Containing Risk: Climate Data and Phase I ESAs - A Case Study of ASTs in High Flood Risk Regions

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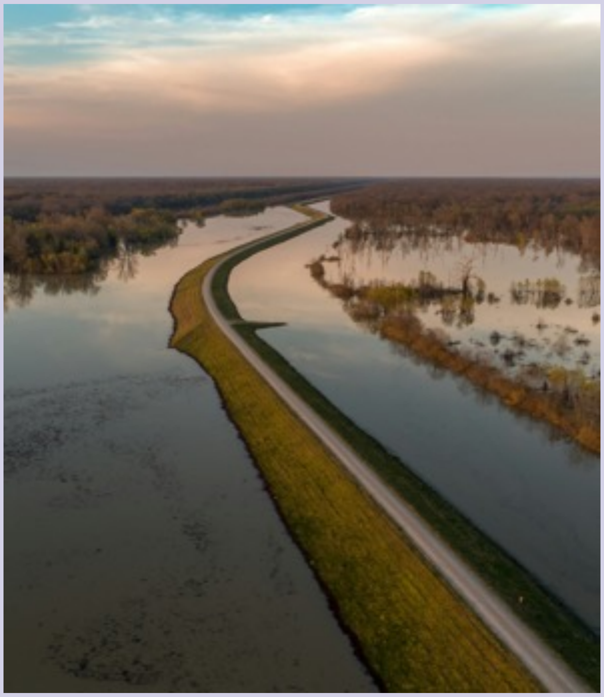
Introduction

You just invested in a warehouse property with fantastic cash flow. Suddenly, there is a flash flood event. It dislodges an aboveground storage tank (AST), which spills hundreds of gallons of diesel over a large area. Several drums of chemicals stored in the yard tip over and discharge onto soil and into an abutting creek. All the money the regulators are mandating that you spend cleaning it up is destroying your return on investment. When you conducted due diligence, your site was not in a FEMA flood zone. So, how could this have happened?

Modern climate risk models that account for various ramifications of climate change have largely rendered FEMA maps antiquated. While flooding is a costly concern to the general structural elements of a building, it can also pose a liability for properties that store hazardous substances and petroleum products.



The goal of this article is to determine if climate data (flood data specifically) can be combined with more general environmental data to help identify hidden risks on properties during the environmental due diligence process.

Current Phase I ESA Framework

The environmental risk management community has been watching the evolution of climate risk models and assessments with a keen eye. There is an intuitive feeling that there is a crossroads up ahead where climate models will play a significant role in environmental due diligence assessments, but that intersection has appeared distant and foggy. Yet, if we look back at our good ole' friend, the ASTM E1527 Phase I standard, that fog may clear.

The E1527-21 definition of a REC includes "the presence of hazardous substances or petroleum products in, on, or at the subject property **under conditions that pose a material threat of a future release** to the environment" (emphasis added).

A typical example of what has been considered a "material threat of a future release" (as provided in Appendix X4.3 of E152721) is the following: there is a damaged AST (containing diesel fuel) on a gravel surface that is "not protected by a roof, bollards, or a containment structure." One accidental bump by a vehicle backing up would undoubtedly lead to a release of diesel fuel onto the gravel surface and into underlying soils. Hence, this AST in this precarious position would be considered a REC.

Is the location of a property in an area of high flood risk a similarly precarious condition that could qualify as a Recognized Environmental Condition (REC)? In the past, there have been many counterpoints against this approach. But it is time to reassess.

Growing climate-related risks, including flood risks, highlight the need for a new approach. It's time to start rethinking the basic assessment framework before we get inundated by rising future risk.

Pairing Climate Risk Data with Environmental Records

Can an integrated dataset that combines climate risk modeling with environmental records ultimately assist environmental professionals in identifying RECs (per the E1527-21 definition)?

To determine how this would work, we assembled a unique dataset to see where an overlap may exist. Flood risk models (provided by ClimateCheck) were integrated with aboveground storage tank (AST) locations (provided by ERIS), which resulted in some interesting findings. Our analysis uncovered that areas with a seemingly low flood potential had a much higher than anticipated risk. If we consider how climate change has increased flood risk in the areas where ASTs are located, we may be opening the floodgates of countless new RECs.

