What role do the ground-water/surface water interactions have with water resource sustainability, water quality, and ecosystem vitality?

As development moves into the ground water recharge areas, what impact will there be on water sustainability and quality?

What impact does faulting have on the flow dynamics of the ground water system?

How contiguous is the protective clay layer over the primary drinking water aquifer, to what extent do breaches in the clay layer exacerbate the potential for contamination?
Aquitard presence: focus on marine seismic acquisition

Aquitard breach: focus on land seismic acquisition
Shallow aquifer water table – flow is primarily toward the river systems

Note: dotted lines represent inferred water levels
Memphis aquifer potentiometric surface – flow is primarily toward the well fields (~210 mgd)
Red dotted polygon boundary represents area where the water table elevations exceed those of the Memphis aquifer; vertical gradient is downward.
Pink dotted polygons represent anomalous depressions in the water table possible indicative of an aquitard breach.
The mixing of waters between aquifers can be an indicator of preferential leakage

The shallow aquifer is more prone to contamination, and leakage of this water to the Memphis aquifer through aquitard breaches is of great concern.
Overview of seismic reflection data acquisition

Use elastic waves (a.k.a. seismic waves – mostly P- and S-waves) generated by seismic sources and recorded by receivers to determine the velocity distribution and to locate subsurface interfaces.

Widely and successfully applied in hydrocarbon exploration, continental studies and in geotechnical and environmental problems.
Prior land seismic reflection investigation of identified aquitard breach north of unlined Shelby County landfill using S-wave
### Land seismic acquisition parameters

<table>
<thead>
<tr>
<th>Field parameter</th>
<th>Farm Road</th>
<th>GWI 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy source</td>
<td>1.8 kg sledge hammer/I-beam</td>
<td>1.8 kg sledge hammer/I-beam</td>
</tr>
<tr>
<td></td>
<td>(5 impacts)</td>
<td>(5 impacts)</td>
</tr>
<tr>
<td>Source interval</td>
<td>2 m</td>
<td>3 m</td>
</tr>
<tr>
<td>Receiver</td>
<td>14 Hz horizontal geophones</td>
<td>14 Hz horizontal geophones</td>
</tr>
<tr>
<td>Receiver interval</td>
<td>2 m</td>
<td>3 m</td>
</tr>
<tr>
<td>Spread configuration</td>
<td>split spread</td>
<td>split spread</td>
</tr>
<tr>
<td>Recording system</td>
<td>Seistronix RAS 24</td>
<td>Seistronix RAS 25</td>
</tr>
<tr>
<td>Sample Interval</td>
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<td>0.25 ms</td>
</tr>
<tr>
<td>Maximum fold</td>
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<td>Field filters</td>
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<td>Out</td>
</tr>
<tr>
<td>Record length</td>
<td>500 ms</td>
<td>1000 ms</td>
</tr>
</tbody>
</table>

**Diagram:**

- Survey line is marked with coordinates: 89°51'0"W to 89°50'30"W and 35°8'15"N to 35°8'0"N.
- Key points include:
  - TH#1 (NW)
  - Sh:Q-125 (NE)
  - Sh:Q-125 (NW)
  - Sh:Q-125 (SE)
  - Sh:Q-146 (SW)
  - Sh:Q-150 (SE)
  - Sh:Q-151
  - A, A'
  - Gravel road
  - Walnut Grove

**Additional notes:**

- Farm Road
- GWI 1 and 2
Land seismic acquisition results (GWI1 line) – north of Shelby County landfill

(a) Gravel road (SE) and approximate A-A' tie

(b) Faulting, liquefaction, or land surface condition

(c) Deep faulting, liquefaction, or land surface condition

(d) Paleochannel bottom

0 100 200 300 400
Distance (m)

0 50 100 150 200
Depth (m)

TH#1 (NW)

0 250 500
Time (ms)
Mapped aquitard breach with understanding of origin
Seismic reflection line near first site, but at higher resolution and using P-waves
Determination of optimum seismic energy source and spacing using a walk-away test

- 12-gauge shotgun
- 7.5-kg sledge hammer
- 20-kg weight drop
Walk-away test results
Seismic reflection parameters

<table>
<thead>
<tr>
<th>Field parameter</th>
<th>Survey line</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>North of Shelby County landfill</td>
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<tr>
<td></td>
<td>N-S line to Wolf River</td>
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<tr>
<td>Energy source</td>
<td>1.8 kg sledge hammer/I-beam (5 impacts)</td>
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<td></td>
<td>12-gauge shot gun (200 g gun powder)</td>
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<td>Source interval</td>
<td>3 m</td>
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<tr>
<td></td>
<td>1 m</td>
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<tr>
<td>Receiver</td>
<td>14 Hz horizontal geophones</td>
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<tr>
<td></td>
<td>40 Hz vertical geophones</td>
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<tr>
<td>Spread configuration</td>
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<td>500ms</td>
</tr>
</tbody>
</table>
Land seismic acquisition results
Aquitard presence: focus on marine seismic acquisition

Aquitard breach: focus on land seismic acquisition
Mississippi River hi-res seismic survey

**ACQUISITION PARAMETERS**
- Length: 300 km
- Shot interval: 9 m
- Receiver interval: 3.125 m
- Source: Sercel GI airgun 15/15 in$^3$
- CDP interval: 3 m (nominal)
Mississippi River hi-res seismic survey: reflection data

NW

(Cottonwood Grove Fault seismicity)

SE

Caruthersville, MO

TWT

0.6

0.7

0.8

Kr

Pz

km

0

6
Mississippi River hi-res seismic survey: Chirp data

Single channel sub-bottom profiler
Higher frequencies (0.7-12 kHz)
Sub-meter resolution
Max penetration ~20 m

2009
Mississippi River hi-res seismic survey: reflection and Chirp data
CUAHSI is having conversations with PASSCAL (under IRIS), to develop relationships between these two NSF funded organizations.

CUAHSI members will be able to access the seismic equipment at PASSCAL for the cost of shipping and connect with geophysicists who can assist in field application.

**Geophysics workshop**

CUAHSI Biennial Colloquium  
Boulder, CO  
July 19-22 with the workshop on the afternoon of July 21  