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Assessment of Shallow Ground-Water Quality in Agricultural and Urban Areas Within the Arid and Semiarid Western United States

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BACKGROUND

NAWQA investigated shallow ground water underlying agricultural and urban areas within the arid/semiarid Western United States:

Arizona (CAZB) -- Agricultural
Utah (GRSL) -- Urban
Nevada (NVBR) -- Agricultural and Urban
New Mexico (RIOG) -- Agricultural and Urban
California (SACR,SANJ,SOCA) -- Agricultural and Urban

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PURPOSE

Identify regional factors influencing shallow ground-water quality within agricultural and urban areas in the arid/semiarid Western United States

Concern of compromised shallow ground water entering deeper aquifers thereby contaminating possible potable supplies

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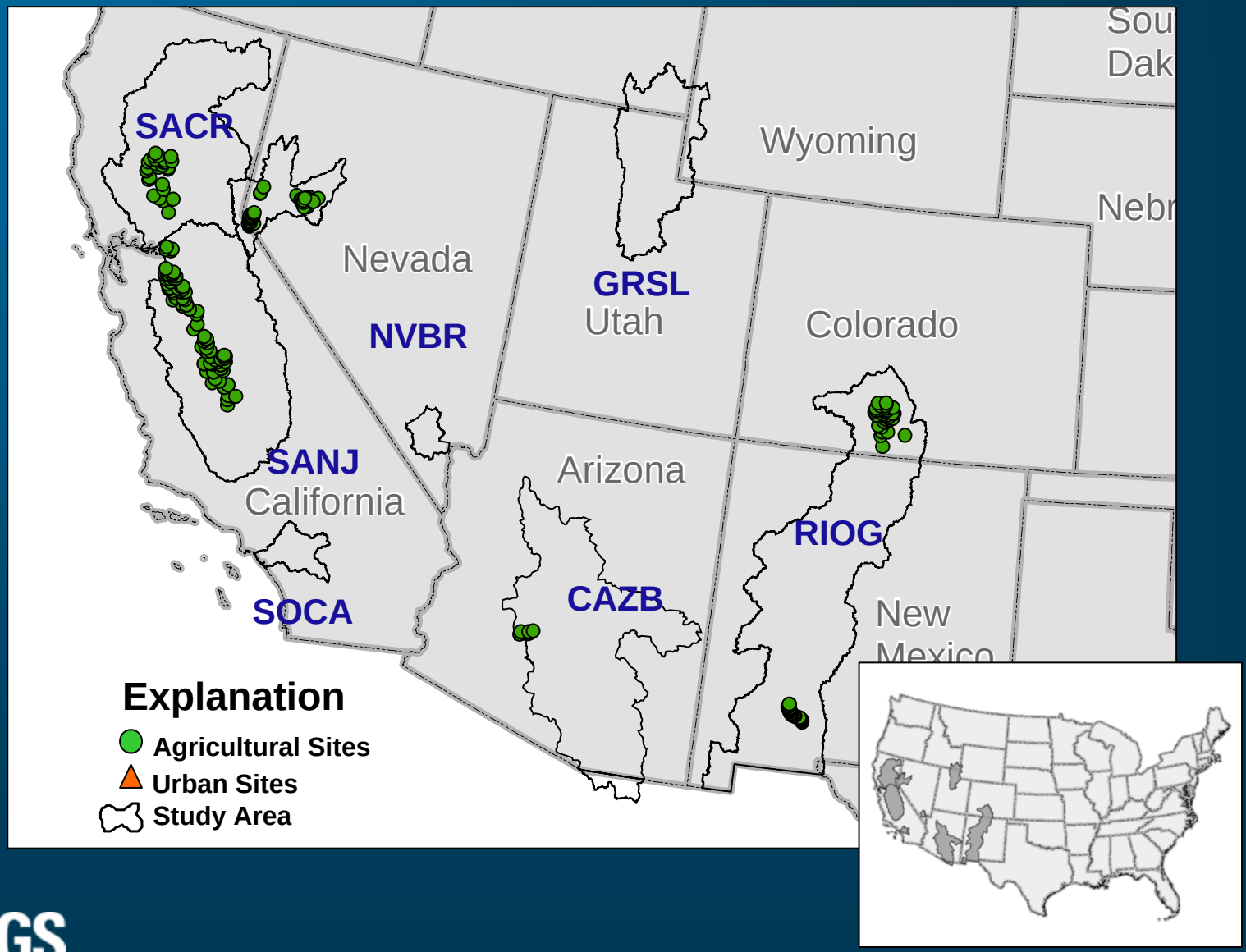
Sampling Sites



BACKGROUND

- **Growing Population**
  - From 1990 to 2000 the percent change in population within the study area ranged from 13 to 66 percent.
- **Changing Land Use**
  - Agricultural and desert lands are being converted to residential and industrial areas.
-
- **Increasing Need For High-Quality Water**
  - Increasing demand on ground-water supplies
  - Increasing reuse of water

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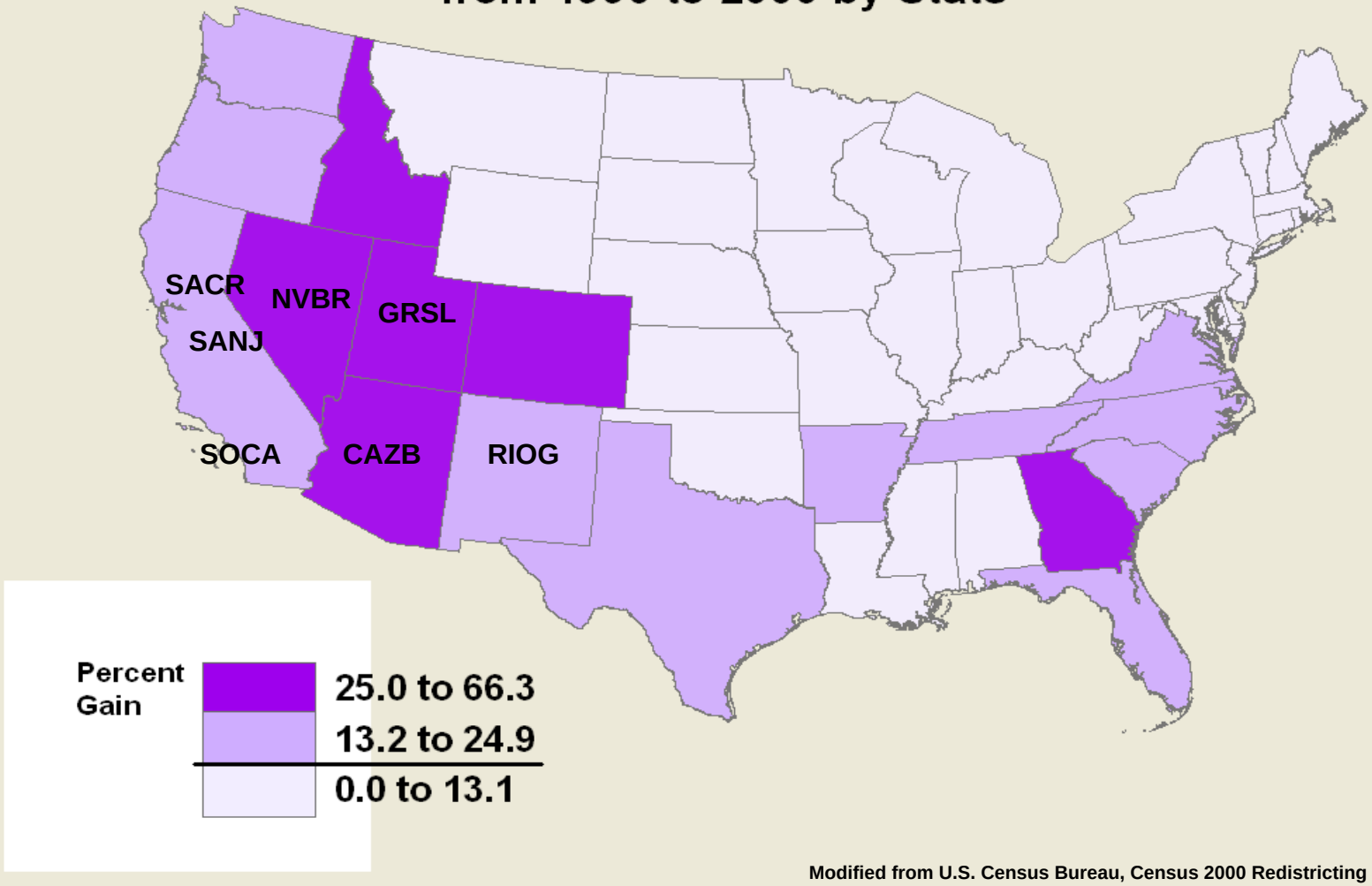
Percent Change in Total Population from 1990 to 2000 by State



Modified from U.S. Census Bureau, Census 2000 Redistricting Data (P.L. 94-171) Summary File.

