WWDC Wind/Bighorn River Basin Plan, Groundwater Study (Level I)

WSGS – USGS – WRDS 2008-2010

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Geologist

Wyoming State Geological Survey (WSGS)

Laramie, Wyoming

Introduction

Wind/Bighorn plan (WBH) Plan II, Groundwater Study (Level I)

- Commenced in June 2008

Cooperative Water Study

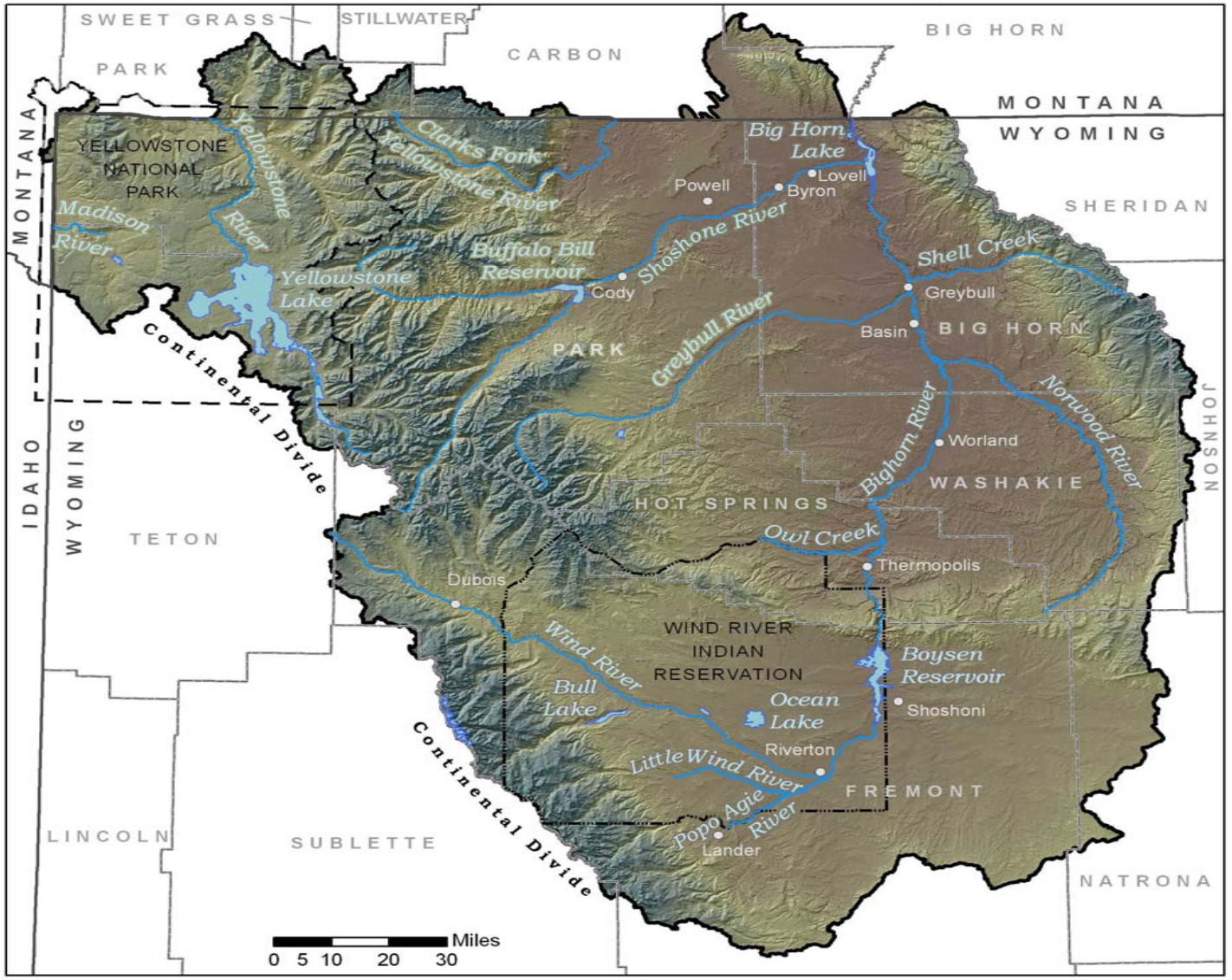
- Wyoming Water Development Commission (WWDC)
- Wyoming Water Development Office (WWDO)
- Wyoming State Geological Survey (WSGS)
- U.S. Geological Survey (USGS)
- Water Resources Data System (WRDS)
- Surface Water Consultant – WWC Engineering, Laramie
- Other interested parties

WBH Groundwater Study Team

WWDO *Project Manager – Jodi Pavlica*

- **WSGS** – Laramie – *Keith Clarey/Paul Tuacher (Energy Compliance)/Scott Quillinan*
- **USGS** – Cheyenne – *Tim Bartos*
- **WRDS** – University of Wyoming – *Steve Gray*

Major Drainages and Water Bodies, Wind/Bighorn River Basin



WSGS 2009

Projection: NAD 1983
UTM Zone 12N

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Data Sources:

USGS National Hydrography Dataset

USGS National Elevation Dataset

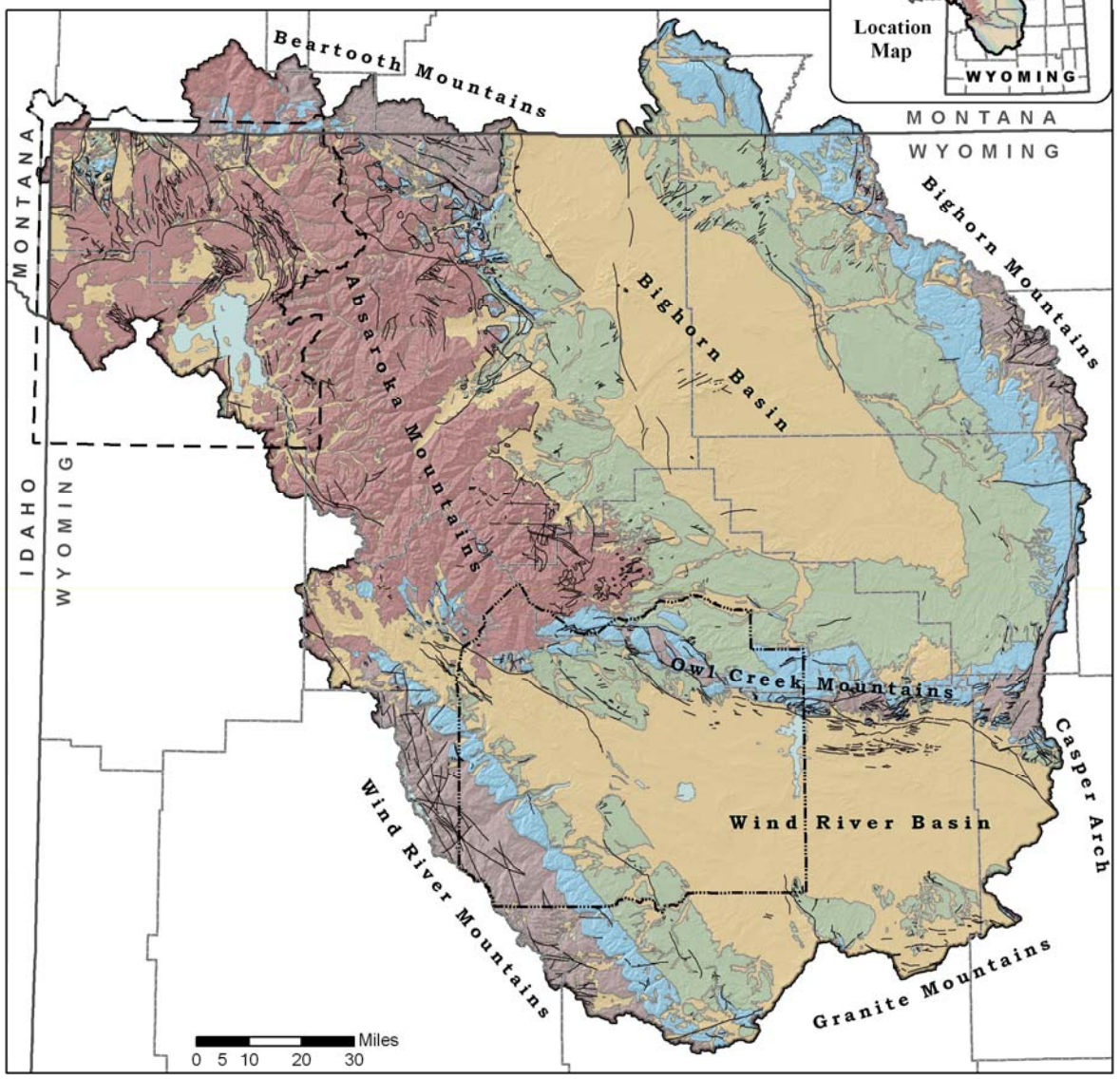
WBH Groundwater Study

- Identify & inventory the aquifers present within the drainage basin area
- Determine 3-dimensional configuration of the aquifers (outcrop areas, geologic structures, & depths)
- Estimate aquifer recharge rates, storage quantities, & discharge rates
- Identify areas with interaction between groundwater & surface water
- Assess the quantity & quality of groundwater available in the aquifers
- Investigate the usage of groundwater in the basin

Geologic Setting of the WBH

- Complex structural basin with folds, faults, & uplifts
  - 35,000 feet of structural relief between the basin and Bighorn mountains
- WBH formations range from Precambrian to Quaternary in age
  - Wyoming – 93 GIS geologic units
  - Montana – 43 GIS geologic units

Geologic Features, Wind/Bighorn River Basin



Explanation

- Fault, includes buried thrusts
- Yellowstone National Park Boundary
- Wind River Reservation Boundary
- Water and Ice
- Volcanic Rocks

Major Aquifer Groups

- Cenozoic
- Mesozoic
- Paleozoic
- Precambrian

WSGS 2009

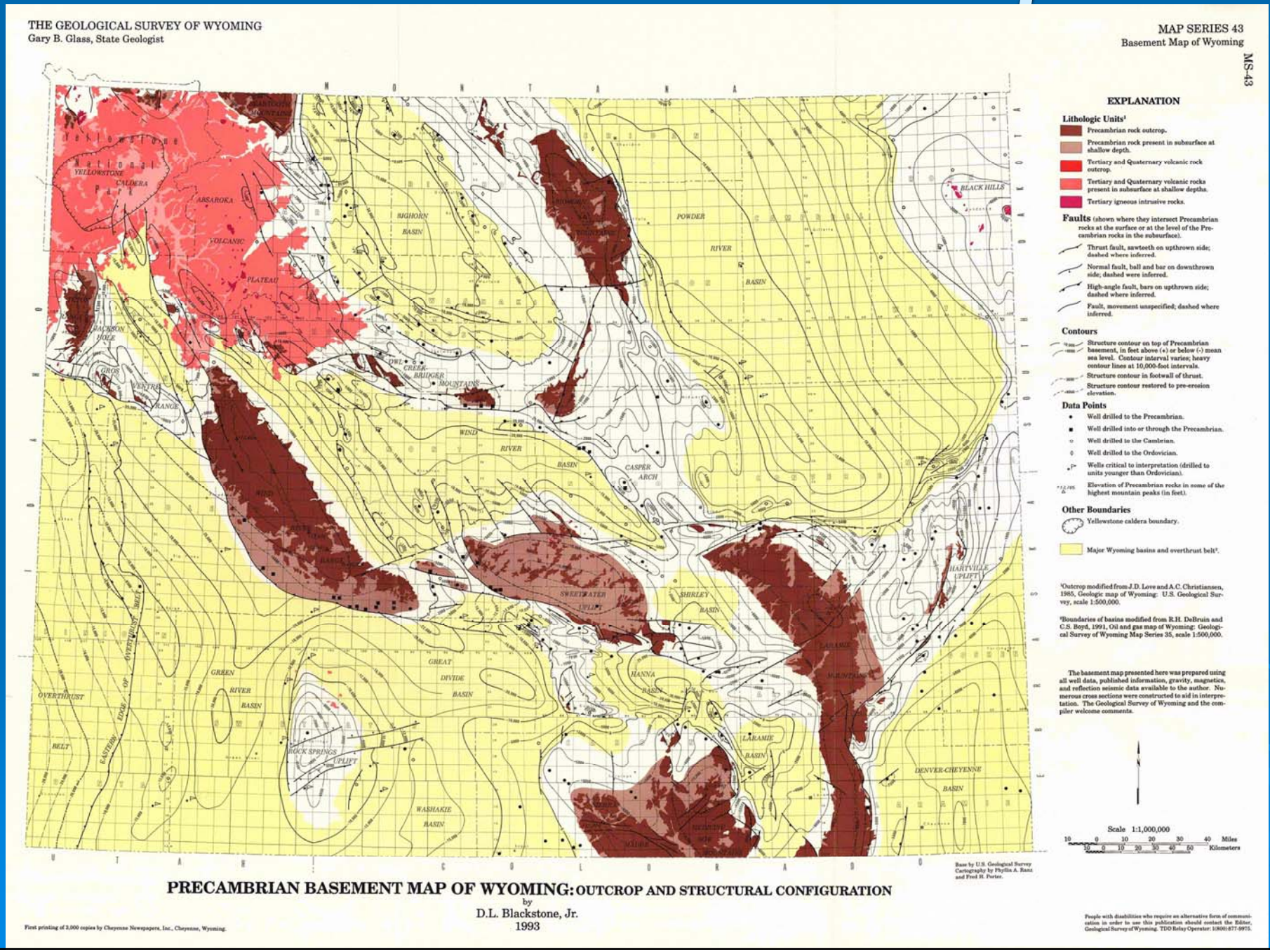
Projection: NAD 1983
UTM Zone 12N

Data Sources:

