GROUND WATER QUALITY AND SUBSURFACE WASTEWATER SYSTEMS

Presented to:

Water Policy Interim Committee

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Helena, MT

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TOPICS

- CONTAMINANTS IN WASTEWATER
- WATER QUALITY / NONDEGRADATION BACKGROUND
- IMPACTS FROM WASTEWATER DISCHARGES
  - GROUND WATER
  - SURFACE WATER
- EXAMPLES

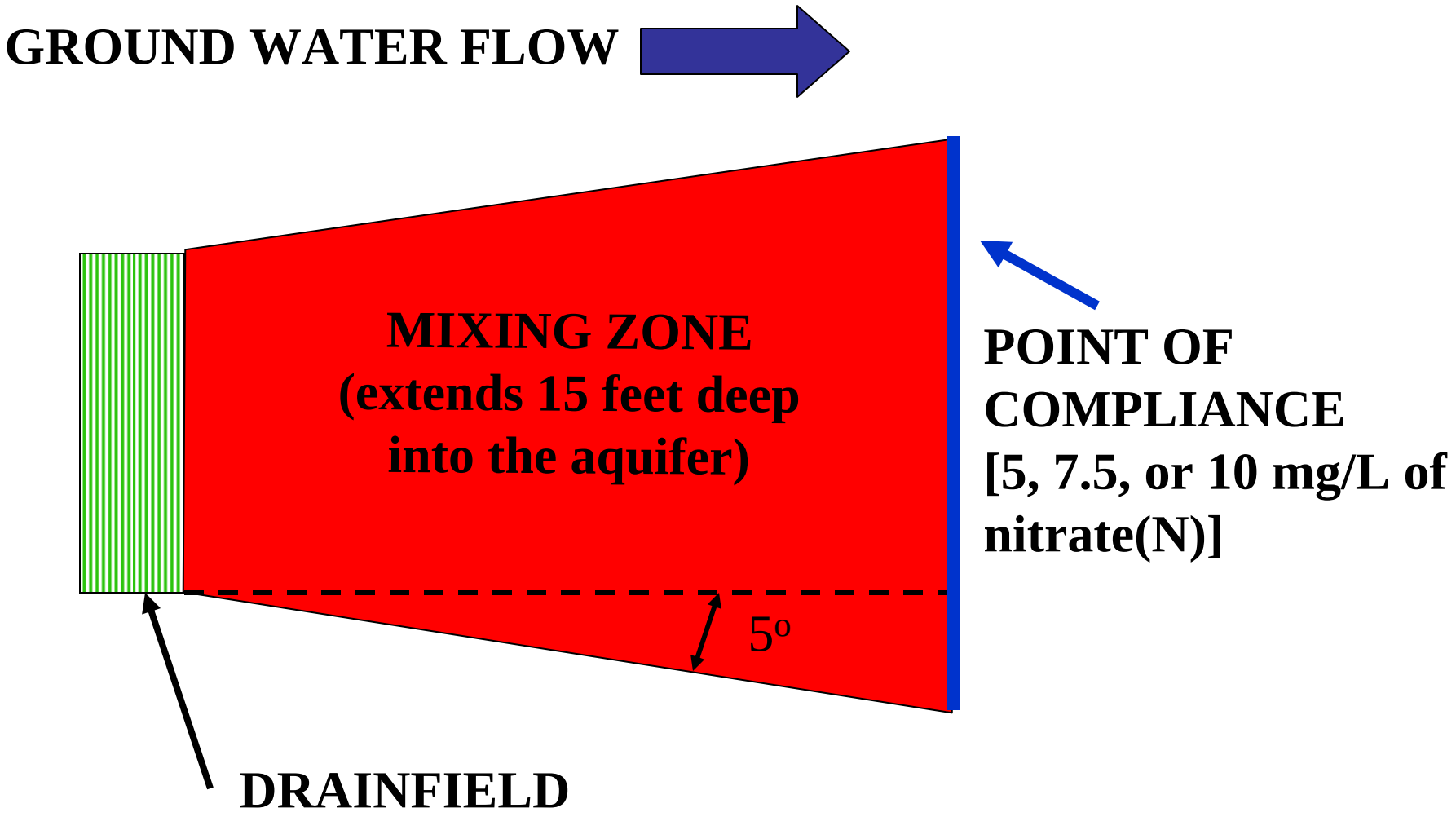
CONTAMINANTS OF CONCERN

- **PATHOGENS**
  - **Bacteria, viruses**
  - **Drainfields designed to remove**
- **NITROGEN**
  - **Human health impacts**
  - **Eutrophication in surface waters**
- **PHOSPHORUS**
  - **Eutrophication in surface waters**
- **PERSONAL CARE PRODUCTS & PHARMECEUTICALS (?)**
  - **Aquatic life impacts documented**
  - **Human health impacts not defined**

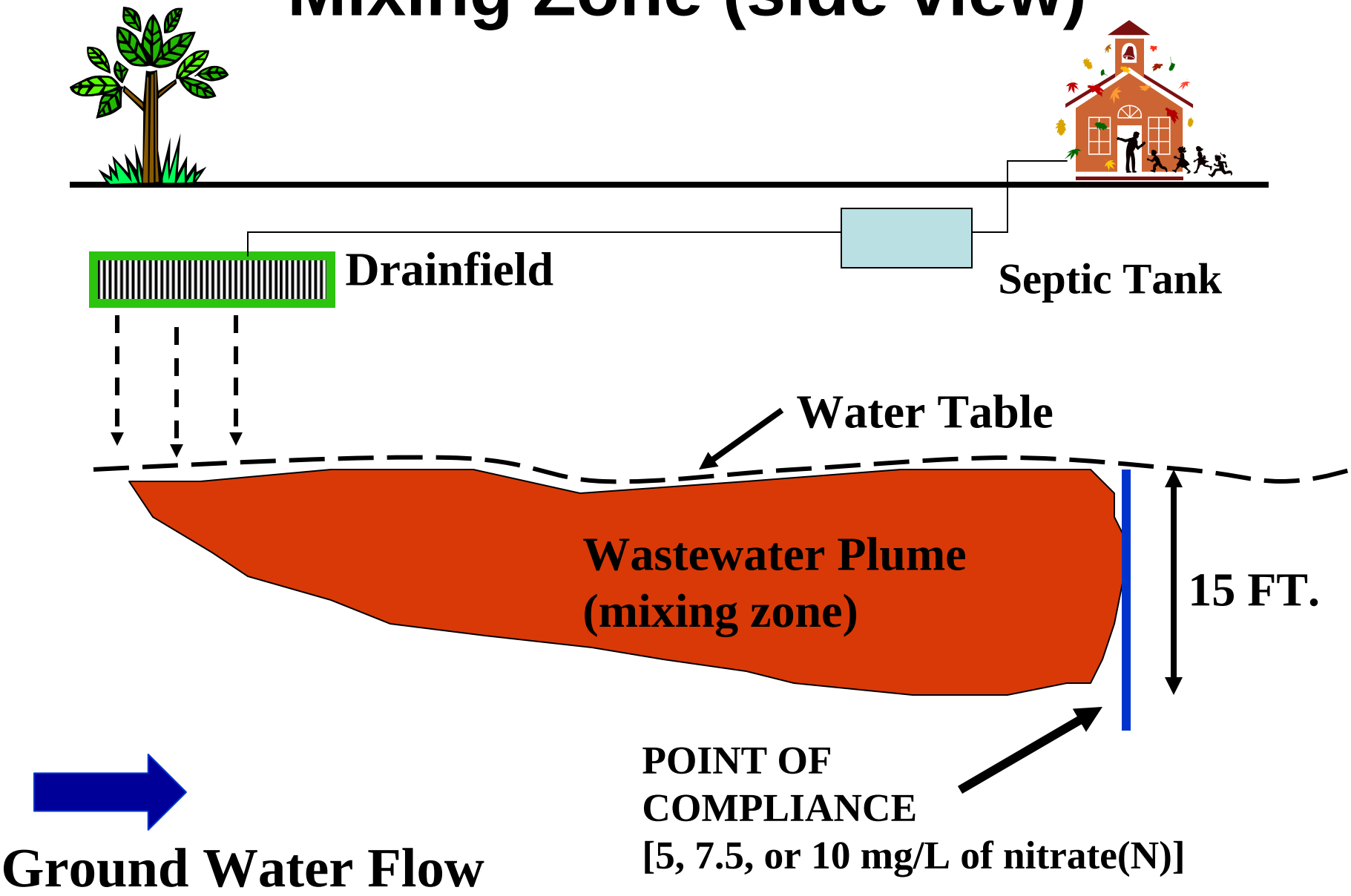
GROUND WATER QUALITY STANDARDS - NITROGEN