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APPROACH

- Use existing NAWQA data available for:
  - Water Quality
  - GIS Datasets
- Each well was characterized using 500 m buffer zones (0.785 km^2 area).
- Statistical and geochemical analysis:
  - Nutrients
  - Pesticides
  - VOCs

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REGIONAL FACTORS

- Land Use
- Pesticide Use
- Population Density
- Aquifer Characteristics
    - Dissolved Oxygen (redox condition)

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DATA ANALYSIS

- Samples were collected between 1986 and 2004 from
    - 179 Urban Wells (11 to 250 feet deep)
    - 272 Agricultural Wells (11 to 390 feet deep)
- The most recent sample from a given well was used in data analysis

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Nutrients

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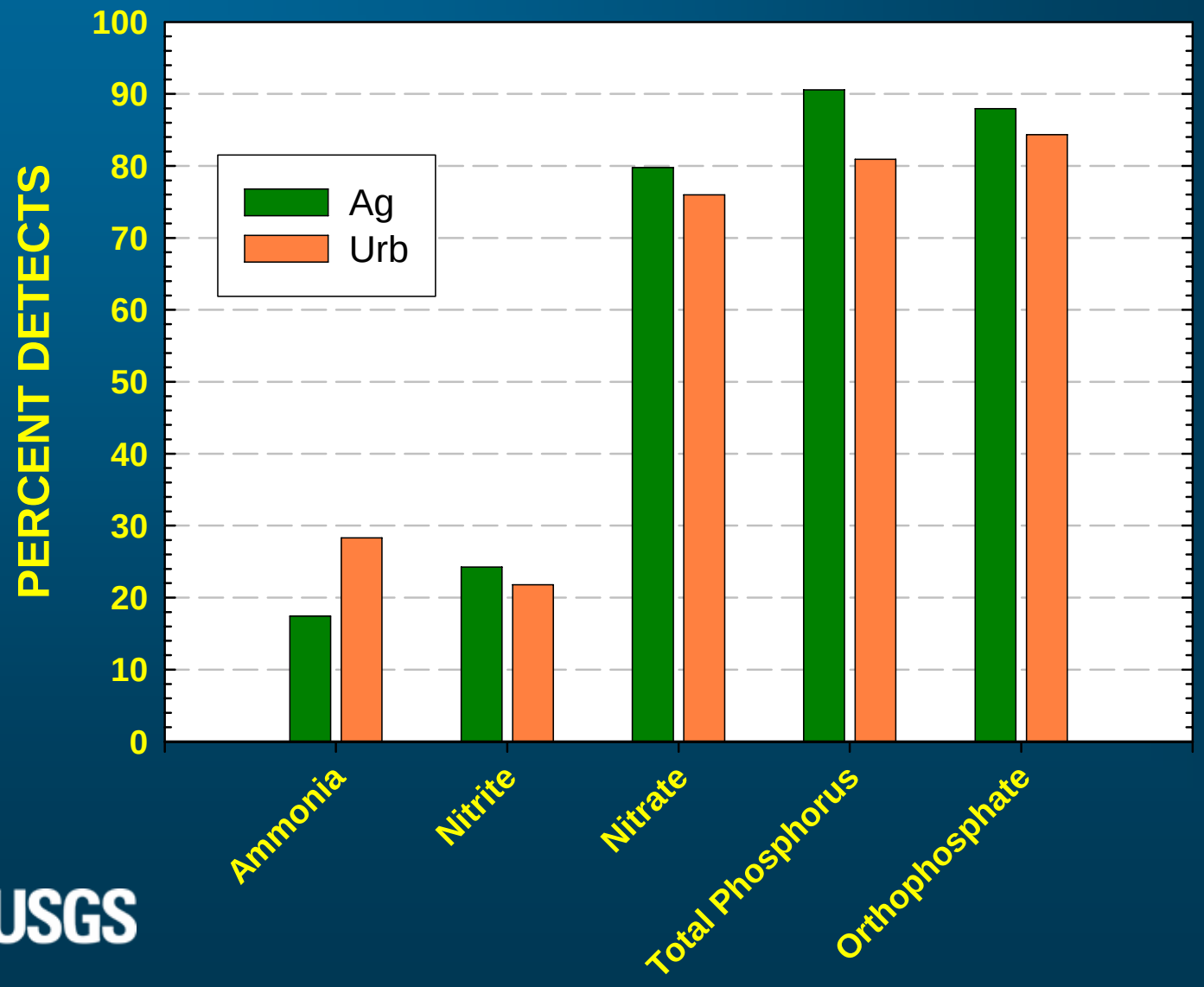
Detection Frequency is Similar for Agricultural and Urban Areas



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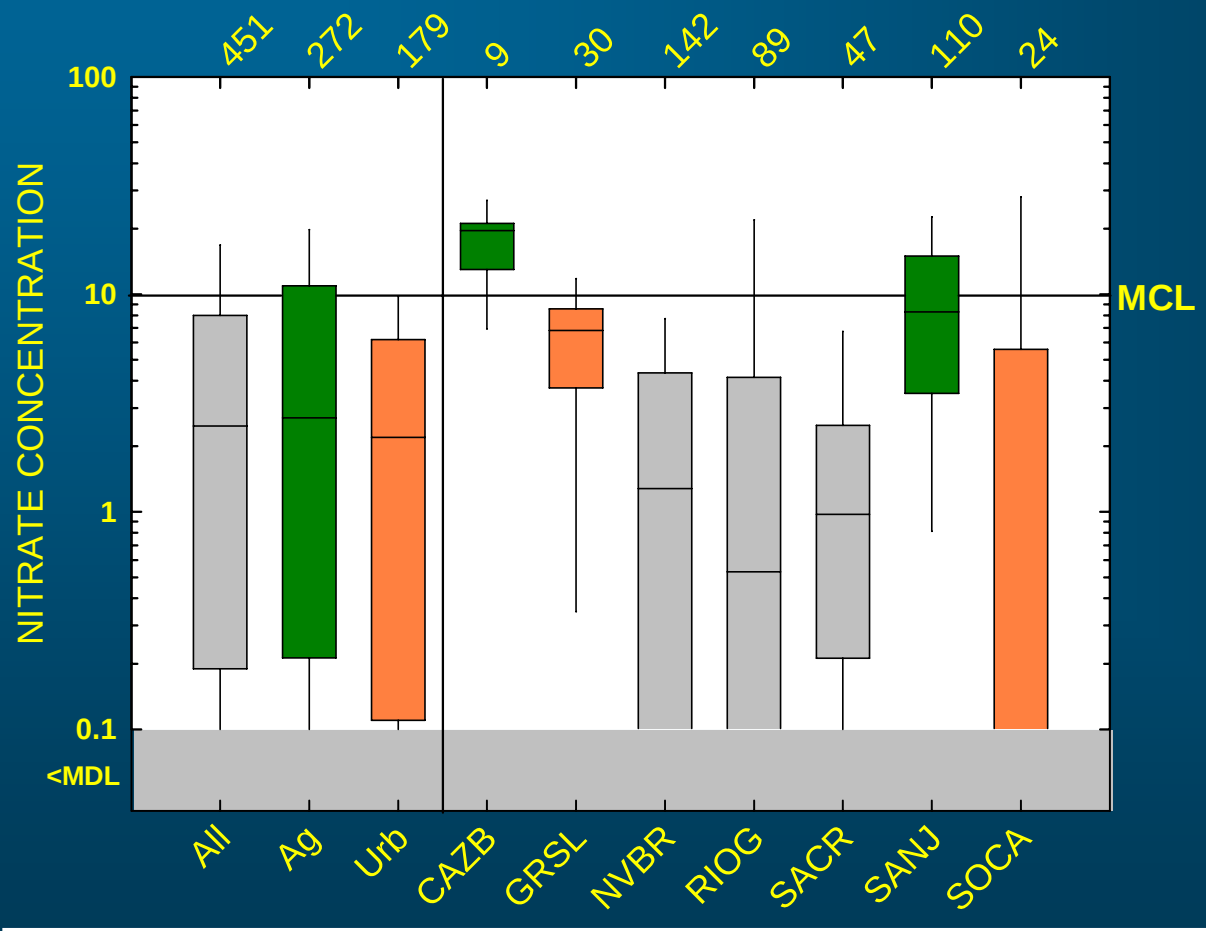
Nitrate Concentrations



1. Ag and Urban appear similar.
2. Nitrate concentrations differ greatly among study areas.
3. Many samples exceed MCL (27% Ag; 7% Urban)

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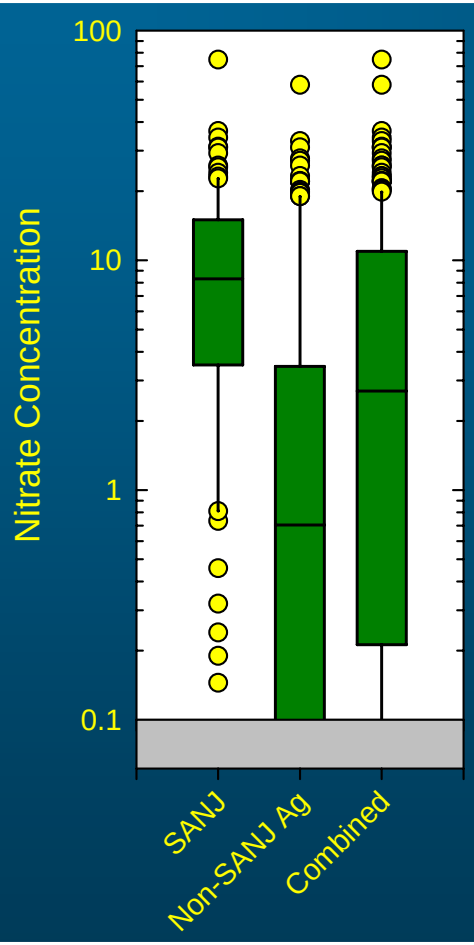
Bias From Sampling Intensity



1. SANJ comprises 40% of Ag samples
2. Significant difference between SANJ and non-SANJ samples.
3. One study unit can have a disproportionate influence on summary statistics.