Stoeser, et al. (2005)

USGS National Elevation Dataset

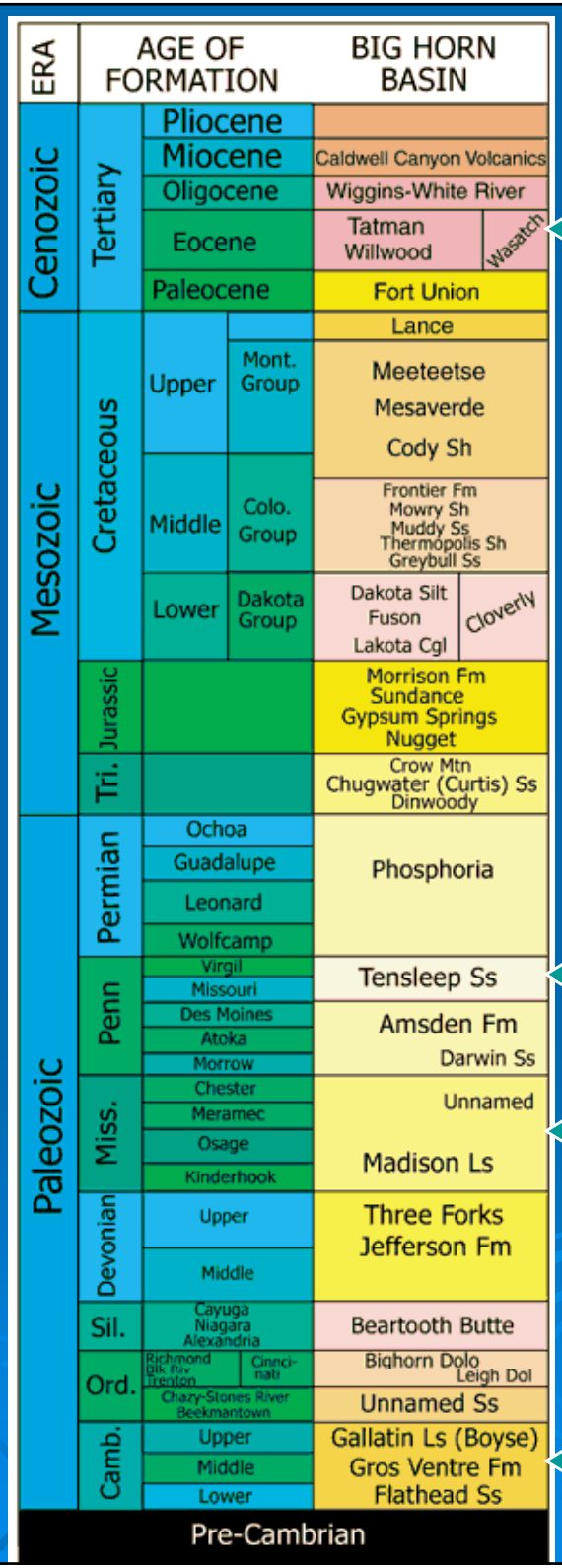
Precambrian Basement Map - WY



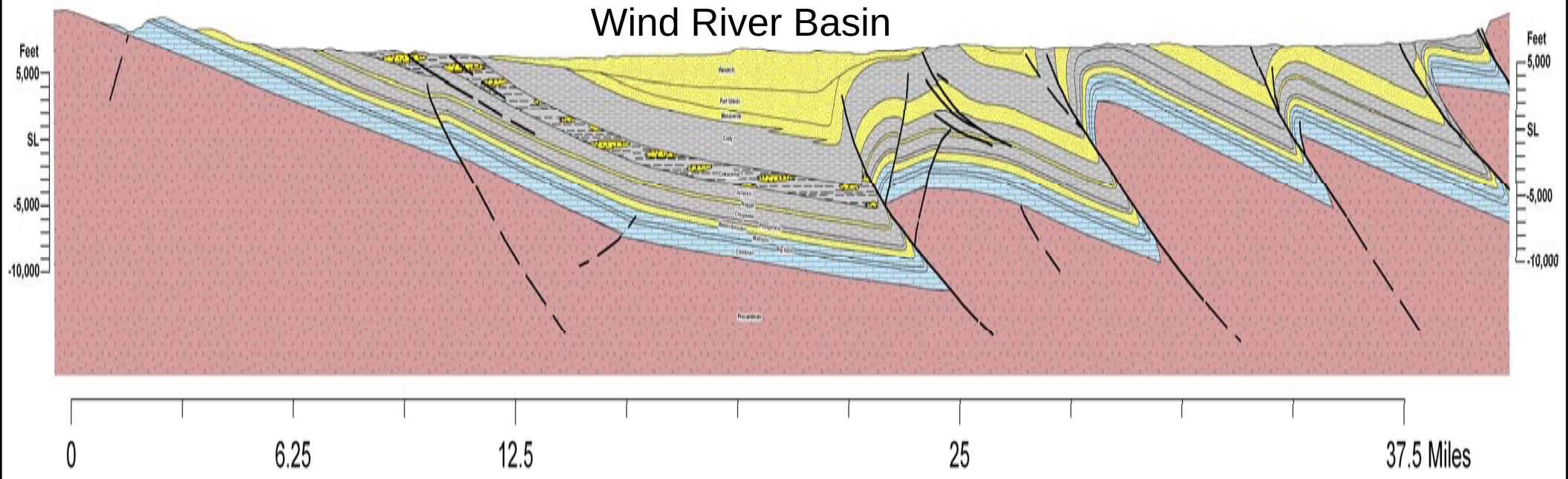
Wind/Bighorn Basin Stratigraphy

&

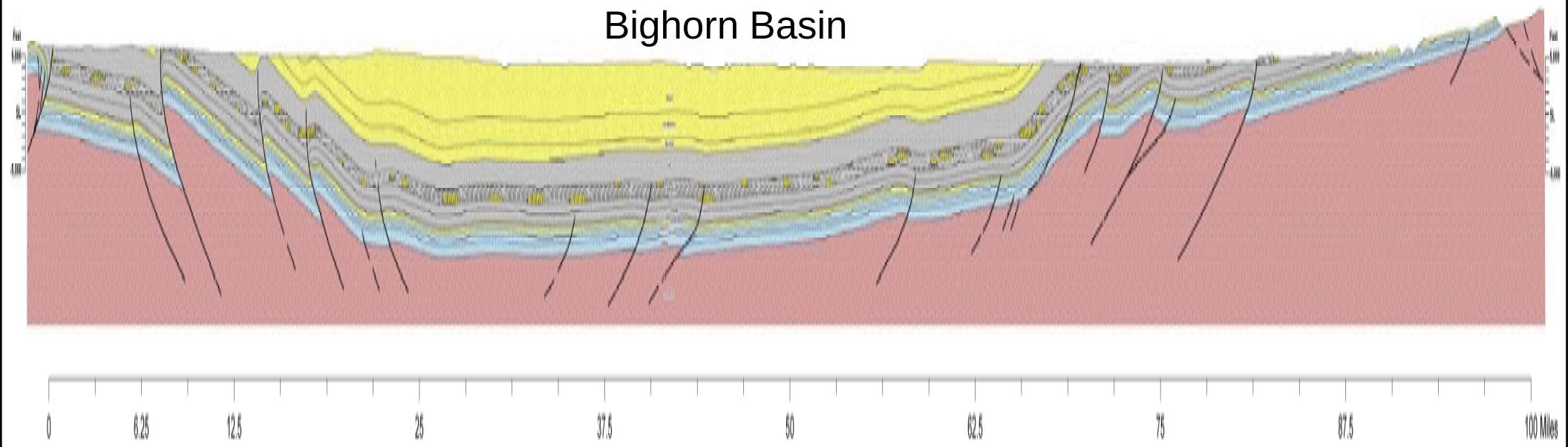
Identified Major and Minor Aquifers



