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Planning, Projecting, and Paying: How to Save Dollars through “Risk-Informed” Decision Making.

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The Car Salesman Analogy

When you buy a car, what's the game?

- **Imagine**
- Focus on **monthly payments**
- If you can afford the payments, you may **overlook the total amount!**

UST Funds share a similarity:

- If your annual budget balances, you're great.

The Actuarial Reality of "low monthly payments" for UST sites

- Small quarterly expenditures can add up to massive total costs!

Project the costs for prolonging and plan to eliminate the sources of delay.

Loss Development Triangle - Incurred Losses

As of December 31, 2023

(All figures in thousands of dollars)

Accident Year	12 Months	24 Months	36 Months	48 Months	60 Months	72+ Months
2019	8,450	12,680	15,920	17,850	18,940	19,250
2020	7,890	11,450	14,200	16,780	17,650	—
2021	9,240	13,890	17,450	19,200	—	—
2022	8,670	12,950	15,840	—	—	—
2023	9,100	13,420	—	—	—	—

Ultimate Loss Projections

Accident Year	Current Incurred	Ultimate Projected
2019	19,250	19,250
2020	17,650	17,933
2021	19,200	22,290
2022	15,840	20,992
2023	13,420	18,851
TOTAL	**85,360**	**99,316**

Accelerated: Making Final Clean-up in years 4 and 5.

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The Problem

Modeling data from multiple midwestern fund states suggests that it would take 100 people working full-time for 33.3 years to complete a 500-site portfolio, assuming current practices remain unchanged.

The estimated cost for the work is $ 612.3 million.

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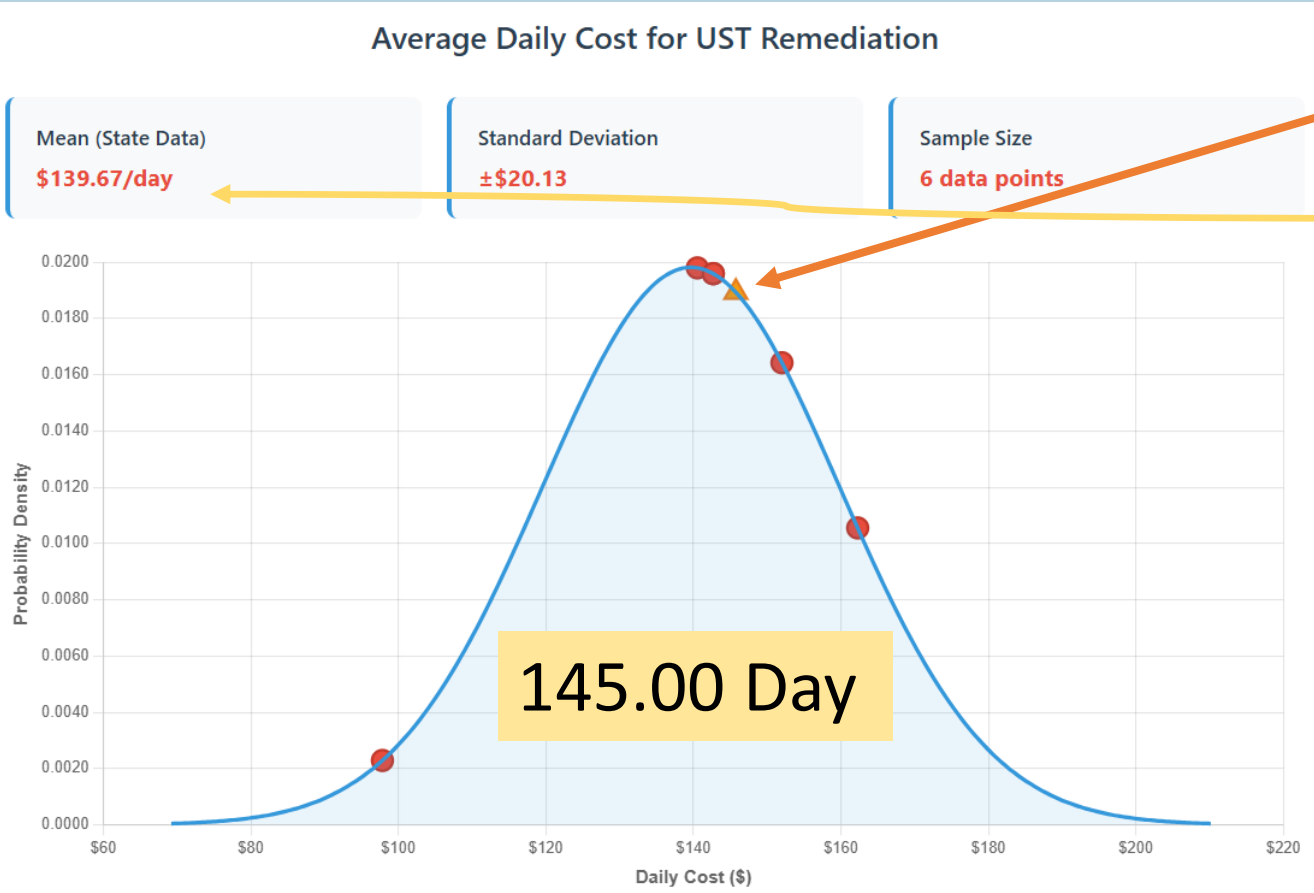
Estimating a Generic per-Day Costs for Open Sites



- Estimated value (Sum of individual costs) = $145.75
- Estimated, from 5 state's data = $139.67

- Statistical Precision (Pull the lowest & highest)
  Mean: $144.48/day
  Standard Deviation: ±$4.43 (Drops)
  Comp. Accuracy: 99.1% ($145.75 est vs $144.48 mean)

  **These values are weighted to the central U.S.
  The multiplier for generalizing:

  California statewide average: 1.38x ($200.00)

  New York state average: 1.20x ($173.00)

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Time is not on your side.