- **GROUND WATER MIXING ZONE**
  - **Dilution is the Solution**
  - **Allows limited distance (100-500 ft) below discharge to exceed water quality limits**
- **THREE LIMITS:**
  - **10 mg/L – human health standard (DEQ-7)**
  - **7.5 mg/L – nondegradation (Level 2)**
  - **5.0 mg/L – nondegradation (non Level 2)**
- **CUMULATIVE IMPACTS ARE CALCULATED**

Ground Water Mixing Zone (aerial view)



Mixing Zone (side view)



SURFACE WATER QUALITY STANDARDS - NITROGEN

- **TWO NONDEGRADATION STANDARDS:**
  - ***Trigger Value* - can only increase nitrate by 0.01 mg/l in surface water**
  - ***Narrative standard* – no numeric value (aesthetic and ecological impacts)**
- **CUMULATIVE IMPACTS (?)**
  - **TMDLs**

WATER QUALITY STANDARDS - PHOSPHORUS

- GROUND WATER STANDARD
  - None
- SURFACE WATER STANDARDS
    - Distance setbacks
    - Trigger value (increase of less than 0.001 mg/L)
    - Narrative standard
- CUMULATIVE IMPACTS (?)
    - TMDLs

WATER QUALITY STANDARDS – PERSONAL CARE PRODUCTS & PHARMACEUTICALS

- NO WATER QUALITY STANDARDS BY EPA (www.epa.gov/ppcp/)
- NO REGULATIONS FOR WASTEWATER SYSTEMS
- HELENA VALLEY STUDY (Miller & Meek)
  - Detected PPCPs in 32 of 35 wells tested
- MISSOULA STUDY (Godfrey & Woessner)
  - Detected PPCPs in septic tanks, WWTP influent, and WWTP effluent

