1. DPR Ground Water Sampling Program

2. Hexazinone Detections Related to Use

3. Study on Offsite Movement in Alfalfa

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# Mandate for Monitoring and Regulation

- 1985 - Pesticide Contamination Prevention Act was Enacted requiring DPR (then CDFA) to:

  1. Maintain data base for statewide well sampling and respond to reported detections

  2. Sample for pesticides with potential to move to ground water either to determine presence or to determine if detection is valid and from non-point source

  3. Review/regulate detected pesticides
     - Part of regulation is modifying use of detected pesticides in vulnerable areas

# Source Considerations and Wells Sampled

Nonpoint Source Applications – Chemicals applied to large contiguous areas of land

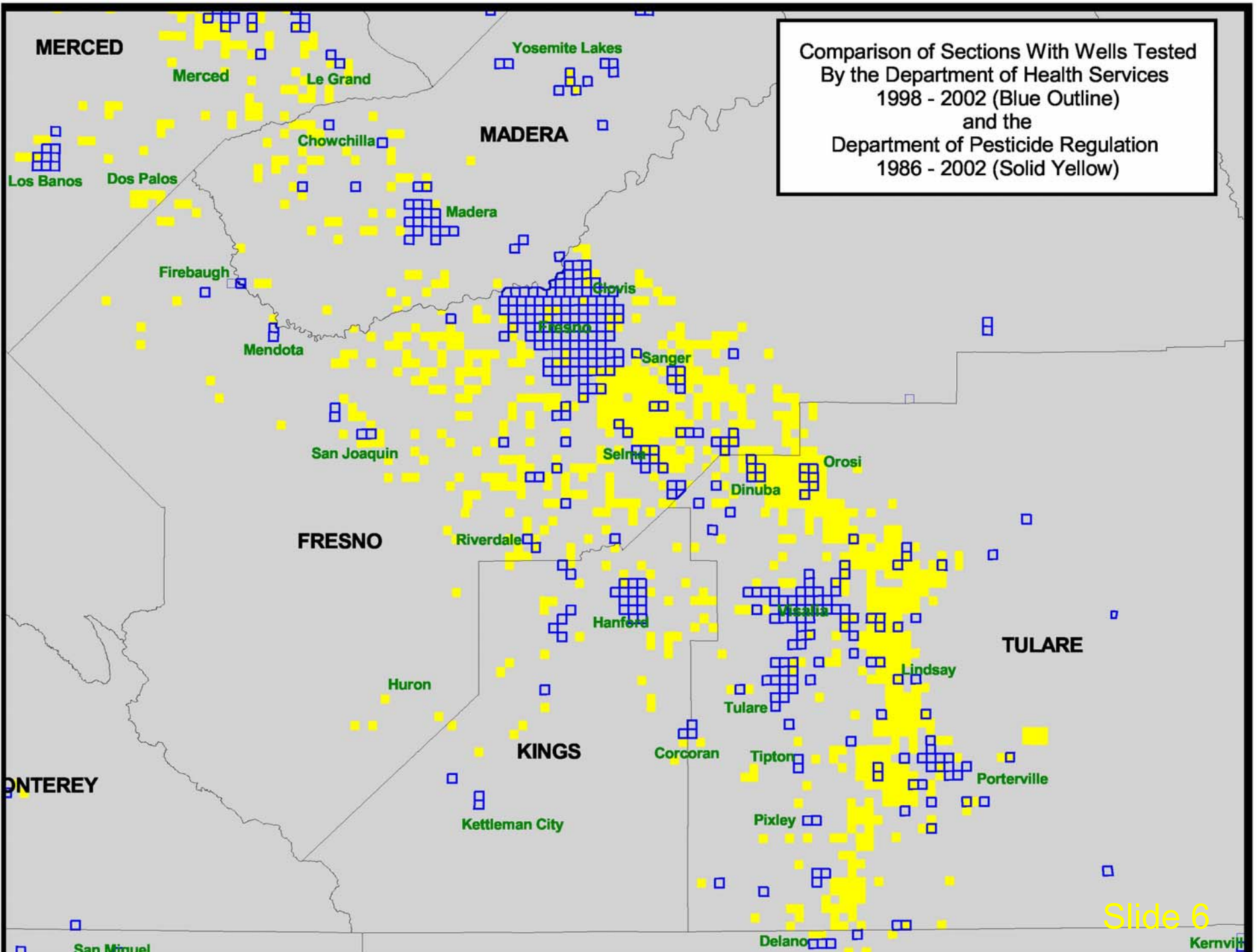
Assigning exact source/field is not possible – recharge water extracted by well is a mix originating from many sites

