



# Well Site Spill Protection: Impacts, Trends and Technologies for Preventing Releases to Water Sources

Presented by:

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# SHALE GAS IN THE NEWS

19 HEAD OF  
CHEMICAL E  
Shreveport Times

## Did fracking turn this squirrel purple?

BY JESS ZIMMERMAN  
14 FEB 2012 10:50 AM

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Dilbert

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# Groundwater Impacts

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- Study by UT Austin Energy Institute (Feb. 2013) concluded:
  - No direct connection between hydraulic fracturing and reports of groundwater contamination
  - Many reports of contamination can be traced to above-ground spills or other mishandling of wastewater



## Spills - Primary Causes

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- Study by Chem Risk LLC on surface spills (presented at AIHce 2013):
  - 343 new spills in Colorado in 2011 with 58 impacting groundwater.
  - Tank battery systems represented a major point of origin for spills
  - Equipment failure, including corrosion was a common cause of a spill
  - Only 3 spills were reported as human error.



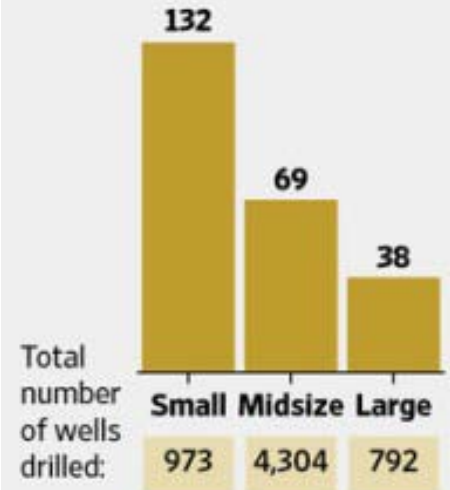
# Compliance....and Perception

“The rate of environmental violations has steadily dropped as major energy companies have bought up smaller drillers, according to a Journal review of Pennsylvania Department of Environmental Protection inspection records for Marcellus operations from 2008 through 2012”

Wall Street Journal, April 1, 2013

## Compliance Record

Regulatory violations per 100 wells drilled in the Marcellus Shale, by size of drilling company, 2008-12:



Source: Pennsylvania Department of Environmental Protection

The Wall Street Journal



# Spill Response Regulations

- Colorado – Regulated by the Colorado Oil and Gas Conservation Commission
  - *Control and contain the spill immediately upon discovery to protect the environment;*
  - *Investigate and clean up the spill as soon as practicable;*
  - *Take additional action as directed by the COGCC to prevent or mitigate significant adverse environmental impacts and comply with state soil and ground water standards;*
  - *Determine the cause of the spill and, to the extent practicable, implement measures to prevent similar spills in the future;*
  - *Notify the COGCC as soon as practicable, but not more than 24 hours after discovery, if the spill impacts or threatens to impact any state water, residence or occupied structure, livestock, or public byway;*
  - *Notify the COGCC within 10 days if the spill exceeds 210 gallons;*
  - *Notify the COGCC within 24 hours if the spill exceeds 20 barrels; and*
  - *Notify the surface owner as soon as practicable, but not more than 24 hours after discovery, if the spill is reportable to the COGCC.*



# Spill Response Regulations

- North Dakota – Regulated by the North Dakota Industrial Commission (NDIC), through its Oil and Gas Division (OGD)
  - Any spill or discharge of waste which may cause pollution of waters of the state must be reported immediately (*Source NDAC 33-16-02.1-11*)
  - The North Dakota Department of Health may require the owner or operator to
    - Take immediate remedial measures
    - Determine the extent of pollution to waters of the state
    - Provide alternate water sources to water users impacted by the spill or accidental discharge
    - Any other actions necessary to protect human health and the environment



# Spill Response Regulations

- Texas – Regulated by the Railroad Commission of Texas (RRC)
  - The RRC serves as the lead agency for spills or discharges from all activities associated with the exploration, development, or production, including storage or pipeline transportation (excluding highway transport and refined product spills), of oil, gas, and geothermal resources pursuant to *Texas Natural Resources Code §85.042, 91.101, and 91.601*.
  - Commission rules require all free-standing fluids to be picked up and properly disposed of
  - Impacts to surface waters are reported to the Texas Commission on Environmental Quality (TCEQ)





