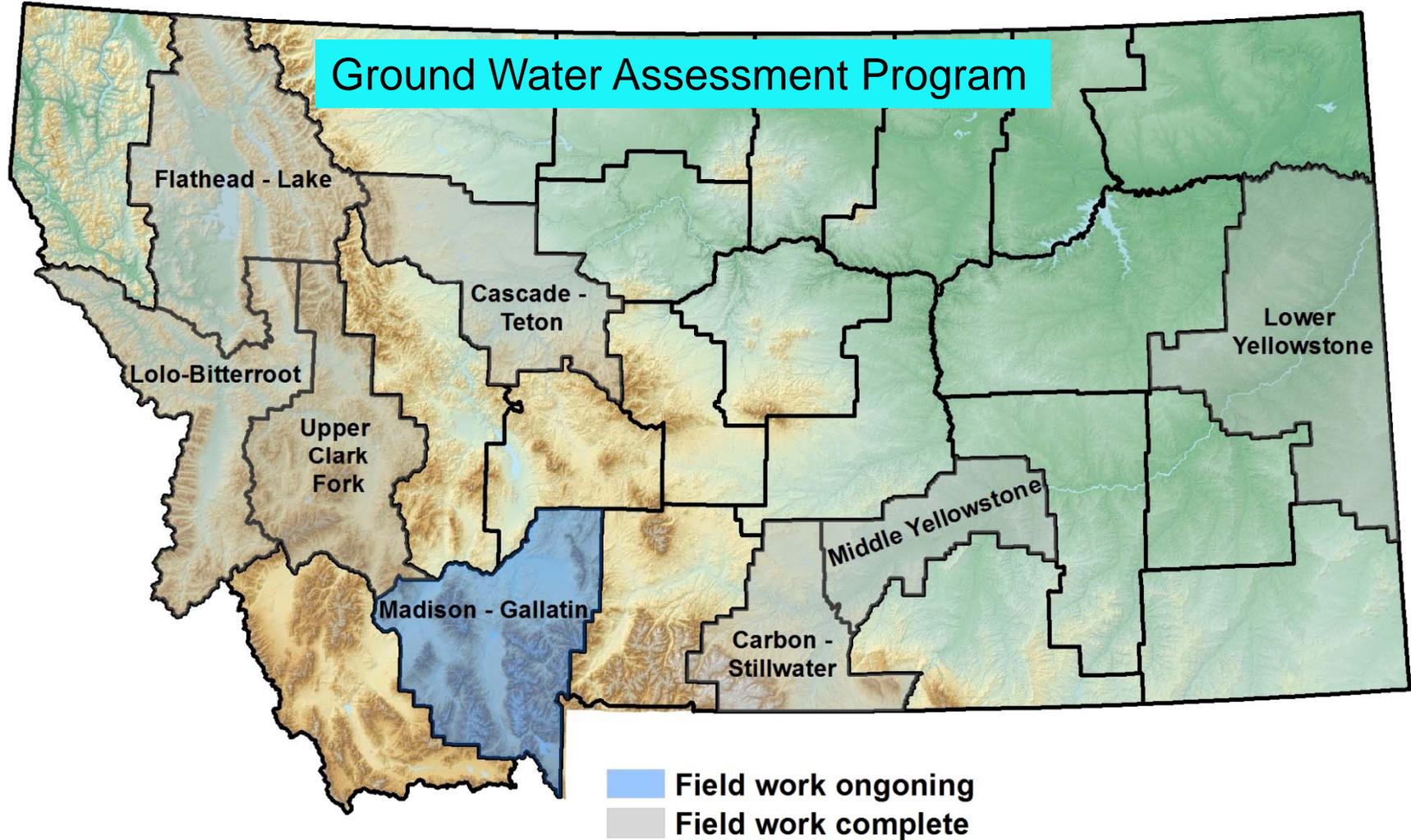# Exempt Well Statistics
Montana Overview

John Metesh
Montana Bureau of Mines and Geology
Presented to:
Water Policy Interim Committee
Helena, MT June 21, 2011

Ground Water Assessment Program

A multi-watershed, multi-county evaluation of ground-water resources:
- well inventories
- baseline water quality
- monitoring (water levels, quality)
- database (GWIC)

Ground Water Investigation Program

6 of the 7 current projects are focused on exempt well and septic system issues
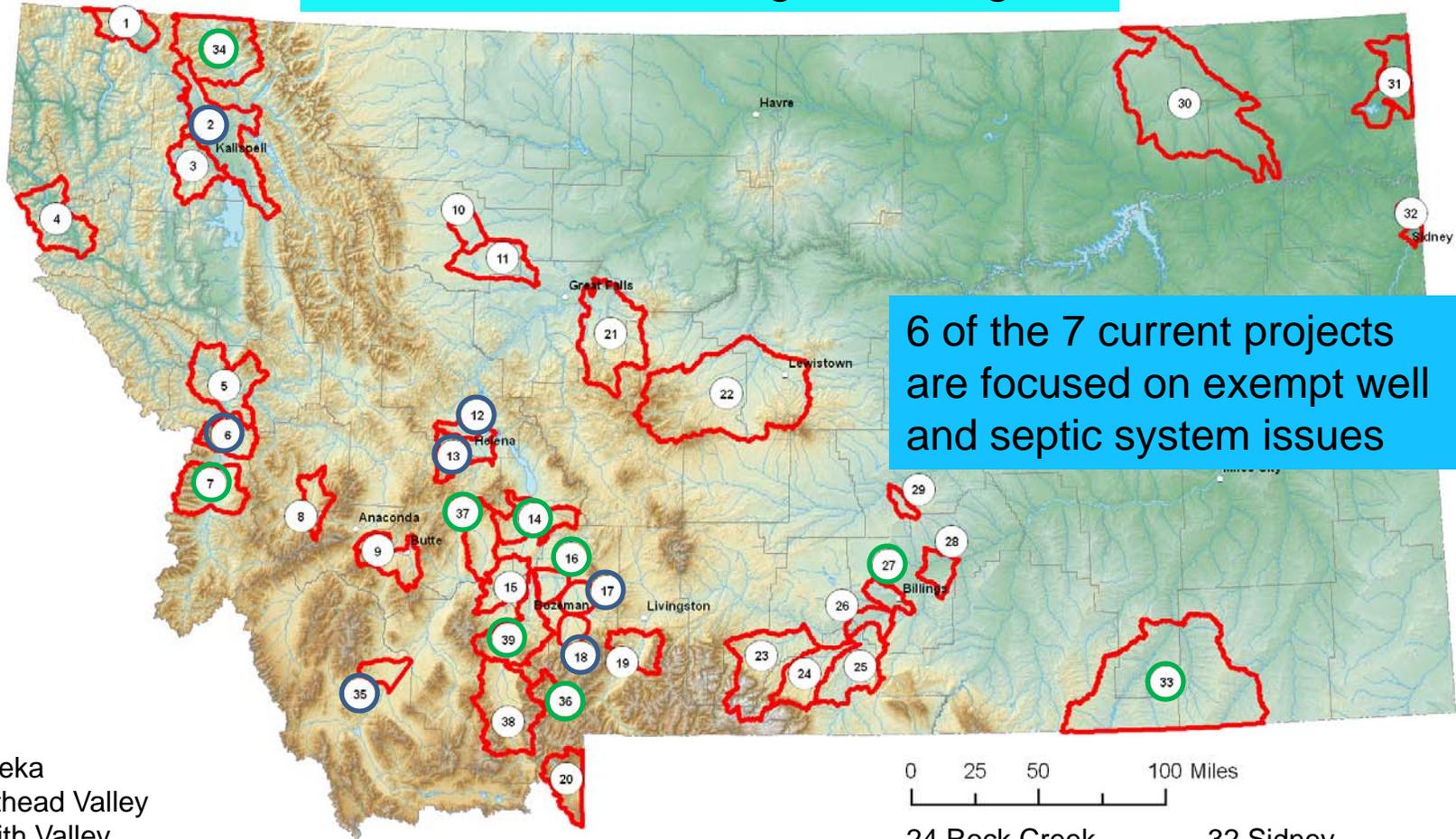
1 Eureka
2 Flathead Valley
3 Smith Valley
4 Noxon
5 Missoula Valley
6 Florence
7 Hamilton