Domestic wells sampled

- Located in rural areas
- Extract water from shallow, vulnerable aquifers
- Program relies upon voluntary acceptance by well owners to allow for sampling

Slide 4

Cotton Picker
Spindle Cleaner


Comparison of Sections With Wells Tested
By the Department of Health Services
1998 - 2002 (Blue Outline)
and the
Department of Pesticide Regulation
1986 - 2002 (Solid Yellow)
MERCED
Merced
Le Grand
Yosemite Lakes
MADERA
Chowchilla
Los Banos
Dos Palos
Madera
Firebaugh
Clovis
Fresno
Mendota
Sanger
San Joaquin
Selma
Orosi
Dinuba
FRESNO
Riverdale
Hanford
Visalia
TULARE
Lindsay
Huron
Tulare
KINGS
Corcoran
Tipton
Porterville
ONTEREY
Kettleman City
Pixley
Delano
San Miguel
Kernvil

# Well Selection Protocol

A standard operating procedure has been developed for choosing wells to sample in order to assure that samples are representative of the aquifer
http://www.cdpr.ca.gov/docs/emon/pubs/sops/fswa00601.pdf

- Obtain well log if possible
- Domestic wells preferred over irrigation or public supply wells
- Pad in good condition with no cracks
- Well is above grade of runoff
- No storage around well, especially pesticide containers
- Preference for wells that operate regularly , assuring fresh water in well

# Choice of Pesticide to Sample

Protocol to choose pesticides to sample from the 6800(b) list of potential GW contaminants
http://www.cdpr.ca.gov/docs/emon/grndwtr/polprocd/gwplai.pdf

Sample for pesticide residues with potential to move to ground water but not yet detected in GW

Long-lived

Loosely bound by soil

Select areas to sample domestic wells based on

- Pesticide use data
- Vulnerable areas denoted ground water protection areas (GWPAs) based on:
  - Previous detection in a section or
  - Section with soil characteristics and depth to GW data similar to sections with detections

# Detection and Management

Legal agricultural use determination

- 2 wells within a section or in an adjacent section
- No obvious point sources

http://www.cdpr.ca.gov/docs/emon/grndwtr/polprocd/policy26.pdf

DPR does not routinely conduct long-term monitoring in all detected wells because the number of wells is large and there are numerous combinations of cropping patterns and soil types

Instead, follow-up studies focus on pathways to ground water and on management practices to prevent further contamination

http://www.cdpr.ca.gov/docs/emon/grndwtr/contproc.htm

# Hexazinone Detections and Use Patterns

Use patterns are important guides in determining areas to sample

Roadside use to control weeds is reported on a county basis and not a section basis.

Residues in well in LA County provides an example where residues can be detected but no indication of use in section

Hexazinone detected at 0.07 and tebuthiuron at 0.05 ug/L Tebuthiuron only used for non-crop/roadside weed control. No reported use of either in section but use reported by county for roadside applications.