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Pesticides

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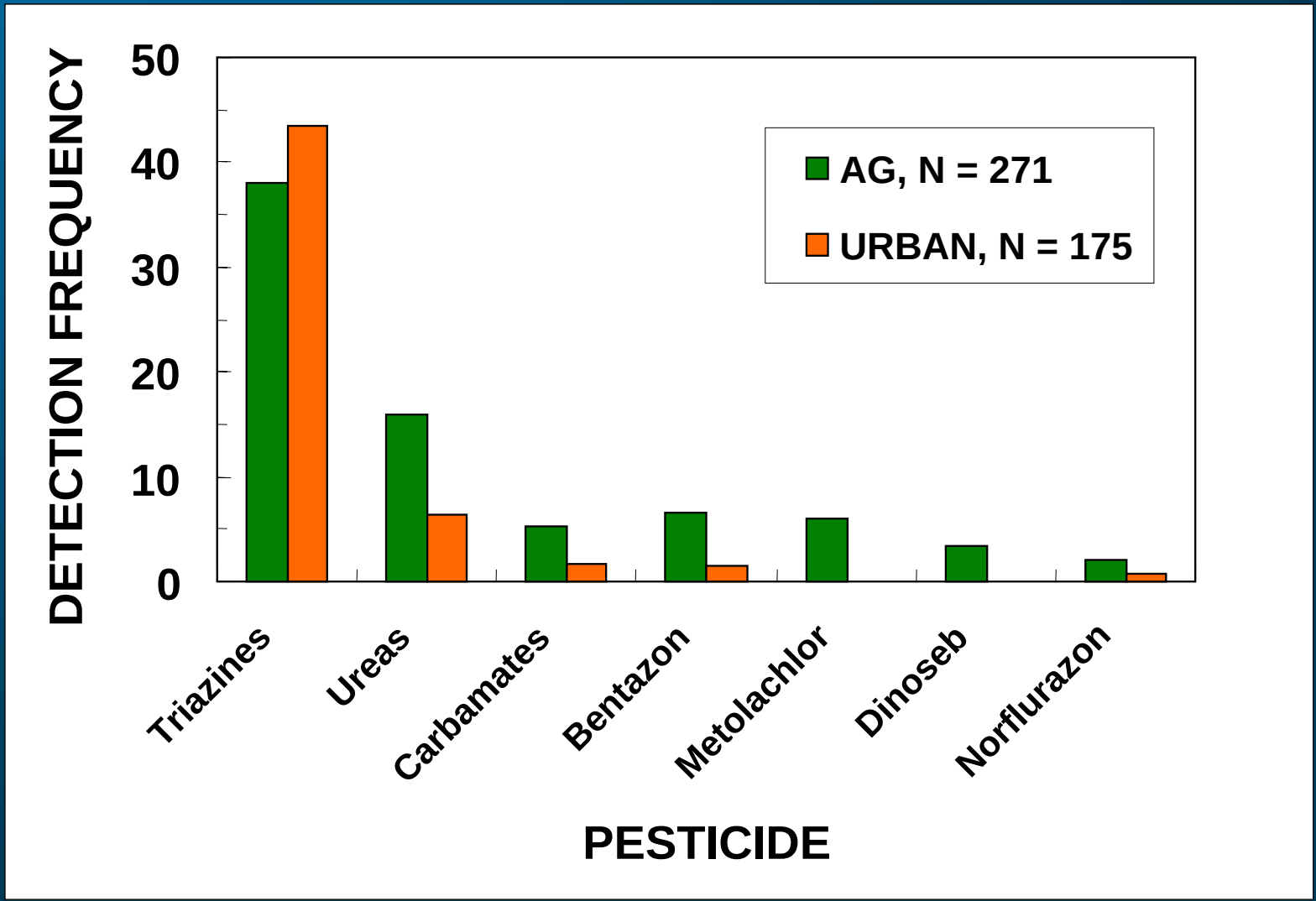
Detection Frequencies of Selected Pesticides In Study Area



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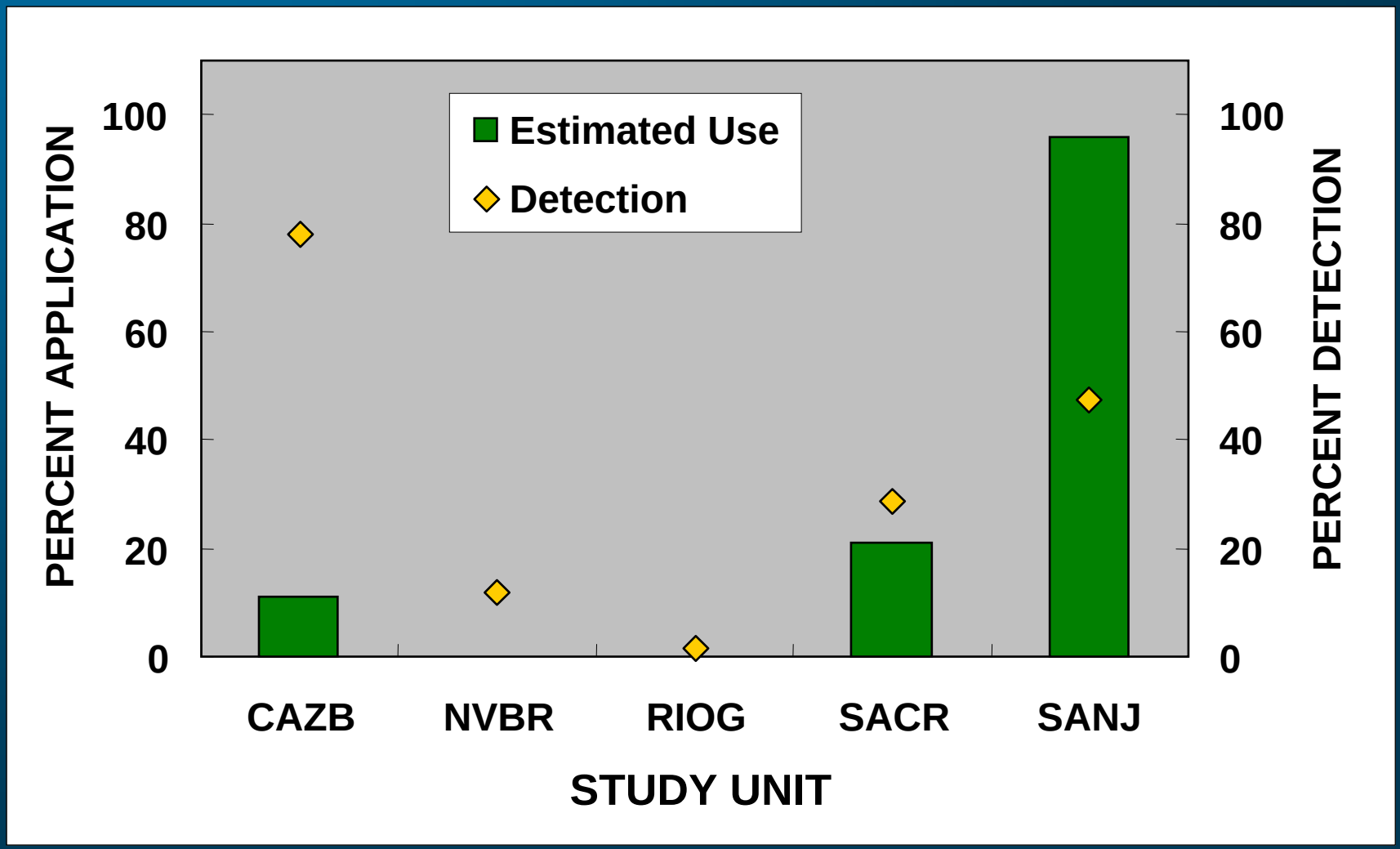
Estimated Simazine Use and Detections (Agricultural Wells)