Wind River Basin

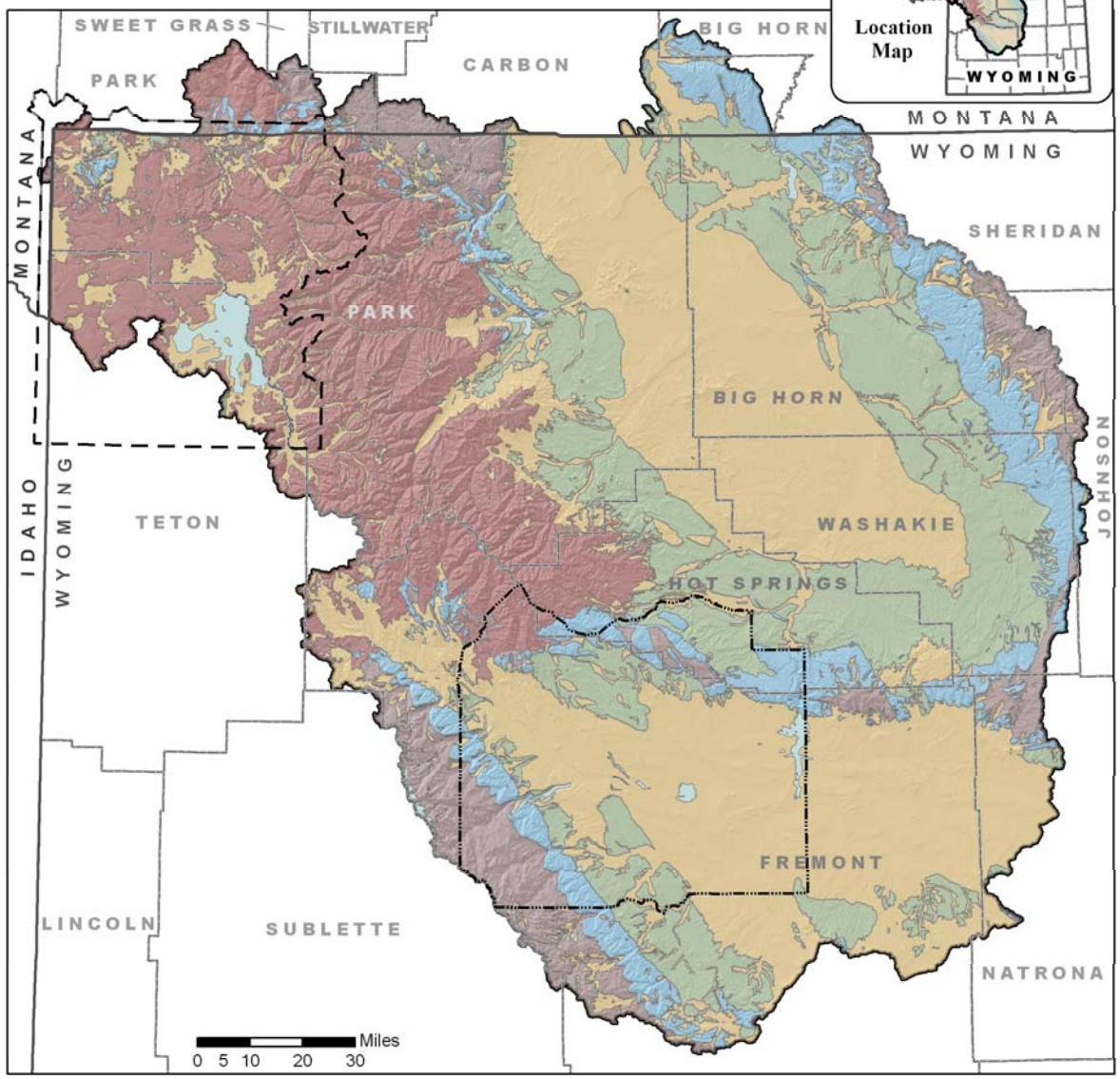


Bighorn Basin



From D.S. Stone 1987

Major Aquifer Groups, Wind/Bighorn River Basin



Explanation

- Yellowstone National Park Boundary
- Wind River Reservation Boundary
- Water and Ice
- Volcanic Rocks