8 Georgetown Lake
9 Summit Valley
10 Priest Butte Lake
11 Greenfield Bench
12 North Hills
13 Scratchgravel Hills
14 Townsend, Toston

15 Three Forks
16 Manhattan
17 Belgrade
18 Four Corners
19 Pine Creek
20 W.Yellowstone
21 Belt, Monarch
22 Little Belt Mtns
23 Stillwater Valley

24 Rock Creek
25 Prior Mtns
26 Park City
27 West Billings
28 East Billings
29 Roundup
30 Flaxville gravels
   (several sub basins)
31 Clear Lake

32 Sidney
33 Coalbed methane
   (several sub basins)
34 NF Flathead
35 Beaverhead – west
36 Big Sky
37 L Boulder
38 Ennis
39 L Madison

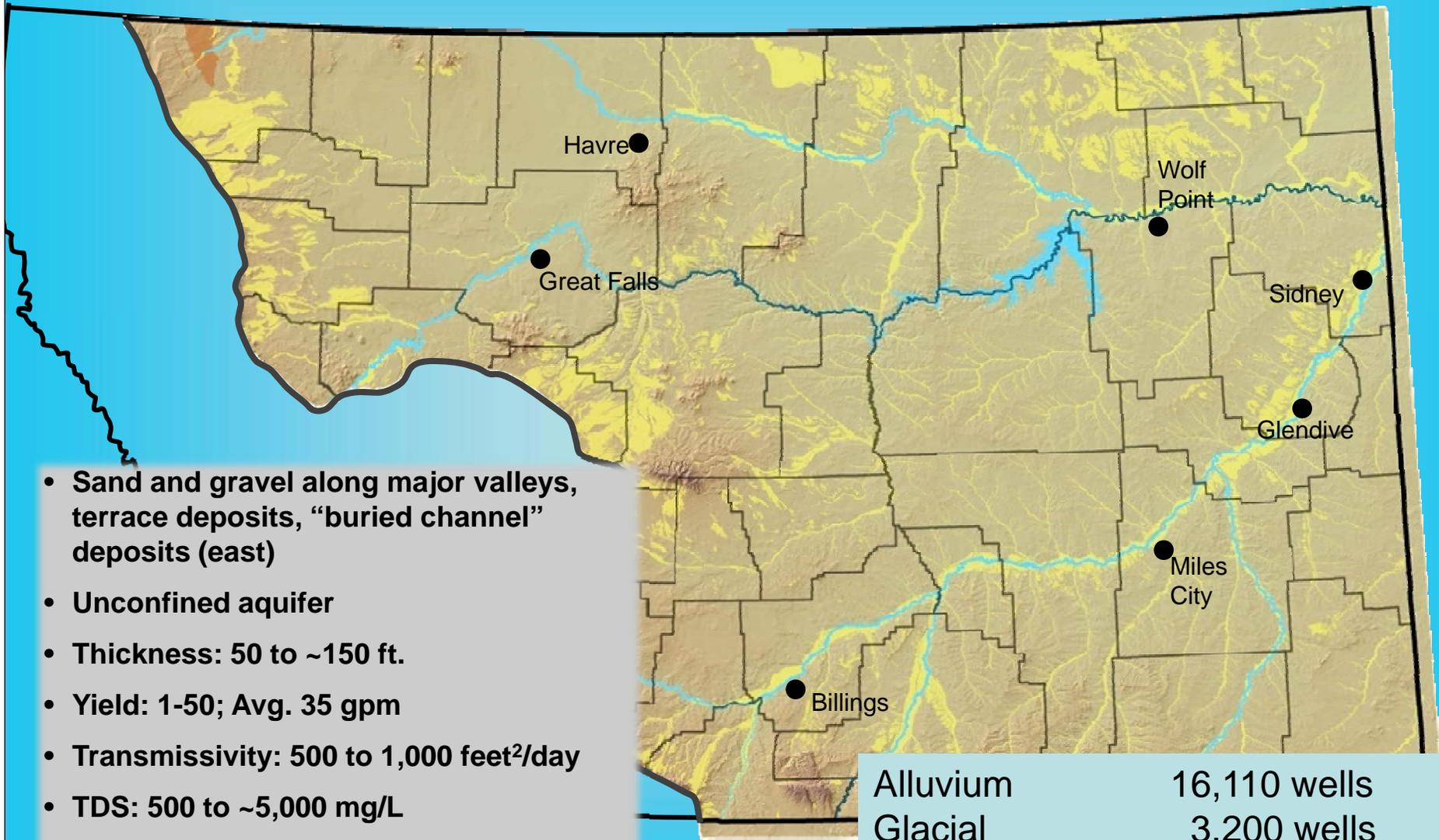# Exempt Wells in Montana (well log vs water right)

- changes in the law = changes in reporting
  (eg well use; filing logs prior to 1973)

- not all report forms are filled out completely
  (use, geologic source, yield, etc.)

- well log/record does not mean a water right
  (domestic well may not have a Notice of Completion or permit)

- exemption is based on <u>rate</u> and <u>volume</u> (35gpm/10acft/y)
  not <u>use</u> (domestic, irrigation, stock…)

- reported yield or capacity is rarely actual use (having a 35gpm right doesn't mean your well will produce it; having a 100gpm well doesn't mean you have a right to it)

Principal Aquifers of Montana
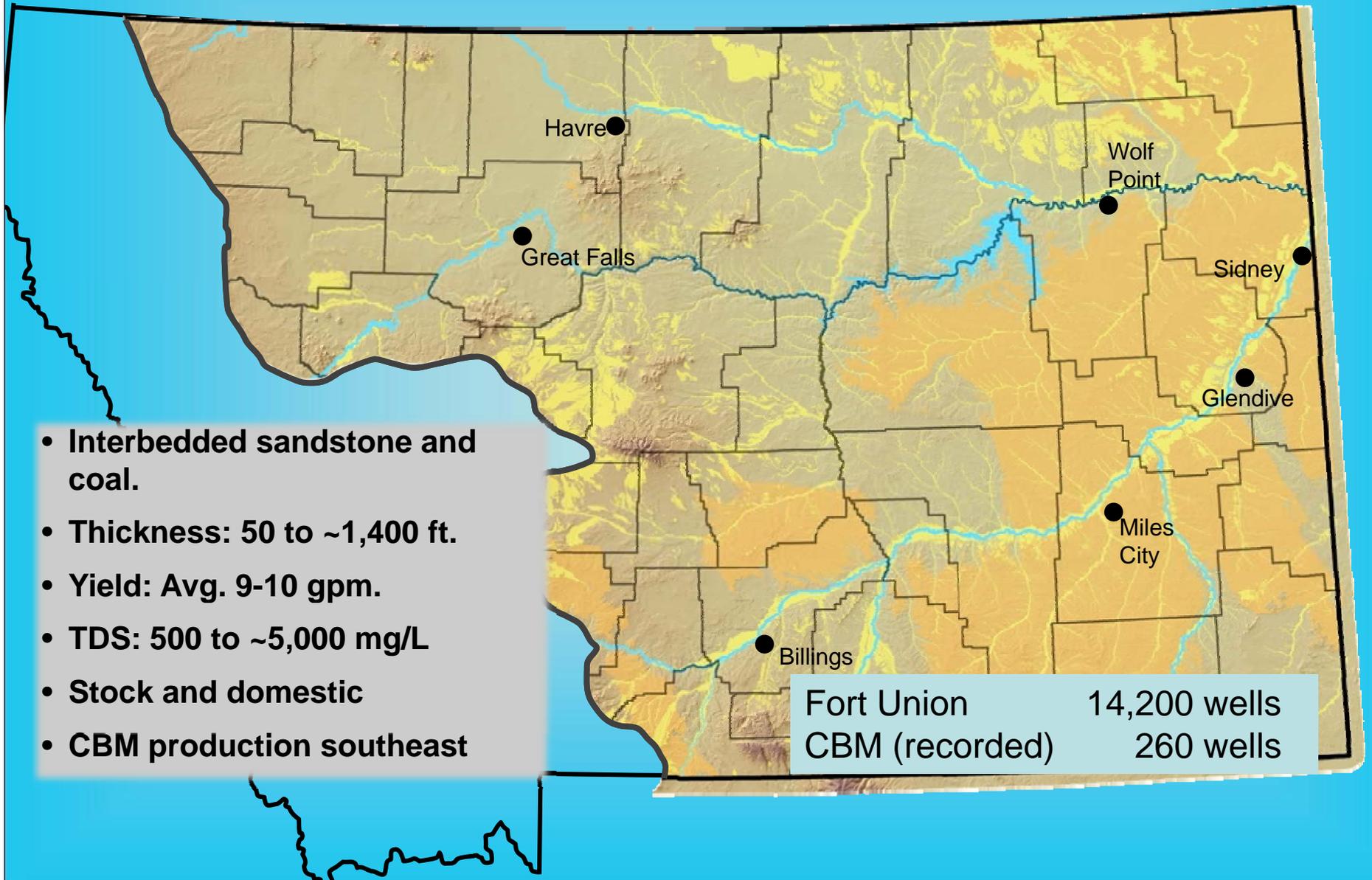(based on yield, wells, availability)