# Hexazinone Detections and Use Patterns

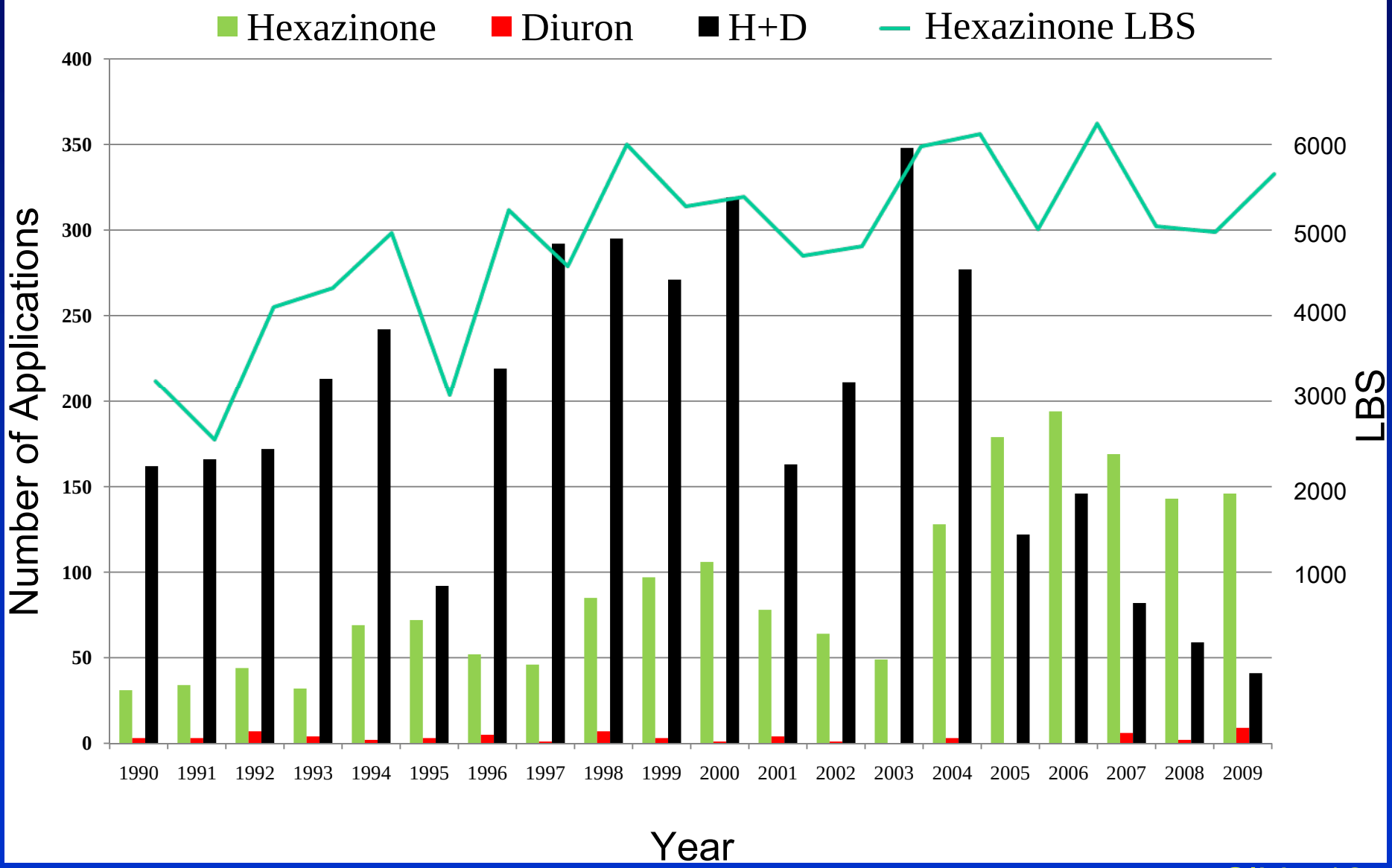
Source of detections from use on alfalfa was determined from a combination of

- Pesticide use reports
- Co-occurrence with diuron residues in wells
- Results of a field study on movement to GW from use on alfalfa

Prior to 2005 combined application of hexazinone and diuron to an alfalfa crop was frequent

Diuron is a detected pesticide on the 6800(a) list with regulations on use. Residues have been detected in at least 400 separate wells. In 2009 780,000 lbs of diuron was sold compared to 94,900 lbs for hexazinone

# Applications of Hexazinone and Diuron to Alfalfa In Ground Water Protection Areas



# Multiple Residues Detected in Wells!

Developed analytical screen that captures regulated pesticides denoted as 6800(a) listed in regulations

Currently, most are pre-emergence herbicides and multiple residue detections in wells is common

0.13 Atrazine
0.08 Simazine
0.31 DEA
0.85 ACET
0.62 DACT
0.42 Diuron
1.47 Bromacil
0.20 Norflurazon

Used in combination: simazine+diuron
bromacil + diuron

Similar physical/chemical properties among pre-emergence herbicides so substitutes also found - norflurazon

Similar Pathway for Residues Moving to Ground Water

# Hexazinone Detections and Use Patterns

Tables 1 and 2 in the handout present results for analysis of hexazinone and diuron in the same well sample in relation to reported use of both in the section