Major Aquifer Groups

- Cenozoic
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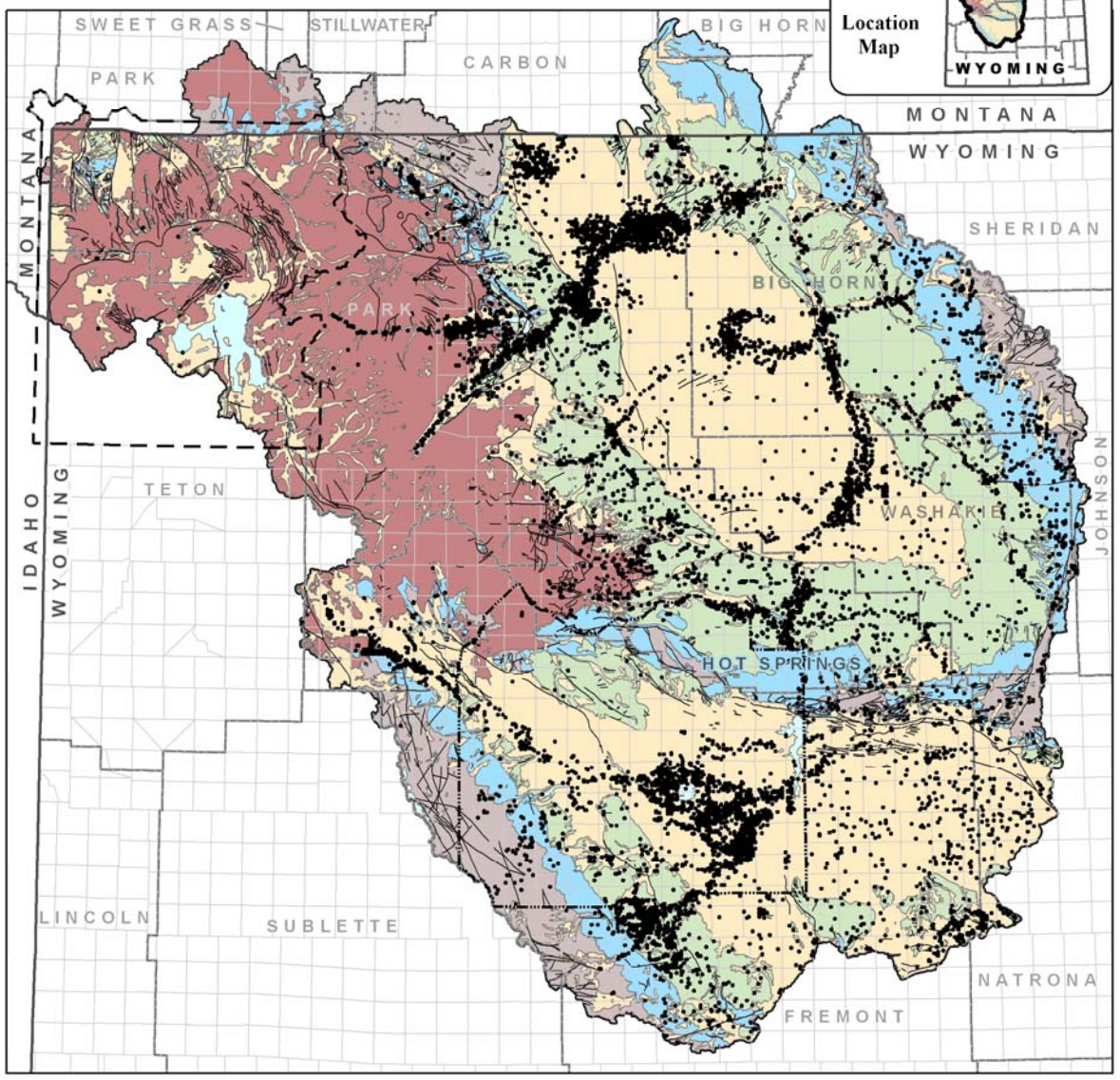
USGS National Elevation Dataset

Percentages of WBH Map Area

- **Cenozoic Aquifer System**
  - **42%**
- **Mesozoic Aquifer System**
  - **20%**
- **Paleozoic Aquifer System**
  - **10%**
- **Precambrian Aquifer System**
  - **7.3%**
- **Volcanic**
  - 19%

Wells in Wyoming Permitted by the Wyoming State Engineer's Office (WSEO), Wind/Bighorn River Basin



Explanation

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- WSEO Well
- Fault
- Yellowstone National Park Boundary
- Wind River Reservation Boundary
- Water and Ice
- Volcanic Rocks

Miles
0 5 10 20 30

Major Aquifer Groups

- Cenozoic
- Mesozoic
- Paleozoic
- Precambrian

WSGS 2009

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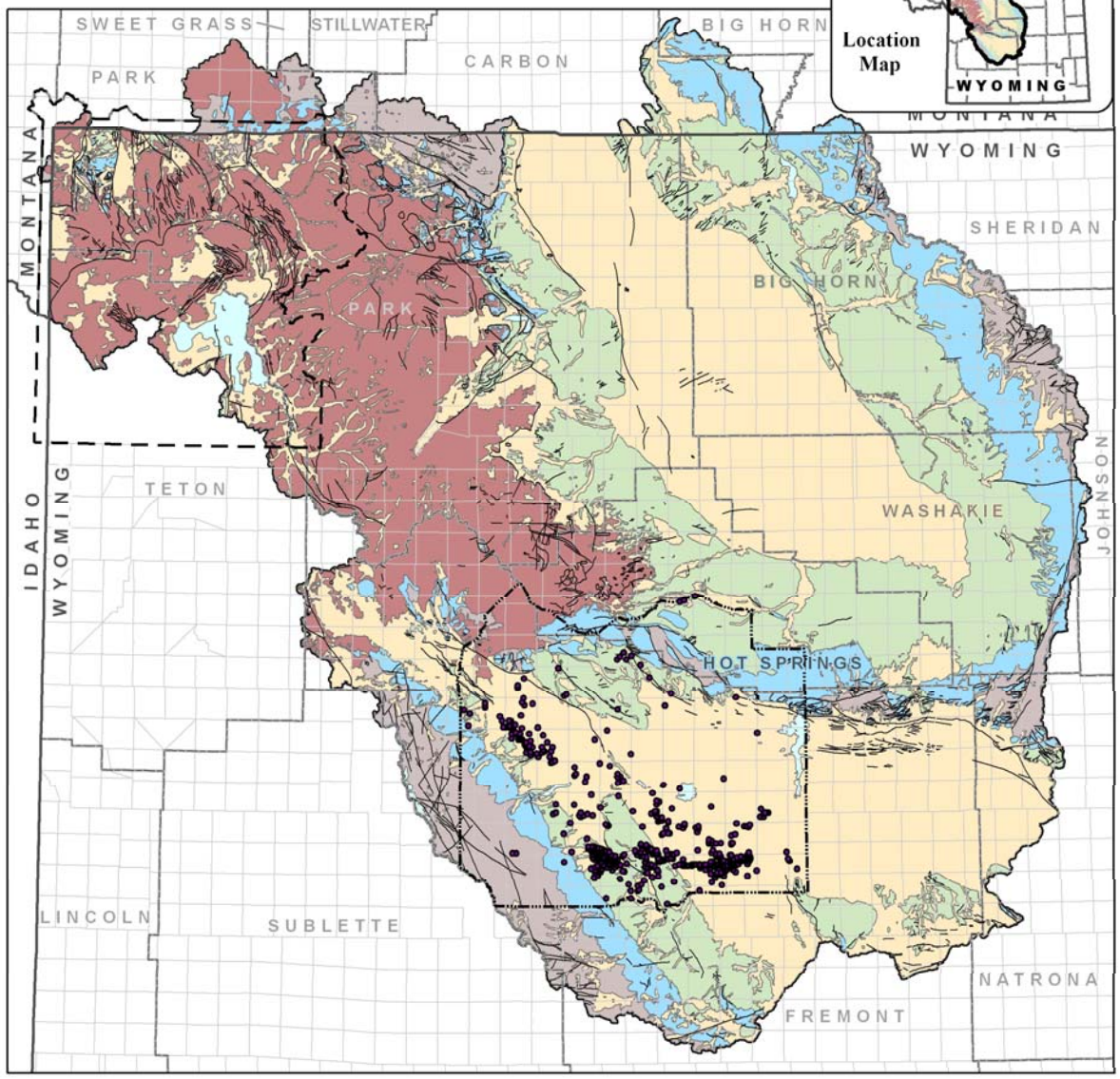
UTM Zone 12N