Overview of ASTs

Aboveground Storage Tanks (ASTs) are enclosed containers that are, well, above the ground. They can hold innocuous items such as water, like the large water towers you see in small rural towns or liquid ingredients for food. Our discussion, however, is focused on ASTs that contain hazardous substances (HS) and/or petroleum products (PP). While you are unlikely to get many complaints about a tank full of strawberry jelly that tips over, you will likely face stiff fines and potential litigation if a tank containing a hazardous solvent spills and contaminates an underlying groundwater aquifer. Thus, ASTs containing HS/PP typically require the local fire department, for example, to conduct periodic inspections of the tank and ensure the facility has a permit to operate the tank.

AST permits are public records. A set of digitized AST permit data was collected and analyzed for this study. The dataset used includes 26,303 sites with registered ASTs. In particular, three AST records were provided:

National sources

1. **Facility Response Plan (FRP) Tanks (1,599 locations):** This list essentially consists of facilities across the entire nation with massive quantities of oil storage (we are talking about bulk oil terminals with over one million gallons of oil) that could reasonably be expected to cause "substantial harm" to the environment if a release occurred.

California-specific sources:

2. **Delisted California Environmental Reporting System (CERS) Tanks (9,051 locations):** This list is a snapshot of all the registered ASTs in California in 2009 (the list is no longer updated).
3. **California Environmental Reporting System (CERS) Tanks: (15,653 locations):** This consists of active registered ASTs in California.

Risk Analysis Methodology

Flood risk for each AST site was assessed using the ClimateCheck flood risk analysis. This assessment includes risk from the following types of flood events:

1. Storm surge flooding
2. High-tide coastal flooding
3. Fluvial (riverine) flooding
4. Pluvial (surface) flooding

The probability and likely depth of each of these four types of flood events are synthesized into a risk scale that uses 0 as the lowest possible flood risk and 100 as the highest possible flood risk (see Graphic 1 below).

Graphic 1: ClimateCheck Flood Risk Rating

0-100 Risk Descriptions

0-19	Relatively Low
20-39	Significant
40-59	High
60-79	Very High
80-100	Extreme

Graphic 1 displays the scoring breakdown for how each site is classified using the risk model. For example, a site with a score of 25 would be considered a “significant” flood risk, while a site with a score of 75 would be considered a “very high” flood risk.

Data Analysis and Findings

The 26,303 AST sites were scored using the flood risk rating cited in Graphic 1. The distribution of each is present in the pie chart (Chart 1) below.

Chart 1: Pie Chart of the breakdown of the flood risk rating of the 26,303 AST sites

