Risks and mitigation options for on-site storage of wastewater from shale gas and tight oil development

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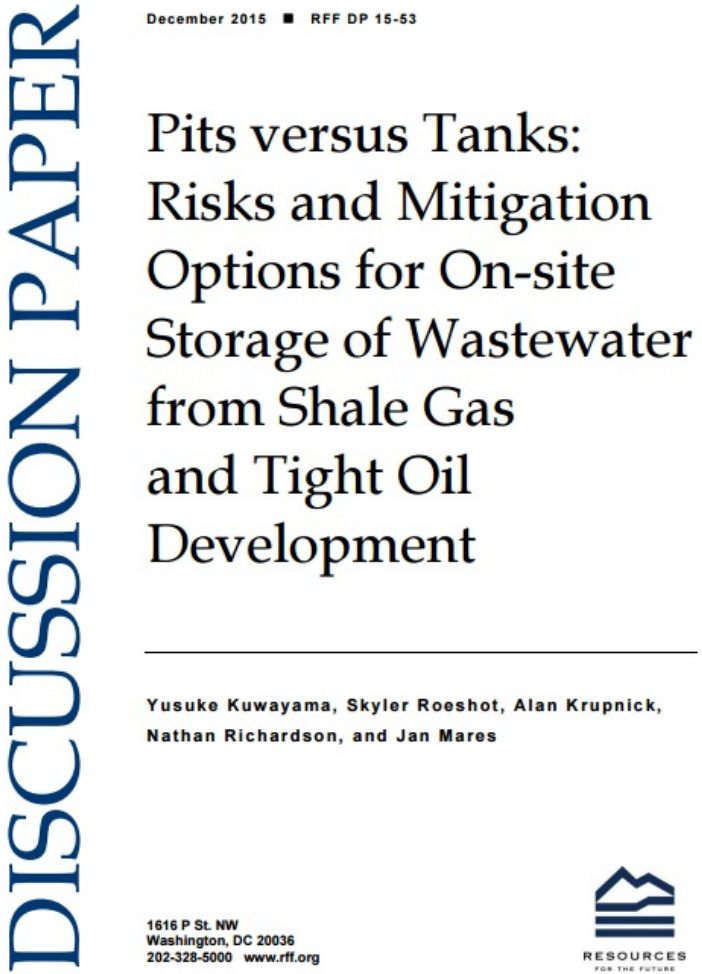
RFF Discussion Paper