Data Sources:

Stoeser, et al. (2005)

Wyoming State Engineer's Office, Cheyenne, Wyoming

Tribal Wells
on the Wind River Indian Reservation, Wyoming



Explanation

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Miles
0 5 10 20 30

- Tribal Well
- Fault
- Yellowstone National Park Boundary
- Wind River Reservation Boundary
- Water and Ice
- Volcanic Rocks

Major Aquifer Groups

- Cenozoic
- Mesozoic
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- Precambrian

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Data Sources:

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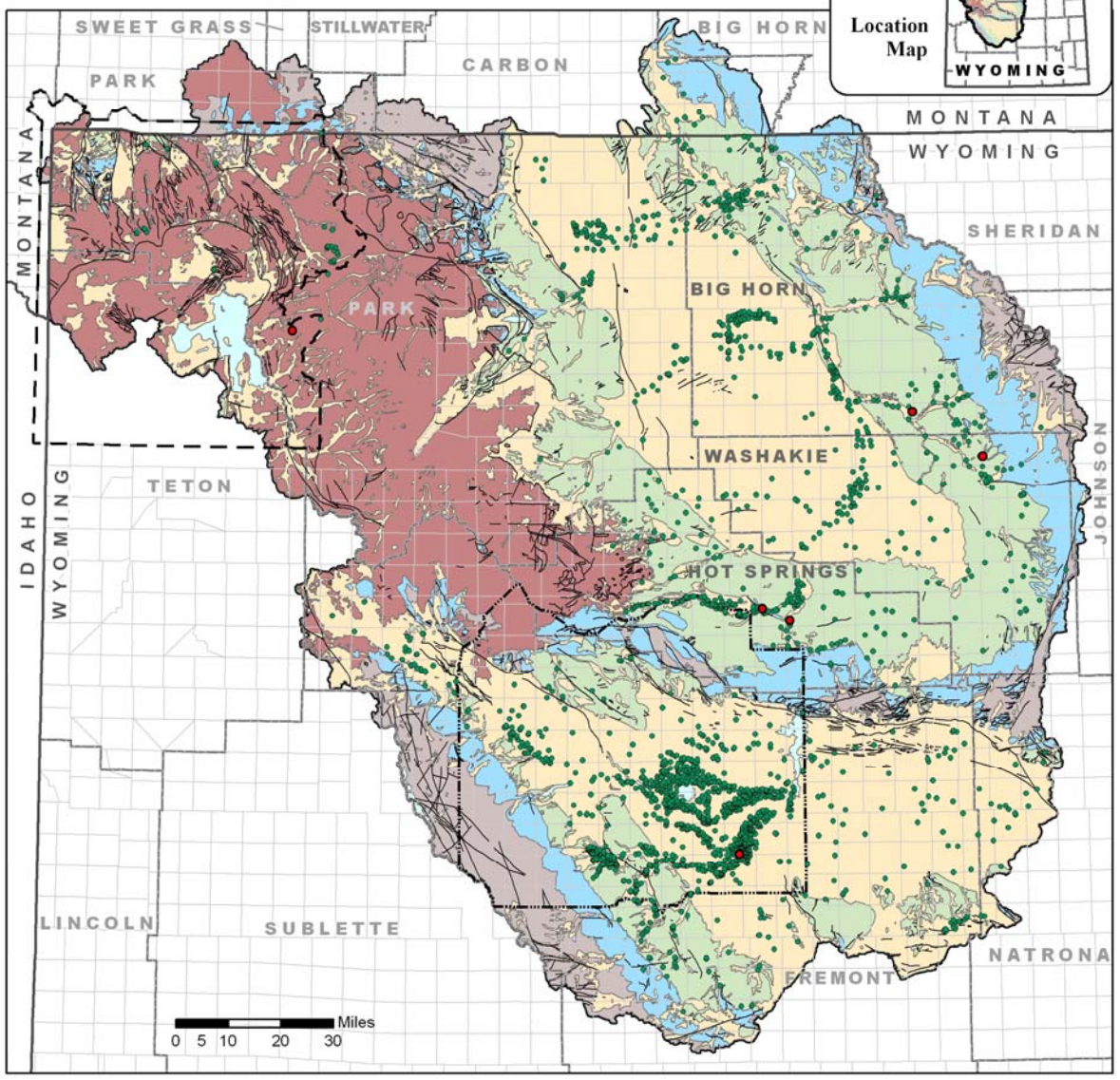
Wyoming State Engineer's Office, Cheyenne, Wyoming

U.S. Geological Survey
Groundwater Monitoring Locations,
Wind/Bighorn River Basin



Explanation

USGS Monitoring Locations

- Manually measured
- Mechanically measured

- Fault
- Yellowstone National Park Boundary
- Wind River Reservation Boundary
- Water and Ice
- Volcanic Rocks