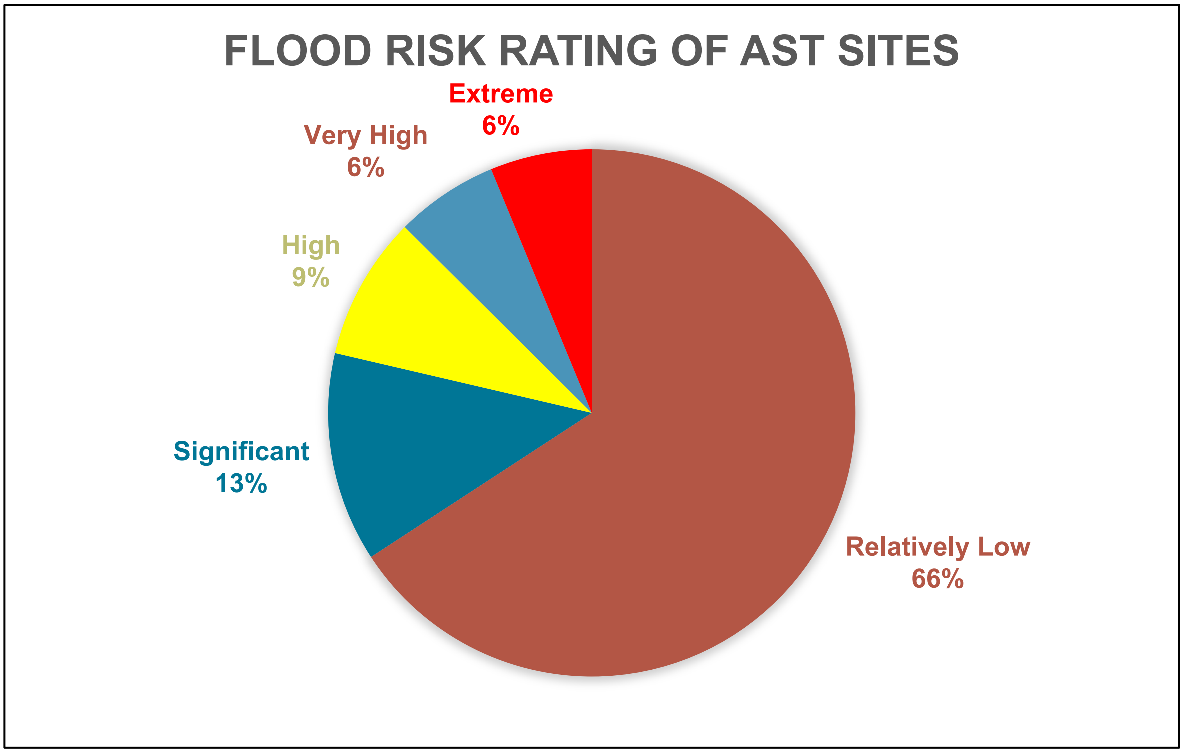


Chart 1: Pie Chart of the breakdown of the flood risk rating of the 26,303 AST sites.

A majority of the listed AST sites were identified to be “relatively low” flood risks. However, approximately 21% of sites (5,617 of the total 26,303 sites) were located in areas of high to extreme flood risk. Approximately 13% of sites (3,300 of the total 26,303 sites) were in areas of very high to extreme flood risk. Approximately 6% of sites (1,640 of the total 26,303 sites) were in areas of extreme flood risk.

This suggests that more than 1 in 5 sites with permitted ASTs are in elevated flood risk areas. This is a number that should raise the eyebrows of environmental professionals. As our climate continues to evolve, the danger of an AST being damaged by a flood may no longer be considered a remote possibility.

Part of the risk analysis was not just determining the chance of a flood but also the likely flood depth (see Table 1 and Chart 2):

Table 1:

Likely Flood Depth	Total ASTs	ASTs with no FEMA zone	ASTs with FEMA zone = 0.2 percent	ASTs with FEMA zone = 1 percent**
none	15,458	15458	0	0
less than 1 foot	4,975	3312	1130	533
1-3 feet	2,473	1353	590	530
3-6 feet	911	329	121	461
over 6 feet	1,134	315	57	762
tidal/unknown	1,352	287	652	413

Table 1: Number of storage tank sites within each range of likely flooding depth, broken into FEMA designations. Risk categories are based on the expected depth of a flood most likely to occur in the next 30 years (based on a radius search of data around each site).

**0.2 percent represents sites that have a 0.2% annual chance of a flood occurring (500-year floodplain)*

***1 percent represents sites that have a 1% annual chance of a flood occurring (100-year floodplain)*

Chart 2:

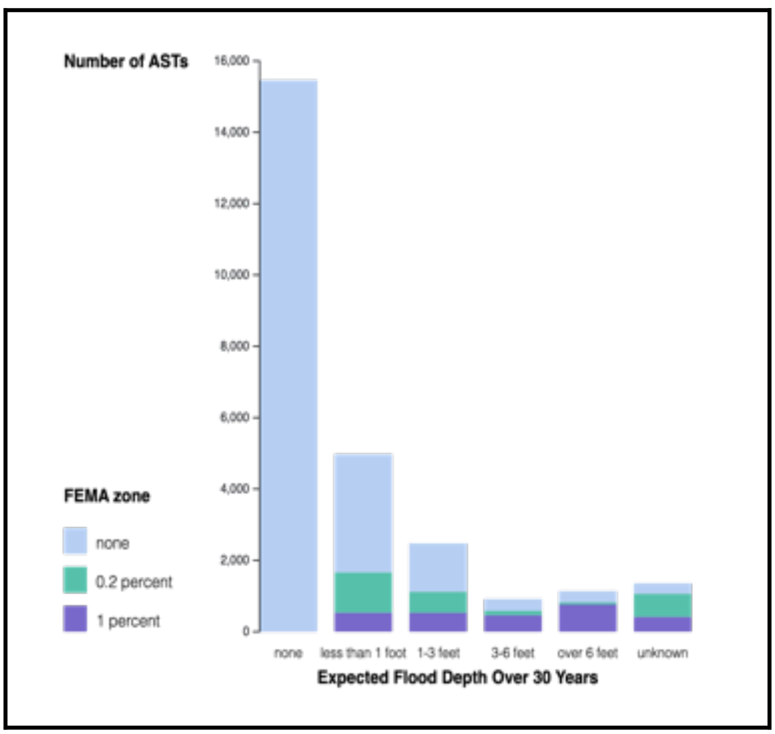


Chart 2: Distribution of the expected depth of a flood at the locations over 30 years (a graphical representation of Table 1).

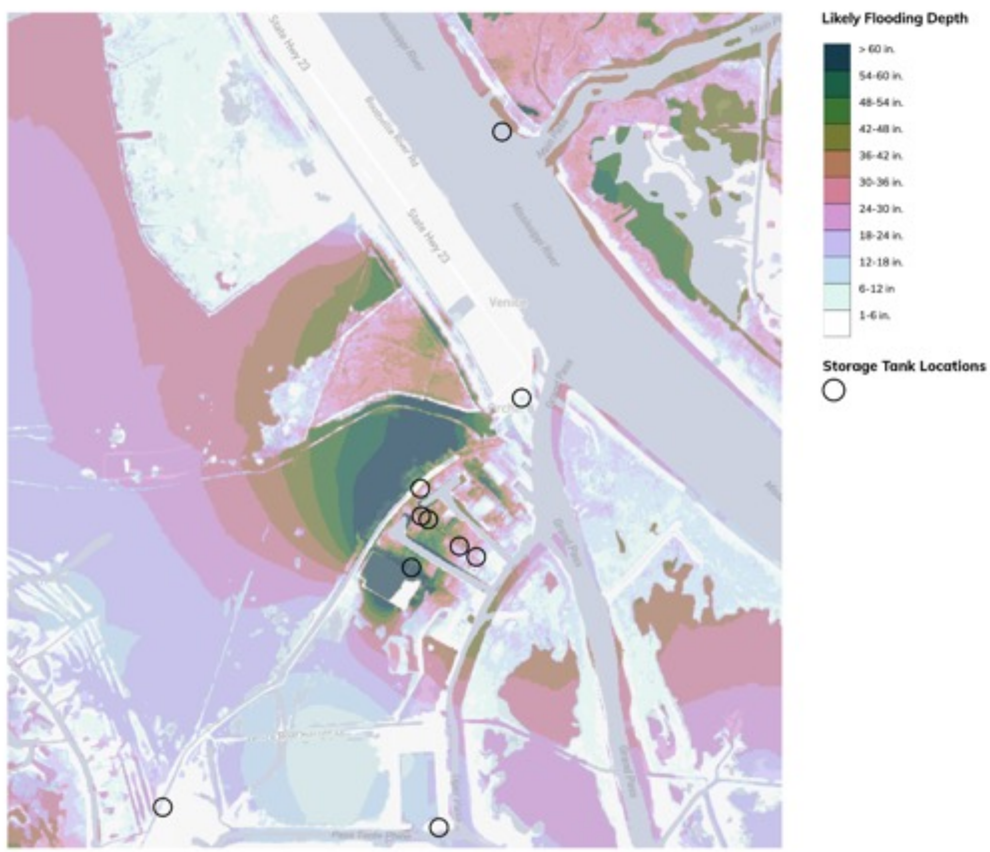
Table 1 and Chart 2 give us some insight into probable flood depths. From an environmental professional's perspective, the risk of a flood less than one foot may not be much of a concern for a site where hazardous substances are properly stored in elevated secondary containment. However, at a site with poor housekeeping (including various stained areas and corroded containers stored on bare soil), a one-foot flood may present a much higher risk. For a site with an AST, depending on the configuration of the AST, an environmental professional may consider any flood below three feet to be a fairly limited hazard.