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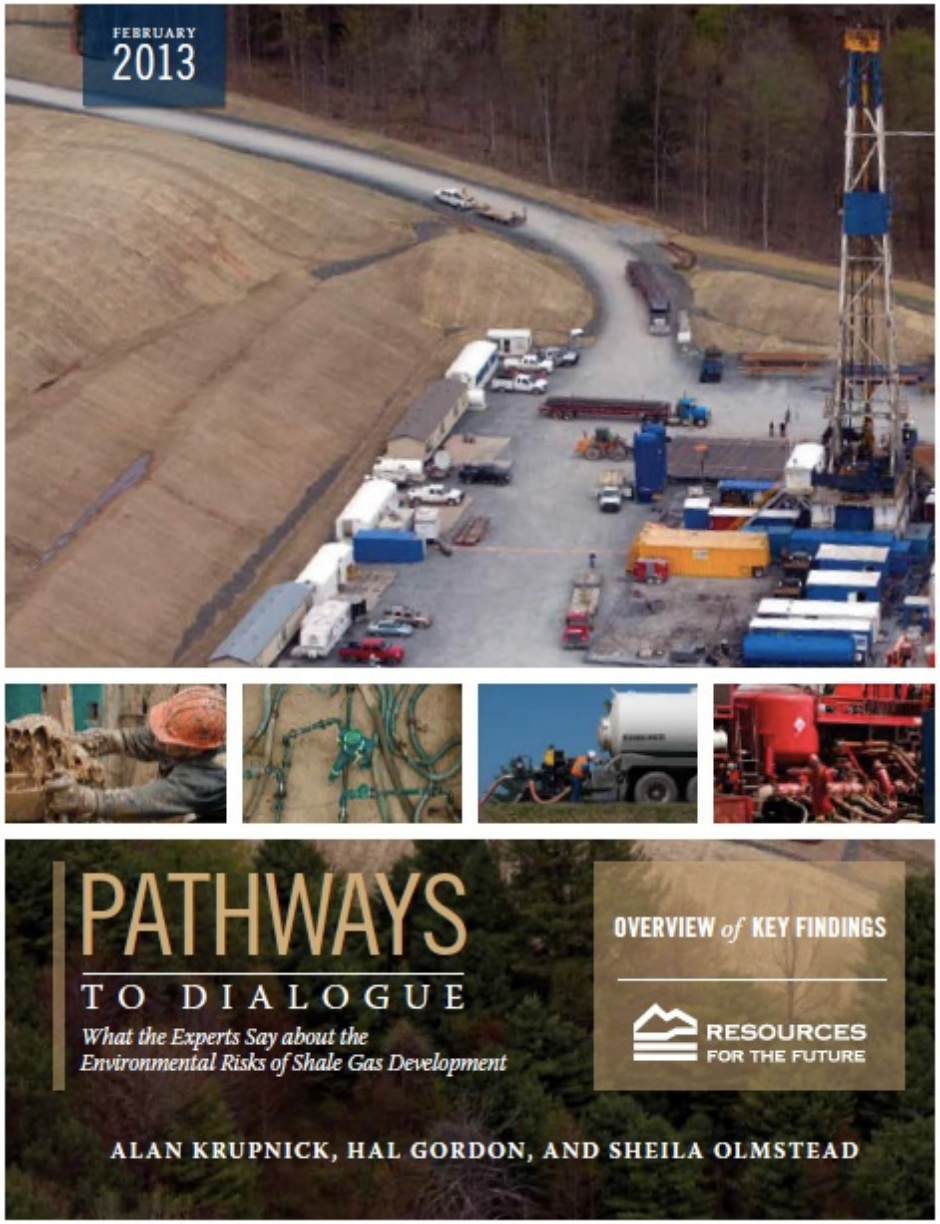
http://www.rff.org/research/subtopics/shale-gas

Motivation: RFF expert survey



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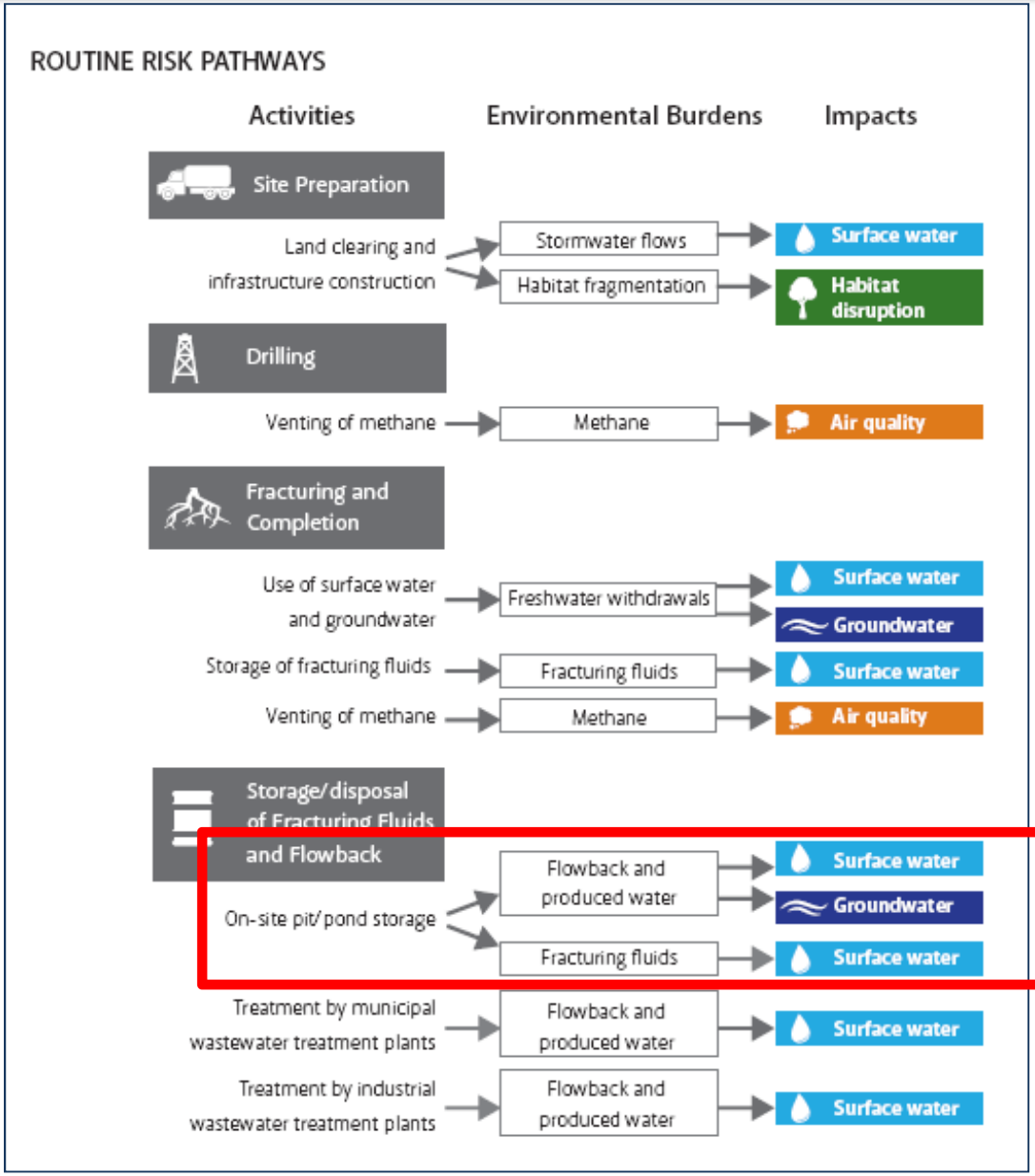
On-site pit storage of flowback and produced water is a "consensus routine risk pathway"



