

Part 2: Priority Groundwater Data and Research Needs— KGS Perspective



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KGS Role in Groundwater Monitoring and Studies

Mission:

- We are a Research and Public Service Unit within UK.
- KGS Mission is to Characterize and Provide Information about Ky's Geological, Mineral, Energy, and Water Resources.
- No Regulatory Responsibilities or Functions.

Legislative Mandates:

- KRS 151.035 “Official Repository for Groundwater Information.
- KRS 151.625 “Establishment of Long-Term Groundwater Monitoring Network”.
- KRS 151.113 Kentucky Water Resources Board (source of “technical assistance”).

All Groundwater Data Collected In Kentucky is Stored and Accessed By the Groundwater Data Repository (GWDR).

- Initiated in 1990 by legislative mandate (KRS 151:035) and maintained by KGS.
- Currently:
 - Over 92,000 water well records.
 - Approximately 5,100 spring records.
 - About 60,000 groundwater-quality analyses.
- Over 15 contributing agencies, including KDOW, USGS, and EPA Storet.
- Largest single source of data: Kentucky certified water-well driller records from KDOW.

<http://kgs.uky.edu/kgsweb/DataSearching/watersearch.asp>

The screenshot shows the 'Data Searching' page on the Kentucky Geological Survey website. The header includes the KGS logo and navigation links. The main content area is titled 'Groundwater Information Via The Kentucky Groundwater Data Repository' and contains a search form with tabs for 'Water Wells & Springs', 'Groundwater Quality', and 'Other Water Information'. Under the 'Water Wells & Springs' tab, there are two sections: 'Search for Water Well & Spring Records' and 'Water Well & Spring Location Map'.

<http://www.uky.edu/KGS/water/index.htm>

The screenshot shows the 'Water' page on the Kentucky Geological Survey website. The header includes the KGS logo and navigation links. The main content area is titled 'Water' and contains a list of links: 'Water Information', 'Water Data', 'Water Research', and 'Search Online Water Databases'. There are also several images showing water-related activities and a large image of a sinkhole.

Priority Groundwater Data and Research Needs

- **Statewide Long-term Groundwater Observation Network.**
- **Aquifer Delineation and Mapping.**
- **More Quantitative Data on Aquifer Yield and Hydraulic Properties.**
- **Development of Improved Groundwater Management Tools.**

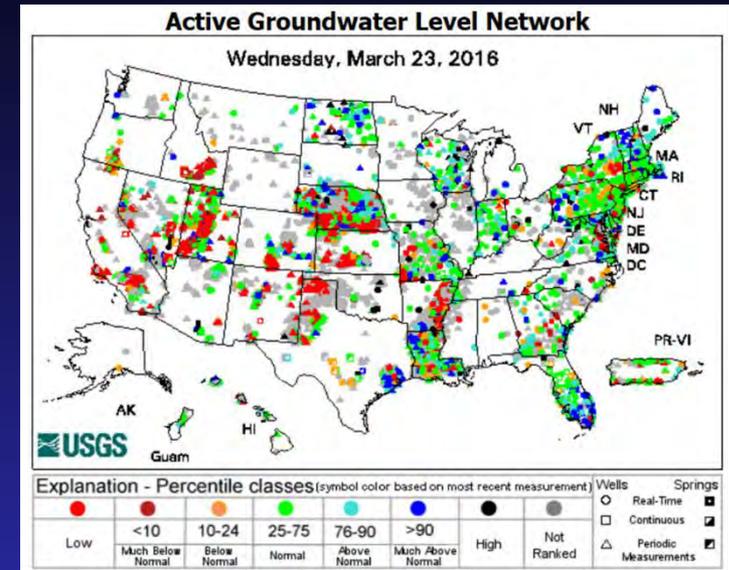
Priority Groundwater Data and Research Needs

Statewide Long-term Groundwater Observation Network

- Continuous monitoring of water levels in a suitable network of observations wells is needed to build a database capable of identifying and tracking trends in groundwater levels and assessing changes in groundwater recharge, storage, and discharge (withdrawals).
- Calculations of meaningful statistical parameters such as mean, maximum, and minimum groundwater levels will require at least 5 years of data.

Need for a Ky Groundwater-Level Observation Network

- Previously a statewide network of up to 64 wells was operated jointly by USGS and KGS from the mid-1950s to the early-1990s.
- Continual decreases in Federal and state funding steadily eroded the network over the years, eventually leaving only one well being continuously monitored in Kentucky by USGS as part of a national groundwater network.
- In recent decades, comparatively more effort has been given to the collection of groundwater-quality data, largely driven by the needs of state and federal regulators.
- Information about current groundwater conditions is unavailable in most parts of the state, and it is not uncommon for available water-level data to be 25 years or more out-of-date.



Source: <http://groundwaterwatch.usgs.gov/>



In 2015 KGS Started Work Rebuilding A Statewide Kentucky Groundwater Observation Network (KGON)

- Helps meet critical need for continuously updated groundwater-level data and re-establishment of a statewide long-term groundwater monitoring network.
- Helps fulfill KGS legislative mandate to establish a network “...for the purpose of characterizing the quality, quantity, and distribution of Kentucky’s groundwater resources.”
- “...in areas of demonstrated need.”
- Wells serve as fixed monitoring sites representative of specific aquifers or aquifer types (e.g. karst, fractured sedimentary rock, etc.).
- “...support research efforts that develop models for groundwater systems...”, and “...to determine and monitor trends...”.

Capitalization

- KGS: App. \$75K one-time internal funding contributed to establish initial network of up to 15 observation wells in critical areas and cover 12 mo. operations costs (implementation during 2015-16).
- Annual O&M costs (app. \$30K) are presently anticipated to be covered by KGS for first 3 years; unanticipated cost increases, funding cuts, or resource re-allocation decisions could potentially affect this.
- Long-term maintenance, expansion or enhancement of network and data-collection activities, will require additional outside funding and partnerships.

Equipment Installation At the Network's 1st Observation Well

Monitoring a fractured-karstic limestone aquifer at Kentucky Horse Park, Scott Co.

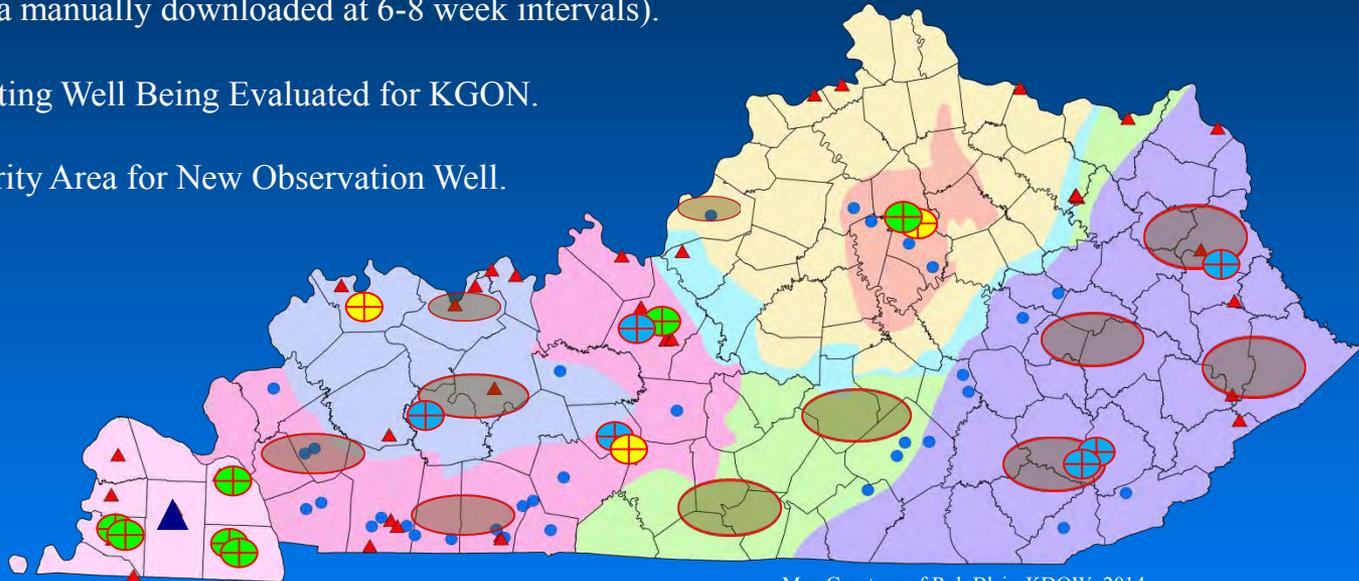
Clockwise from upper left:

1. Preparation of anchor point (datum) for pressure transducer.
2. Measuring out transducer data cable length.
3. Inserting transducer and cable into well.
4. Final field check of transducer and telemetry equipment.