Continental Divide

Rocky Mountain
Geologic Province

Interior Plains
Geologic Province
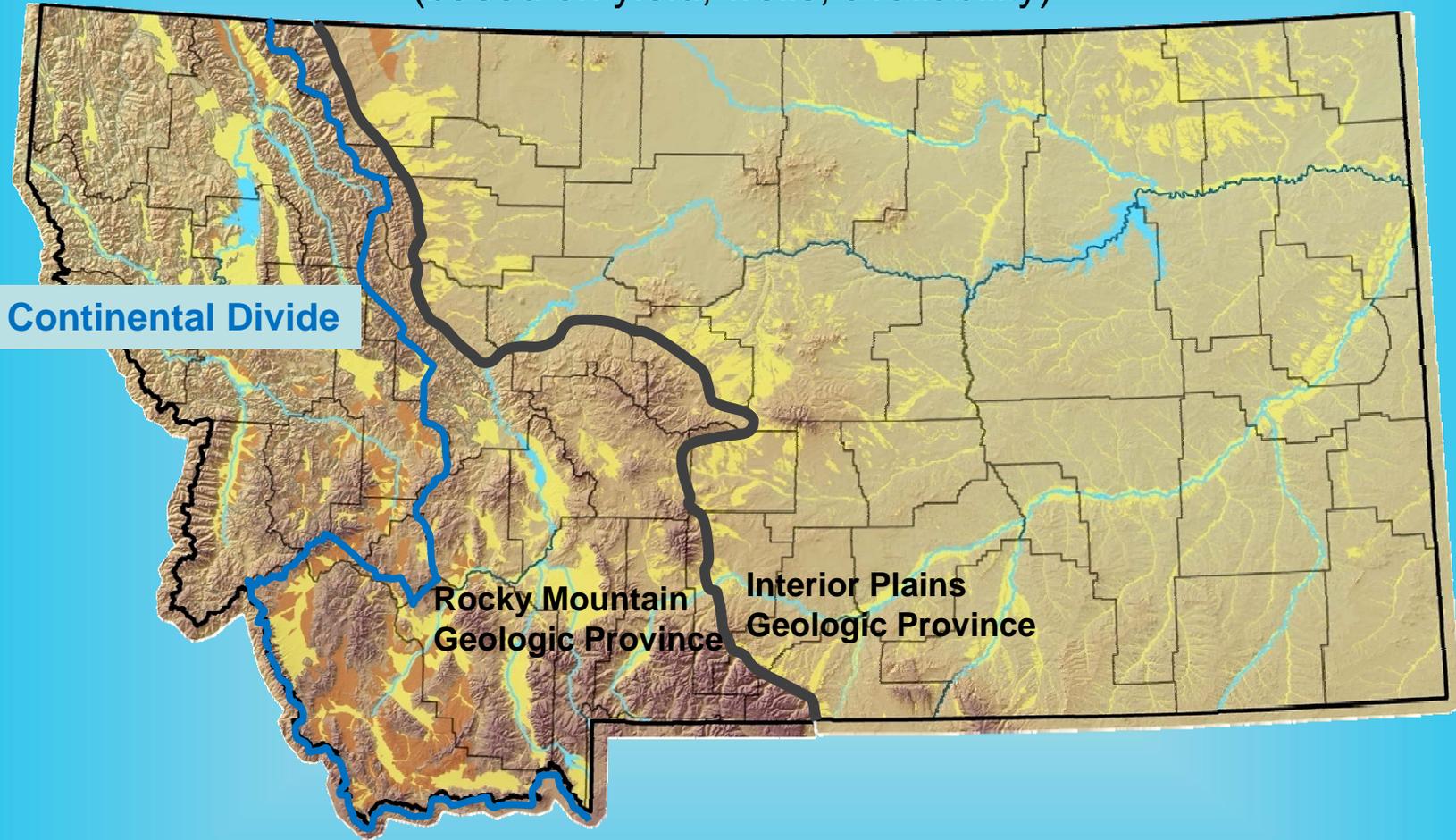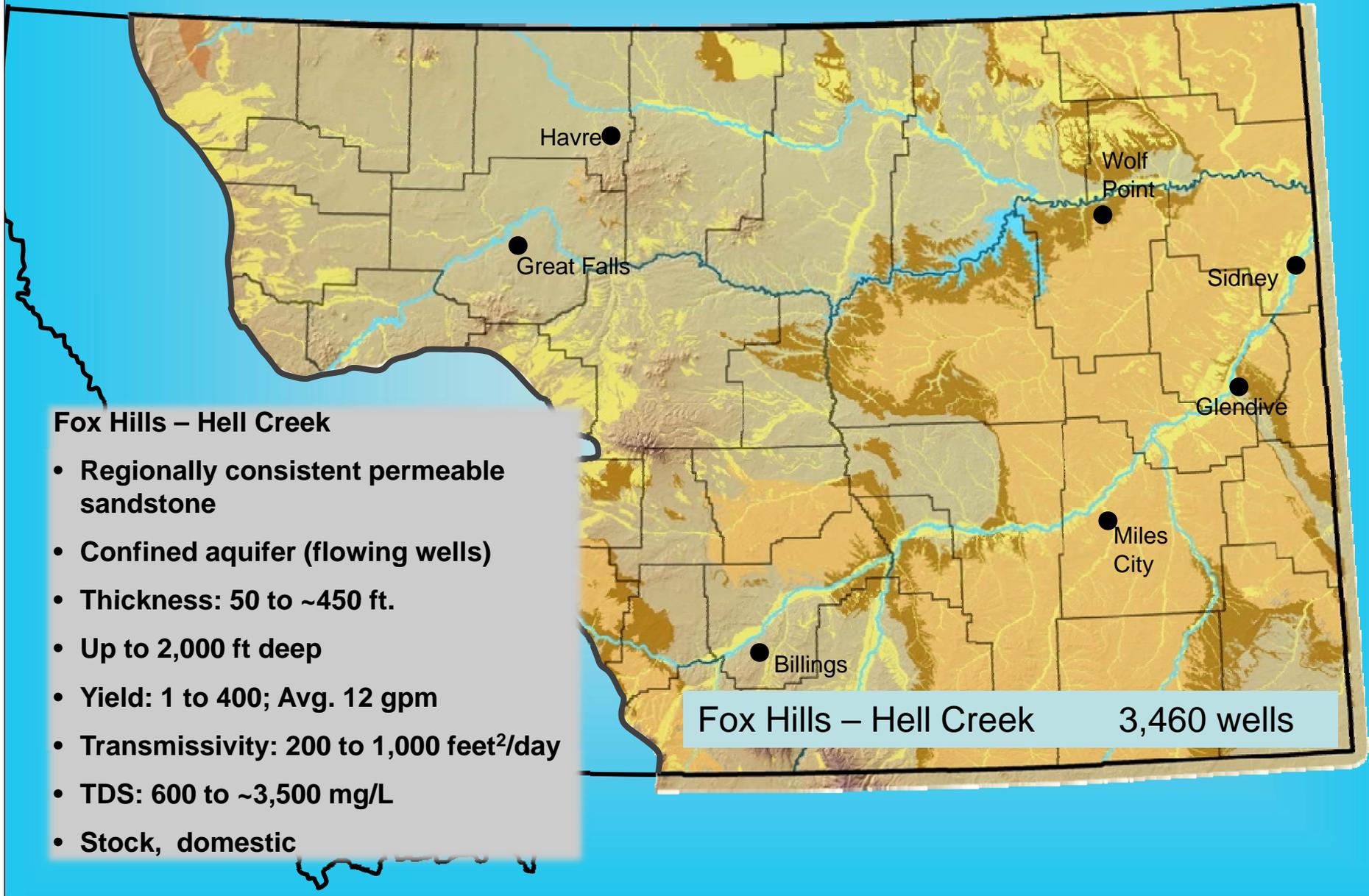
Alluvial aquifers: east