Project overview

Objectives:

1. Identify potential risks to human and ecological health
2. Describe government regulations or industry actions that may mitigate these risks
3. Provide a list of recommendations specific to on-site wastewater storage

Information sources:

1. Existing literature
2. Existing state regulations (19 states)
3. State databases of environmental incidents (CO, NM, PA, OK)
4. Informal survey of IPAA members
5. Feedback from state regulators

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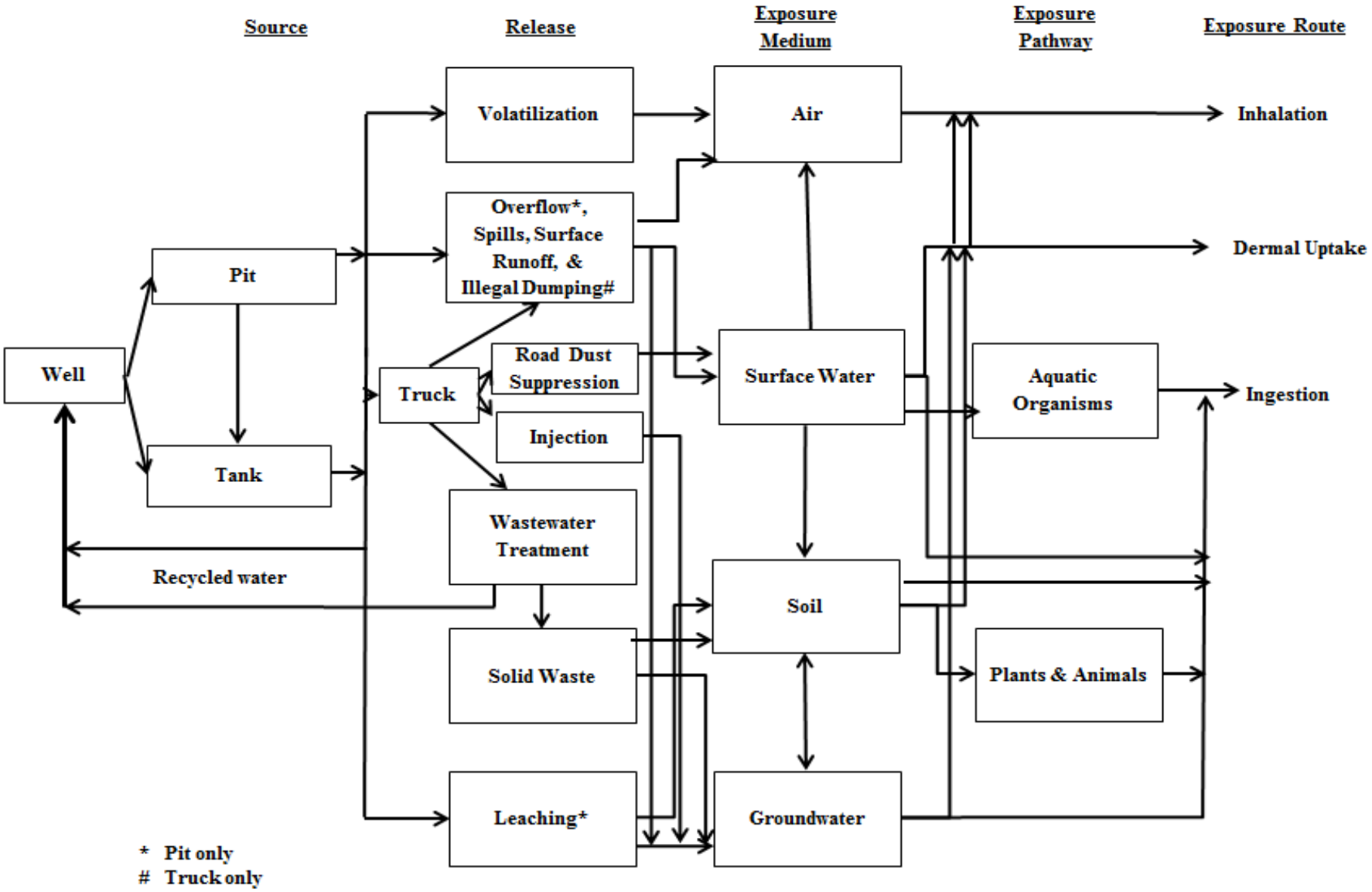
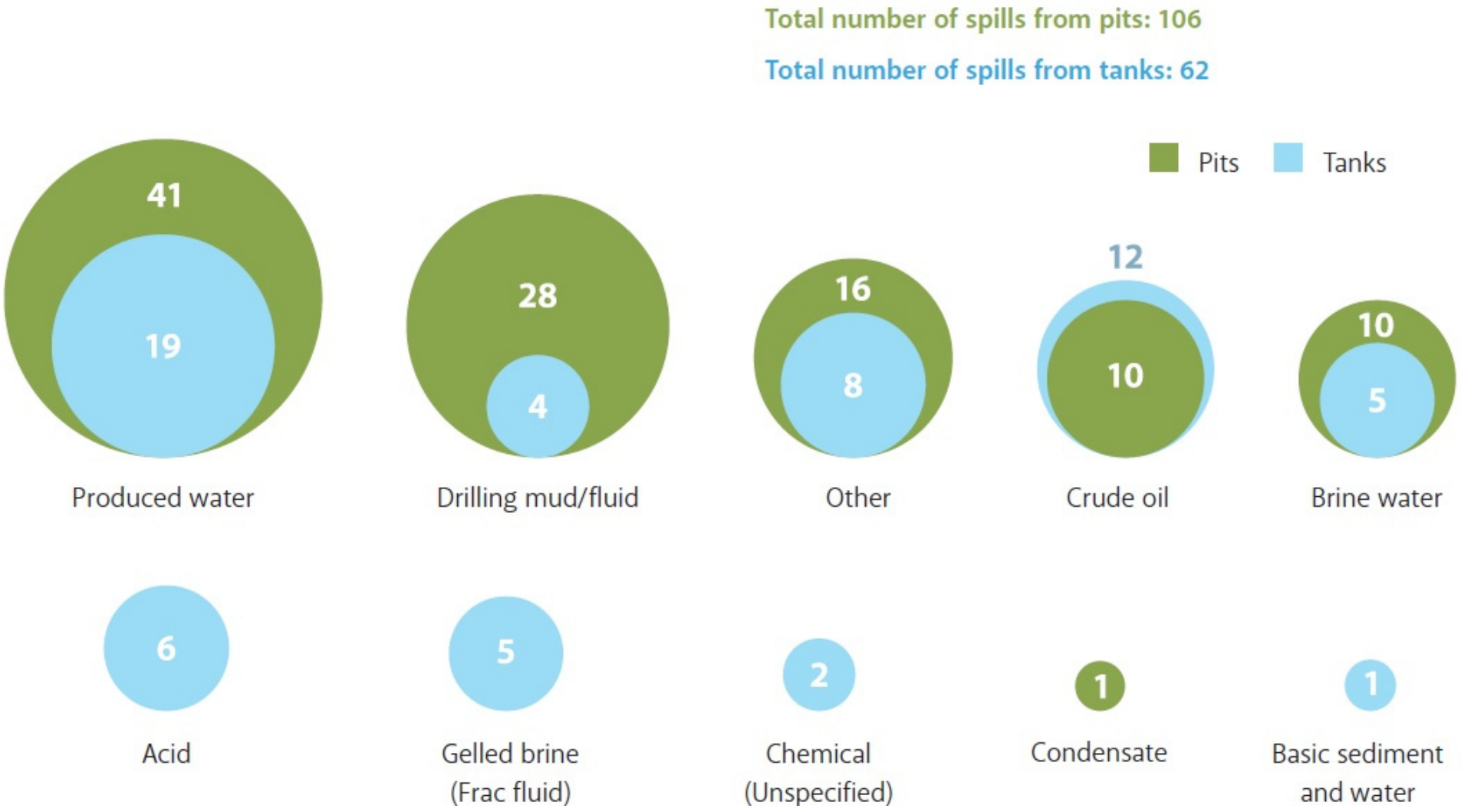
Literature review – Potential contaminant exposure mechanisms