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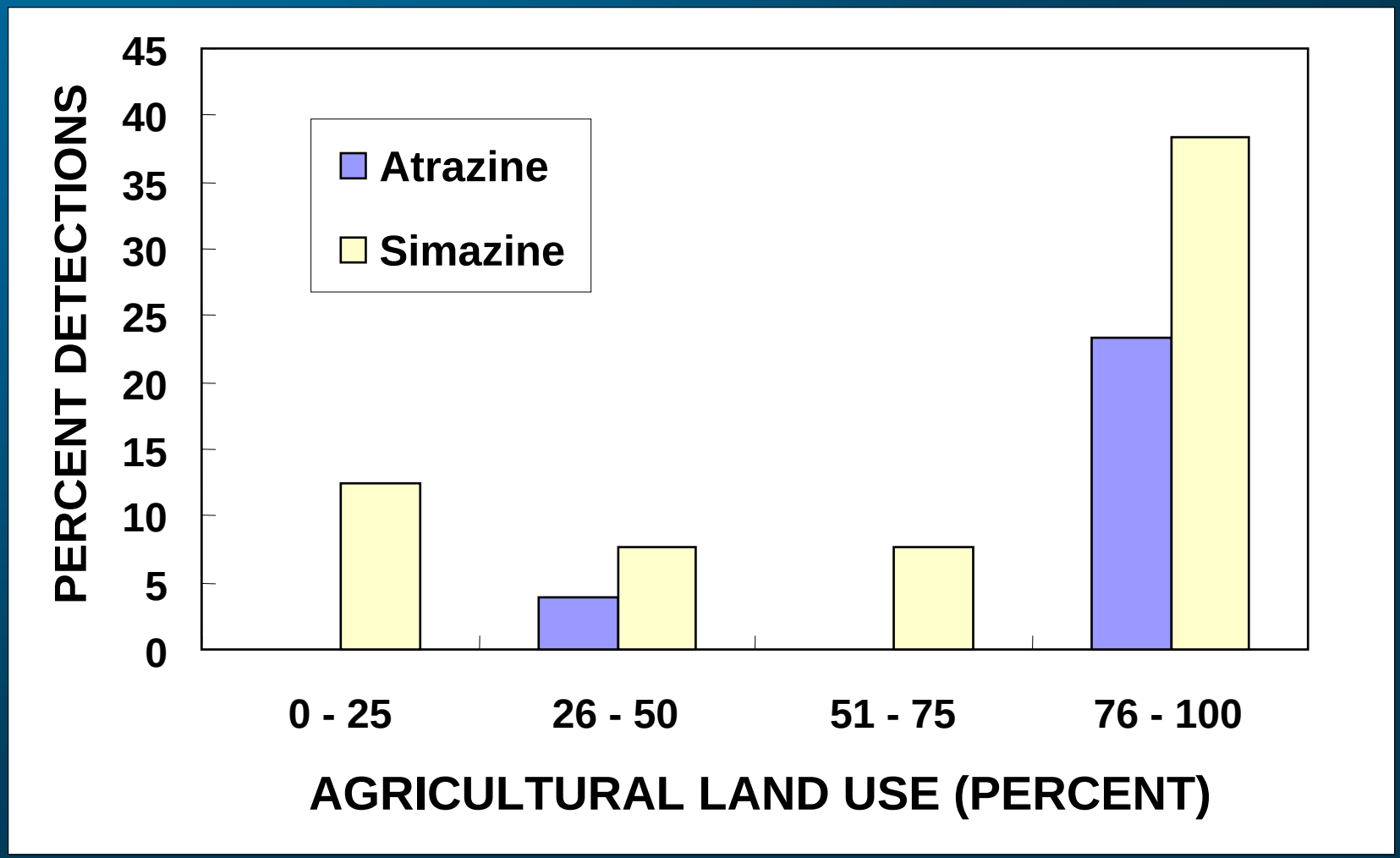
Triazine Detections and Agricultural Land Use



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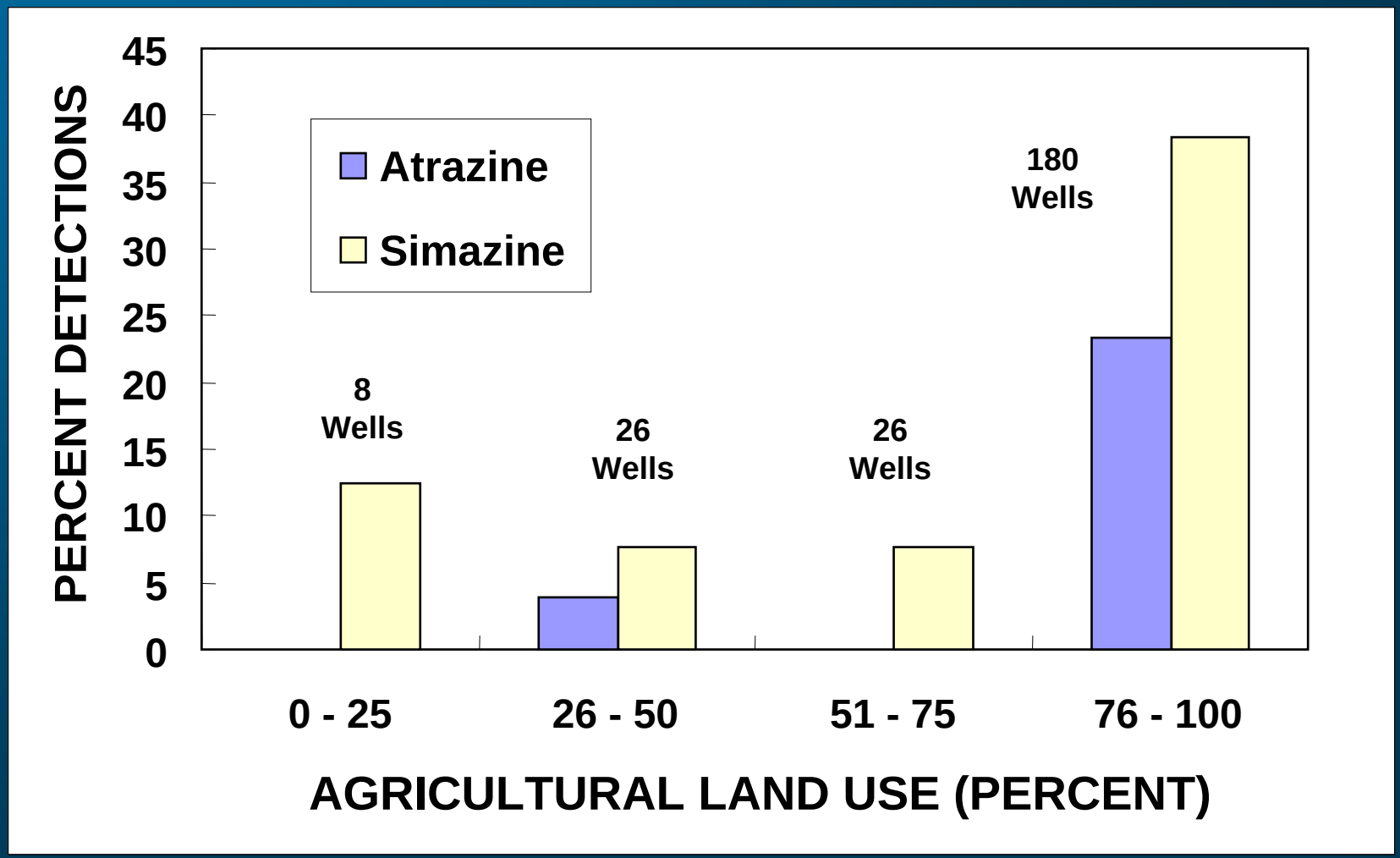

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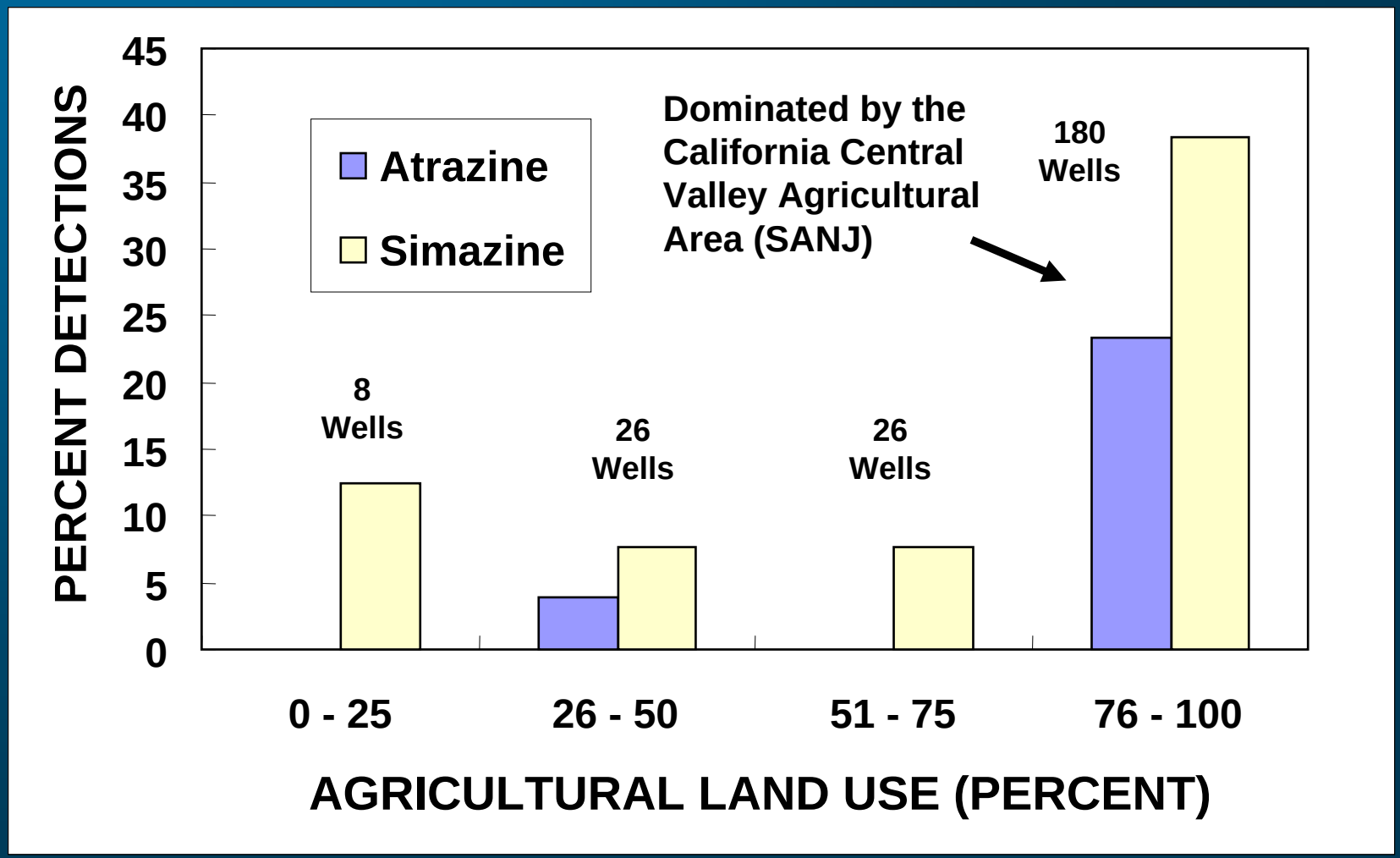