- **Sand and gravel along major valleys, terrace deposits, "buried channel" deposits (east)**

- **Unconfined aquifer**

- **Thickness: 50 to ~150 ft.**

- **Yield: 1-50; Avg. 35 gpm**

- **Transmissivity: 500 to 1,000 feet^2/day**

- **TDS: 500 to ~5,000 mg/L**

- **Stock, domestic and some irrigation.**

Havre

Wolf Point

Great Falls

Sidney

Glendive

Miles City

Billings

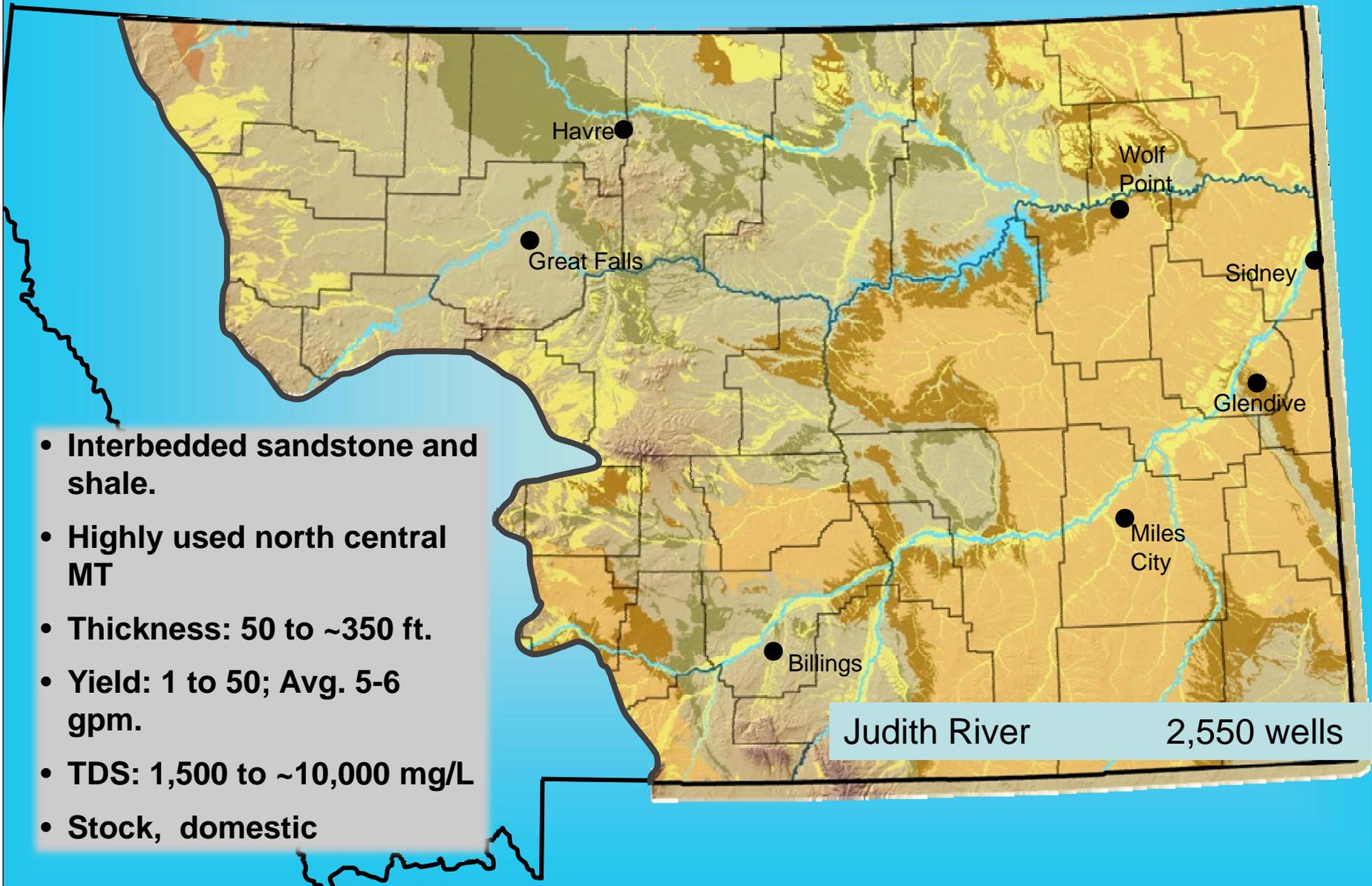| Alluvium | 16,110 wells |
| Glacial | 3,200 wells |

Fort Union Formation

- **Interbedded sandstone and coal.**
- **Thickness: 50 to ~1,400 ft.**
- **Yield: Avg. 9-10 gpm.**
- **TDS: 500 to ~5,000 mg/L**
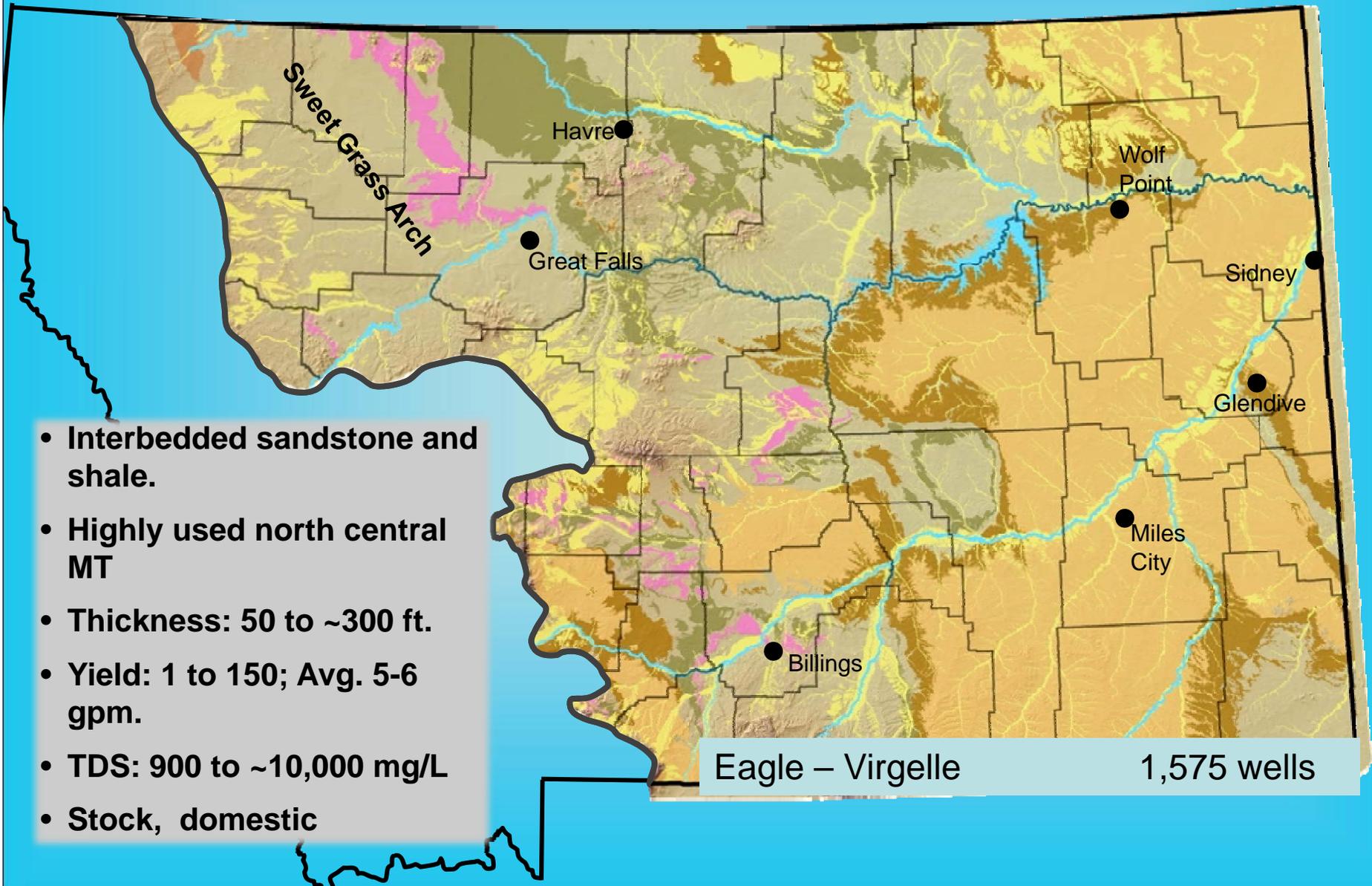- **Stock and domestic**
- **CBM production southeast**