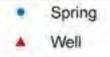
Status of KGS KY Observation Well Network (KGON) Sites As Of August 10, 2016

-  Continuously-Monitored Observation Well
(Data downloaded daily).
-  Continuously-Monitored Observation Well
(Data manually downloaded at 6-8 week intervals).
-  Existing Well Being Evaluated for KGON.
-  Priority Area for New Observation Well.



Map Courtesy of Rob Blair, KDOW, 2014

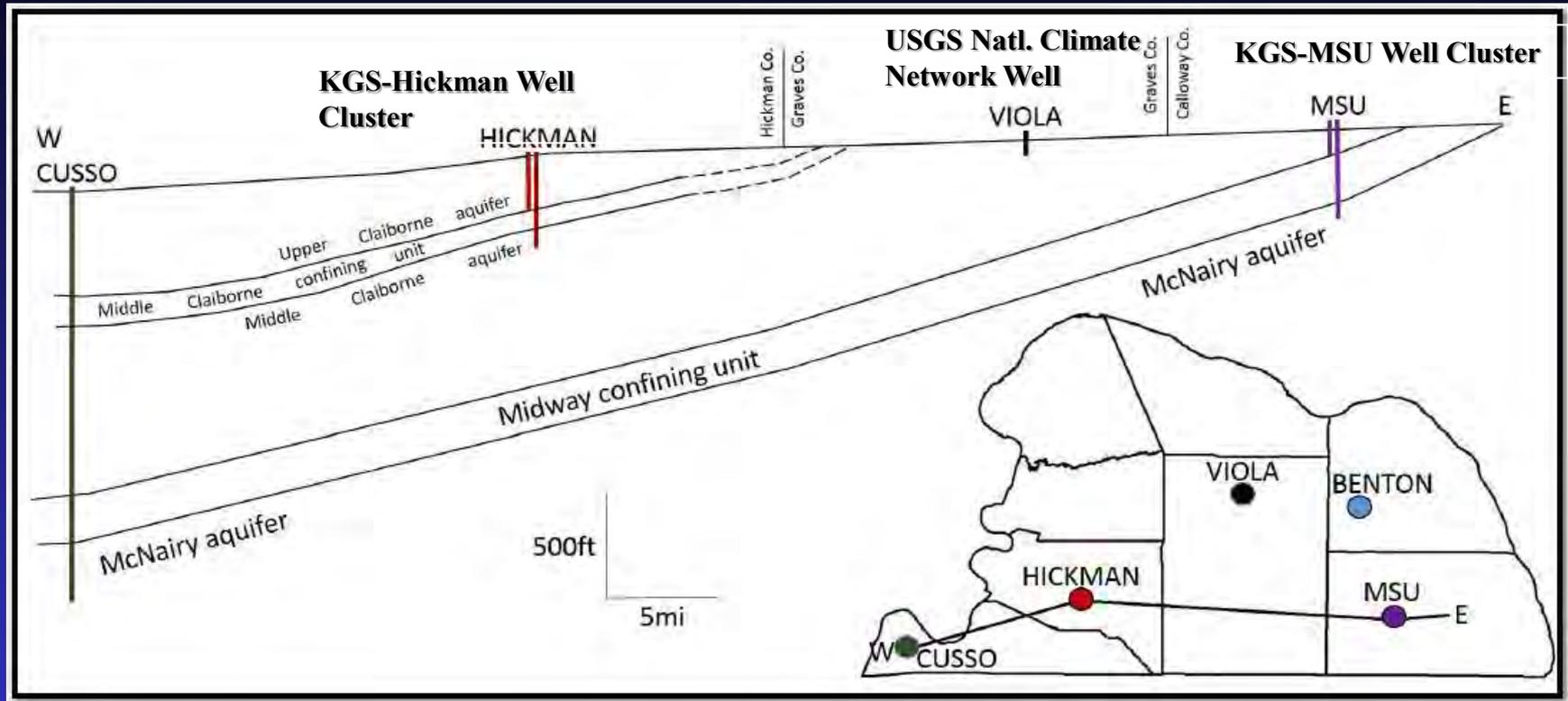
Groundwater Monitoring Sites
Maintained By Other Agencies:

-  Spring
-  Well
-  USGS National Climate-Response Network Well

KDOW-ITAC Periodic Groundwater-Quality Sampling Sites

USGS National Climate-Response Network Well

KGS Groundwater Monitoring Work in JPA



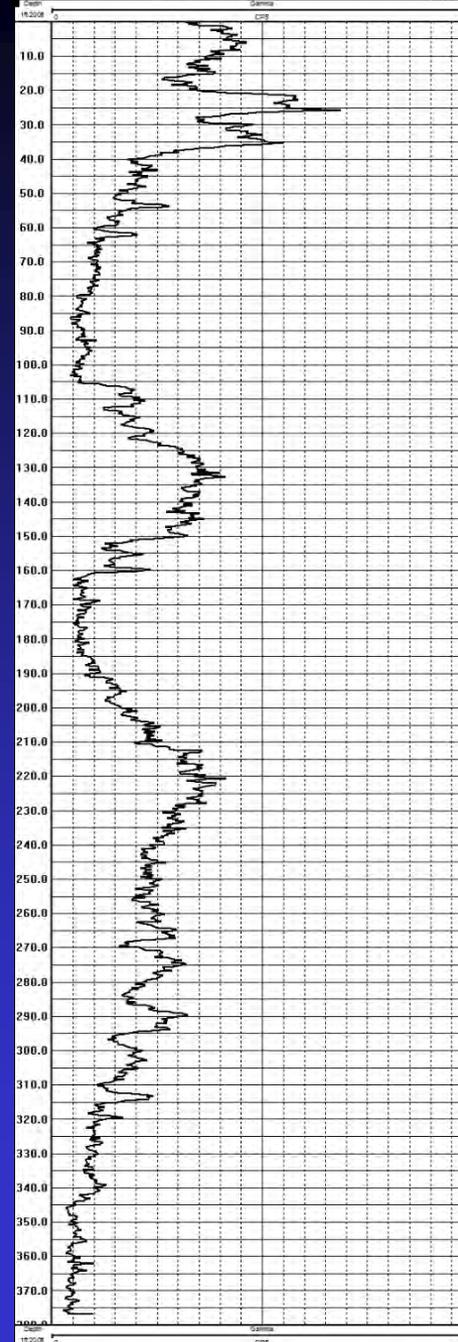
- ✓ **KGS Drilled and Instrumented Two New Observation Well Clusters, and established a Third Observation Well at Benton.**
- ✓ **Collecting Natural Gamma Logs, and other Geophysical Data, to Improve Identification of Subsurface Aquifer Boundaries and Confining Units.**
- ✓ **Collected Additional GWL Measurements and Water Well Data, and Conducted Specific Capacity Tests of Irrigation Wells at Clarks River Wildlife Refuge near Benton.**