One additional finding of note is that FEMA classified the largest percentage of sites with a high to extreme flood score as sites with “minimal” flood risk. While FEMA maps are helpful tools, they were developed for an intended purpose, and their application in this scenario is limited. FEMA maps do not contain an analysis of future changes in potential flood risk related to climate change.

Relevance to Environmental Professionals and Risk Managers

So why is this relevant to environmental professionals and environmental risk managers at lending institutions? If a quarter of sites with ASTs are in locations with high to extreme flood risk, and a large number of these sites are in an area FEMA maps mark as a “minimal” risk, there is potentially a very large blind spot that impedes a full risk assessment of an asset.

Below is a visual (Map 1) of several AST sites overlaid with a flood risk score. While the location of an AST in a high flood-risk area may not typically be on the mind of an environmental professional, something like the below map may help serve as a quick screening tool to understand potential flooding risk at sites that store hazardous substances and petroleum products.



Map 1: An example map showing AST sites (circular features) overlaid with a flood risk score (dark blue is the highest risk of flooding).

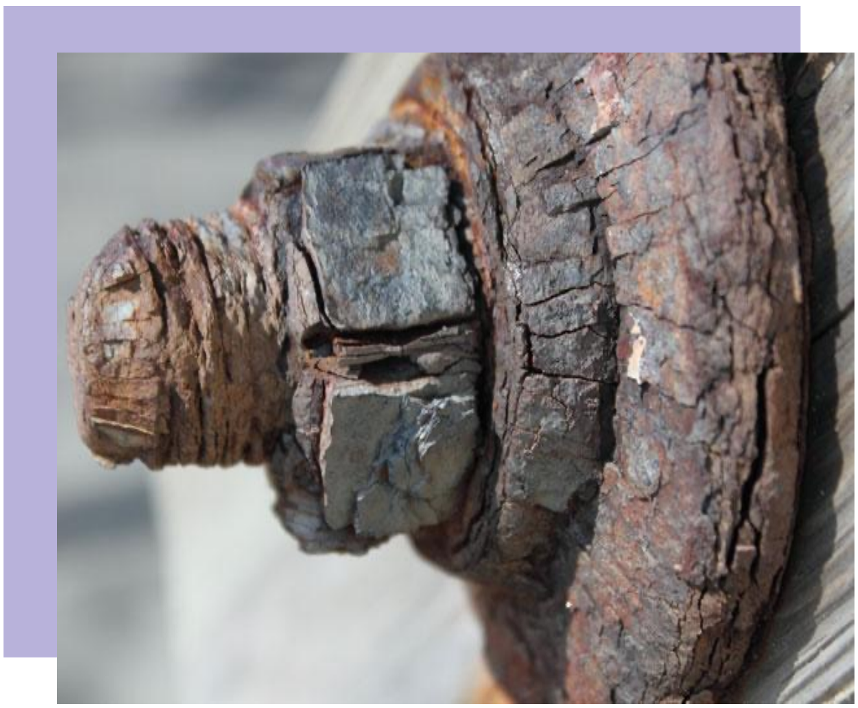
Case studies

Random sites were selected from the data set to see how flood risk may be relevant to environmental professionals and environmental risk managers. The initial details of each site are based on facts. However, for the purposes of this analysis, hypothetical conditions were posited to see if they would alter the conclusions of a Phase I ESA report.

Site #1 - A Bear of a Gas Station

Our first case study is based on a site located in northern California. The property is a rural gas station with a single fuel dispenser connected to a 5,000-gallon AST containing gasoline. Typically, gas stations utilize underground storage tanks (USTs); however, since this is a rural location with a low sales volume, a single AST is utilized.