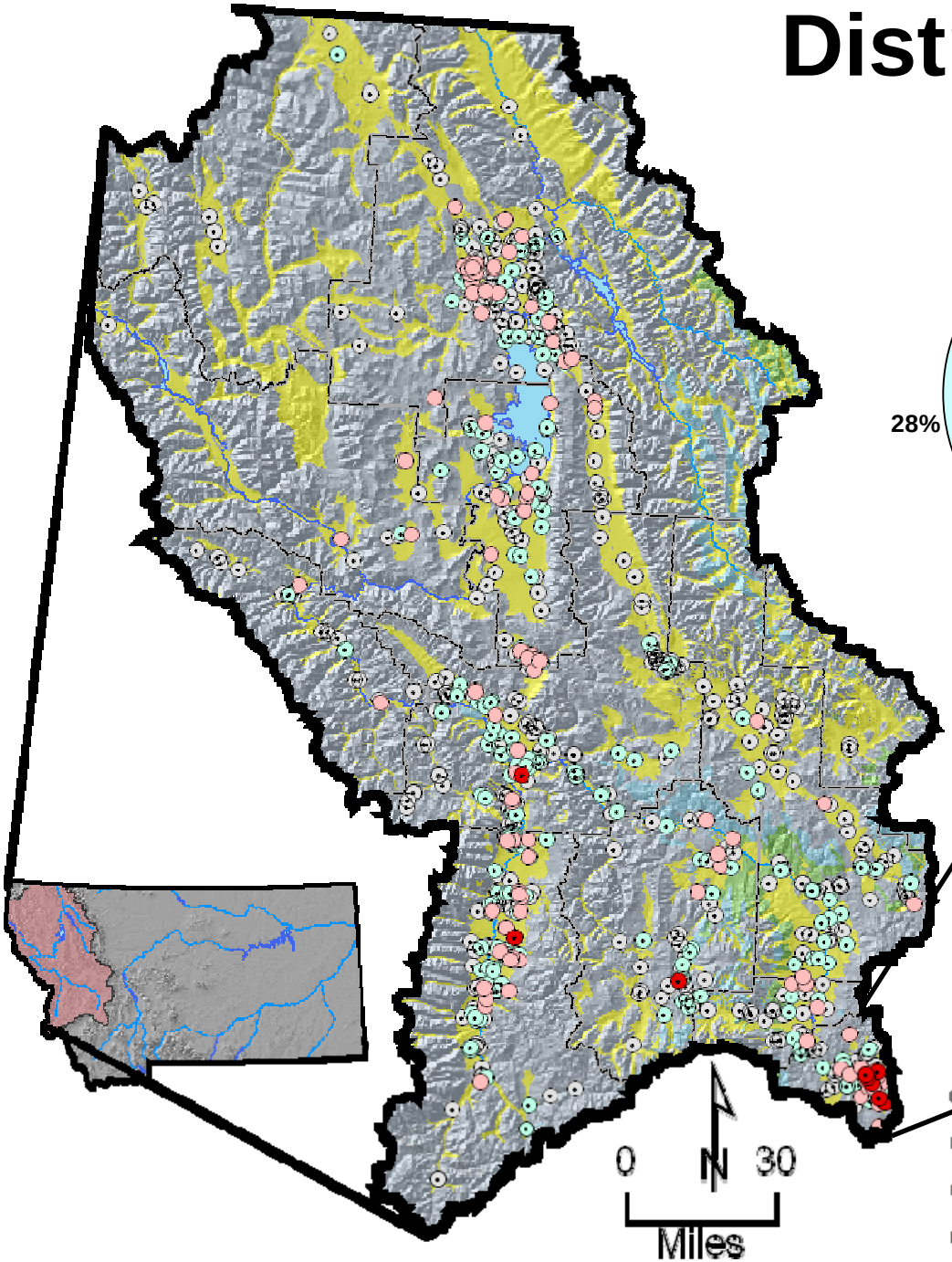
EXAMPLES OF GROUND WATER PROBLEMS AND SUBDIVISION DEVELOPMENT

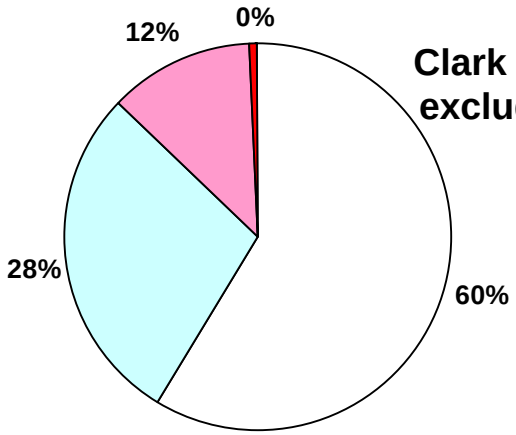
SOUTH OF BUTTE

- Shallow, fractured granitic bedrock (Boulder Batholith)
- High and low density developments
- Poor soils (minimal organic material)
- Unpredictable flow directions
- Unpredictable nitrate concentrations
- Older septic systems(?)

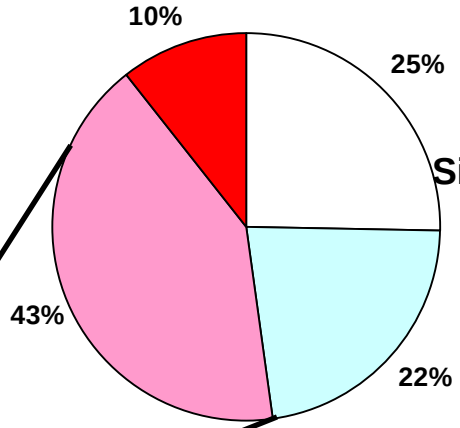
Distribution of Nitrate

Clark Fork Basin





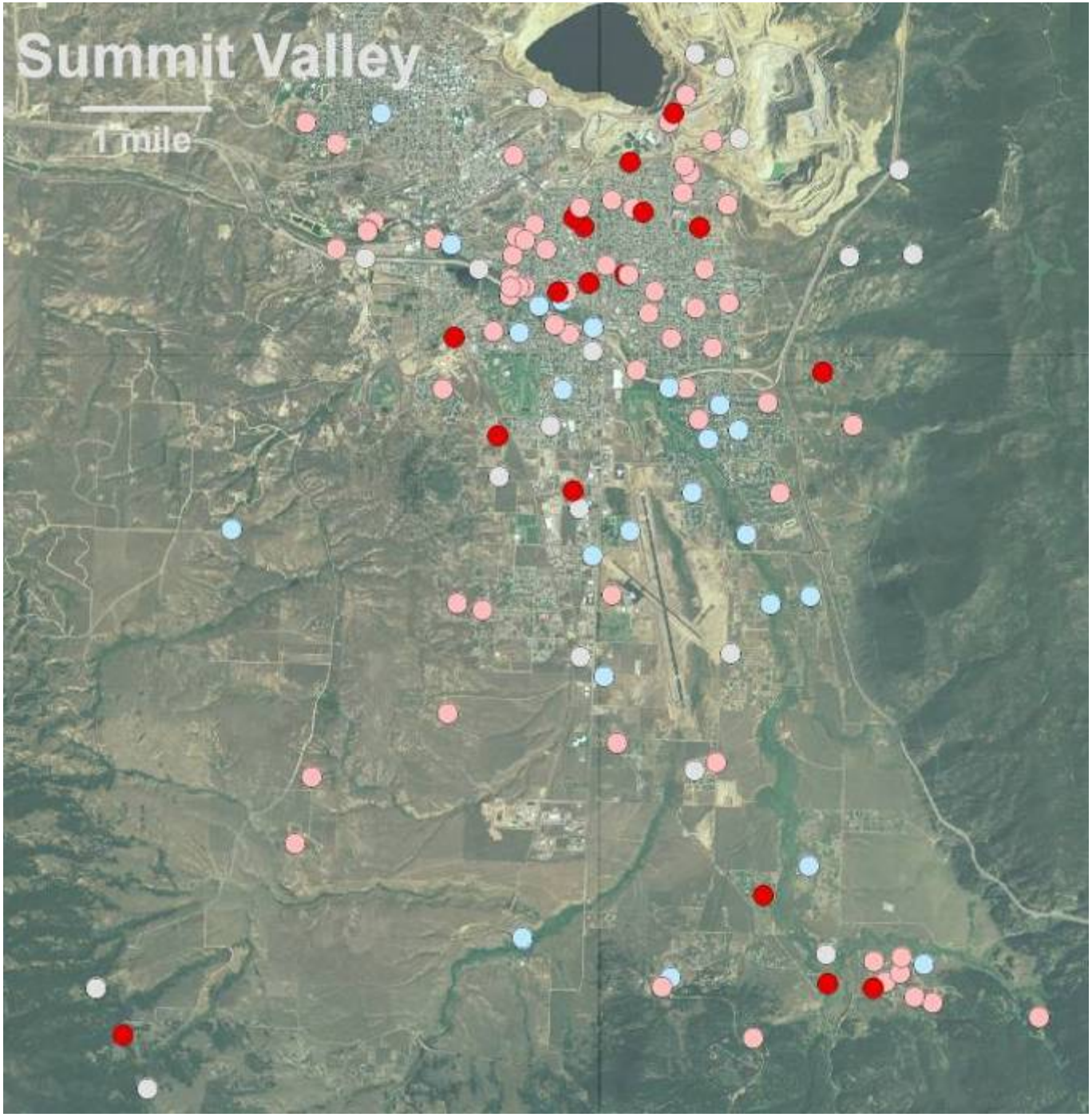
Clark Fork Basin samples excluding Silver Bow Co.
n = 707