KGS Hickman Co. Observation Well Cluster

near Clinton, KY



Hickman Co. #1 Gamma-ray log



Lithology	Hydrogeologic unit
Silt/clay	Soil/loess
Clay	Unnamed unit
Sand	Upper Claiborne aquifer
Clay	
Sand	Middle Claiborne confining unit
Clay	
Sand	Middle Claiborne aquifer

SWL/TD:

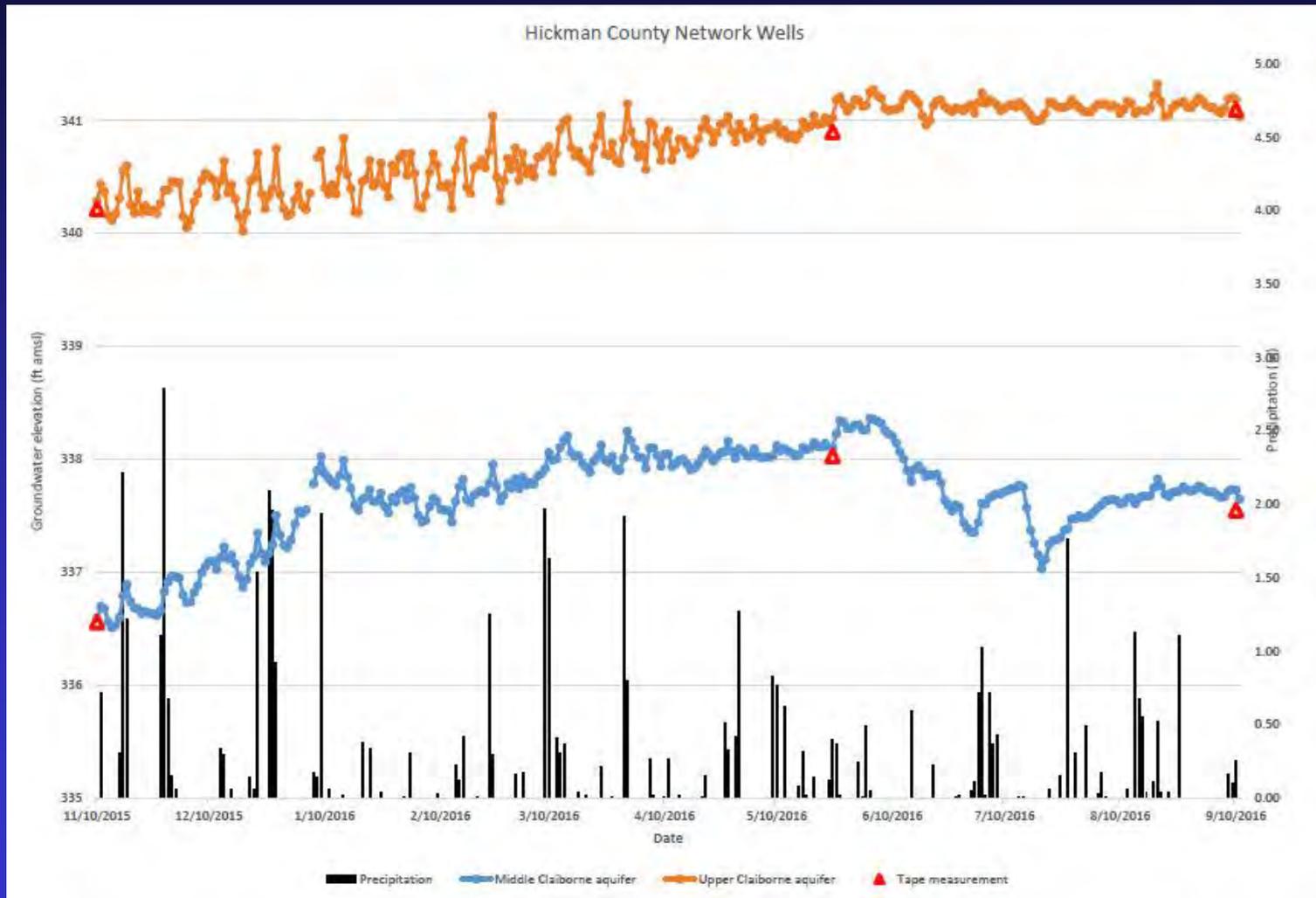
HICKMAN #2 81/180 FBLS

HICKMAN #1 84/380 FBLS

Location of the Hickman Observation Cluster Relative to Some High-Yield Water Wells