Havre

Wolf Point

Great Falls

Sidney

Glendive

Miles City

Billings

| Fort Union | 14,200 wells |
| CBM (recorded) | 260 wells |

Fox Hills – Hell Creek Formations

Havre

Wolf Point

Great Falls

Sidney

Glendive

Miles City

Billings

Fox Hills – Hell Creek

- **Regionally consistent permeable sandstone**
- **Confined aquifer (flowing wells)**
- **Thickness: 50 to ~450 ft.**
- **Up to 2,000 ft deep**
- **Yield: 1 to 400; Avg. 12 gpm**
- **Transmissivity: 200 to 1,000 feet^2/day**
- **TDS: 600 to ~3,500 mg/L**
- **Stock, domestic**

Fox Hills – Hell Creek   3,460 wells

Judith River Formation

- **Interbedded sandstone and shale.**
- **Highly used north central MT**
- **Thickness: 50 to ~350 ft.**
- **Yield: 1 to 50; Avg. 5-6 gpm.**
- **TDS: 1,500 to ~10,000 mg/L**
- **Stock, domestic**

Judith River   2,550 wells

Eagle - Virgelle

Sweet Grass Arch

Havre

Wolf Point

Great Falls

Sidney

Glendive

Miles City

Billings

- **Interbedded sandstone and shale.**
- **Highly used north central MT**
- **Thickness: 50 to ~300 ft.**
- **Yield: 1 to 150; Avg. 5-6 gpm.**
- **TDS: 900 to ~10,000 mg/L**
- **Stock, domestic**

Eagle – Virgelle   1,575 wells

All aquifers: west

Alluvium:

- **Sand and gravel along major valleys, thick basin-fill deposits in intermontane basins**

- **Unconfined aquifers**

- **Thickness: 30 to >1,000 ft**

- **Yield: 1 to 3500; Avg. 35 gpm**

- **Transmissivity: 500 to 200,000 feet^2/day**

- **TDS: < 500 mg/L**

- **Stock, domestic and some irrigation**

- **High demand in small areas**

Bedrock: Belt, volcanics, intrusives, etc.

- **Valley margin or deep wells in valley**

- **Unconfined on margins, deep confined aquifers**

- **Thickness: generally unlimited**

- **Yield: 1 to 5000 gpm typical range**

- **Transmissivity: 50 to 10,000 feet^2/day**

- **TDS: < 100 mg/L**

- **Stock, domestic and rare irrigation**

Alluvium	18,290 wells
Glacial	8,400 wells
Bedrock	4,700 wells

Kalispell

Missoula

Helena

Bozeman
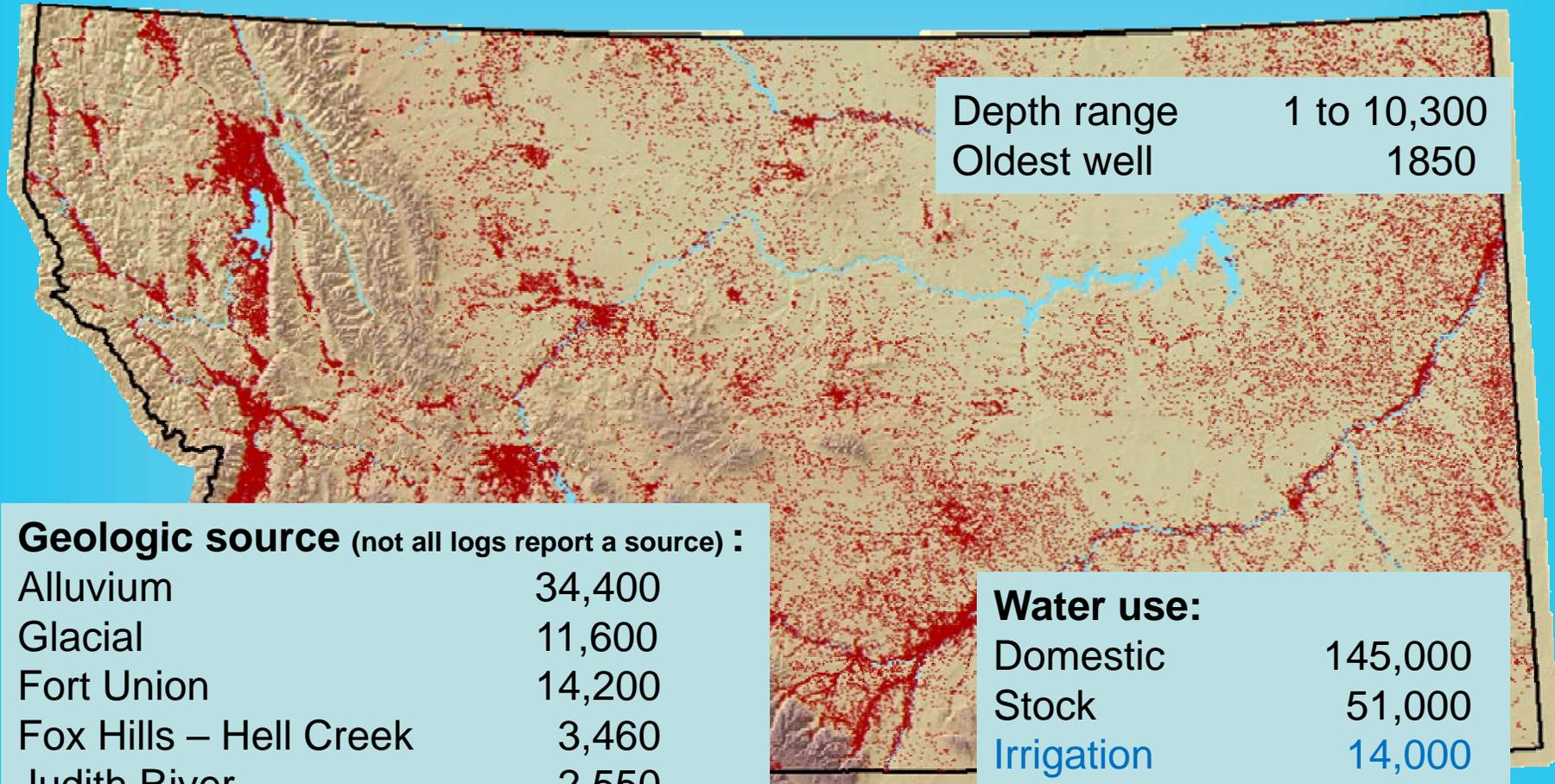
Depth range   1 to 10,300
Oldest well   1850

Geologic source (not all logs report a source) :

Source	Count
Alluvium	34,400
Glacial	11,600
Fort Union	14,200
Fox Hills – Hell Creek	3,460
Judith River	2,550
Eagle – Virgelle	1,575
Kootenai – Madison	2,200
Bedrock (western MT)	4,700

Water use:

Use	Count
Domestic	145,000
Stock	51,000
Irrigation	14,000
Public WS	5,000
Com/Ind	2,000