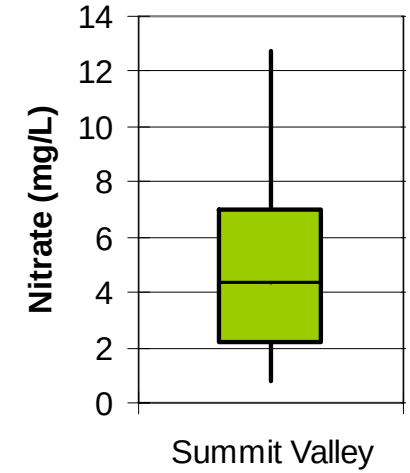


Silver Bow Co. samples
n = 67

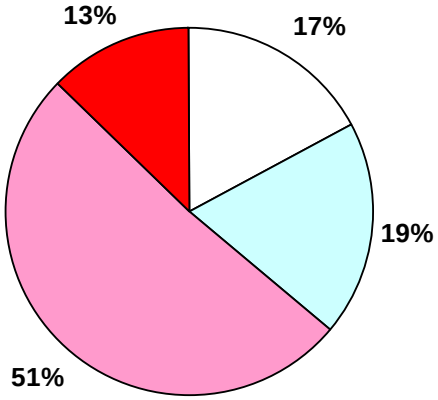
Nitrate Concentrations

- not detected or less than 0.5 mg/L
- Low level: 0.5 - 2.0 mg/L
- Impacted: 2.0 - 10.0 mg/L
- MCL exceedance: > 10.0 mg/L