Preliminary JPA Hickman Well Cluster Hydrograph Data



KGS MSU Observation Well Cluster

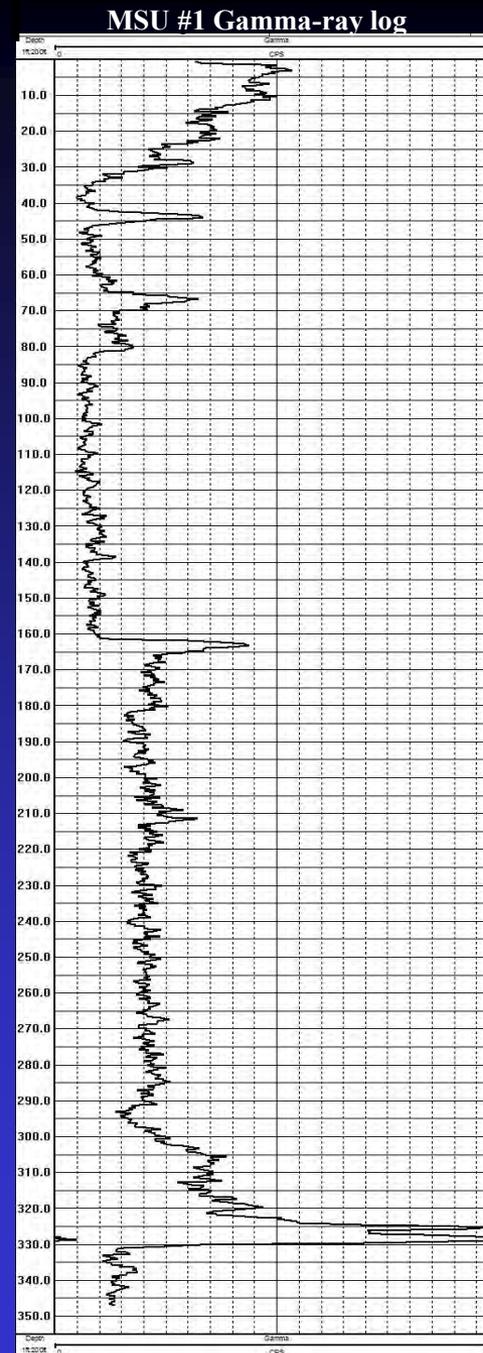
at Murray, Calloway Co., KY



SWL/TD

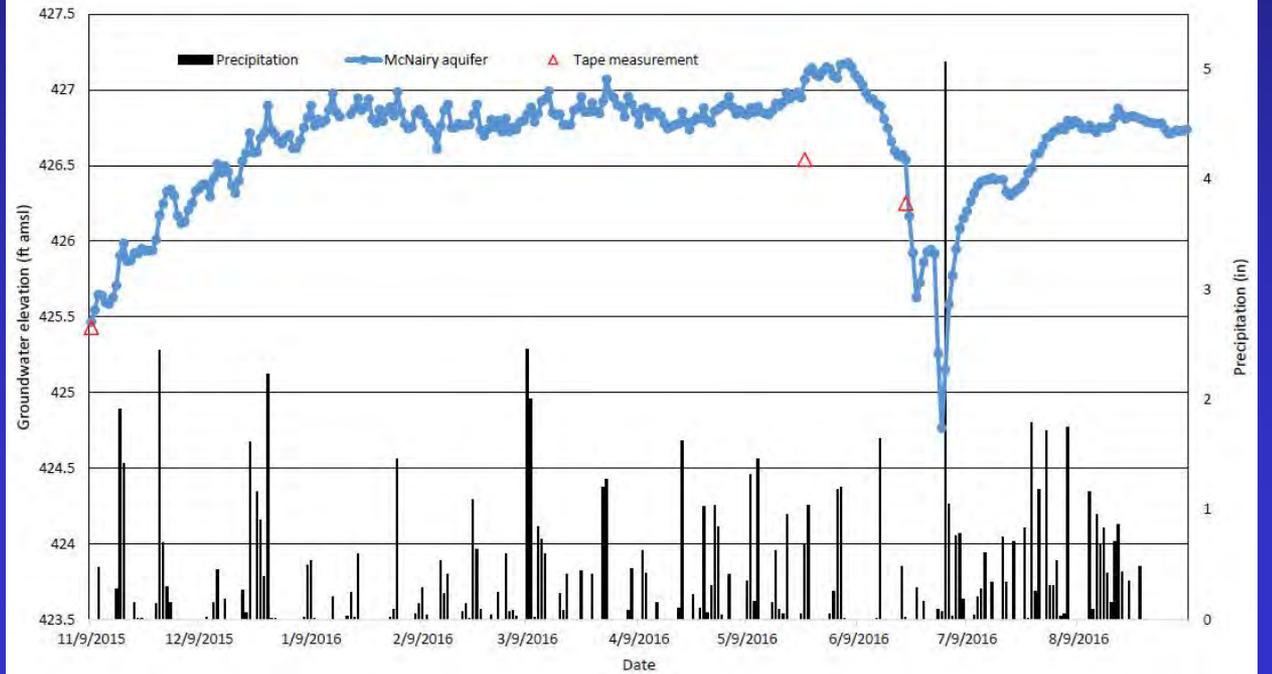
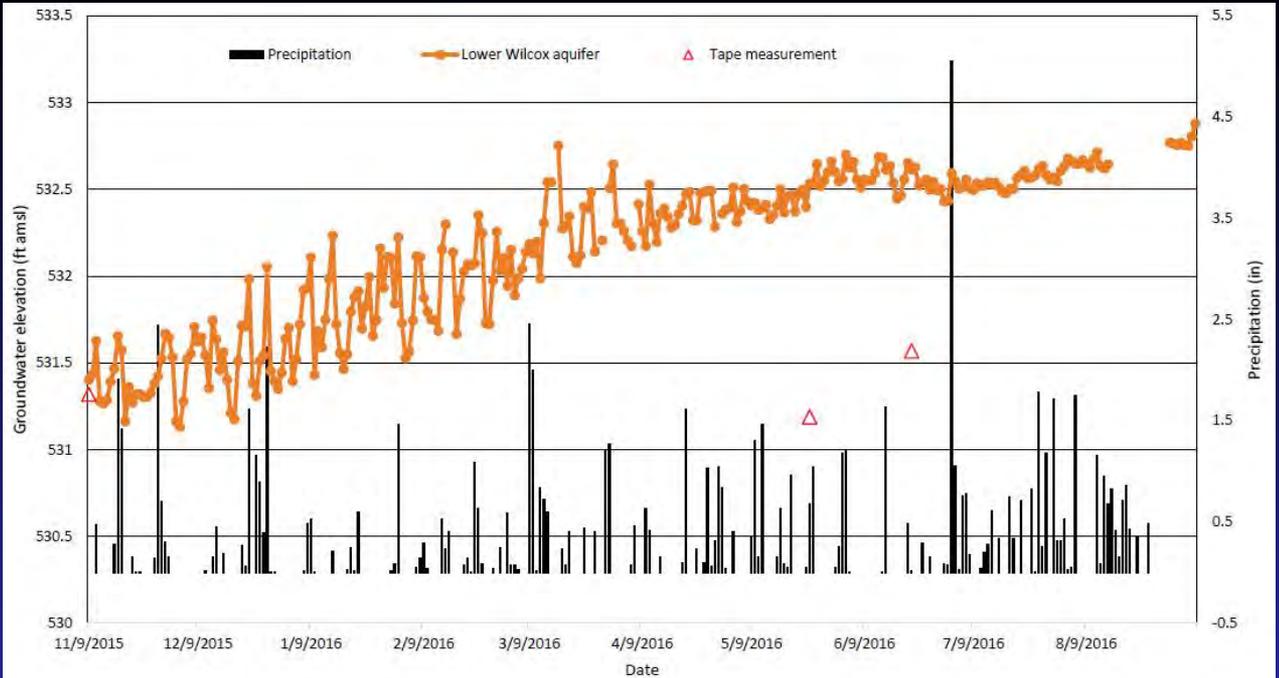
MSU #2 45/150 FBLS

MSU #1 150/350 FBLS

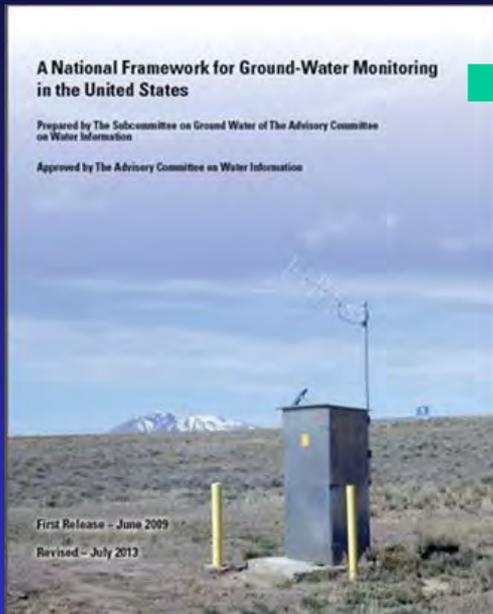


Lithology	Hydrogeologic unit
Silt/clay	Soil/loess
Clay	Unnamed units
Gravel	
Sand	Lower Wilcox aquifer
Clay	Midway confining unit
Sand	McNairy aquifer

Preliminary JPA Murray Well Cluster Hydrograph Data



KGS Using Nationally Recommended Approach to Build a Synergistic Program for Groundwater Monitoring & Assessment



Groundwater Monitoring Network (Groundwater Level and Quality Data)

Surveillance (Synoptic) Sites

For single or periodic measurement of water levels and groundwater quality at many locations (Snapshot-in-Time) data to complement Trend Sites data.

Special Studies

Targeted groundwater investigations conducted to better map and quantify aquifer properties.

Trend Sites (Continuous sites)

For continuous tracking of temporal changes (short and long term) at specially targeted locations. Subnetworks recommended for unstressed and impacted aquifers.

Baseline Monitoring Period of 5 years minimum recommended

Contributors: KDOW, USGS, other UK Departments (Earth and Environmental Sciences, Agriculture) and Ky Colleges

Additional Data Collection Activities Being Conducted by KGS to Support the KY Groundwater Observation Network:

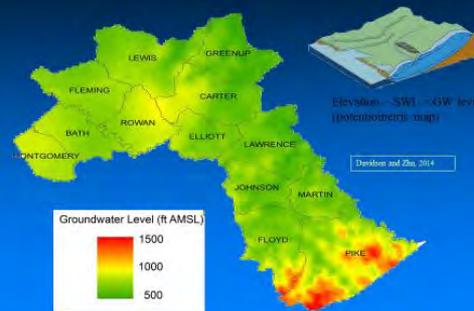
Well/borehole geophysical logging



Aquifer tests



Groundwater levels in the Berea play area (feet above mean sea level)



Synoptic water-level measurements from additional wells. Limited groundwater quality sampling.