Belgrade

Belgrade 1975
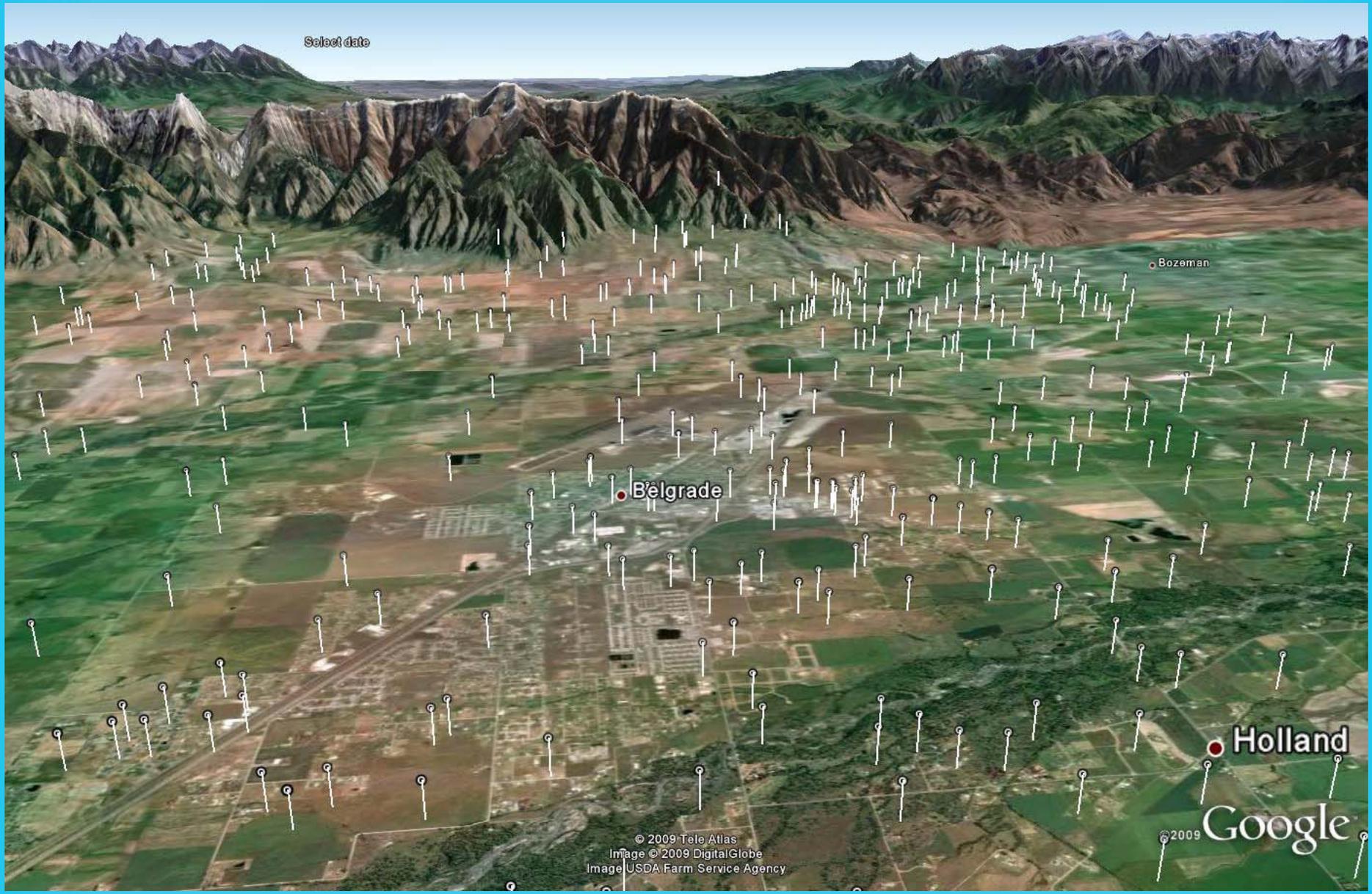
Belgrade today (35 years)
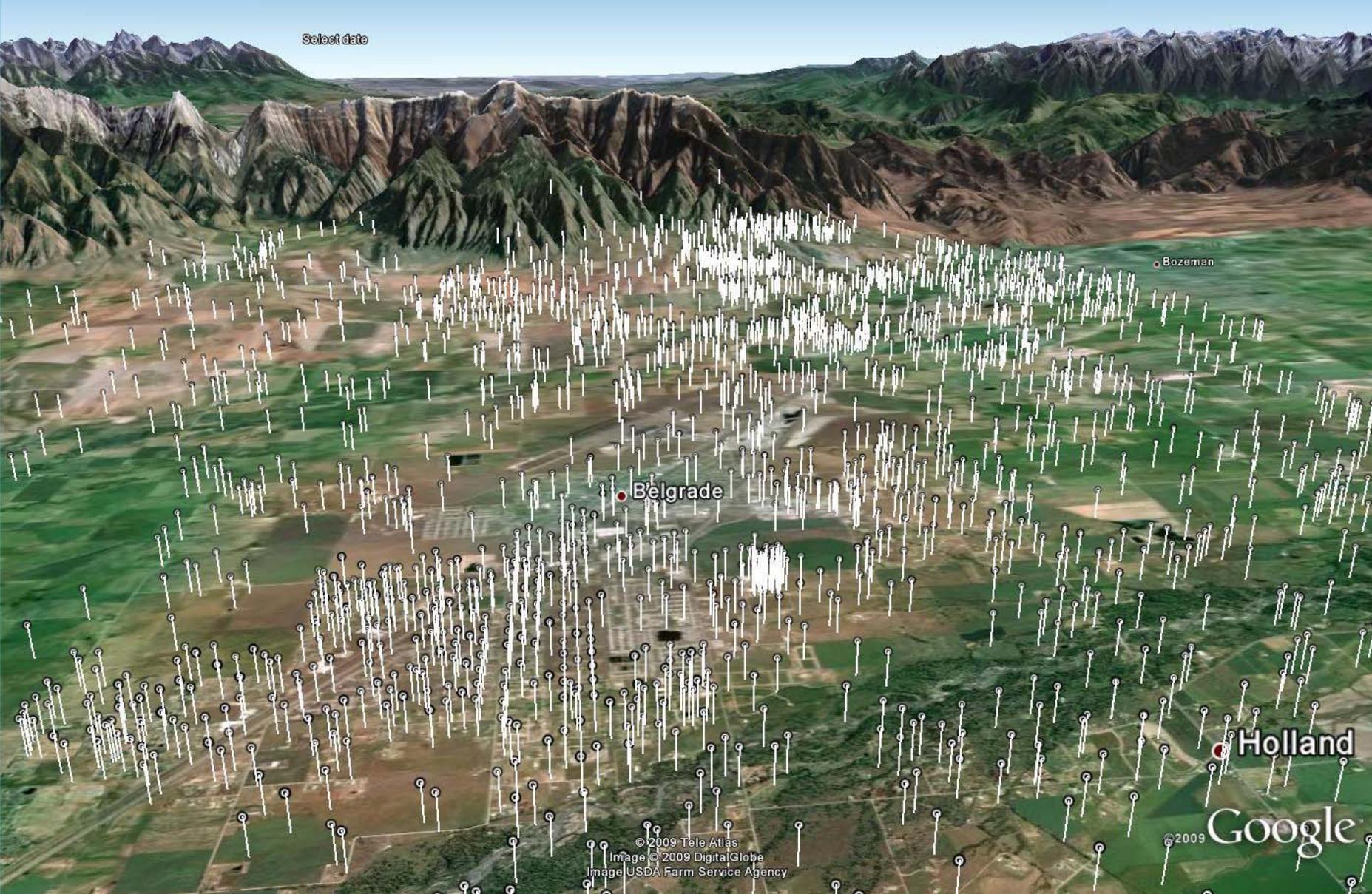
Florence

Florence 1975

Florence today (35 years)

But what **is** the impact of so many wells?

Stream Depletion

Stream depletion simplified...