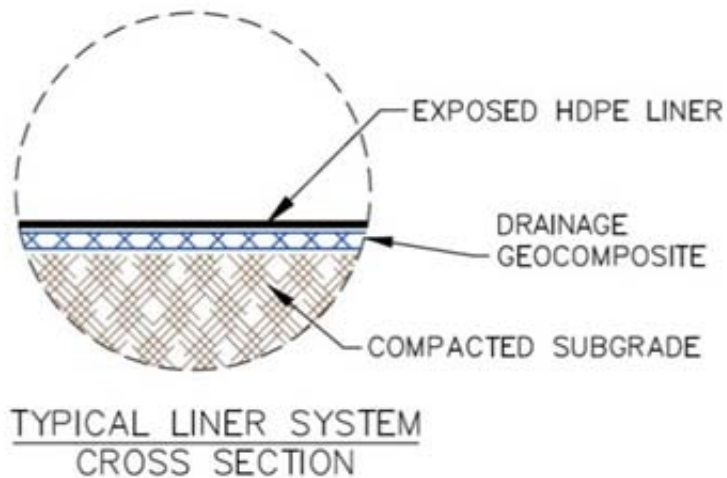
# Spill Response Regulations

- Pennsylvania – Regulated by the Department of Environmental Protection (PaDEP)
  - A spill or release causing or threatening pollution of the waters of this Commonwealth must be reported to the Department of Environmental Protection (*Source Pa.Code §§ 91.33(a) and 78.66(a)*)
  - Remediation of an area affected by a spill or release related to oil and gas operations is required



# Geosynthetic Lining Systems

Goal: To Prevent Soil, Surface Water and Groundwater Impacts





# Applications of Lining Systems

Spill containment on drill pads





## Well Pad Construction

Some designs include a geomembrane liner overlaid by a cushion geotextile and then topped with geocells or other specialty mat or cushioning product





# Applications of Lining Systems

Frac Water, Flowback, and Produced Water Impoundments  
Stormwater Control  
Drill Cutting Disposal





# Mobile Impoundments



Used when high water table is encountered

Can be deconstructed and reused to reduce cost and to reduce ground disturbance





# Geosynthetic Lining Systems – PA Example

## FLOWBACK/ DRILL CUTTINGS CONTAINMENT

- Generally, a more robust lining system
- Centralized impoundments include a primary and a secondary containment liner, with a detection system in between the two liners and groundwater monitoring wells
- On-lease surface impoundments do not require the above secondary containment and leak detection

## WELL PAD

- Many different well pad designs are used
- The minimum requirement is generally a single geomembrane or geosynthetic clay liner
- Other designs combine the two materials to form a composite liner



# Pennsylvania Regulations for Lined Impoundments and Pits

Pennsylvania regulation (PA § 78.56) :

- Two (2) feet of freeboard should be maintained at all times
- The synthetic liner should have a coefficient of permeability of less than  $1 \times 10^{-10}$  cm/s
- The synthetic liner thickness should be greater than 0.75 mm (30 mils)
- The protective subbase should be greater than 150 mm (6 inches) thick
- The bottom of the pit should be at least 20 inches higher than the seasonal high groundwater table
- The pit or tank should be protected from third parties at all times





# Engineering Perspective

- Minimum lining system requirements dictated by state agencies are not consistent. Also, within a single U.S. state, the lining system requirements may differ for pits or tanks containing freshwater or stormwater vs. potentially polluted sediments or liquid
- BMPs influencing liner system design and selection include: material strength (its resistance to tear and puncture), liner material compatibility with the contained medium, installation methods, quality control and inspection, and maintenance and repair procedures
- Common geomembrane liner materials are 40- or 60-mil LDPE or HDPE geomembranes
- Underlying geotextile or geocomposite design to prevent the formation of wales under the liner system and to provide puncture protection
- Subgrade soil stability and cover soil stability should always be evaluated, and may affect the selection of the liner



## Contractor Perspective

- LOCATION, LOCATION, LOCATION! Sites conditions may be challenging
- Weather conditions need to be considered
- Quality control is critical:
  - Nondestructive testing
  - Destructive testing
  - Leak Detection Survey cover soil stability should always be evaluated, and may affect the selection of the liner



## Conclusions

- There is mounting evidence that impacts to groundwater are associated with surface activities and not caused by hydraulic fracturing
- There is increasing pressure from the public and regulators to control surface releases and minimize their impacts
- BMPs from other industries, such as solid waste can be applied
- Geosynthetics offer **versatile** and **cost-effective** solutions in lining systems to minimize the impact of shale gas drilling activities on the surrounding environment



Questions are welcome.  
Thank you for your interest.

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