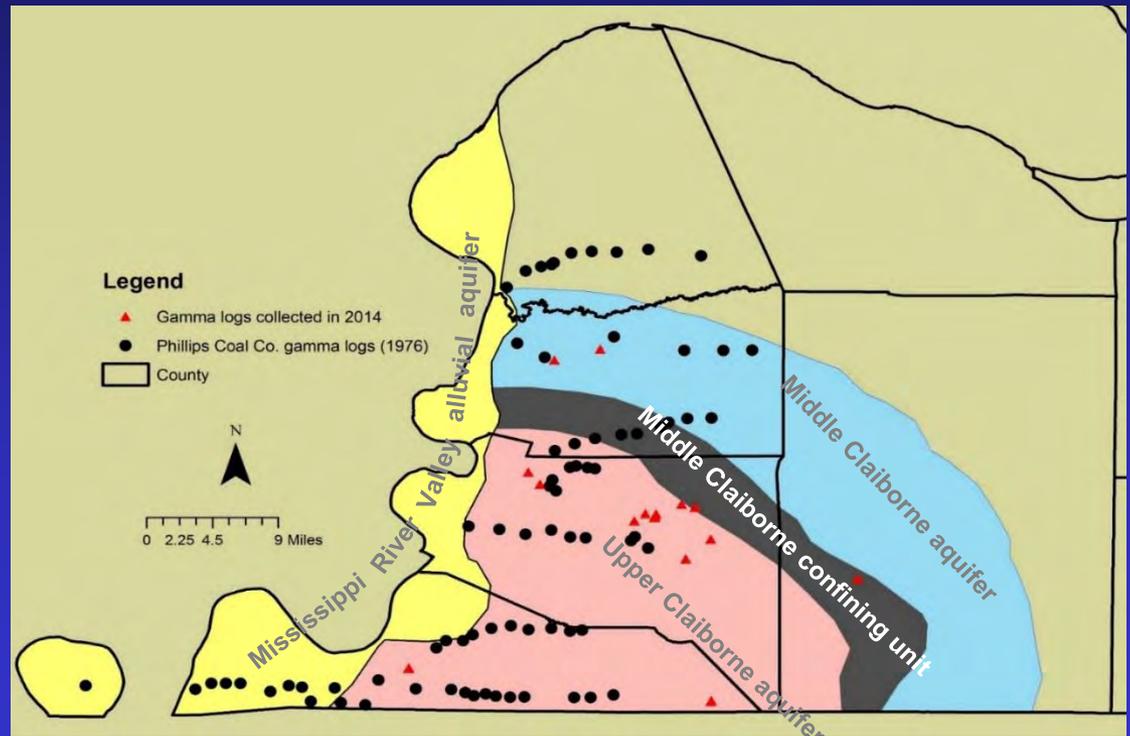
Priority Groundwater Data and Research Needs

Aquifer Delineation and Mapping

- Needed for Improved Groundwater Availability Assessment, and Resource Development and Management.
- Involves Collecting and Synthesizing Data From Multiple Sources including Geological Mapping Data (Stratigraphy and Structure), Geophysical Logs and Well Construction Records Obtained for Water, Oil, and Gas Wells.
- Also Requires Data on Aquifer Hydraulic Properties Obtained from Well Tests.
- KDOW & KGS Working in Collaboration on Proposal for Pilot-Scale Project for Aquifers Used by Permitted Groundwater Suppliers (funding opportunity through USGS National Water Use Program).

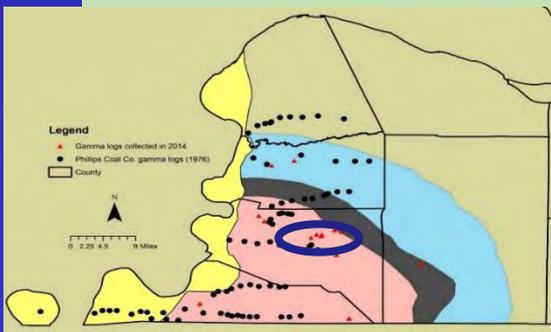
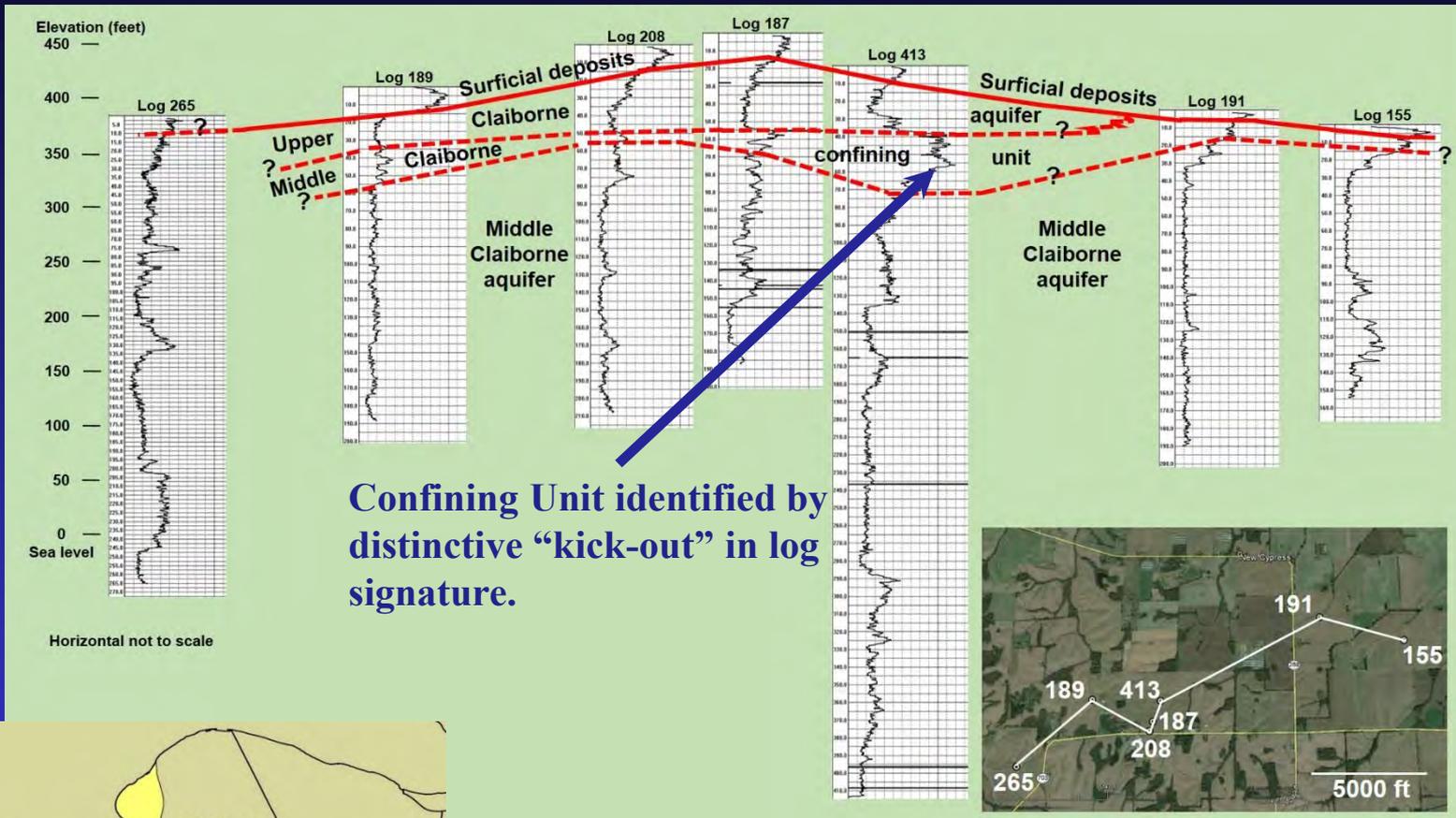
Present Aquifer Delineation Activity in western Jackson Purchase Area—

- Water well inventory and gamma-ray logging of selected irrigation and domestic wells.
- Digitizing scanned gamma-ray logs from Phillips Coal Company boreholes (ca. 1976).