Stream Depletion is (ultimately) equal to

$$\frac{Q_{well(s)}}{Periodicity}$$

For example: the stream depletion for a well pumped at 400 gpm
for 3 months of each year is 100 gpm

$$\frac{400gpm}{12months/3months} = 100gpm$$

...this excludes direct runoff or return flow through ground water
(ie consumptive use)

Stream depletion simplified…

Stream Depletion is independent of stream discharge
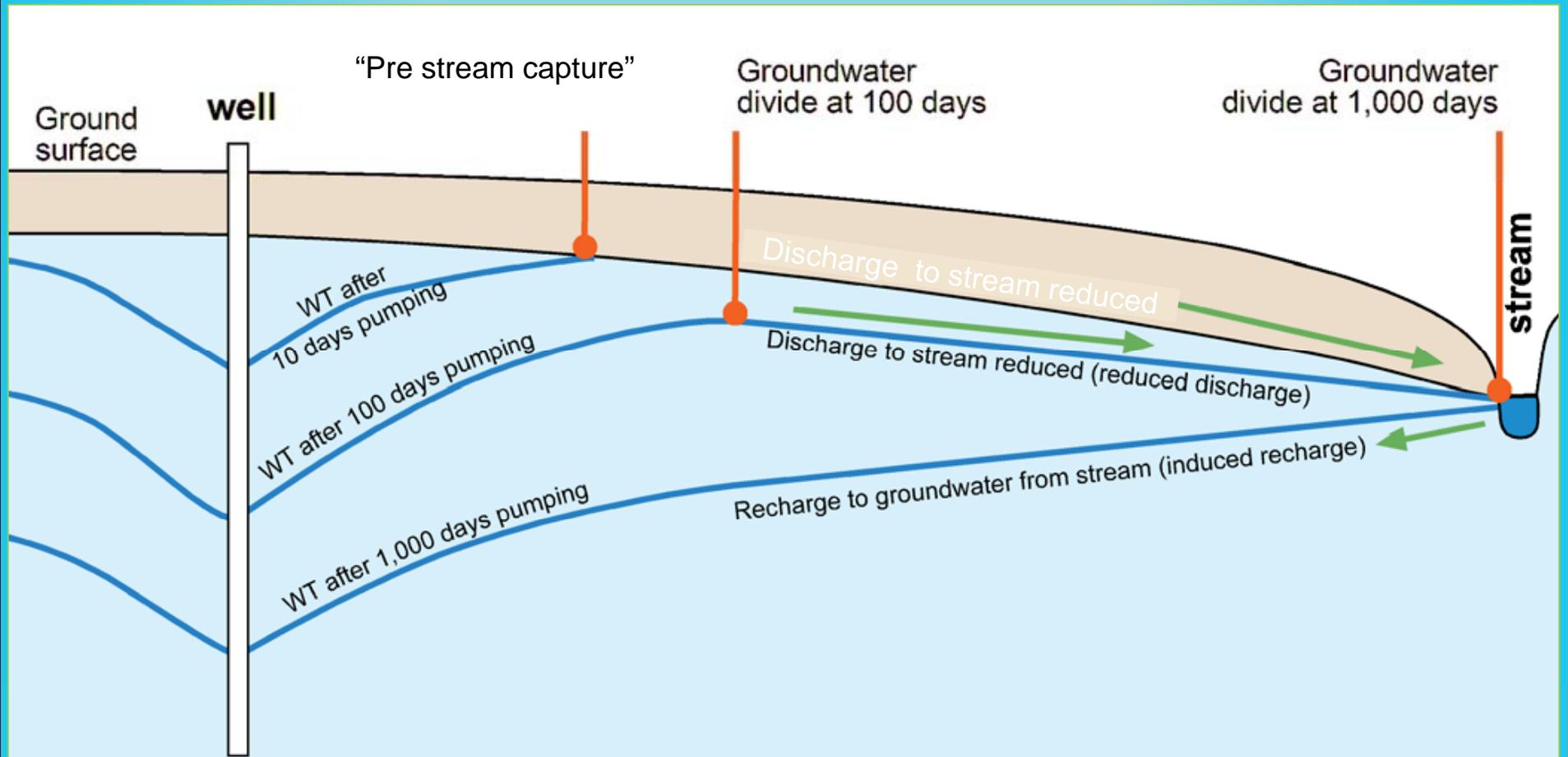same effect whether 1000 cfs or 10 cfs
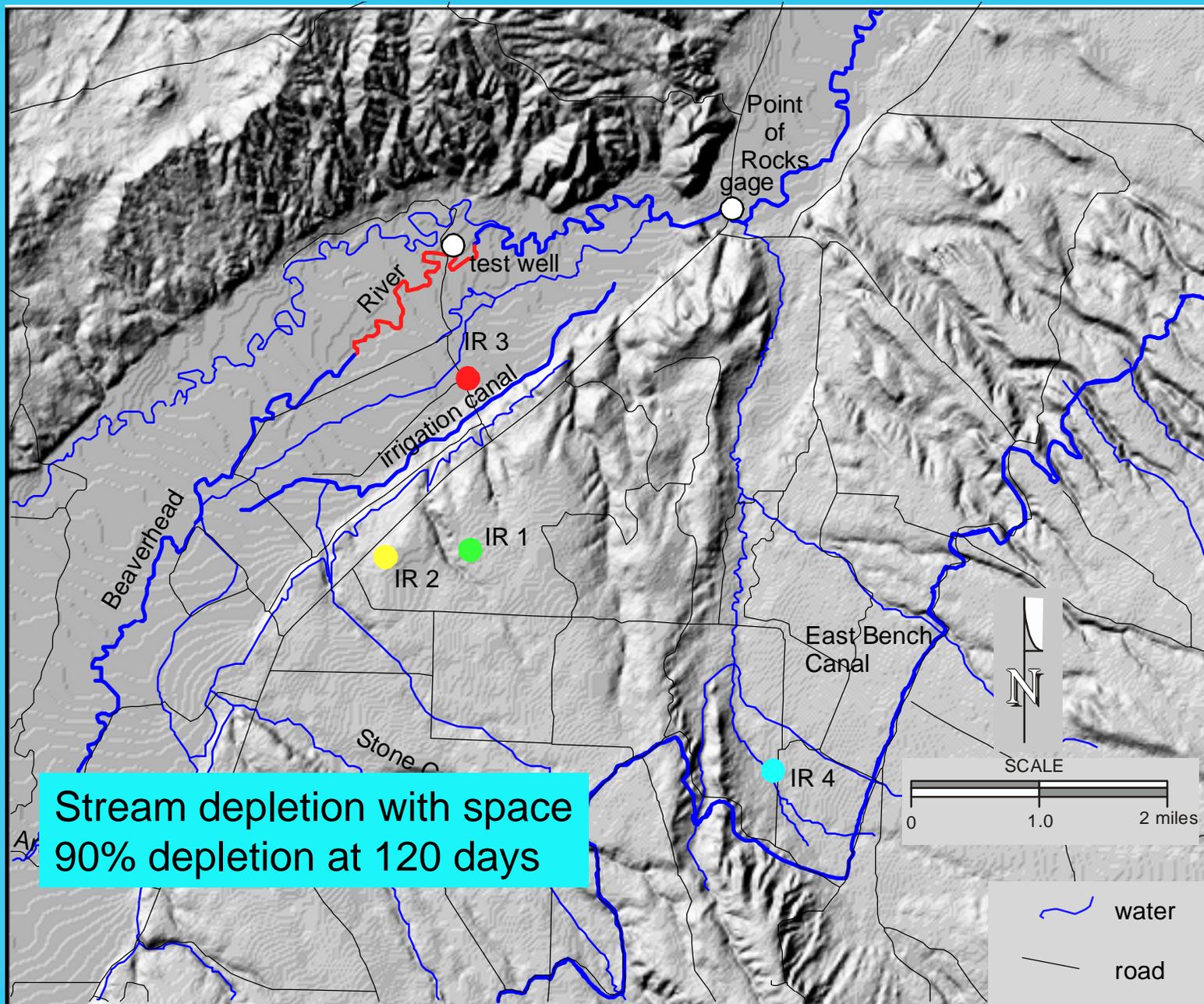
Unless, of course, you dry up the stream