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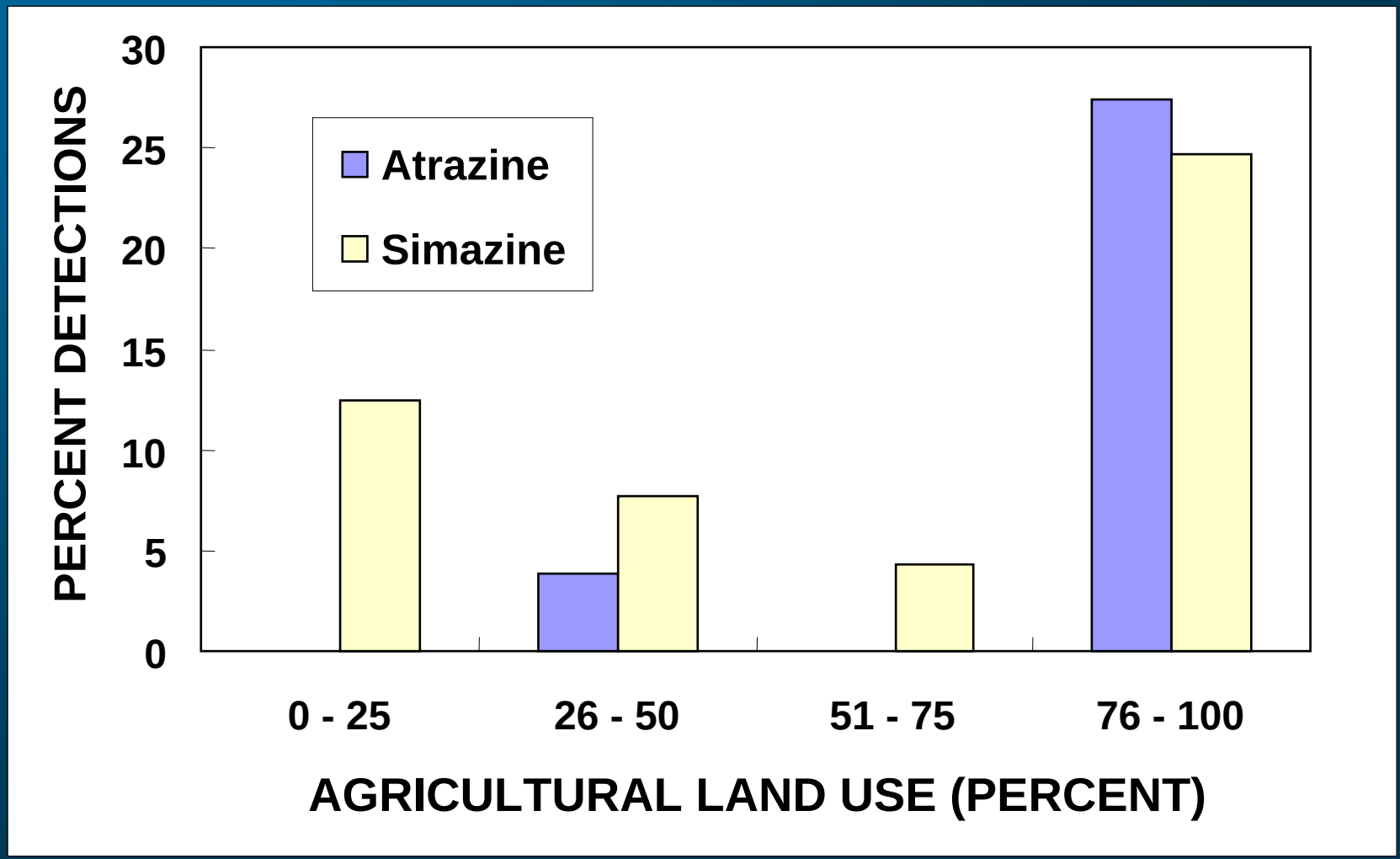
Triazine Detections and Agricultural Land Use (Without SANJ Data)



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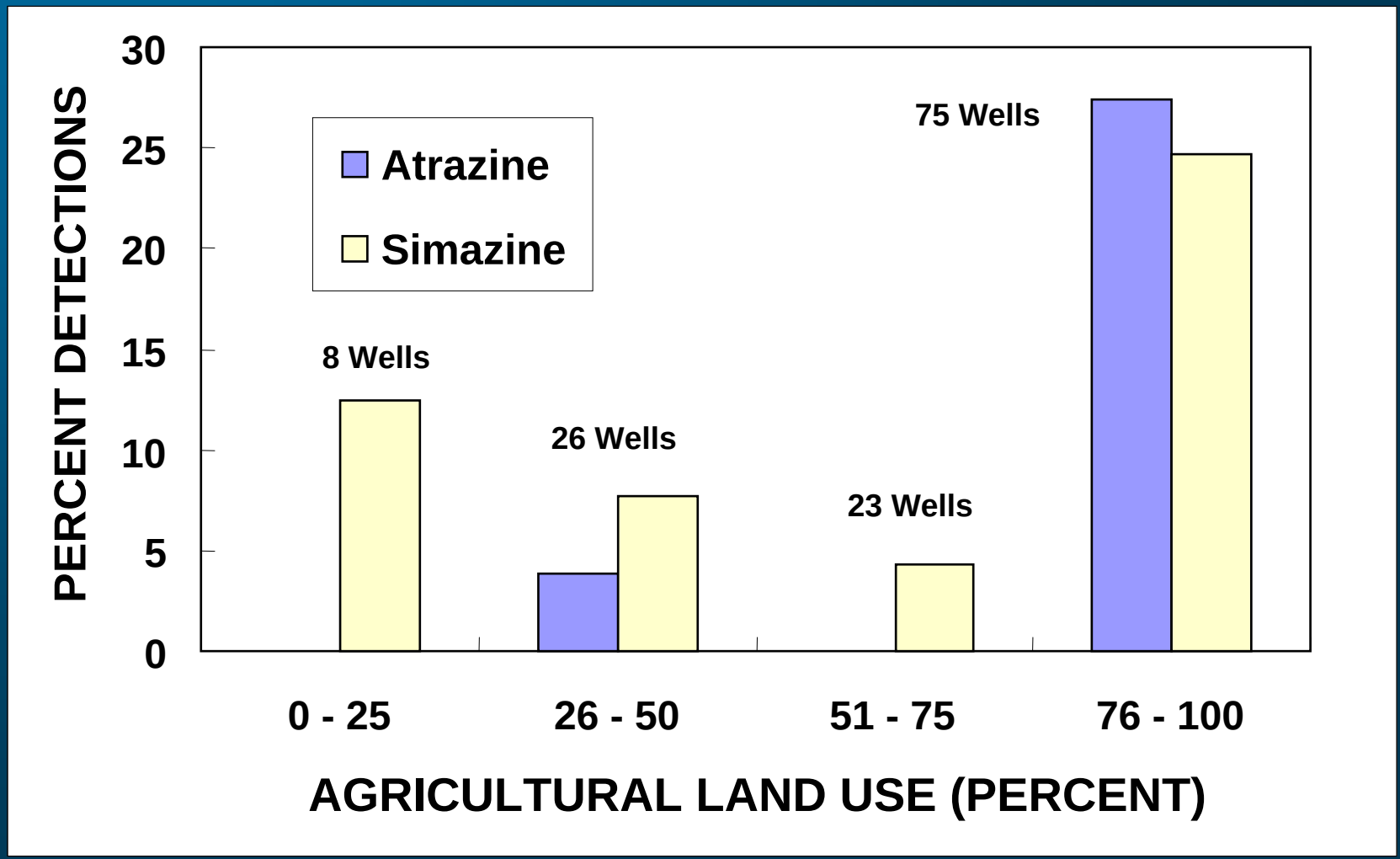