Patterns in Table 1 indicate detections that result from use on alfalfa

- Both herbicides used on alfalfa and both detected in the same well sample
- Reports of only hexazinone application to alfalfa and only hexazinone detected in the well sample

Patterns in Table 2 are grouped indicating detections from roadside/non-crop use or potentially from a combination

# Example of Table 1 in handout that indicates hexazinone diuron detections in relation to use in alfalfa

| | | Hexazinone | | Diuron | | |
|---|---|---|---|---|---|---|
| Likely Source of Detections | Section with Well Detection | Concentration ug/L (Year of Detection) | Reported Alfalfa Use Prior to Year of Detection (lbs) | Concentration ug/L (Year of Detection) | Reported Use Prior to Year of Detection (lbs) | Comments on Pattern of use and Detections |
| Alfalfa use | 48M06N01E23 | 0.13 (2007) | 18,676 | 0.15 (2007) | 7299 Alfalfa<br>0 Other | Years prior to 2007 |
| | 10M17S19E36 | 0.25 (2007) | 6,045 | 0.15 (2007) | 1,166 Alfalfa<br>1,320 Other | Years prior to 2007 |
| | 10M17S19E36 | 0.08 (2007) | 6,045 | 0.08 (2007) | 1,166 Alfalfa<br>1,320 Other | Years prior to 2007 |

# Hexazinone Detections and Use Patterns

Comparison of use in all section with hexazinone analysis:

| | All Sections | | Zero use Excluded | |
|---|---|---|---|---|
| | Median | N | Median | N |
| Detection | 170 lbs | 20 | 287 lbs | 16 |
| No Detection | 0 lbs | 1,548 | 151 lbs | 478 |

# Example of Table 3 in handout that contains co-occurrence of hexazinone with other pesticide residues measured during well sampling.

| | | Pesticide Active Ingredient or Transformation Product | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Hexazinone | | Other Triazine Residues | | | | | Other Pre-emergence Herbicides | | | Alachlor/Metolachlor Transformation Products | | | |
| Section with Well | Date Sampled | Hexazinone | 2-Hydroxy (degradate) | Atrazine | DEA | Simazine | ACET | DACT | Diuron | Bromacil | Tebuthiuron | Alachlor ESA | Alachlor Oxime | Metolachlor ESA | Metolachlor Oxime |
| 06M15N03W36 | 6/13/1998 | 0.06 | - | ND | ND | ND | ND | - | ND | ND | - | - | - | - | - |
| 10M14S21E21- | | | | | | | | | | | | | | | |
| Sample 1 | 3/21/2001 | 0.05 | - | ND | ND | 0.14 | 0.06 | 0.76 | 0.10 | 0.23 | - | - | - | - | - |
| Sample 2 | 10/24/2001 | 0.06 | - | ND | 0.07 | 0.15 | 0.71 | 0.70 | 0.11 | 0.18 | - | - | - | - | - |
| Sample 3 | 10/28/2002 | 0.06 | - | ND | 0.06 | 0.17 | 0.51 | 0.74 | 0.12 | 0.20 | - | - | - | - | - |
| 10M14S22E13 | 3/15/2000 | 0.07 | - | ND | ND | 0.13 | 0.15 | 0.07 | ND | ND | - | - | - | - | - |
| 10M15S22E05 | 4/13/2010 | 0.05 | - | 0.10 | 0.20 | 0.10 | 0.22 | 0.24 | 0.13 | 0.13 | ND | - | - | - | - |

| Determinant Soil Property | Pathway and Control |
| --- | --- |
| Coarse, Sandy Soil – Soils with High Infiltration rates | Leaching with surface water that percolates to ground water<br><br>Minimize Percolation |
| Finer-textured Or Hardpan Present – Soils with Low Infiltration Rates | Residues move offsite in runoff water to sensitive sites<br><br>Improved Incorporation i.e. not by rainfall<br>*Or*<br>Manage Runoff Water |

# Field Study in Alfalfa

## Cracking-clay Soils with Water Table

Leaching or runoff ?