Analysis of state spill databases

Materials spilled from pits and tanks (New Mexico, 2000-2014)



Analysis of state spill databases

Volumes spilled and lost by spill cause (New Mexico, 2000-2014)

Spill cause	# of spills	Spilled (median)	Lost (median)
Pits			
Overflow	35	25	5
Liner malfunction	28	95	45
Improper closure/reclamation	6	12.5	12.5
Berm failure	4	52.5	30
Unlined pit	3	360	360
Blowover	2	11	6
Sinkhole	2	5,050	5,050
Unidentified/undocumented	26	18.5	10
TOTAL	106	35	13.5
Tanks			
Leak	27	40	20
Overfilling	17	32	6
Collapse	2	275	275
Lightning strike	2	46	46
Vandalism	2	925	425
Fire	1	297	19
Unidentified/undocumented	11	10	4
TOTAL	62	36	15

Mitigating risk: Existing regulations

1. Pit location
2. Pit excavation
3. Liners
   a. Material, thickness, permeability
   b. Other features: Stitching, seam joining, anchoring, slack, sub-bases
   c. Leak detection systems
4. Freeboard
5. Fencing, netting, and screening
6. Spill reporting
7. Closure and reclamation
8. Tank features
9. Specifications in permits
10. Liability, insurance, and bonding