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VOCs

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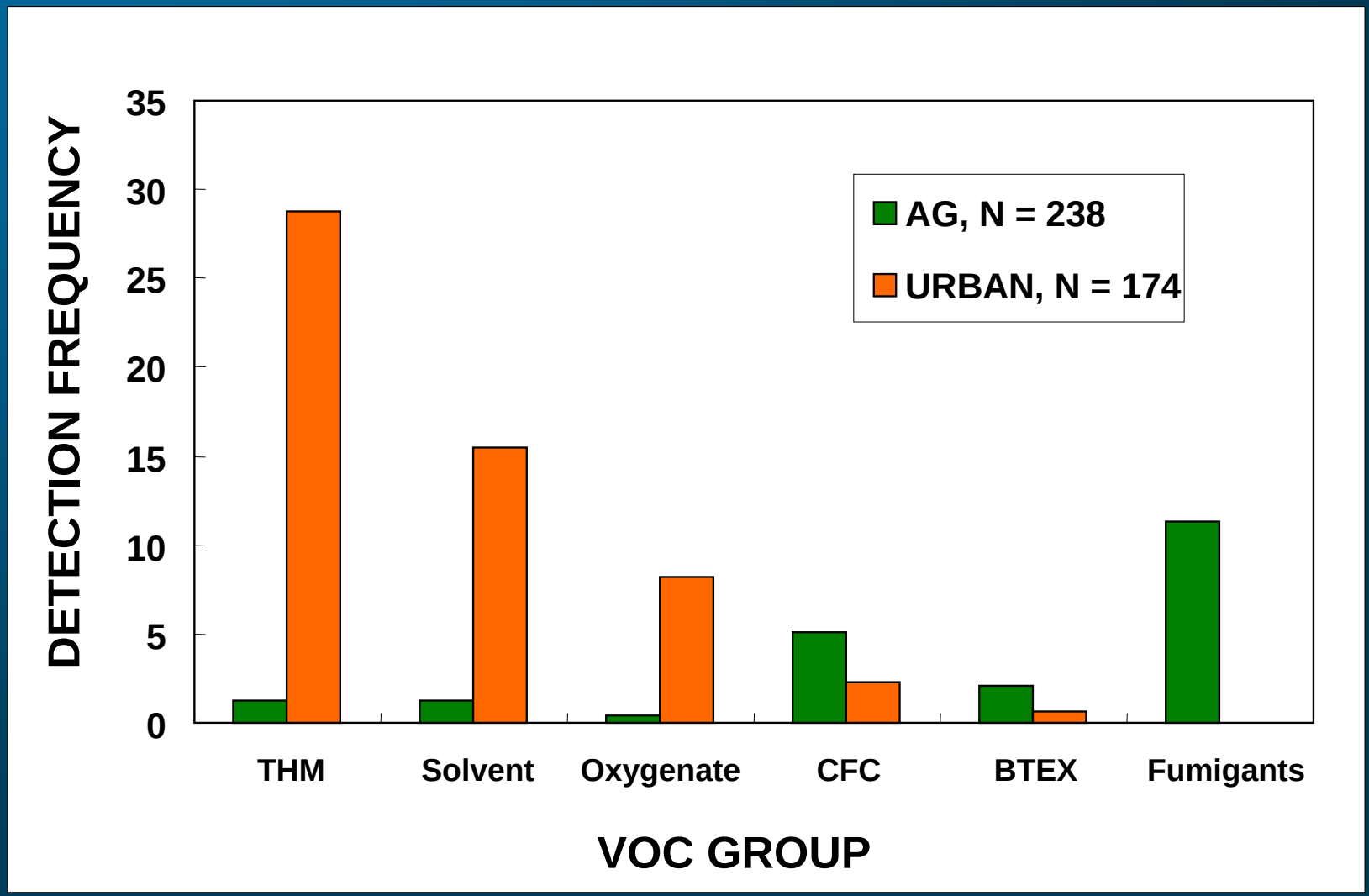
DETECTION FREQUNCY OF SELECTED VOCS



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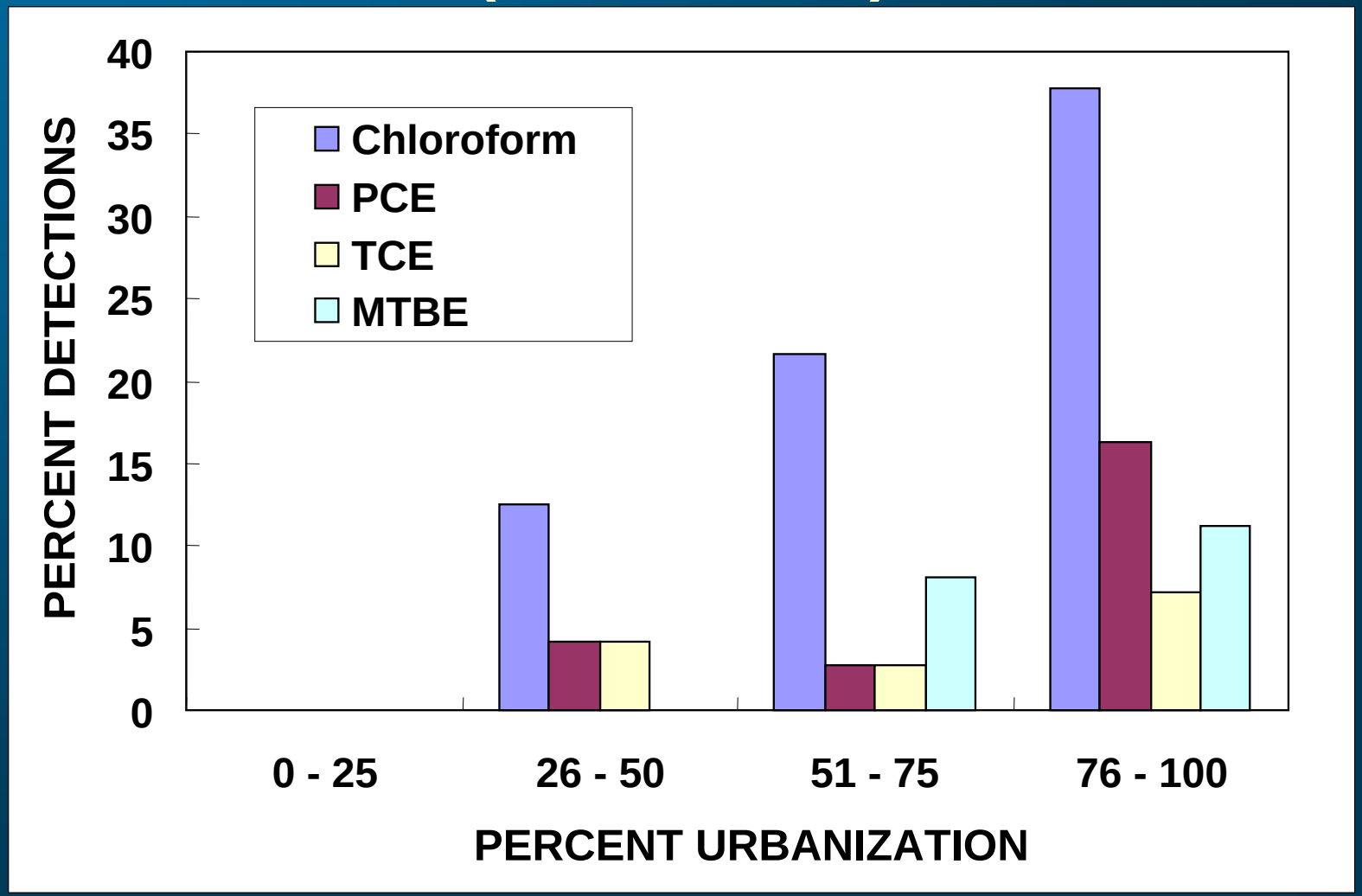
Selected VOC Detections With Land Use (Urban Wells)



