Montana State-Wide Groundwater Monitoring Network

Outline
• Aquifers & Wells
• Monitor Network
• 2017 Flash Drought
• 1 in 30 wells dry?

Assessing Drought Impacts and Ground Truthing Big Data

John LaFave
Montana Bureau of Mines and Geology
Montana AWRA Oct. 19, 2018
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Aquifers and wells
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Network Summary

Principal Aquifer
- QT - ALVM/ Basin-fill: 572
- Fort Union: 92
- Fox Hills-Hell Creek: 46
- Judith River: 37
- Eagle: 31
- Kootenai: 20
- Madison: 16
- Fractured Rock (T-PreC): 79
- Other: 25

Cooperators
- Gallatin LWQD
- Lewis & Clark WQPD
- Missoula Valley WQD
- CSKT
- Sheridan Co.
Drought Impacts

Period of below normal moisture – that can propagate through natural (and engineered) systems

- Meteorological Drought
  - decreased precipitation (increased temp)
- Hydrologic Drought
  - decreased stream flow and surface storage
- Terrestrial Drought
  - decreased soil moisture (agricultural drought)
- Groundwater Drought
  - reduced storage (↓recharge ↑withdrawals)
  - reduced fluxes to other systems (streams and springs)

Groundwater: lagging & buffer
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Drought Impacts

News & Features

‘Flash Drought’ Spreads Across Montana in Less Than 3 Months

More than a third of the entire state is now in severe, extreme or exceptional drought

Montana drought ‘worst we’ve seen in 100 years’

Drought Classification

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
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Drought Impacts

April 2017

Montana - Mean Temperature
April 2017 Departure from 1981-2010 Normal

June 2017 Departure from 1981-2010 Normal

Montana - Precipitation
April 2017 Percent of 1981-2010 Normal

July 2017

Montana - Mean Temperature
July 2017 Departure from 1981-2010 Normal

Montana - Precipitation
July 2017 Percent of 1981-2010 Normal

West/Wide Drought Tracker, U Idaho/WRCC Data Source: PRISM (Final), created 16 AUG 2017
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Drought Impacts

Montana drought drives cattle to market early

Lodgepole Complex fires grow to 250,000 acres; containment now at 20%

August 29, 2017

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Quaternary–Tertiary Alluvium groundwater levels

Extreme/Exceptional Drought
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Fort Union groundwater levels

Extreme/Exceptional Drought
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Fox Hills-Hell Creek groundwater levels

Extreme/Exceptional Drought
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Judith River groundwater levels

Extreme/Exceptional Drought

Groundwater Information Center Well Hydrograph

The following chart represents the current hydrograph for this well. Data reported are static water levels in feet below ground surface. A filter has been applied to the data to remove all dry and non-static measurements.

Static Water Level

Date

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NRCS Well Location Requests Aug & Oct 2017

Extreme/Exceptional Drought

- Well request location

NRCS Well Requests

210 requests
Aug & Oct 2017

Avg 8 per mo.
Ground Truthing Big Data

Main findings: ... 1-in-30 wells constructed between 1950-2015 were likely dry during 2013—2015

Unsustainable groundwater pumping... is depleting many western US aquifers

One in 30 wells in the West failed in recent years

New research shows just how many wells ran dry between 2013 and 2015.

Emily Benson | NEWS | Oct. 13, 2017
Main findings: ... 1-in-30 wells constructed between 1950-2015 were likely dry during 2013—2015”
Numerous regions in the western US show a high prevalence of dry wells

“water table declines are drying up groundwater wells”

Source: Perrone and Jasechko (2017)
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Ground Truthing Big Data

2013-15

Percent of groundwater wells with pressure head of less than zero (water table below well bottom)
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• Groundwater monitoring critical for understanding:

  o Drought Impacts on Groundwater
    o 2017 Flash drought did not propagate to GW system
  o “Ground Truth” Big and Remote Sensing Data
    o 1 in 30 wells did not go dry during 2013-15

John LaFave
Montana Bureau of Mines and Geology
Ground Water Assessment Program
jlafave@mtech.edu
(406) 496-4306
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Montana Principal Aquifers - west

[Map showing the Montana Principal Aquifers with groundwater flow direction indicated.]
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Montana Principal Aquifers - east

- Eocene
- Paleocene
- Cretaceous
- Jurassic
- Triassic
- Permian
- Pennsylvanian
- Mississippian
- Devonian
- Ordovician
- Cambrian

Aquifers:
- Ft. Union
- Hell Ck
- Fox Hills
- Judith Rv
- Eagle SS
- Kootenai
- Madison