Overview of Potential Water-related Human Exposures

HEI's Energy Research Committee

George M. Hornberger
Vanderbilt University
Committee Chair

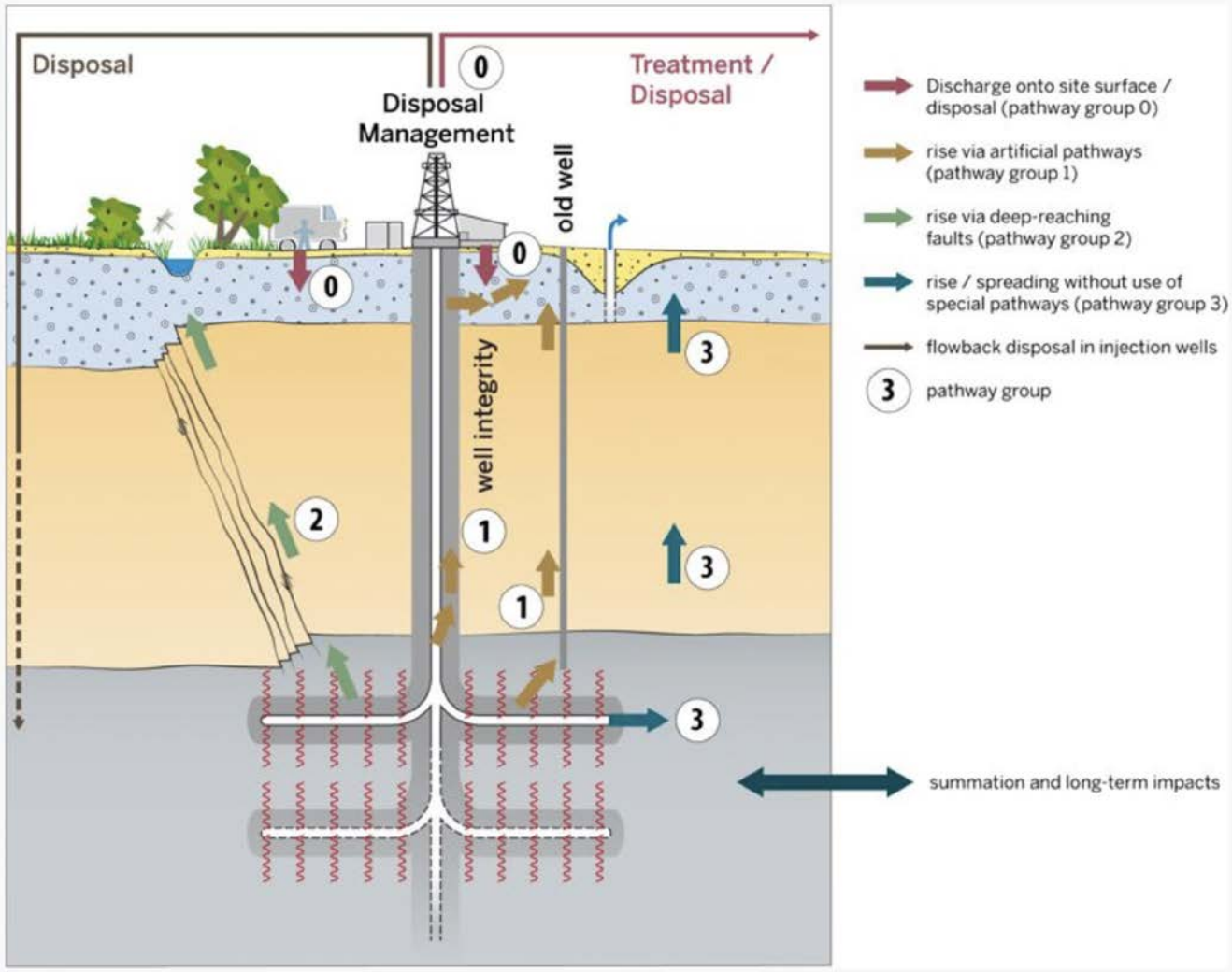


Figure 3
Schematics of potential impact pathways.