- Atrazine, Diuron, Hexazinone detections near Tracy
- Rotation of alfalfa with row crops and corn
- Hexazinone only used on alfalfa
- Soils are a cracking-clay
- Fields had small adjacent ponds
- Cooperative study with UC extension specialists and a grower

Results published and available at:
http://www.cdpr.ca.gov/docs/emon/grndwtr/manuscript2005.pdf

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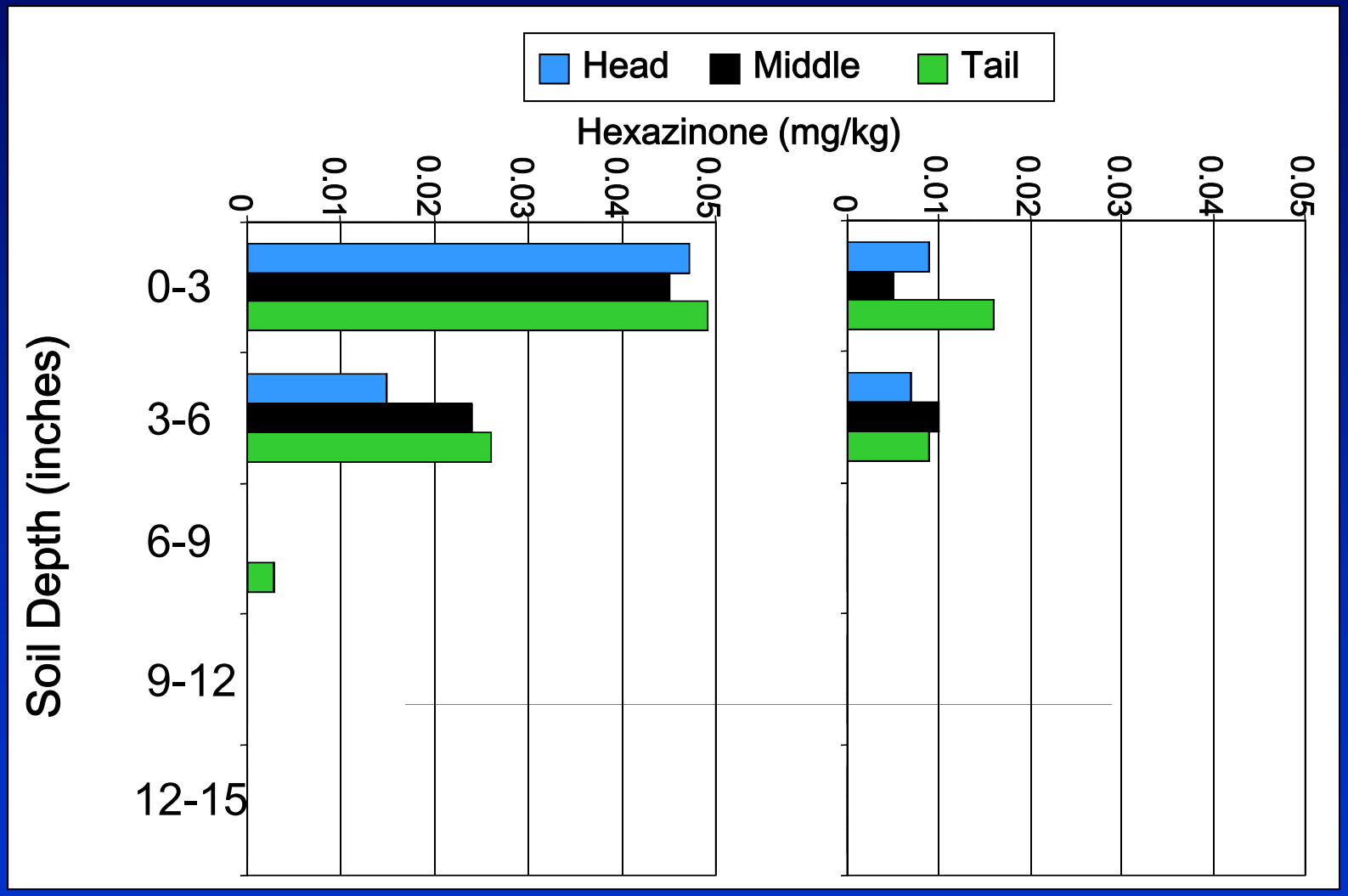
Slide 21