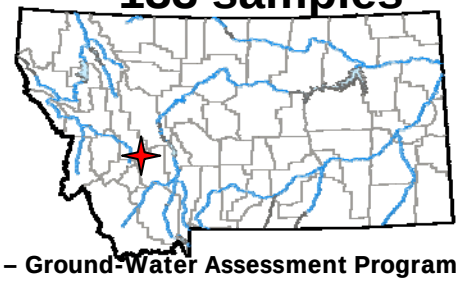




< 0.5 0.5 - 2 2 - 10 > 10

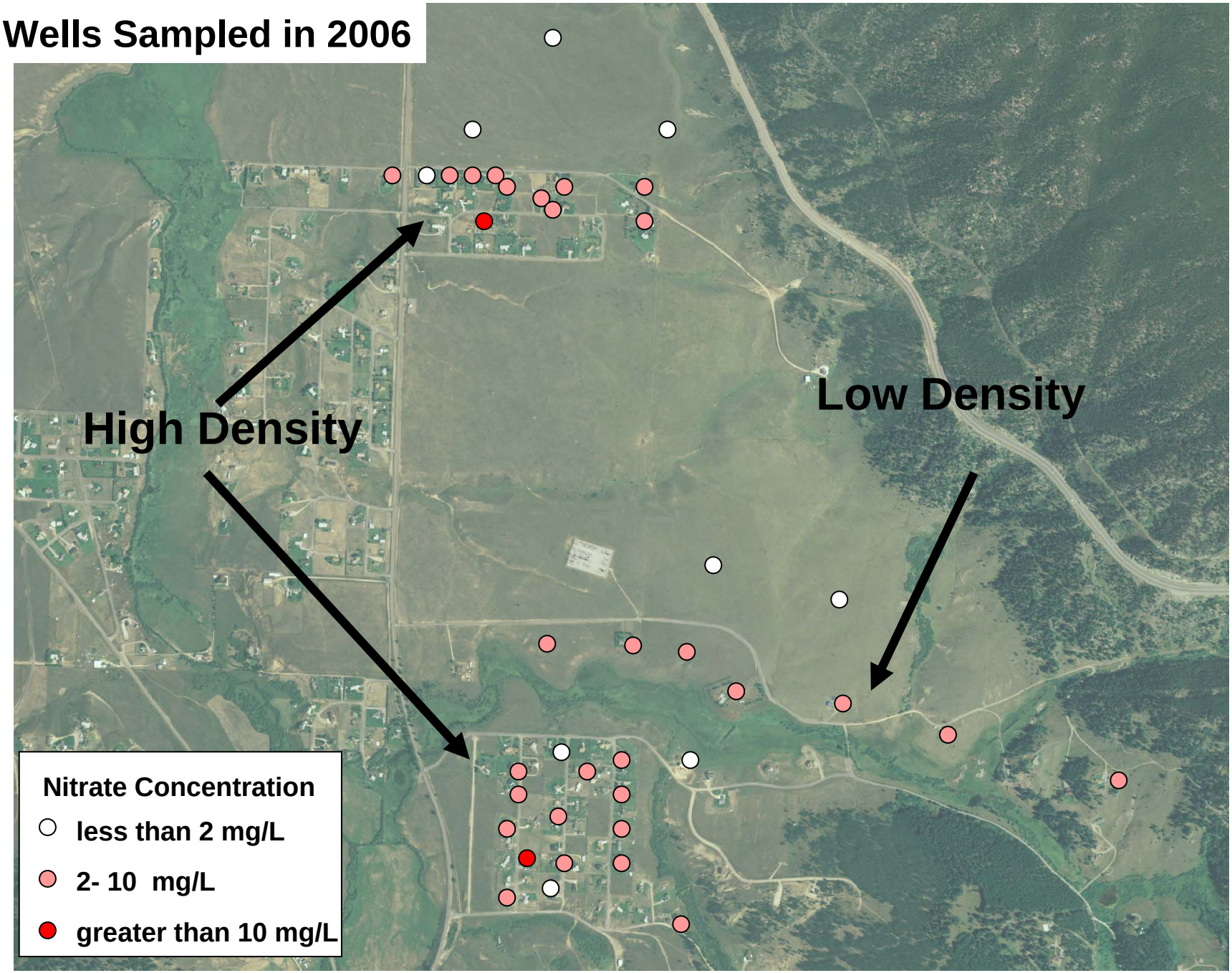


133 samples



MBMG – Ground-Water Assessment Program

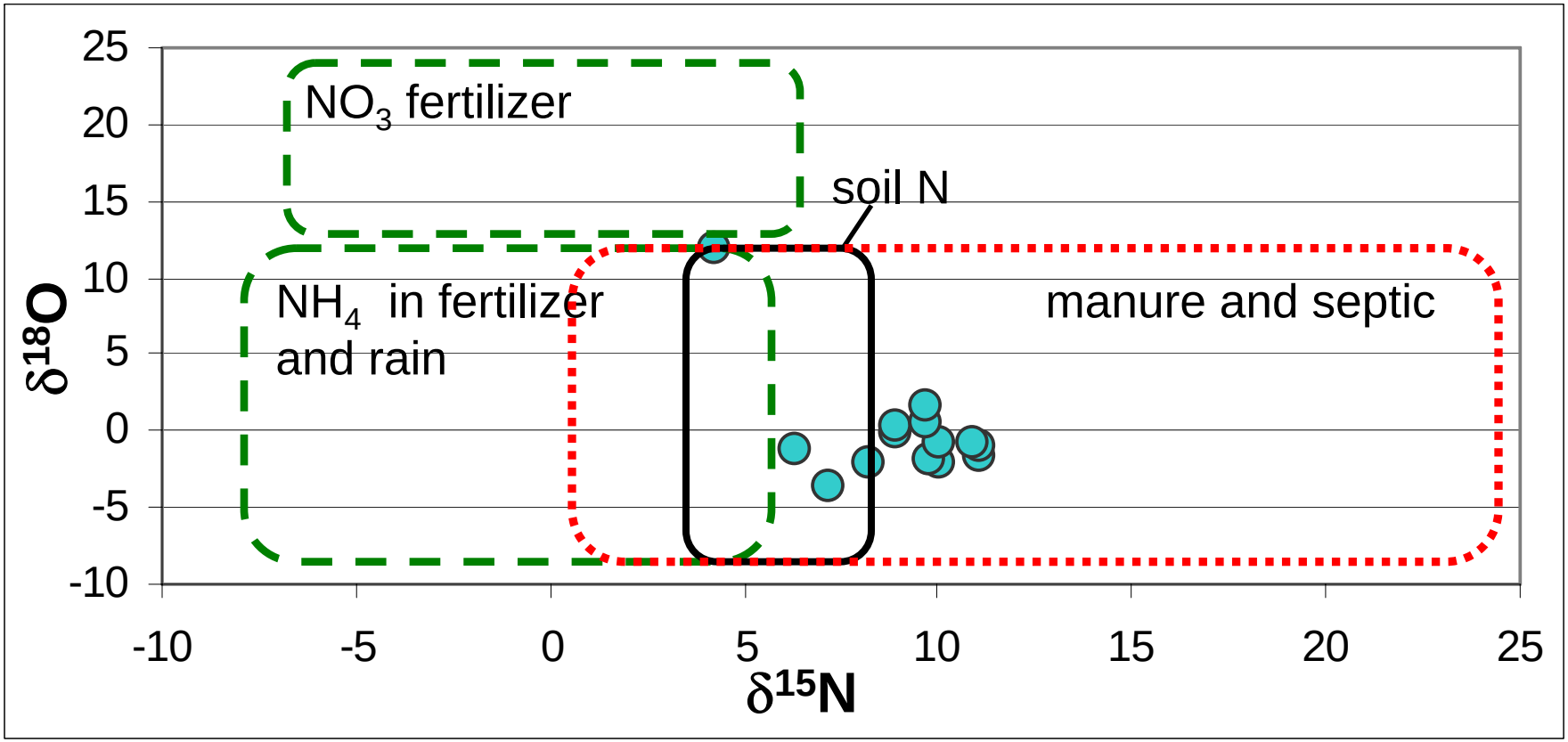
Wells Sampled in 2006



MBMG – Ground-Water Assessment Program

Typical Ranges of $\delta^{18}O$ and $\delta^{15}N$ of Nitrate (NO_3)

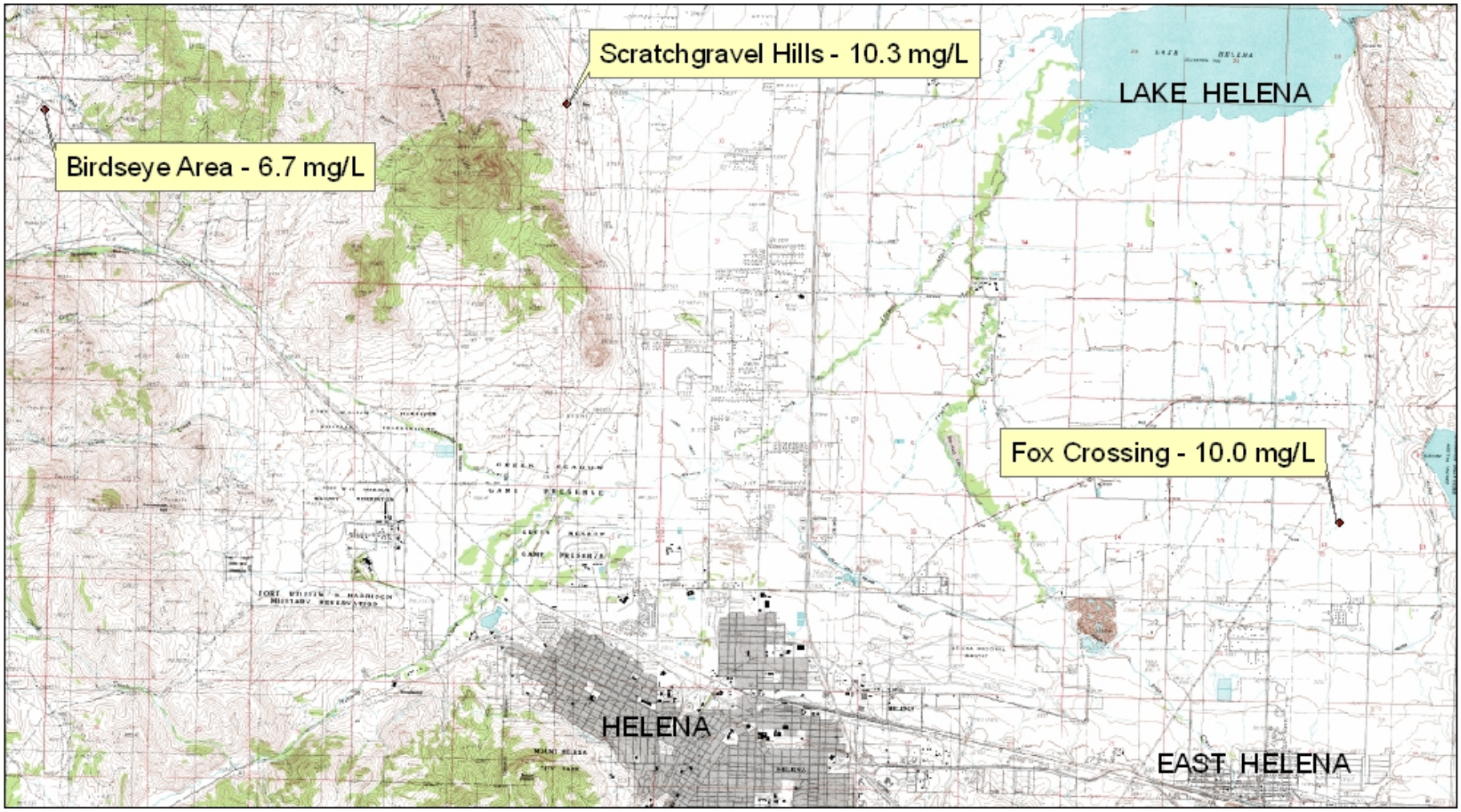
(modified from Kendall and Aravena, 2000)



HELENA

- **Shallow fractured granitic bedrock (Boulder Batholith) on two sites**
- **Finer grained unconsolidated material on third site (Fox Crossing)**
- **Low density upgradient from wells**