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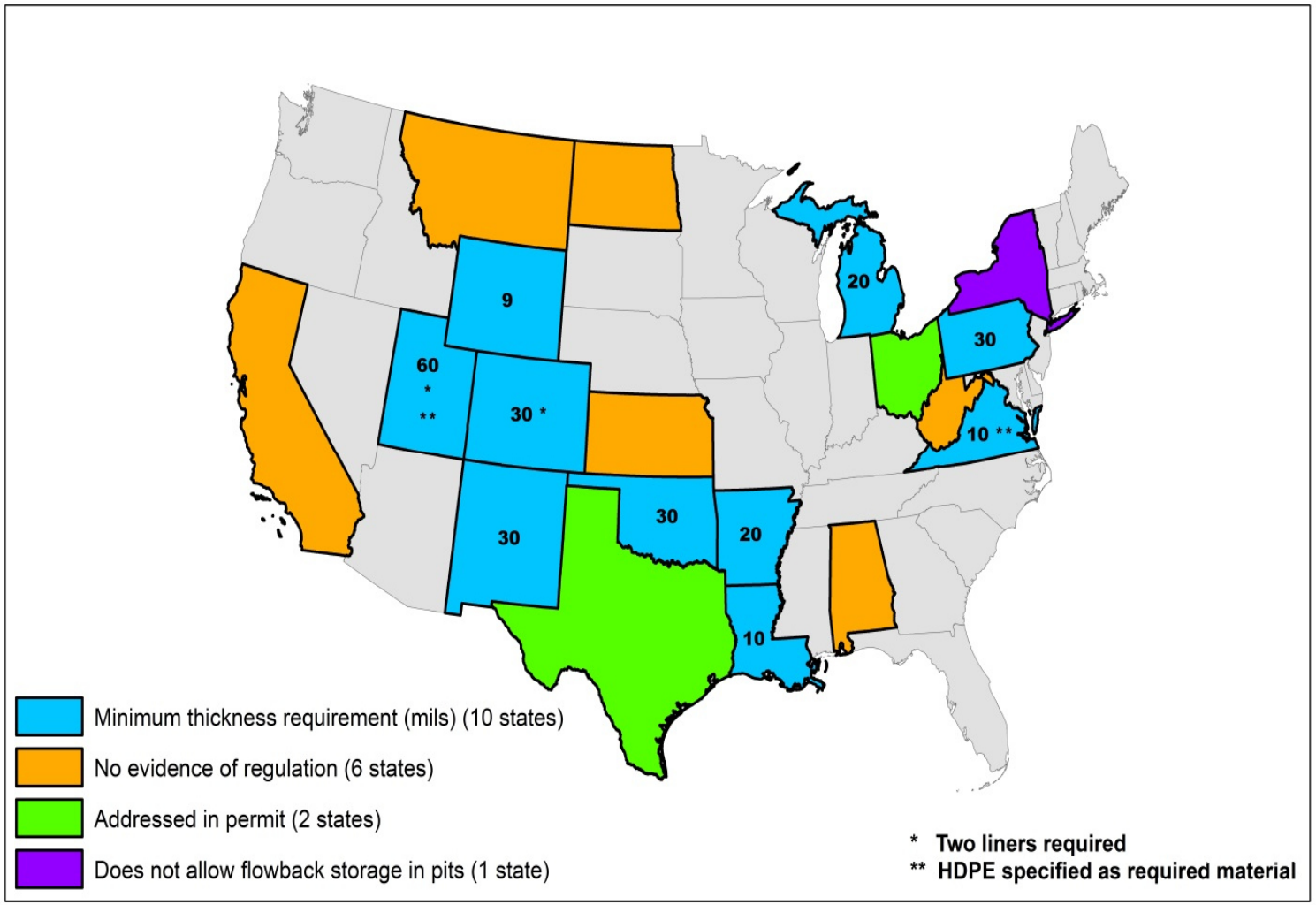
Mitigating risk: Existing regulations