Slide 22

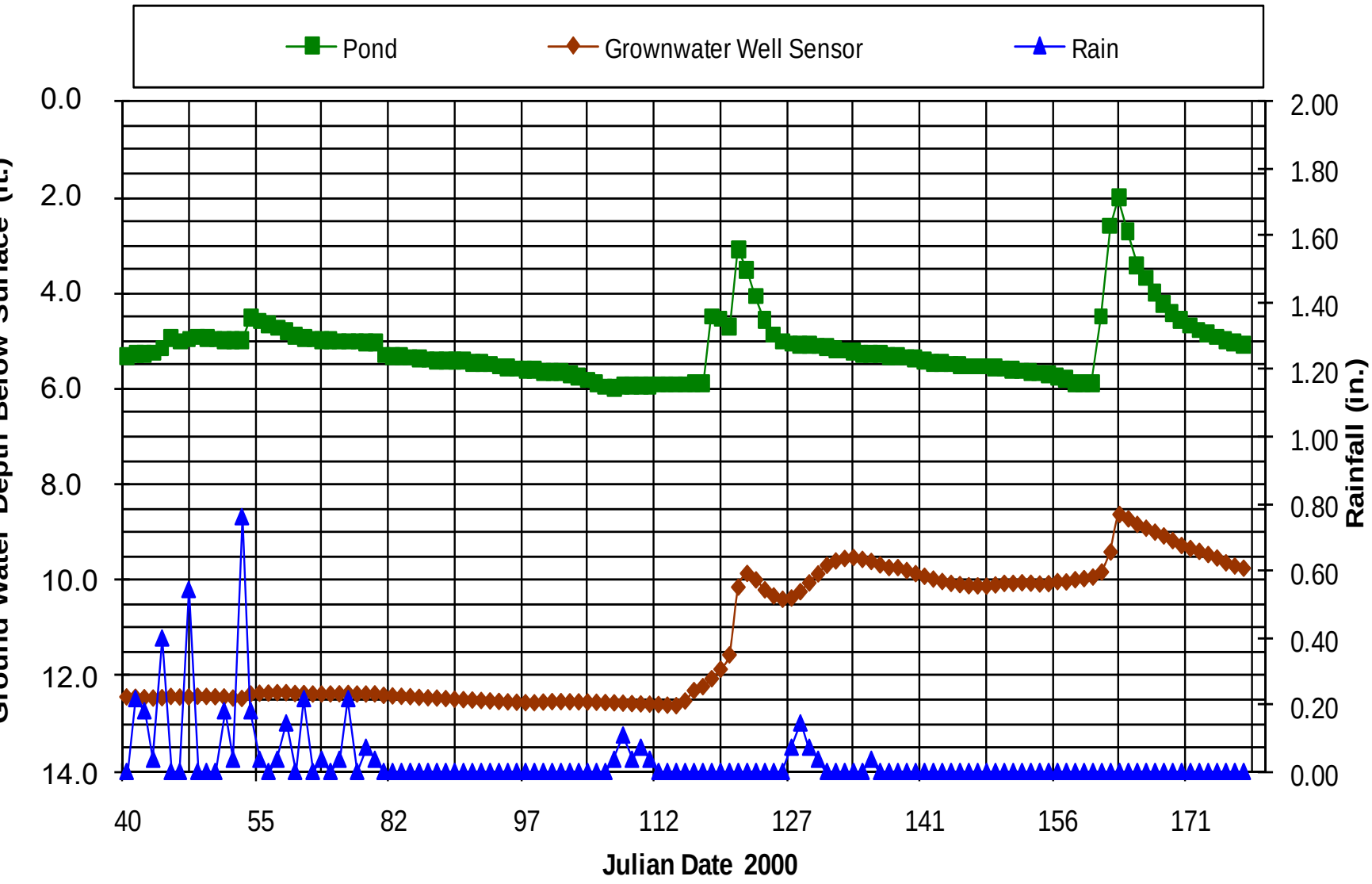
# Comparison of Hexazinone in Field at the Head, Middle, and Tail Portion
## Hexzainone applied on Dec 23, 1999
## Residues retained within the first 6-inches of soil depth