0 – Spills

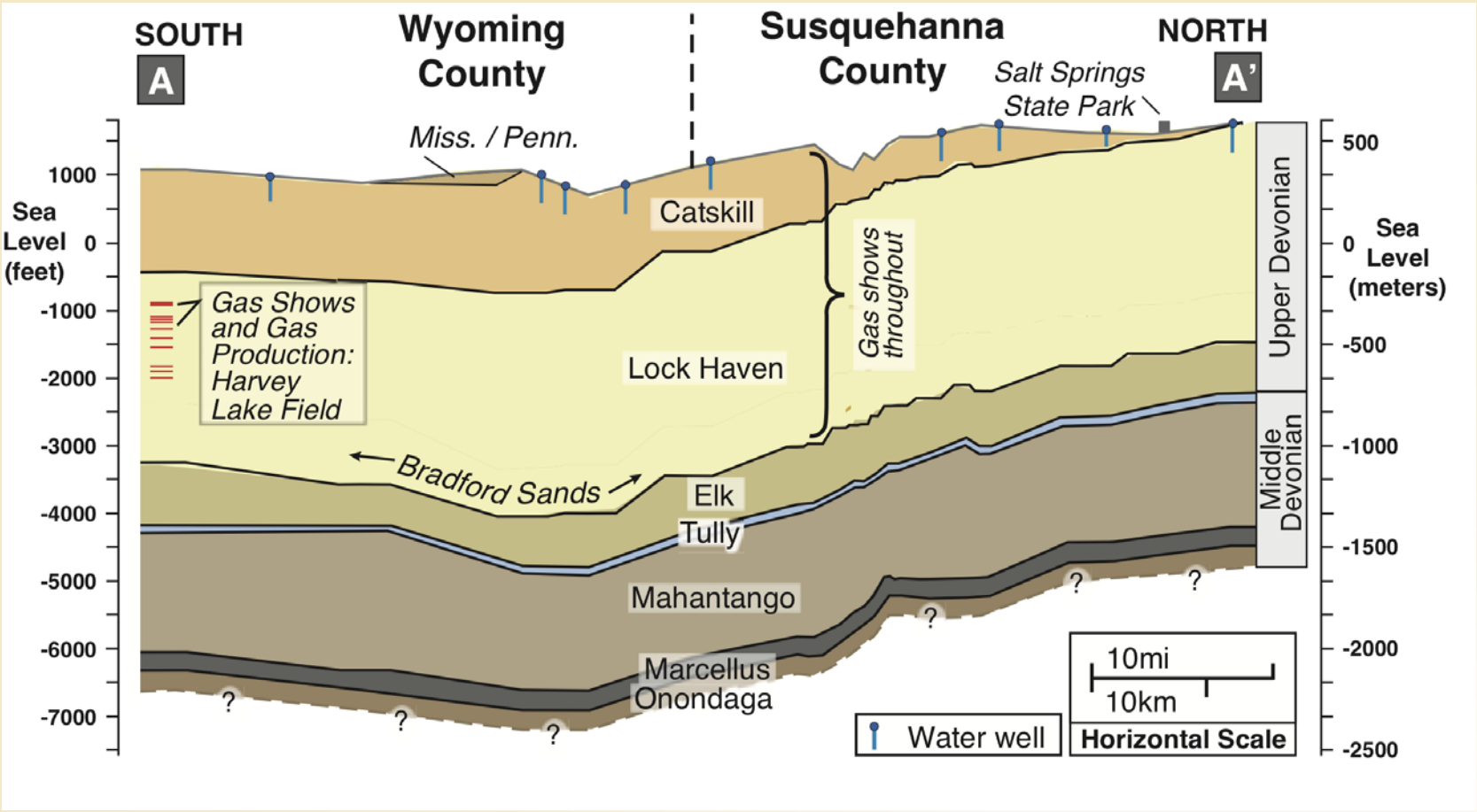
1 – Wellbore failure and abandoned wells

2 – Faults

3 – Diffuse upward transport

From: Bergmann, A., et al. 2014. *Environ Sci Eur 26*: 10. https://doi.org/10.1186/2190-4715-26-10

HEI



Must keep in mind that distortions of schematic figures for illustrative purposes can be misleading.

Figure from: Molofsky, L.J. et al. 2013. *Groundwater 51*: 333-349.

Also, schematic drawings that show a rock unit as a single shade should not be interpreted to indicate geological uniformity.

The bulk flow of fluids can usually be estimated by using average properties across heterogeneities, but the transport of contaminants depends on details of the flow field.

Outcrop showing rock heterogeneity with a superimposed typical grid cell used in reservoir simulations.

(From: Gerritsen and Durlofsky 2005. *Annu. Rev. Fluid Mech. 37*:211–238)

There are several scientific questions about potential water pathways for contamination related to the development of unconventional oil and gas that deserve attention. And all of the questions must be addressed in the framework of the Kaplan-Garrick risk triplet – (1) what can go wrong? (2) what are the consequences? and (3) how likely is it?

- *How can pathways for contaminant migration be identified?*
- *What are the speeds of contaminant migration along the pathways?*
- *How do geochemical reactions affect the concentrations and nature of the contaminants transported?*
- *And many others.*

The "holy grail."
Ground- water quality monitoring prior to, during, and after fracking would help assess the risk to groundwater quality, identify potential fluid migration paths, and provide the data needed for health exposure studies.
Lefebvre 2017. *WIREs Water 4*:e1188. doi: 10.1002/wat2.1188.