The property is located approximately one mile inland from the Pacific Ocean. A creek that leads to the Pacific Ocean abuts the property to the north. The AST is located approximately 200 feet from this creek. FEMA maps classify this area as a “minimal” flood risk, however, the flood risk rating (cited in Graphic 1 above) classifies this site with a flood score of 100 (extreme flood risk).



Hypothetical: During the inspection for a Phase I ESA at this property, a field assessor observes the AST. The AST is on a concrete slab, and the support system underneath is in poor condition. In particular, the bolts that should fasten the AST to the concrete pad are broken, rusted, or missing. Although the assessor did not observe any current releases from the AST, in the event of a flood, the integrity of the AST anchors would likely fail. Failure of the anchoring system would cause the AST to be dislodged and damaged, resulting in the release of the tank contents into the environment.

Because this site is located in a high flood-risk area, one could argue that this represents “conditions that pose a material threat of a future release to the environment” (i.e., a REC) under ASTM E1527.

Site #2 – Flood Rock Quarry

In our second case study, Flood Rock Quarry (not its real name) is in Sonoma County, California, and consists of a steep hill stripped of vegetation. Three 1,000-gallon diesel ASTs and approximately 30 drums (containing waste oil and solvents) are situated at the base of the hill. ASTs and drums are on a concrete pad, but no berms or concrete walls enclose the area.

The property is not in a FEMA flood zone; nevertheless, given the location next to a creek and steep elevation disparity, it is given a flood score of 100 (extreme flood risk; see Graphic 1). The fact that the steep hill is stripped of vegetation compounds the potential risk of flash floods during extreme precipitation. A retention pond is present; however, the water appears to be at grade and at risk of overflowing into the yard area.

Hypothetical: During a Phase I ESA at this property, a field assessor observed leaking valves and piping from all three ASTs, and small amounts of product appeared to be pooling at the base of the tanks. However, the product is confined to the underlying concrete pad and does not extend onto surrounding soils. Drums appear to be rusted and are stored directly on concrete with no secondary containment; no leaks were noted at the base of the drums. Nearly half of the drums do not have lids, and the lids on the remaining drums do not appear to be tightly fastened.

While some of these conditions may be considered a potential compliance concern, since staining is confined to the concrete pad, there is no evidence of a release to the environment. Based on the lack of a release, an environmental professional may not consider these conditions to be a REC.

A week after the Phase I ESA site reconnaissance was conducted, an extreme rainfall event occurs. The drums without lids fill, and a rainwater-chemical mixture overflows. A surge of water down the hill tips several drums over, causing the contents to be released into waters flowing into the retention pond and surrounding soils. The retention pond eventually overflows and raises the waters in the chemical storage area high enough to move and tip the ASTs onto areas of base soil. Given the poor condition of the ASTs and observed leaking components, substantial loss of product occurs.

A follow-up inspection is conducted after the rainfall event, and RECs are identified. Several areas of contaminated soil are observed. A heavy sheen is noted on the retention pond and drainage swales. Contaminated soil and groundwater are suspected at several dry wells.

Should the assessor have classified the observed conditions as a REC during the first site inspection? There was no evidence of a release. However, one could argue that the condition of the drums and ASTs represented a "material threat" of a future release if a flood event were to occur.

Closing argument: Is it a REC or not?

The most important question is: can the risk of a potential flood be factored into determining a REC?

First, let us argue that the answer is "yes." Then, let us delve into how this could have massive ramifications in commercial real estate.

The argument:

Let us pretend that our second case study (Flood Rock Quarry) ends up in court. Suing Condos LLC, an adjoining property owner and developer, had to spend $1.7 million cleaning up contamination that originated from the quarry during the extreme rainfall event and is looking to recover those costs using the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund).

The quarry owner's attorneys claim that the rainfall event was an "act of God." Under the federal Superfund law, a party shall not be liable for a release if it is more probable than not that the release resulted from "an act of God." (CERCLA Section 9607(b)).

However, the attorneys for Suing Condos LLC point out that CERLCA defines the term "act of God" to mean "an unanticipated grave natural disaster or other natural phenomenon of an exceptional, inevitable, and irresistible character, the effects of which could not have been prevented or avoided by the exercise of due care or foresight" (emphasis added).