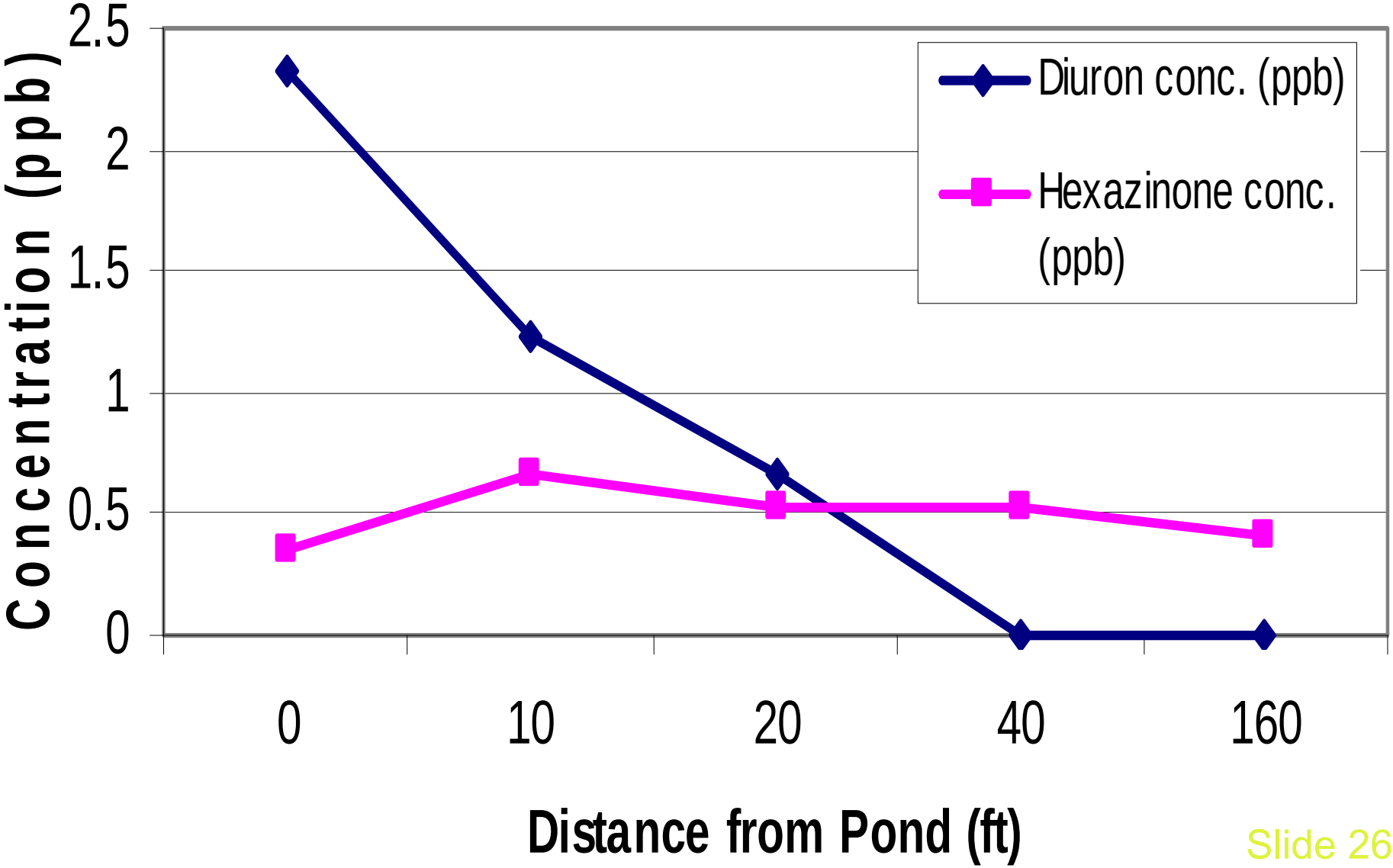

Soil sampled April 6, 2000
before 1st irrigation

Soil sampled June 27, 2000
after 2nd irrigation

# Relative Pond and Ground Water Elevation



# Concentration of Herbicides in Ground Water as a Function of Distance From Pond



# Alfalfa Acreage and Hexazinone Use in GWPAs

Data from 1990 to 2009 from PUR for acres of alfalfa grown in GWPAs compared to annual acres where hexazinone was applied:

| | N | Alfalfa Acres | Hexazinone Acres | Ratio Hex/Alf |
|---|---|---|---|---|
| Mean | 20 | 172,495 | 18,220 | 11.4% |
| Median | 20 | 173,943 | 18,560 | 11.2% |