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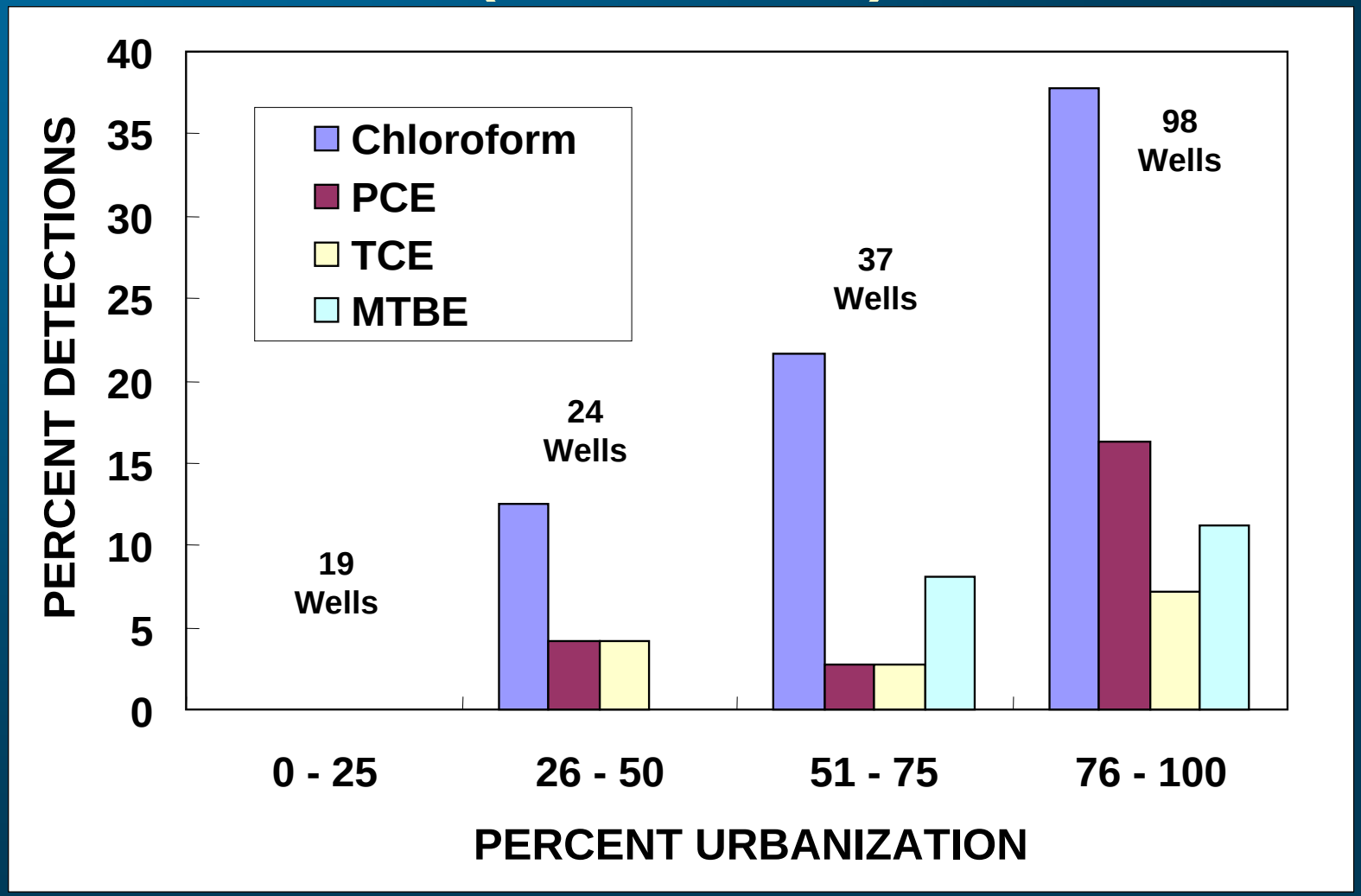

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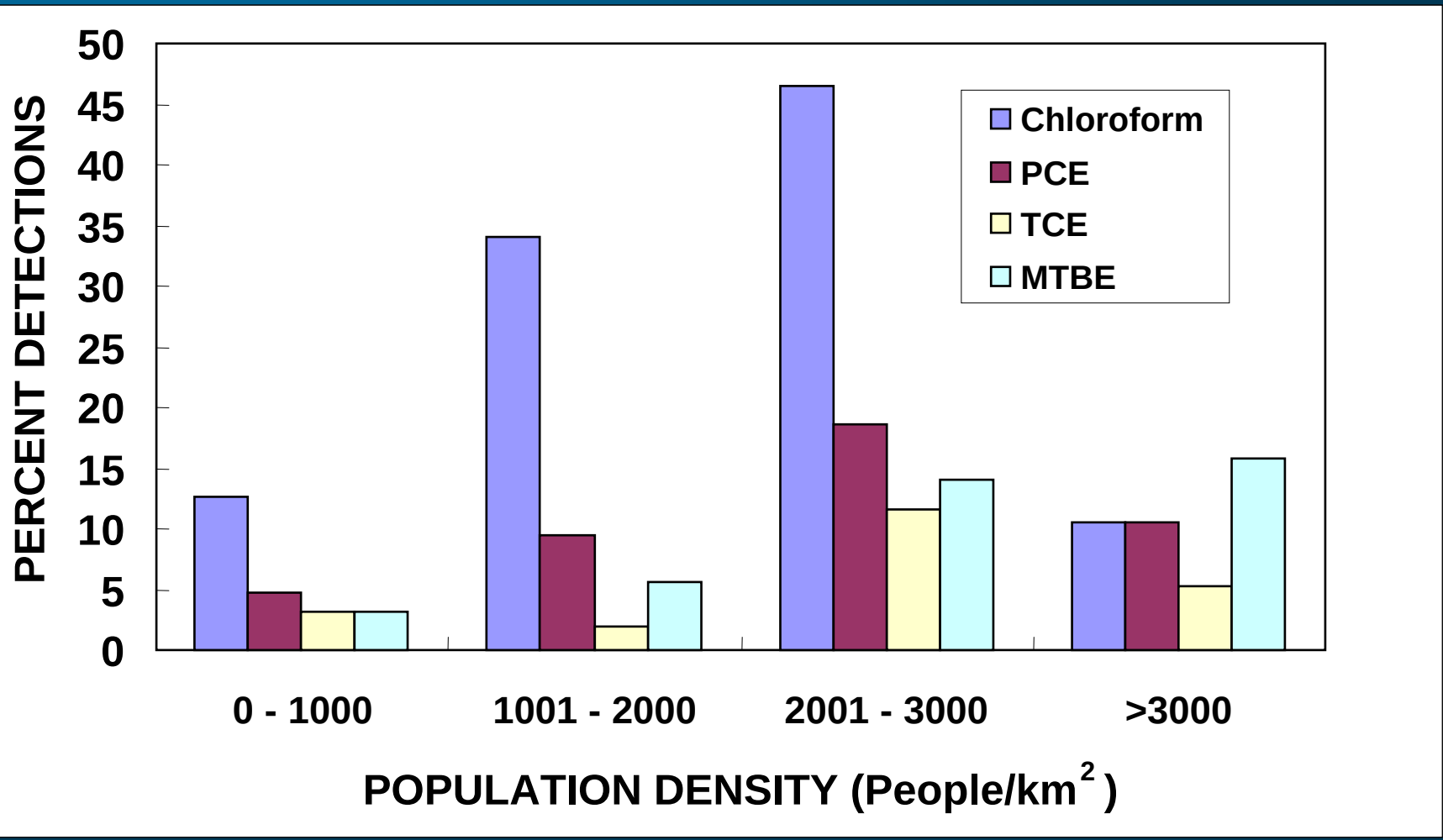
POPULATION DENSITY AND VOCs (Urban Wells)



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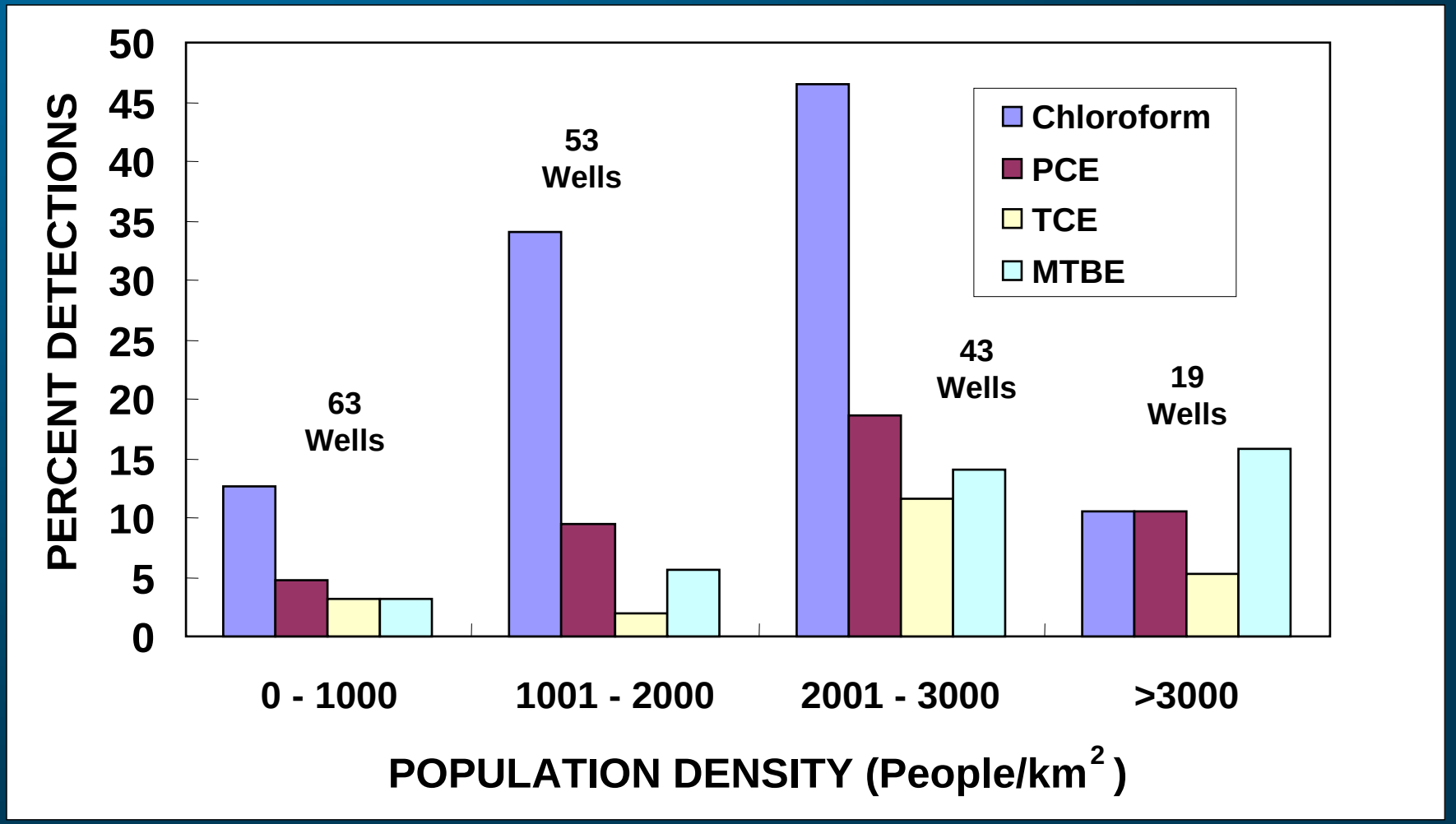