Stream Depletion is independent of well interference
it is both cumulative and additive
1 well pumping 500 gpm
has the same effect as
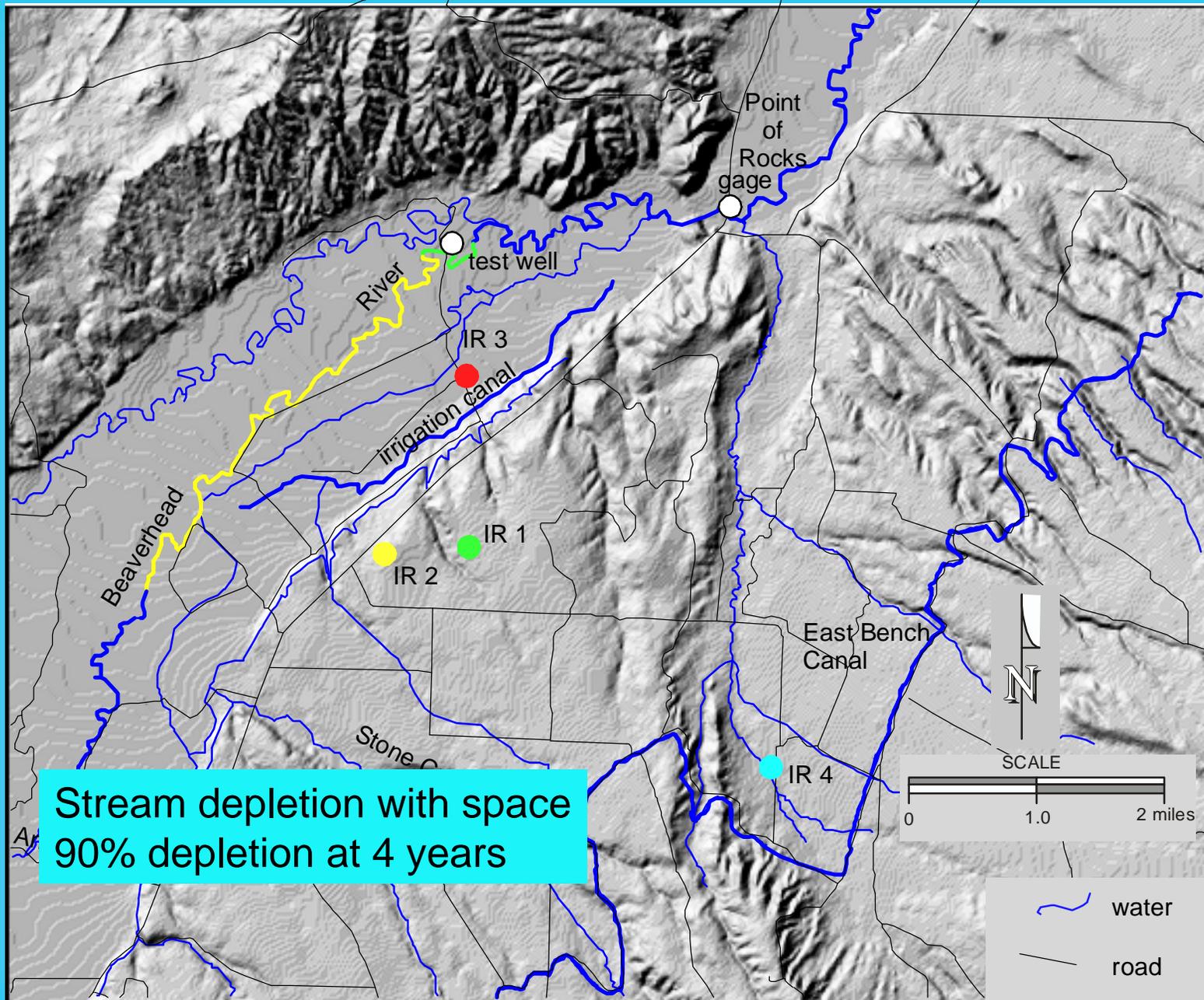50 wells pumping 10 gpm

Stream Depletion is independent of distance from the
well(s) to the stream
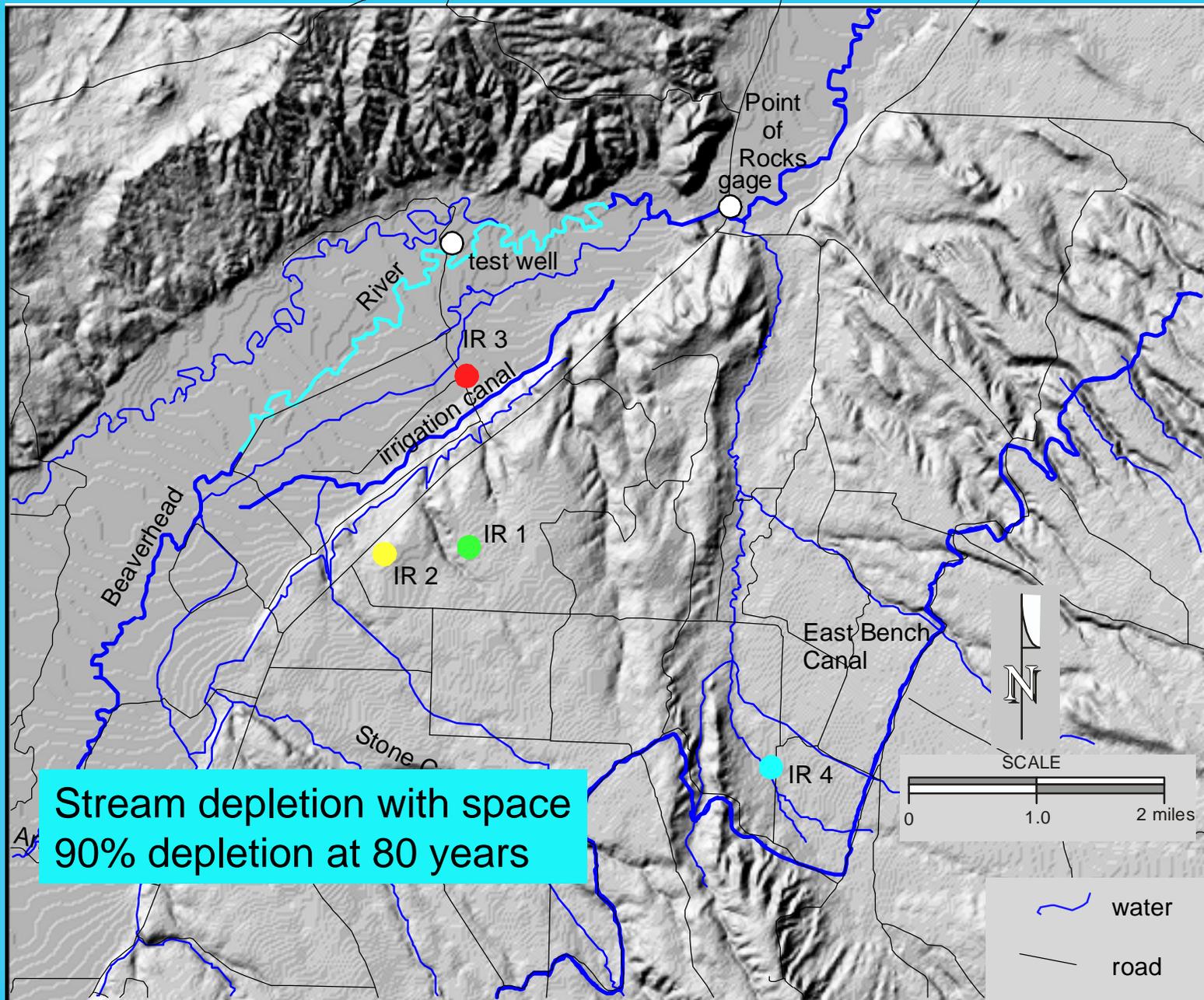BUT the **RATE** of depletion **IS** dependent on distance

Stream depletion simplified...

Stream Depletion occurs before the "cone of depression" reaches the stream
(some applications prior to HB831did not address this)

Point
of
Rocks
gage

test well

River

IR 3

Irrigation canal

Beaverhead

IR 1

IR 2

East Bench
Canal

Stone C

IR 4

N

SCALE

0   1.0   2 miles

Stream depletion with space
90% depletion at 120 days

water

road

Stream depletion with space
90% depletion at 4 years

Stream depletion with space
90% depletion at 80 years