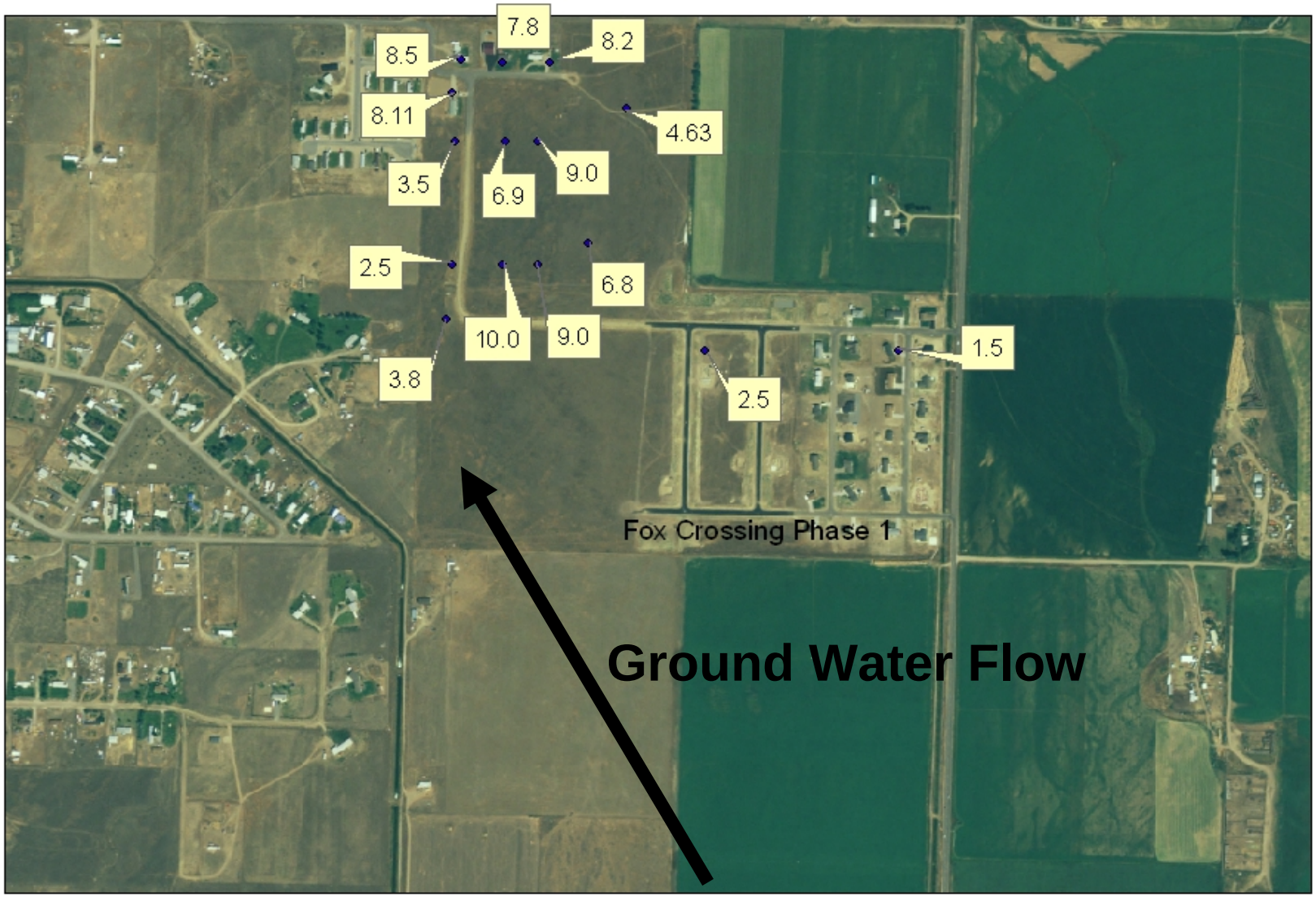
SOME ELEVATED NITRATE LOCATIONS IN THE HELENA VALLEY



N

0 1.25 2.5 5 Miles

FOX CROSSING SUBDIVISION in the ALLUVIAL AQUIFER of the HELENA VALLEY



N

Legend

- WellInfo
Nitrates in mg/L

0 0.1 0.2 0.4 Miles

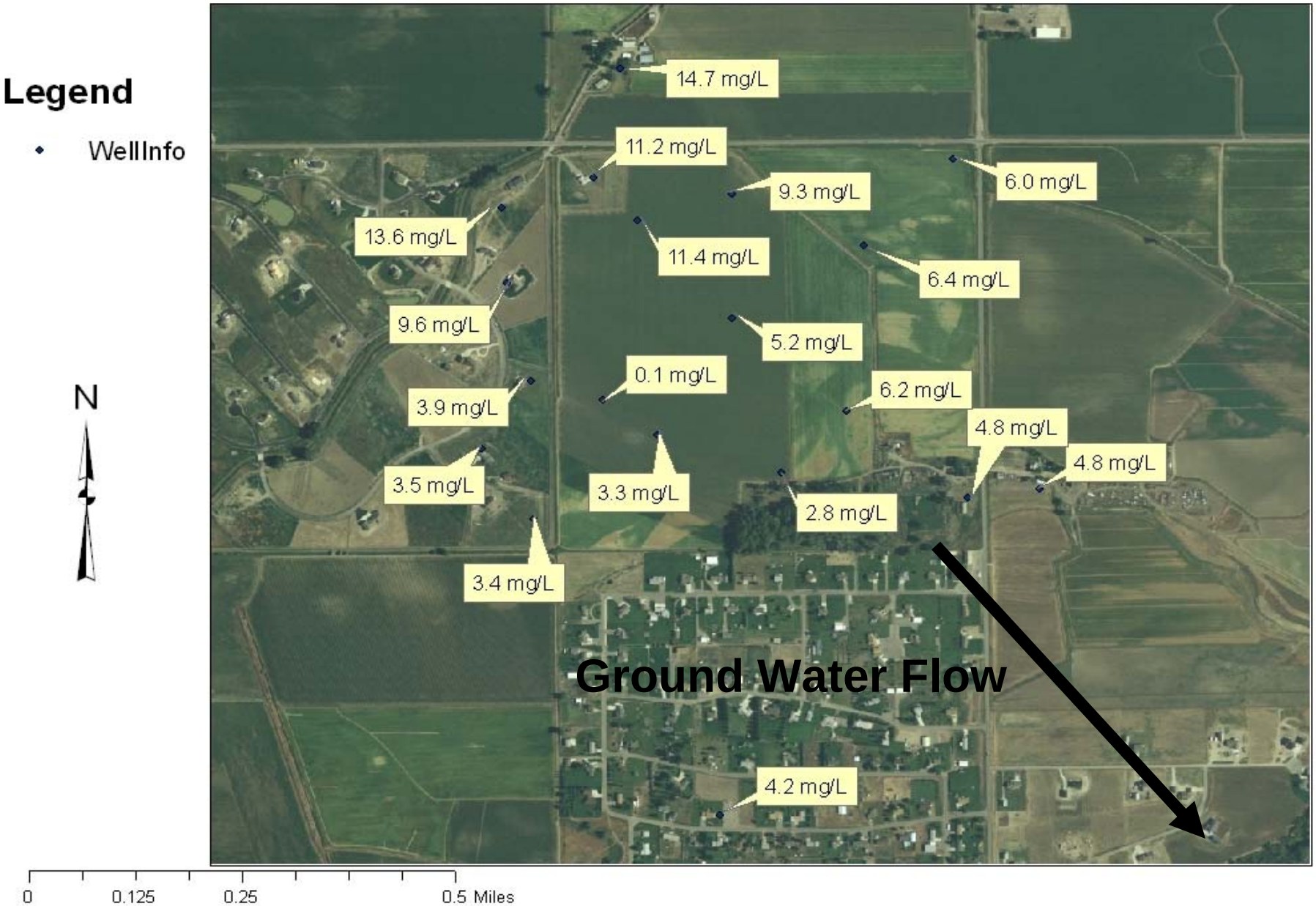
Fox Crossing Phase 1 was not present when the wells were sampled.