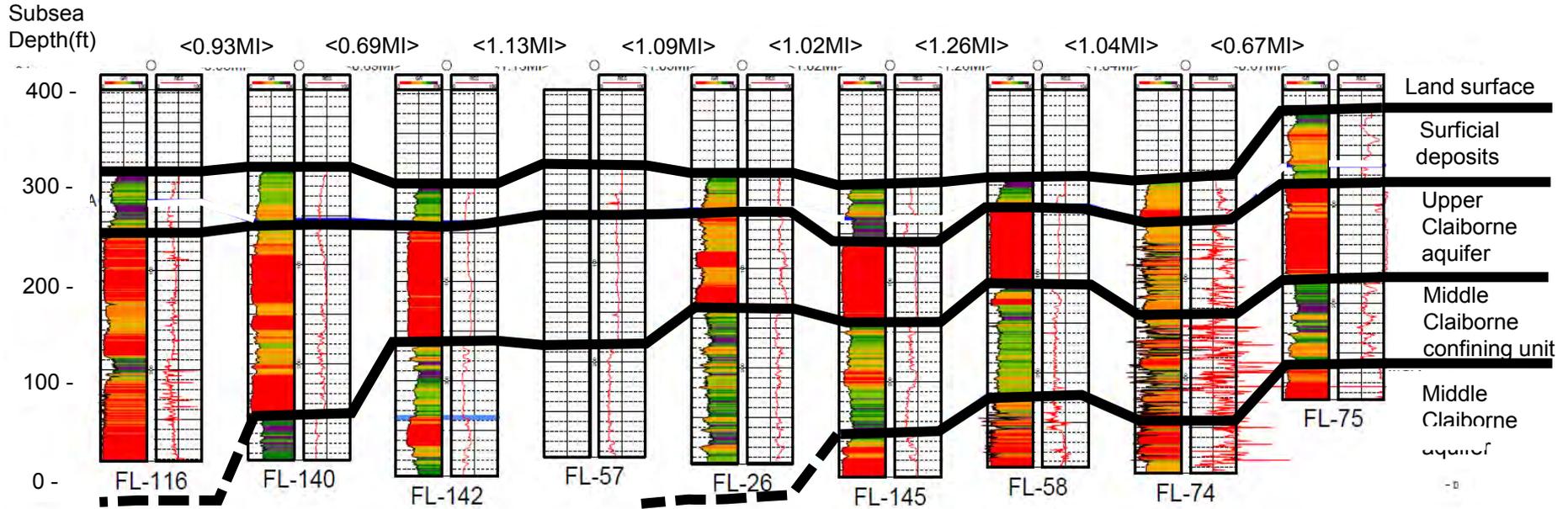
Modified from Lloyd and Lyke, 1995

Gamma-Ray Logs of JPA Wells Raise Questions about Variations in Extent and Thickness of Aquifer Zones and Confining Units

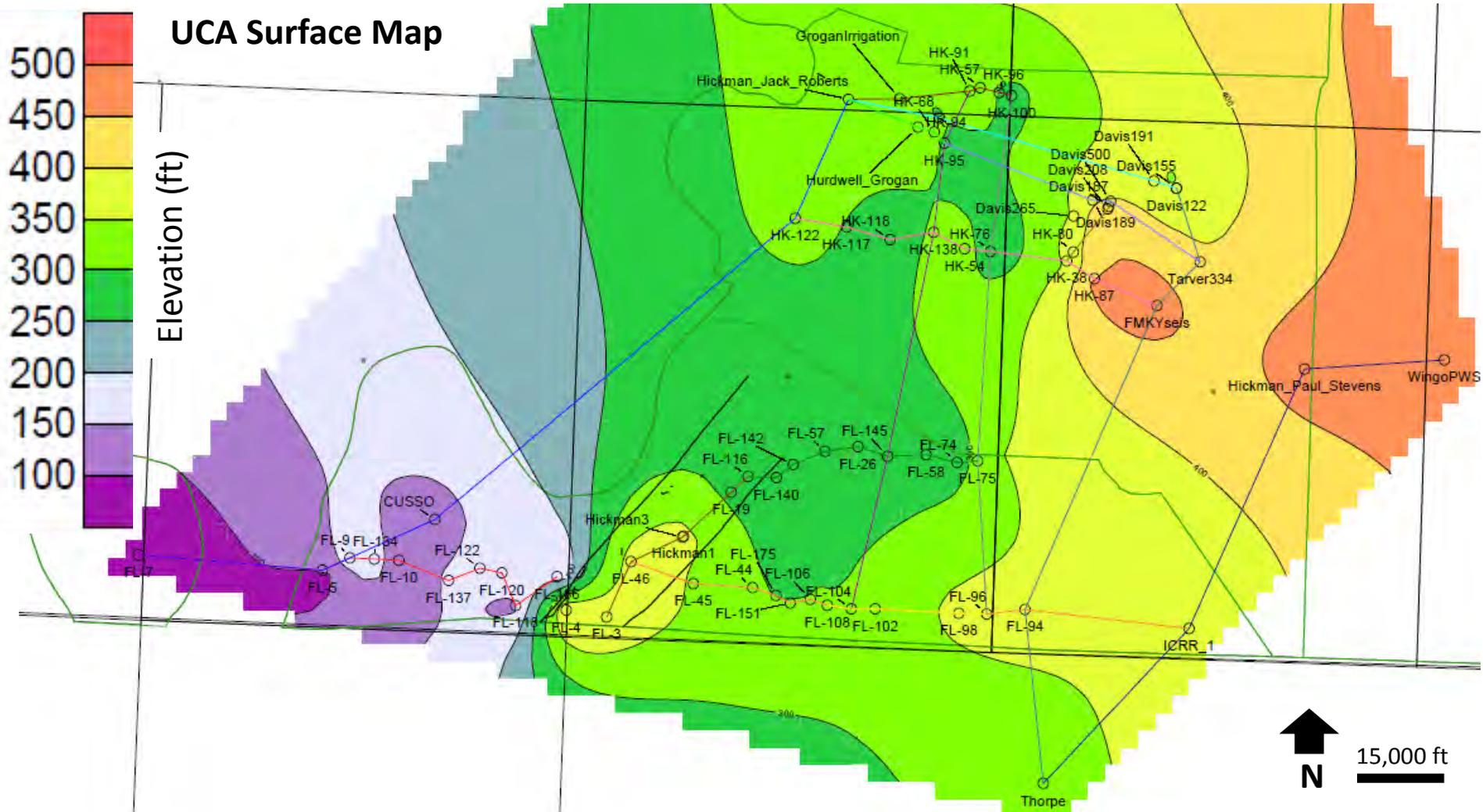


These Questions May Have Important Implications for Groundwater Monitoring and Groundwater and Surface Water Resources Management in the Area.