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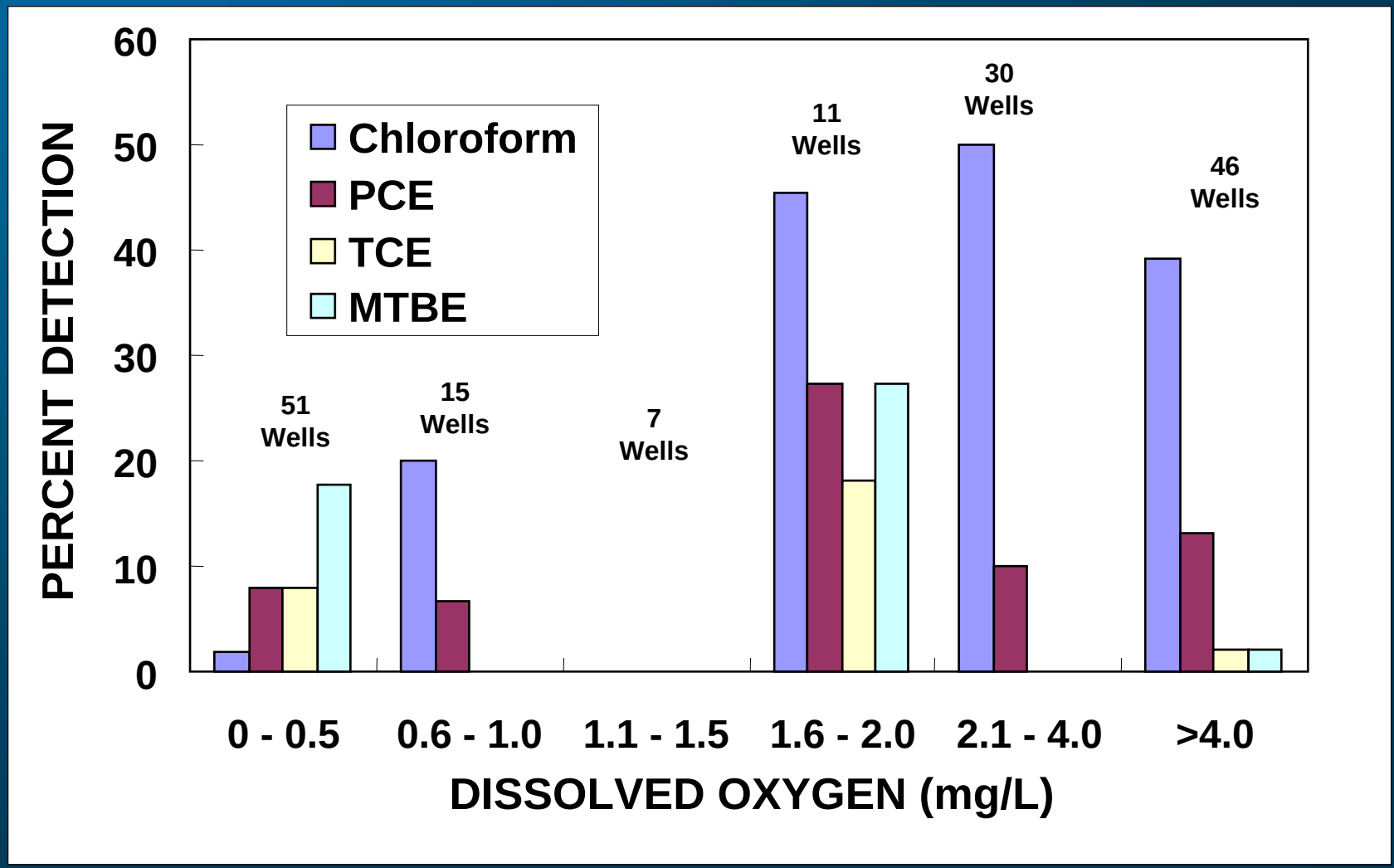
Chloroform, Solvent, Oxygenate Detections



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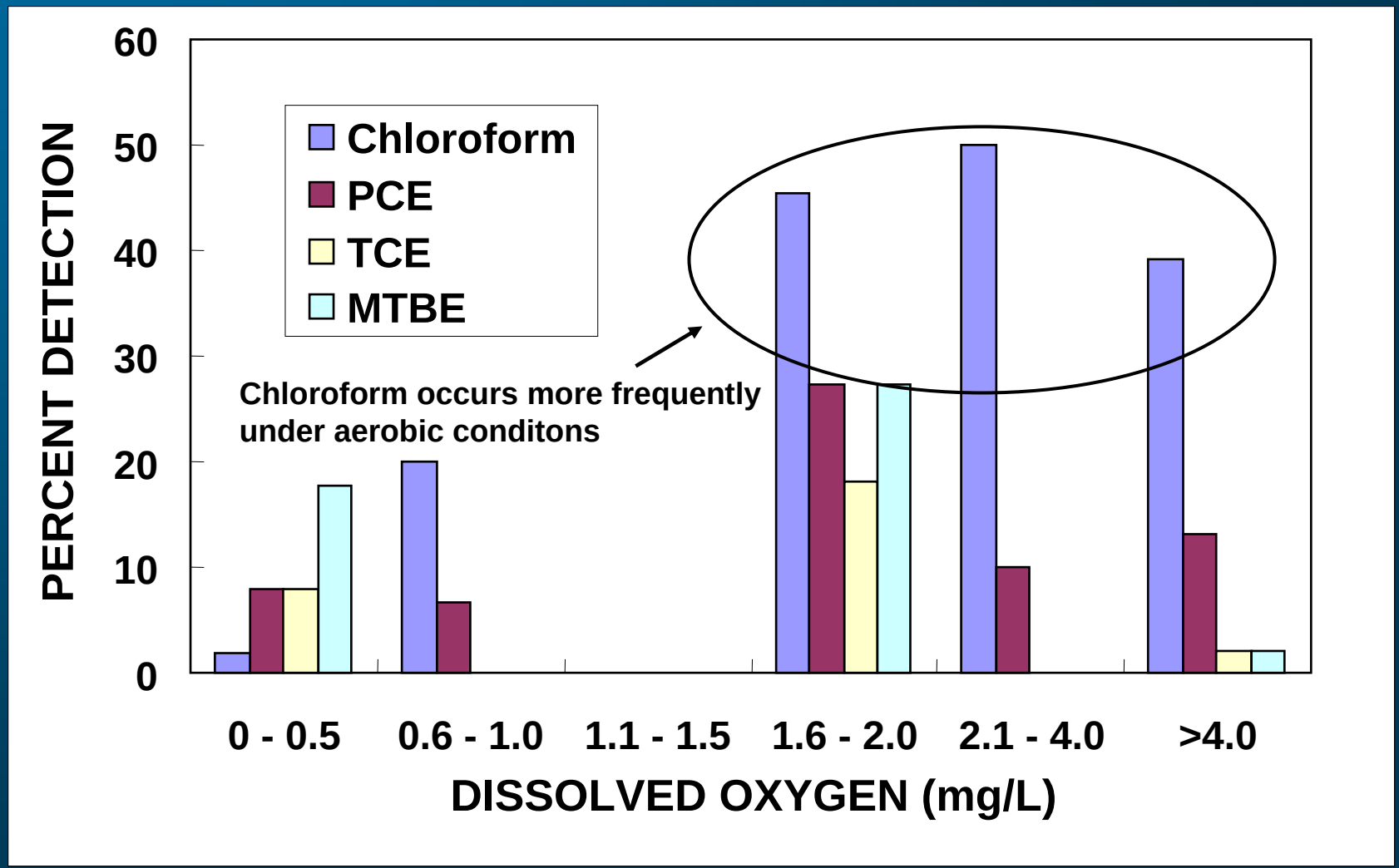

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Possible Sources of VOCs

- Chloroform is likely due to chlorination of water
- PCE and TCE detections are possibly from solvent plumes within the area of influence for wells showing detections (local or upgradient)
  - Additional data of solvent plumes

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Possible Sources of VOCs

- MTBE may be from exposed surface water used in artificial recharge of aquifers, leaking underground storage tanks, or accidental gas spills

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CONCLUSIONS

- Nitrate MCL (10 mg/L) was exceeded in 27 and 7 percent of the agricultural and urban wells sampled, respectively

- Pesticide use data needs to be refined

  - Pesticide concentrations were below EPA Criteria

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CONCLUSIONS

- Two TCE concentrations exceeded the EPA Criterion of 5 µg/L
- The MTBE health advisory (20 – 40 µg/L) was exceeded in two samples
- Further our understanding of shallow to deep ground-water interactions

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