Ground water mapped at N32°W (west side) to N36°W (east side)

BILLINGS/LAUREL

- **High permeability, thin gravel aquifer**
- **Shallow water table**
- **Historic agricultural land use**
- **Converting to residential**
- **Variable nitrate due to fertilization/development patterns (?)**

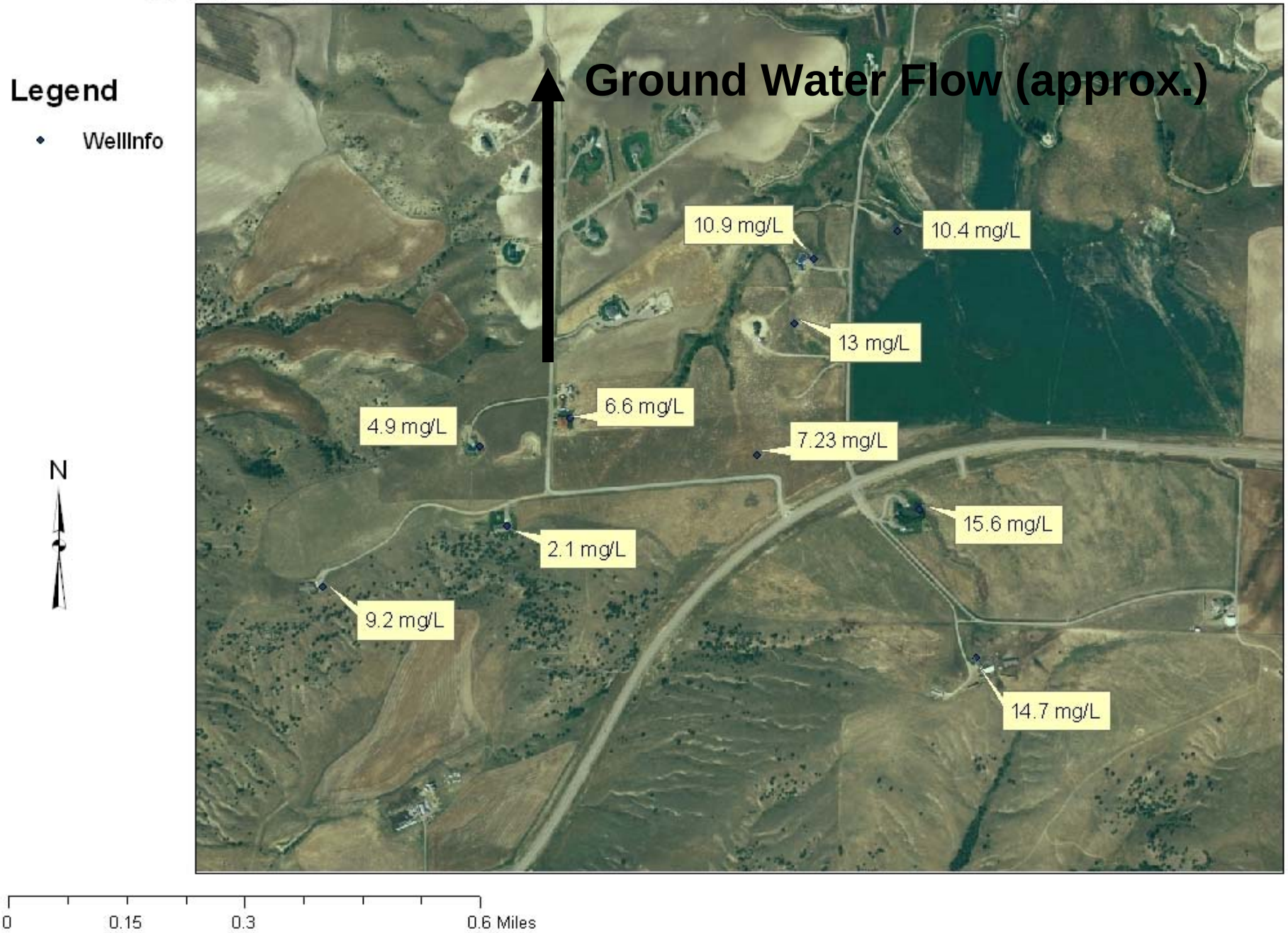
BROOKWOOD - YELLOWSTONE COUNTY - NITRATE CONCENTRATIONS



NORRIS/BOZEMAN

- **Shallow, fractured granitic bedrock (Boulder Batholith)**
- **Low density development**
- **No other surrounding sources**

