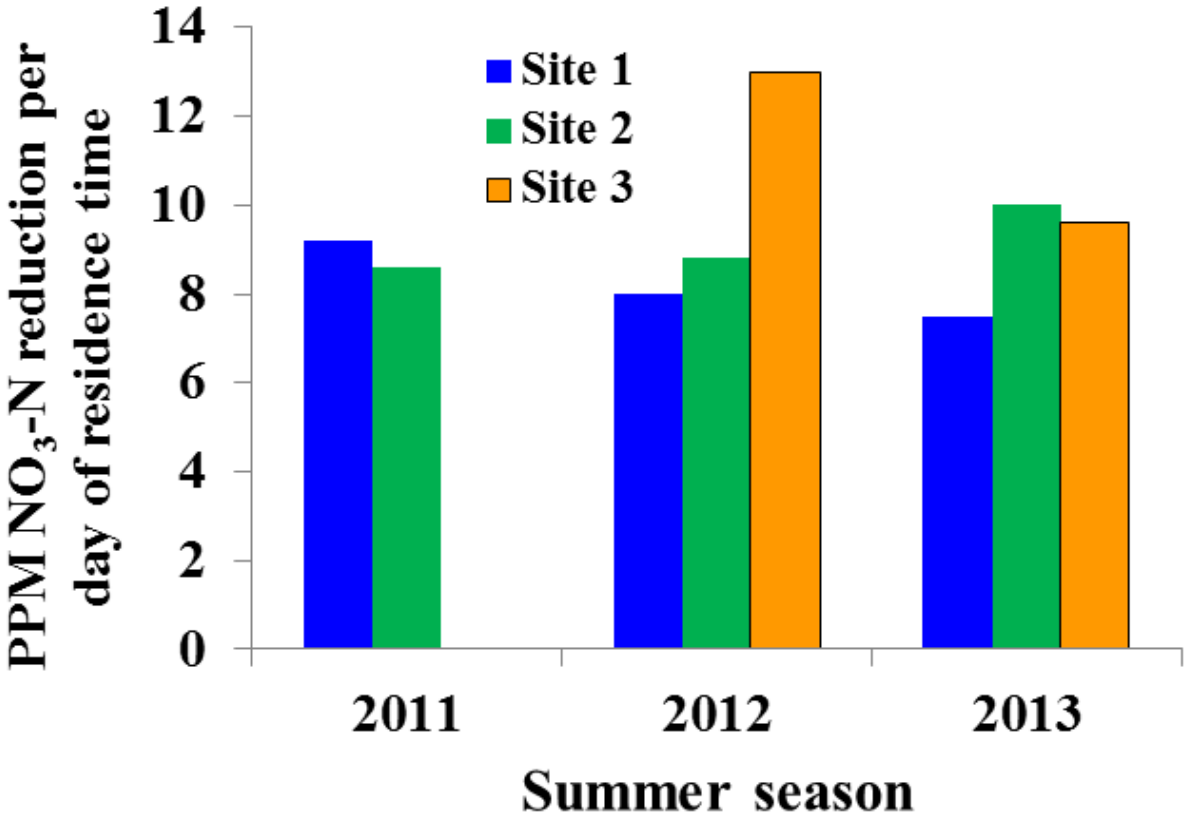
Constructed wetland

Agricultural denitrification bioreactors

Salinas Valley Denitrification Bioreactors:

Mean denitrification rates achieved :

(PPM NO_3-N reduction per day of residence time)



Carbon to power the microbial action is the limiting factor …

So, where are we headed ???

- There are economically feasible improvements to current practices that can significantly reduce nutrient losses to the environment
- Complete compliance with all environmental water quality goals may require regulatory action that affects land use decisions, cropping patterns, economic viability