Furthermore, “due care or foresight” has been interpreted as steps a “reasonable and prudent person would have taken in light of all relevant facts and circumstances.” (H.R. Rep. No. 253, 99th Cong., 2d Sess. 187 (1986) (ASTM E1527-21 legal appendix)).

The Suing Condos LLC legal team argues that the failure of the quarry operator to install basic precautions (like anchoring an AST) in an area of high flood risk is considered a failure to exercise due care or foresight.

Additionally, the quarry operator stored hazardous substances in an exterior yard in uncovered drums and without any form of containment. Based on this lack of due care or foresight, the heavy precipitation event resulted in a release to the environment.

It is further argued that given the increasing trend of annual precipitation data, the rainfall event cannot reasonably be considered a “grave natural disaster” that could not be avoided. Therefore, the legal team argues, the release was easily avoidable if basic due care had been applied.

To further hammer home the point, the Suing Condos LLC legal team posits the following: When is a flood considered a “grave natural disaster?” Is a rainfall event with one inch of water “grave” enough?” What about 6 inches? What about 2 feet? Where is the threshold? Certainly, something as routine as rainfall cannot be an excuse for neglecting to implement AST best practices (exercising due care).

The judge eventually rules that the “act of God” defense cannot be applied in this circumstance. Suing Condos LLC is ultimately able to recover its cleanup costs from the quarry operator.

Ramifications of a REC

If there is industry consensus that potential flood risk can be considered a REC, there could be colossal implications in commercial real estate.

Why would this be the first domino in a long line of consequential outcomes?

First, this would result in an increase in RECs in an average Phase I ESA.

For the real estate investor, more RECs mean more money. More money that will have to be spent installing updated anchoring and containment systems. More RECs also mean more time. More time spent addressing items and delaying funding and closing. This could be especially troublesome for time-sensitive deals.

For lenders, this would mean significantly revising the scope of work for underwriting CRE loans. Climate resilience and climate risk reports are currently more of an optional item with a very slow adoption rate. However, virtually all CRE loans require some form of environmental due diligence. If a future flood risk is a REC, then environmental risk managers at banks would be forced to consider certain future climate risks as part of their due diligence requirements before approving a commercial loan.

For the environmental consulting industry, it would mean a seismic shift in how risk is approached. The relevant ASTM standards would need to be updated and revised to clarify when future climate risks can be considered “a material threat of a release.”

For the EPA, it may mean revising all appropriate inquiries (AAI) to encompass potential climate risks. If AAI requires an assessment of climate risk, the entire commercial real estate industry, including investors, lawyers, regulators, lenders, and consultants, would have to take notice.

Conclusion

Given the ever-evolving nature of climate change, we need to be prepared to utilize new approaches. What was once considered industry best practice may no longer be good enough. As climate models become more widespread, there could be a breaking point where certain climate risks may be considered “common sense,” and the failure to prepare for those risks will no longer be considered defensible.

Post-Script: Mitigating Flood-Related Risks

The focus of this article was to use AST and flood data to find a potential link between the behemoth that is the environmental due diligence industry and the growing field of climate risk data analysis. I would be remiss if I did not, at the very least, address the fact that there are indeed solutions and mitigants to potential flood risk for sites with ASTs.

Perhaps the most straightforward solution is for environmental professionals and risk management teams to take a closer look at anchoring and containment systems for aboveground outdoor storage of hazardous substances and petroleum products. For both example sites provided above, the risks would be abated by ensuring that the ASTs are properly anchored and protected against flood events.

Additional rigor may be required to ensure the proper storage and containment of hazardous substances stored in outdoor areas. Not only is a concrete pad and secondary containment necessary to prevent spills, but containment walls may also be extremely prudent, especially in areas of high flood risk.

The United States Office of Energy Efficiency and Renewable Energy (US EERE) provides guidance on how to properly anchor, plan, and protect ASTs from floods and other extreme weather events.

For more information on preventing damage to ASTs during a flood event, visit:

https://basc.pnnl.gov/resource-guides/fuel-tanks-anchored-disaster-resistance#edit-group-training

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