GALLATIN COUNTY - NORRIS ROAD - WIERDA SUBDIVISION AREA



BOULDER

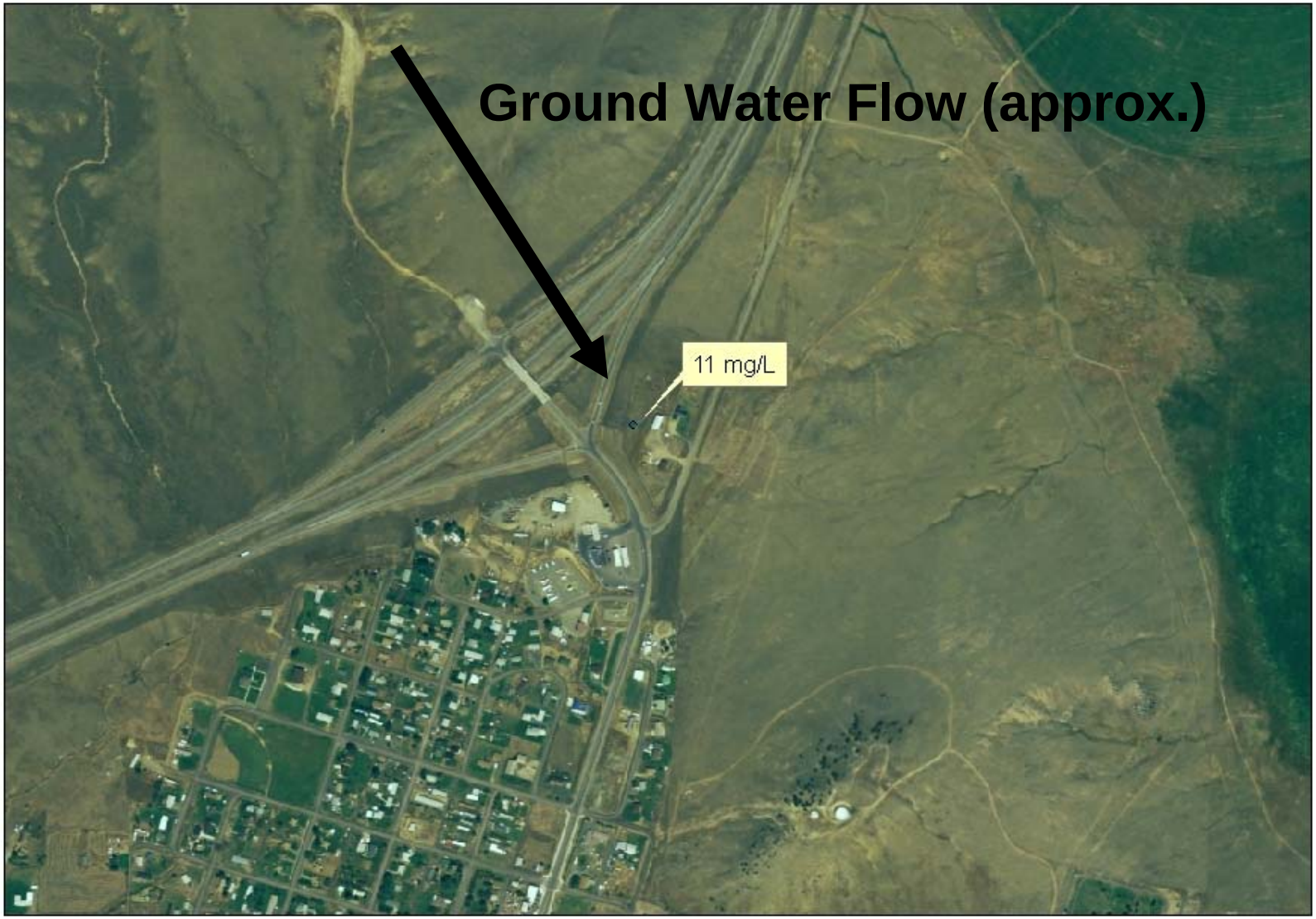
- **Shallow, fractured granite bedrock (Boulder Batholith)**
- **Low upgradient density**
- **No upgradient sources**
- **On-site drainfield downgradient of well**

BOULDER - JEFFERSON COUNTY - NITRATE CONCENTRATIONS

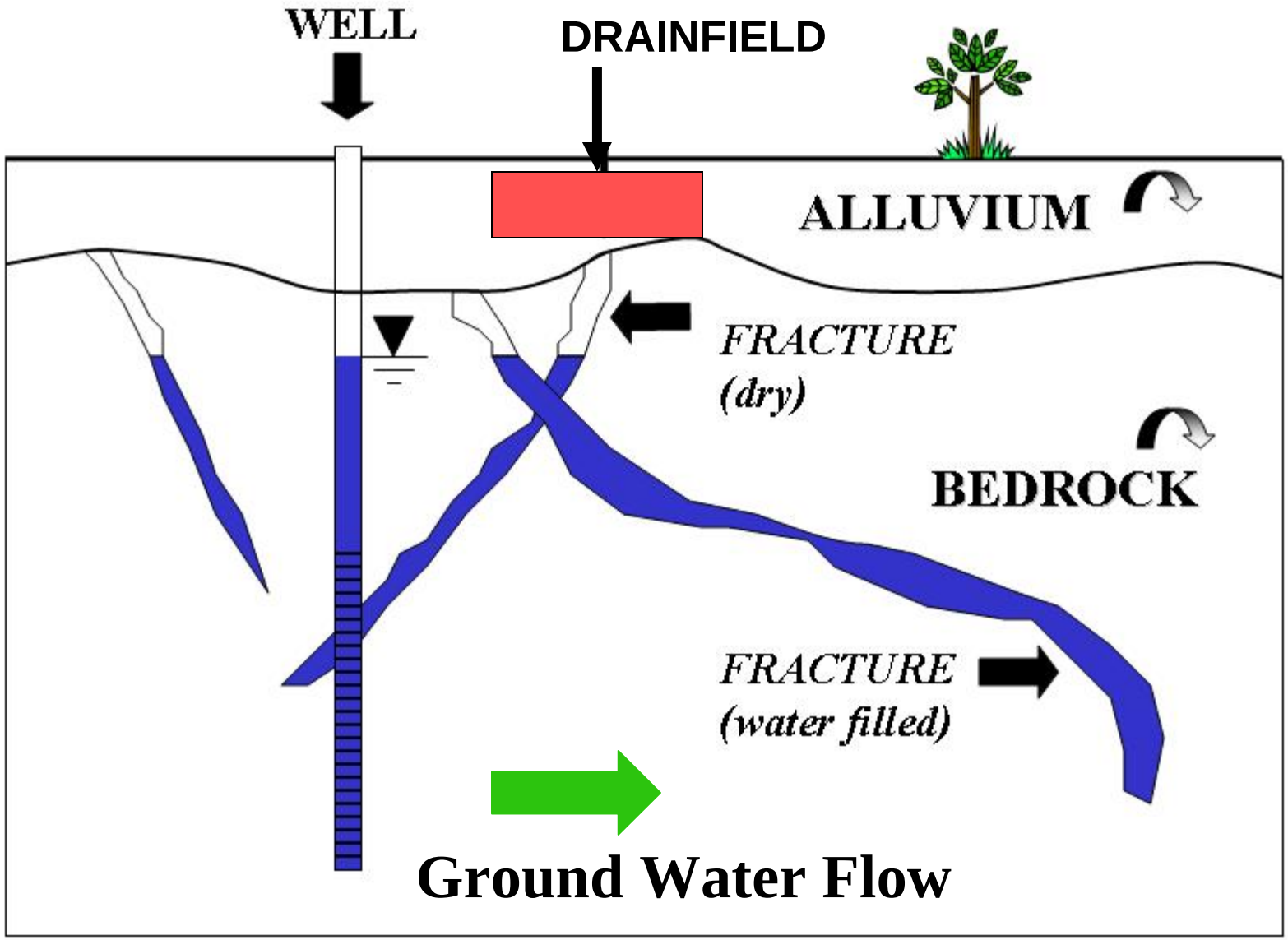
Legend

- WellInfo

N



0 0.1 0.2 0.4 Miles


WELL
DRAINFIELD
ALLUVIUM
FRACTURE
(dry)
BEDROCK
FRACTURE
(water filled)
Ground Water Flow