Example Hydrostratigraphic Cross Section

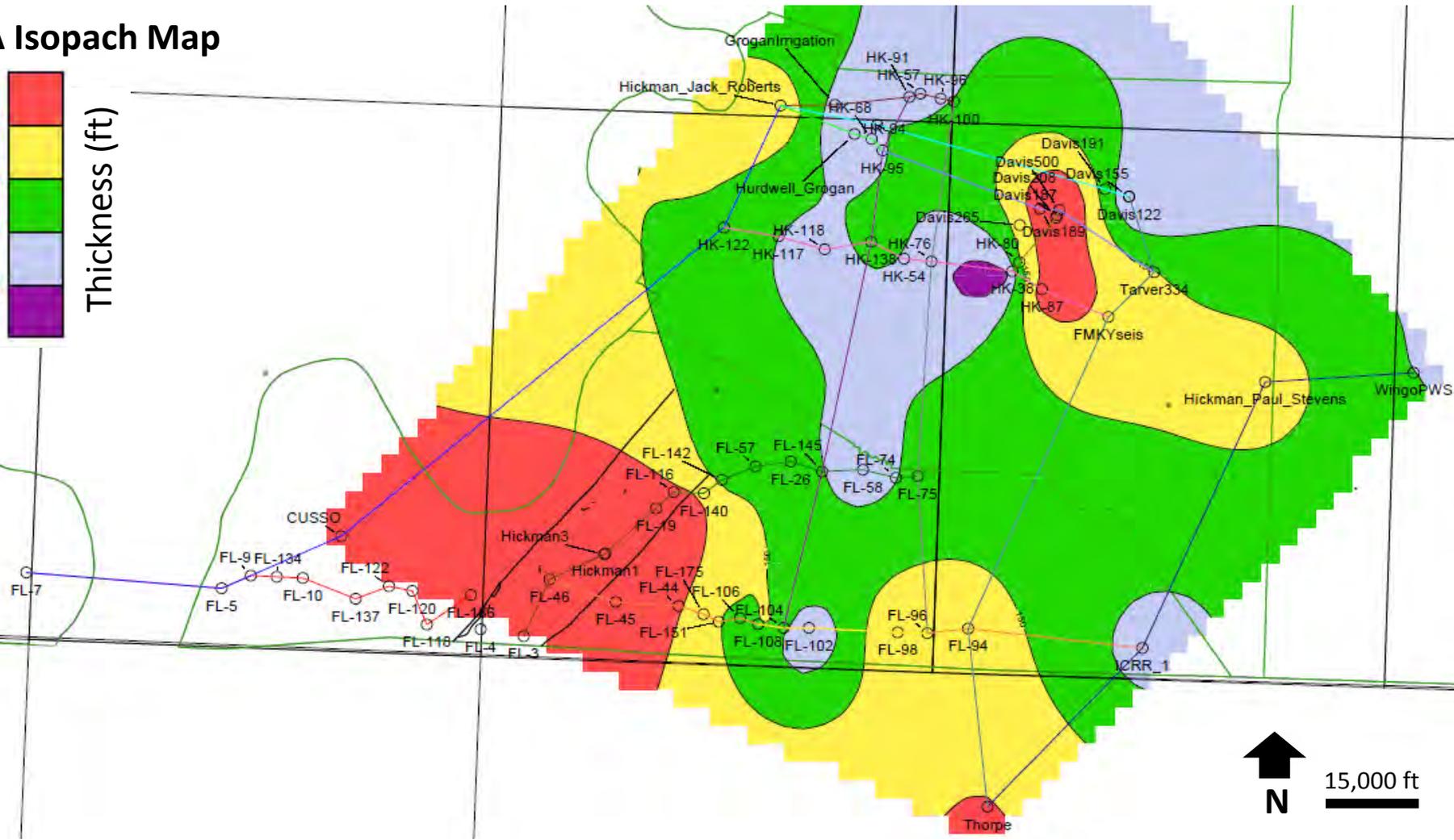
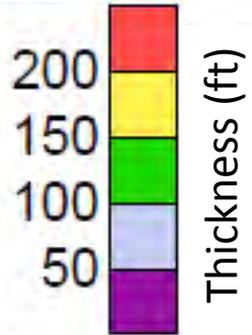


Upper Claiborne Aquifer Surface Map

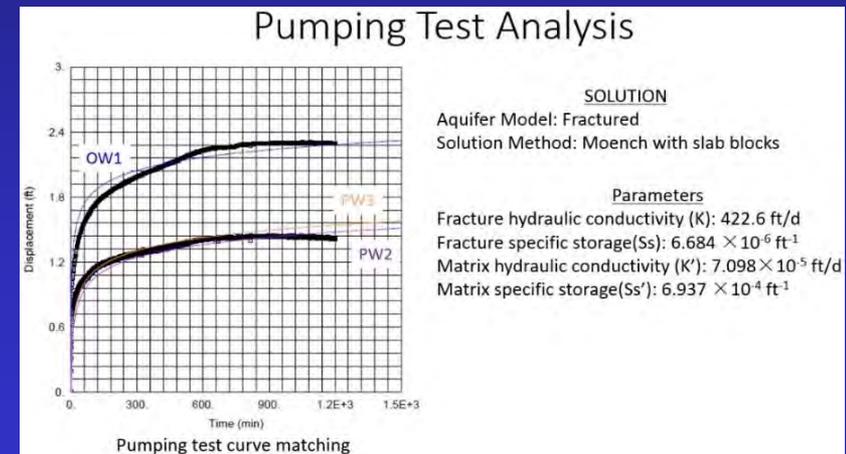
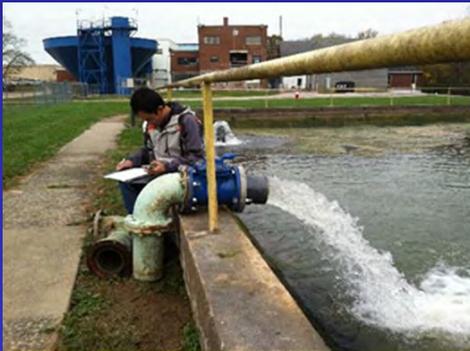
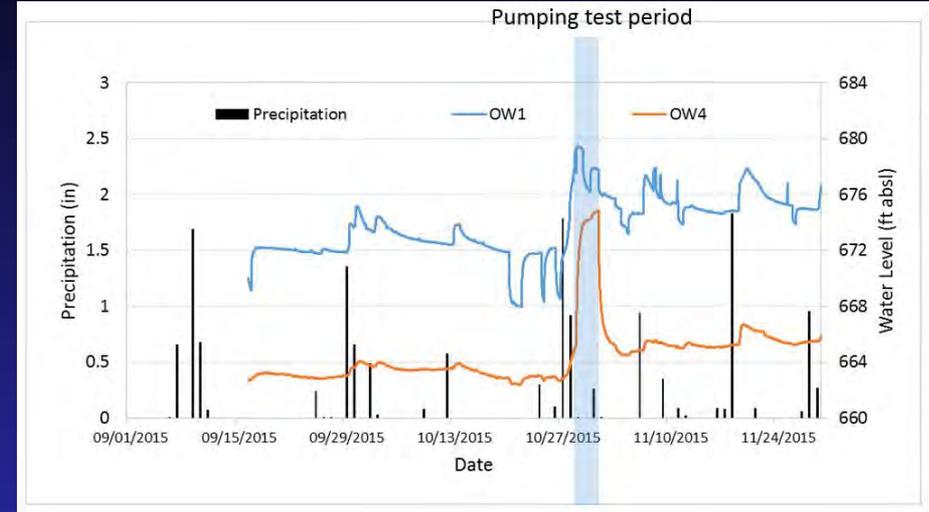