Major Aquifer Groups

- Cenozoic
- Mesozoic
- Paleozoic
- Precambrian

WSGS 2009

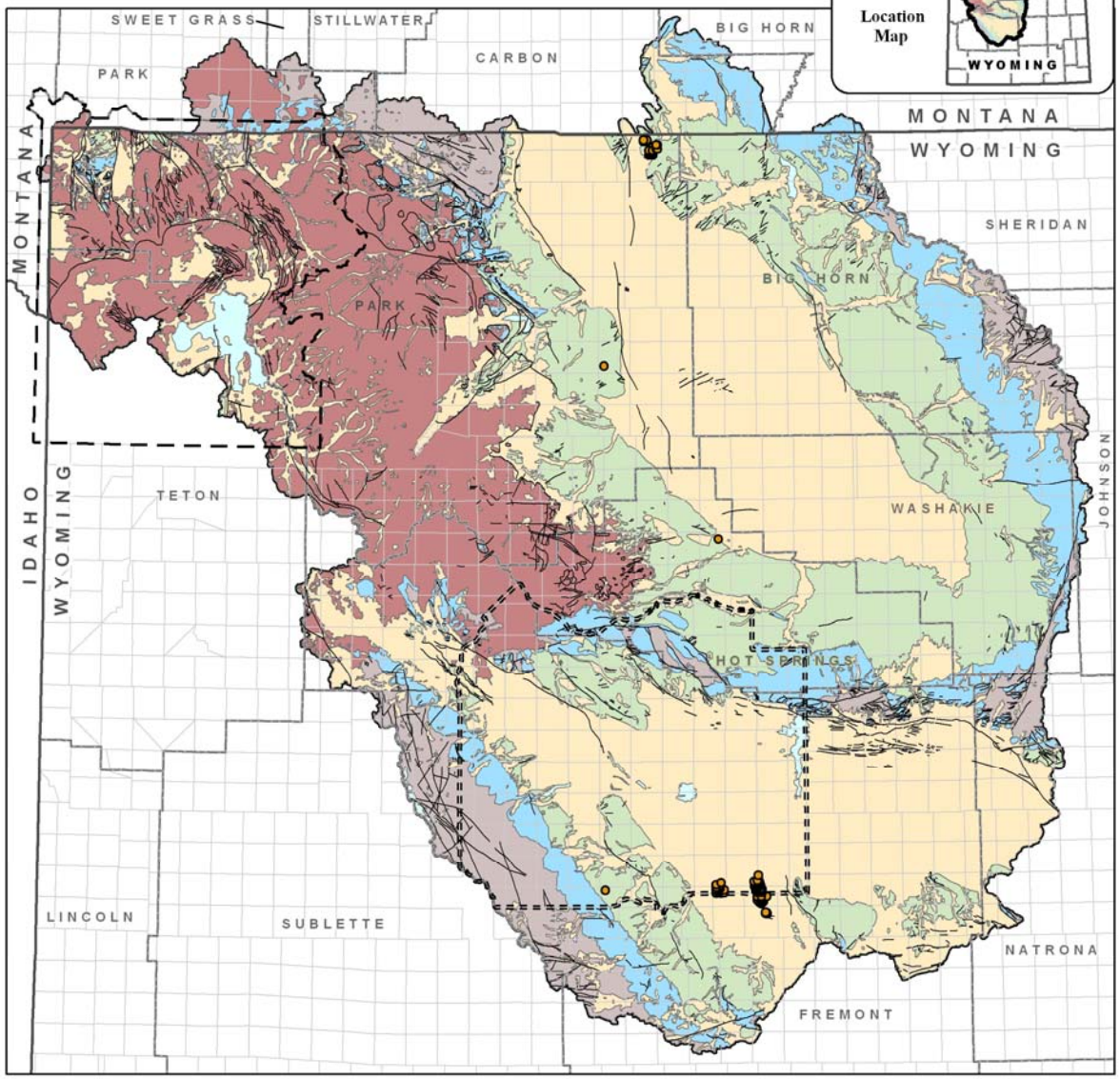
Projection: NAD 1983
UTM Zone 12N

Data Sources:

Stoeser., et al. (2005)

U. S. Geological Survey (USGS)
Water Data for the Nation
(http://waterdata.usgs.gov/nwis)

Permitted Coal Bed Natural Gas (CBNG) Wells in Wyoming, Wind/Bighorn River Basin



Explanation

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WOGCC Permitted CBNG Well

Fault

Yellowstone National Park Boundary

Wind River Reservation Boundary

Water and Ice

Volcanic Rocks

Major Aquifer Groups

Cenozoic

Mesozoic

Paleozoic

Precambrian

Miles
0 5 10 20 30

WSGS 2008

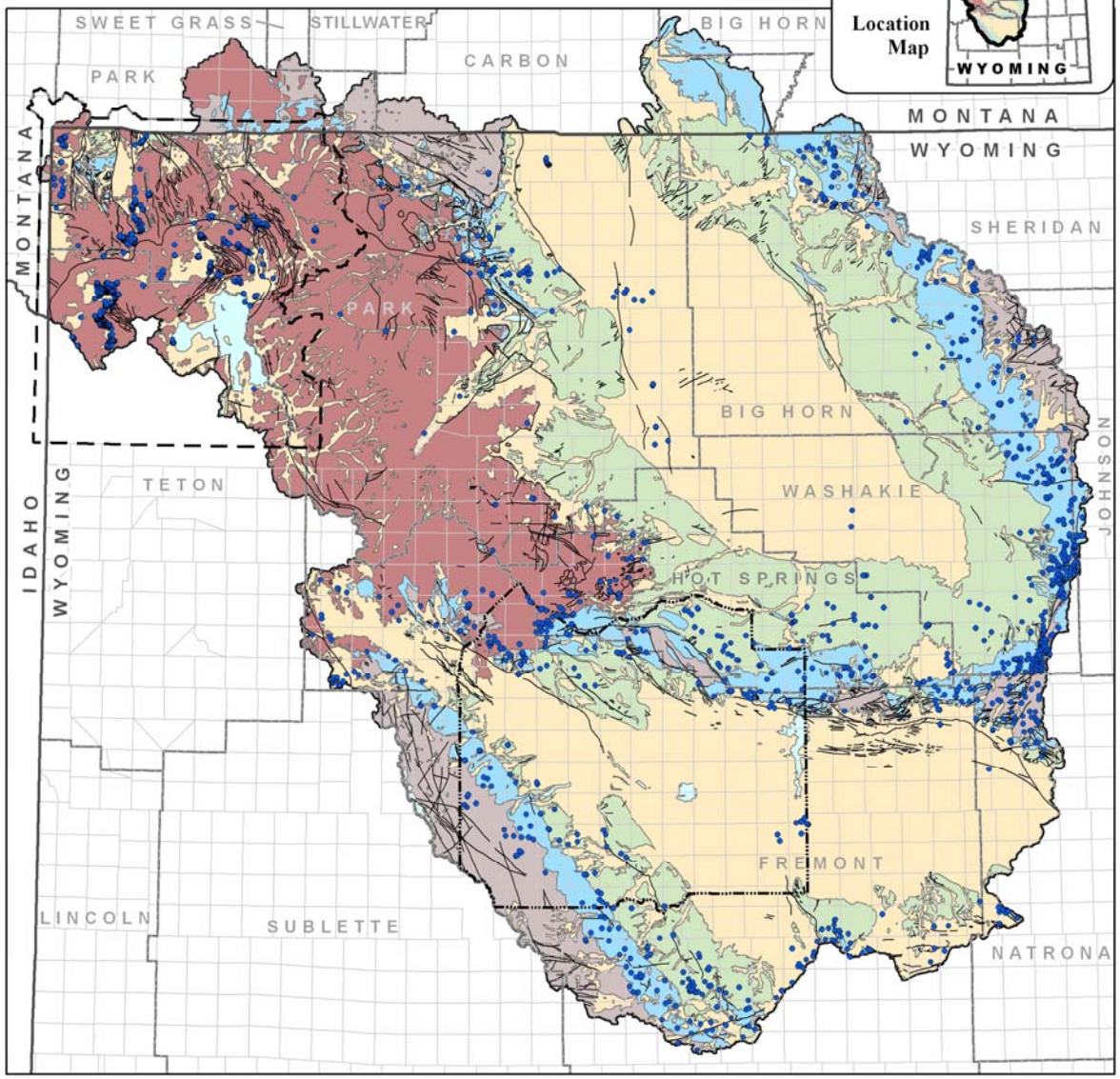
Projection: NAD 1983
UTM Zone 12N

Data Sources:

Stoeser, et al. (2005)

Wyoming Oil and Gas Conservation Commission (WOGCC), Casper, Wyoming

U.S. Geological Survey Mapped Springs in Wyoming, Wind/Bighorn River Basin



Explanation

N
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Miles
0 5 10 20 30

- Spring
- Fault
- Yellowstone National Park Boundary
- Wind River Reservation Boundary
- Water and Ice
- Volcanic Rocks

Major Aquifer Groups

- Cenozoic
- Mesozoic
- Paleozoic
- Precambrian

WSGS 2009

Projection: NAD 1983
UTM Zone 12N

Data Sources:

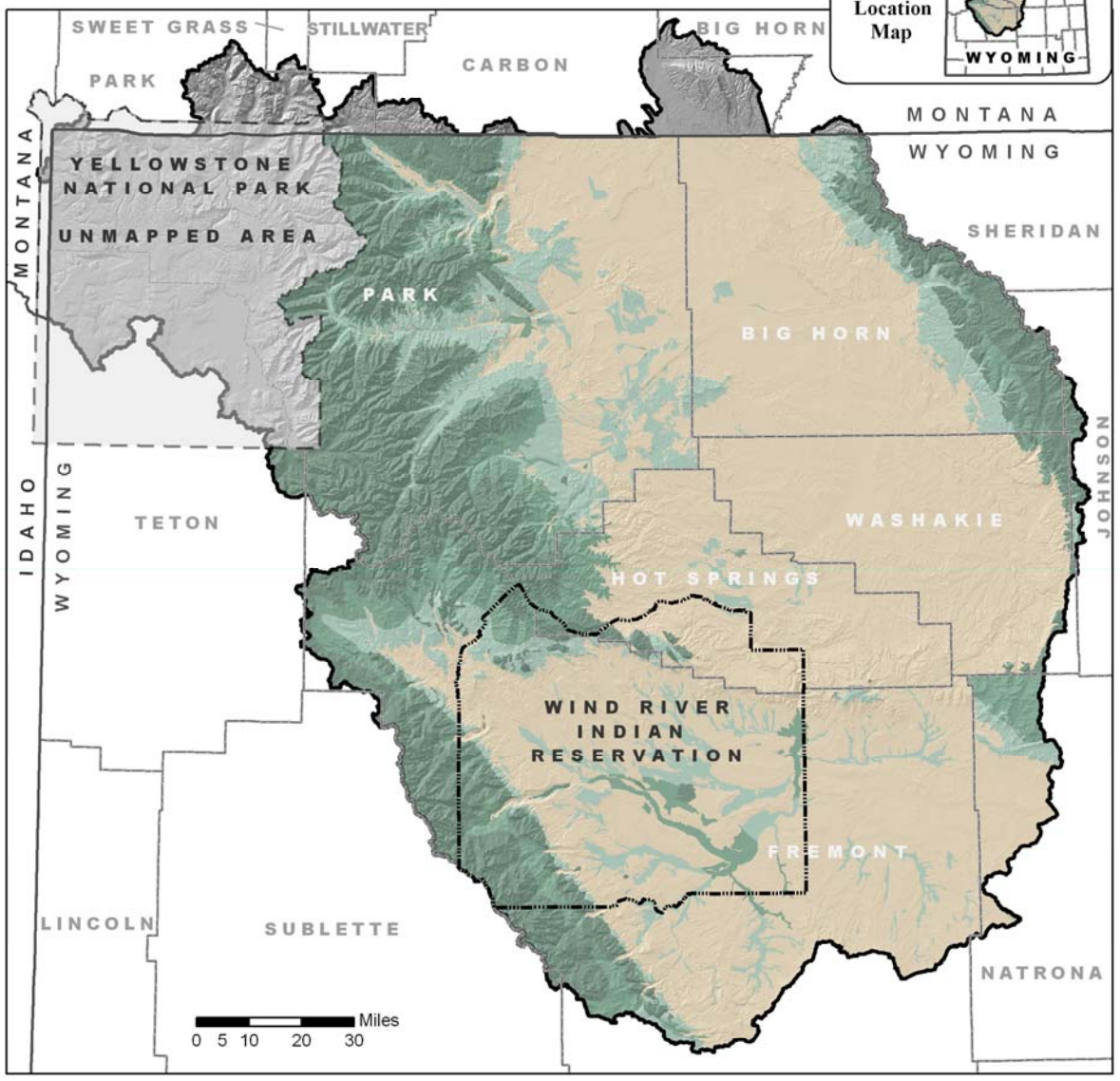
Stafford and Gracias (2008)

Stoeser, et al. (2005)

Aquifer Recharge & Discharge

- **Recharge to Aquifers**
  - Infiltration from precipitation & snowmelt
  - Seepage from streams, ponds, lakes, reservoirs, & rivers
  - Infiltration of irrigation water
- **Discharge from Aquifers**
  - Evapotranspiration
  - Discharge from springs
  - Discharge to streams & rivers
  - Subsurface leakage from an aquifer to adjacent aquifers
  - Pumpage from water & coal bed natural gas (CBNG) wells
- **Estimates of Recharge & Discharge Rates**

Estimated Aquifer Recharge in Wyoming, Wind/Bighorn River Basin



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Estimated Average Annual Aquifer Recharge (inches / year)

< 1 | 1 - 4 | 5 - 7 | 9 - 12

WSGS 2009

Projection: NAD 1983
UTM Zone 12N

Data Sources:

Hamerlinck and Arneson, Eds. (1998)

USGS National Elevation Dataset

Aquifer Storage

- Very little is known about water storage quantities in WBH aquifers.
- Estimates of groundwater storage and availability are being prepared based on a set of assumptions from aquifer properties.
- Estimates of storage quantities will incorporate volume calculations based on areal extent and thickness of the aquifers in the WBH.

Summary

- The WSGS-USGS-WRDS team is progressing with the groundwater study for the updated Wind/Big Horn Basin study.
- Aquifers in the WBH are being inventoried and characterized from the available data.

Thank you, Questions?

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