State-level regulations on pit liner thickness requirements



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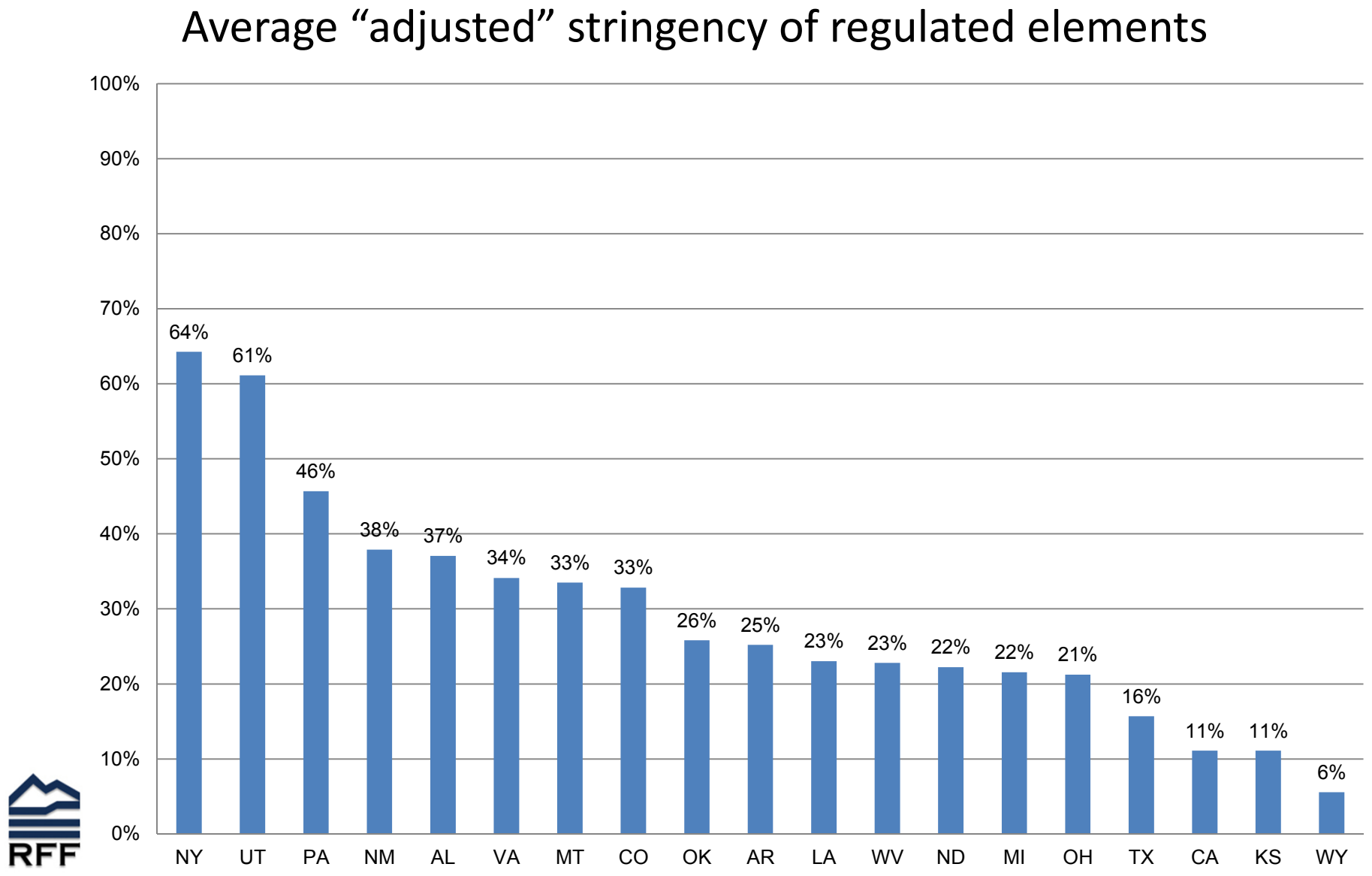
Comparison of existing state regulations



Conclusions

1. Literature review:
   a. Measured concentrations of contaminants in wastewater from hydraulic fracturing may pose risks to human health.
   b. At least in some cases, exposure to substances in shale gas and/or tight oil wastewater through airborne vapors has been sufficient to entail risks to human health, especially for workers involved in flowback operations. Exposure mechanisms have been most clearly identified for VOCs, particularly benzene.

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Conclusions (continued)

2. State databases of environmental incidents suggest that tanks are associated with smaller and less frequent spills than pits, but tanks are not infallible.
3. In CO, NM, and OK, pit overflows, tank overfills, and liner malfunctions are the most common causes for the release of shale gas and tight oil wastewater into the environment.
4. There is significant heterogeneity across states in the number and stringency of regulated elements.

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Future research would ideally address:

1. Concentration of contaminants in wastewater from oil and gas development in formations other than the Marcellus
2. Properties of wastewater that is specifically contained in pits or tanks
3. Contaminant concentrations in the air beyond the immediate vicinity of pits and tanks and potential risks for surrounding communities
4. The degree of exposure to substances in wastewater through surface spills and leaching into groundwater
5. The suitability of existing liner technology and installation/maintenance practices
6. The risks of wastewater stored in pits and tanks on ecological systems

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