Upper Claiborne Aquifer Thickness Map

UCA Isopach Map



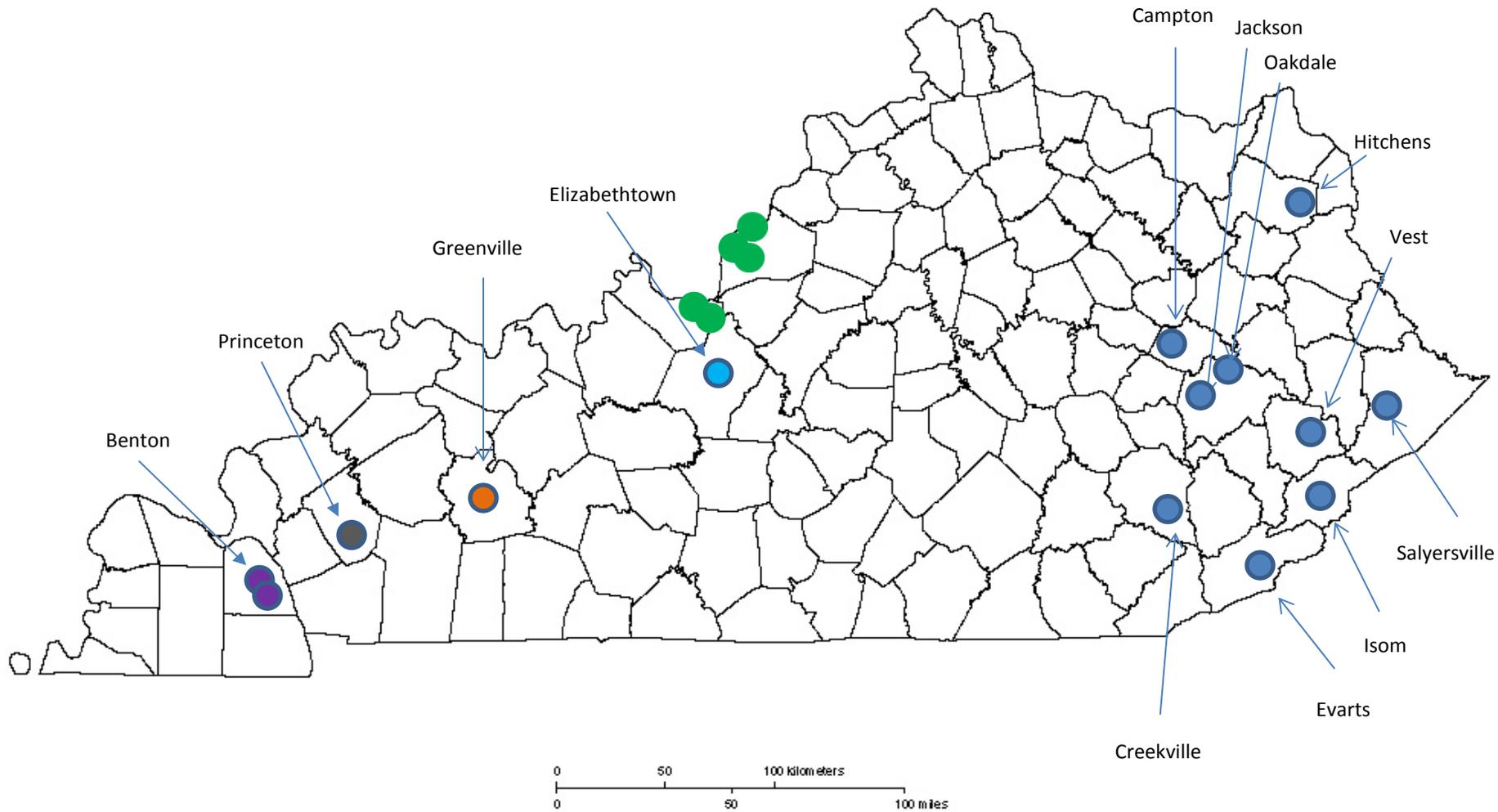
More Quantitative Data on Aquifer Yield and Hydraulic Properties—Example: Elizabethtown municipal well field



KGS is actively working with KY Rural Water and others to identify water wells for testing.

KENTUCKY

Aquifer Tests Performed by Kentucky Geological Survey



KGS Is Creating an Public-Accessible Aquifer Test Archive and Webpage Site



Site of well near location of proposed Campton Water Plant.



Well sites on a 7.5-minute topograph base of the Campton quadrangle.

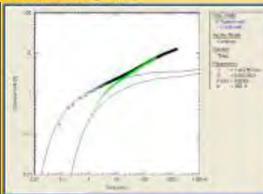
Campton, Wolfe Co. New Plant Well (Brewer Trail Road) December 19, 2009

BACKGROUND

The City of Campton had been looking for an additional groundwater supply well to supplement water production drawn from nearby Campton Lake. KGS was asked in 2006 to assist in performing aquifer tests on three wells: one by the old water plant, one at the city's lift station on Swift Road, and one plant



City of Campton's Swift Road well, adjacent to a city lift station. Generator powers pump in well in foreground, overflow is pumped to creek in background.



Theiss equation solution on drawdown data comparing Turbine well and nearby city pumping well near the creek.

Campton, Wolfe Co. Swift Road Well December, 2008



Plot of Campton wells on the KGS online geologic map. Wells are situated on the Pikeville Formation, the Corbin Sandstone, or Quaternary alluvium.



Water volume is measured



Geologist checks groundwater for iron content.

Greenville, Muhlenberg Co. 03/2009

BACKGROUND

The City of Greenville had drilled a water well to supplement their water supply from a reservoir. They asked KGS in 2009 to assist with an aquifer test on the well to determine the zone of influence as the well was pumped. The production zone was white sand at 800 feet depth.

It was determined that the well was suitable as a supplemental well.



Greenville well during preparation for aquifer test.

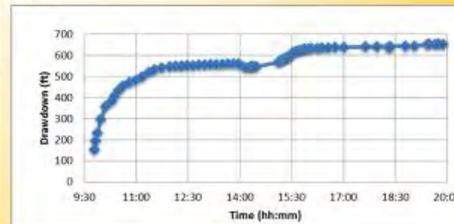


Groundwater upwelling from a white sandstone aquifer at 800 feet.

Greenville, Muhlenberg Co. 03/2009



Geology map showing location of the Greenville well situated on the Carbondale Formation, but the production zone was at 800 feet, likely the Caseyville Sandstone.



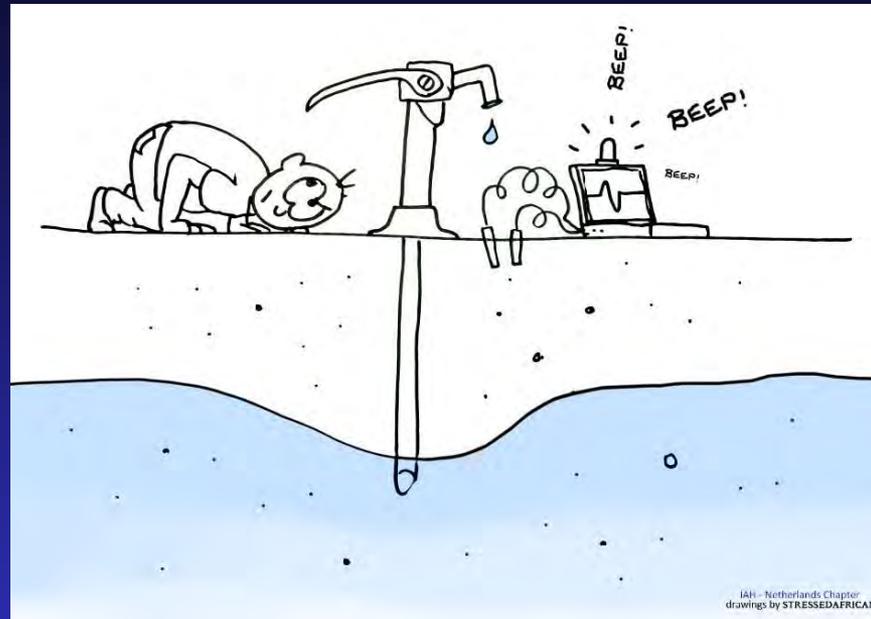
Graph showing drawdown versus time in the Greenville well.

Priority Groundwater Data and Research Needs

Development of Improved Groundwater Management Tools

- To Be Determined
- May Involve Creation of Groundwater Flow Models or Well-Hydraulic Response Simulation Tools that Can Help Predict Groundwater Availability and Sustainability.
- This Objective Requires Access to Sufficient High-Quality Hydrogeological Data, and Proper Conceptualization of the Aquifer. Therefore Its Eventual Realization Depends on the Previous Priority Items We've Discussed.

Questions and Discussion



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