- A one-day increase in project duration corresponds to ≈ $145.00 increase in total project costs.
- Using the average annual inflation rate of the past 15 years (2010–2025), in 10 years, the cost will be ≈ $187.60.
- Presently, a single month of delay is $4,350.00.
- Assume the PMs are acting “average”

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Time to Final Closure 2024 Data - Chi-Squared Model

- Mean = 5.84 years
- Standard Deviation = 3.46 years
- Median = 5.35 years
- Mode = 4.0 years
- 98th percentile is 9.2 years

Legend

- **Chi-Squared Distribution** - PDF with k=6 degrees of freedom
- **Sample Data Points** - Observed closure times (n=5)
- **Target 98th Percentile** - 9.0 years constraint
- **Distribution Mode** - Most likely closure time (4.0 years)

5.35 years X 365 days/year X 145.00 per day
= $283,148.75 median site cost

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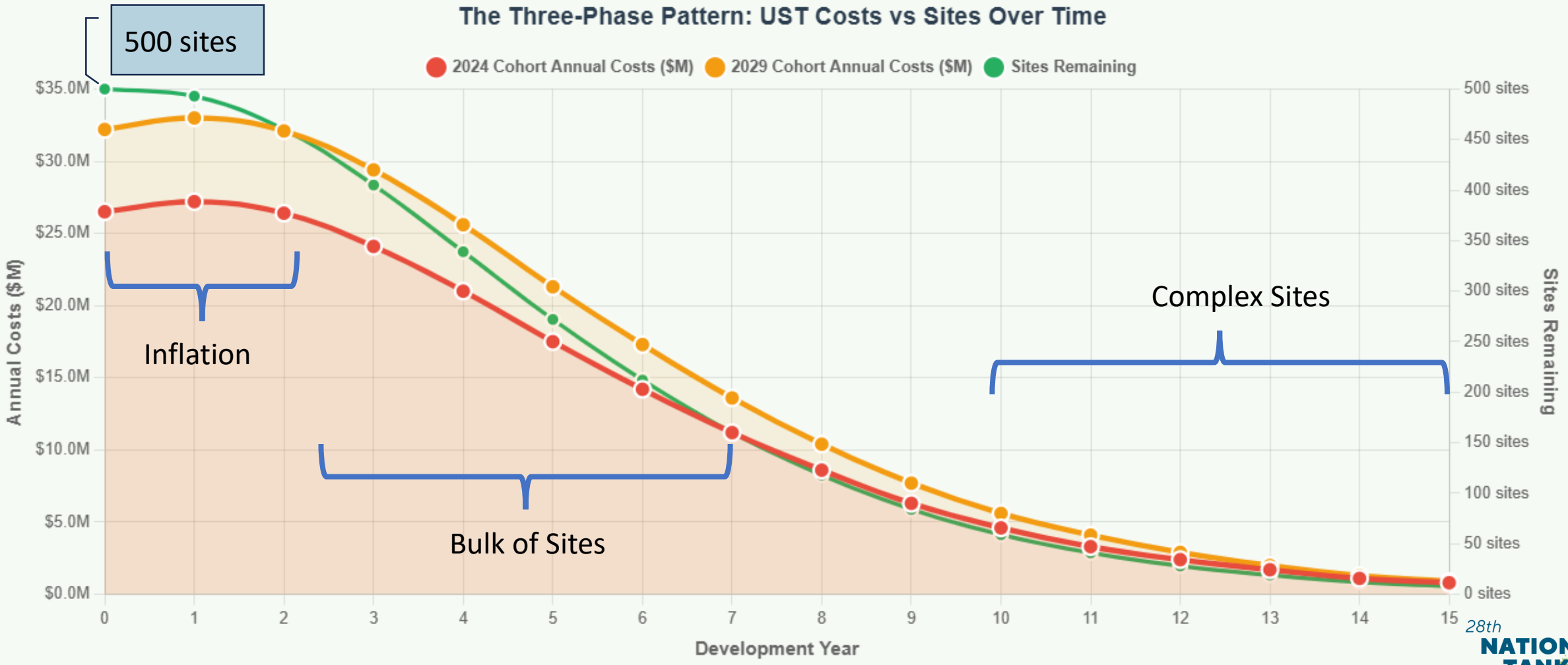
Mixed Portfolio of 500 Sites in Various Phases of Clean-up

Using the data presented, we generate daily costs for 15 years (Accelerated for Illustration Purposes).



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What Does the Model Illustrate for Us?

Key Lesson: Early intervention

- In Years 0-2, inflation outpaces savings
- **The critical performance period in Years 3-7.**
- Later actions face 22-33% higher costs.
- Final 59 sites from the 2024 cohort (Year 10) still generate $4.6-5.6M in annual costs.

Success Metrics Evolution

- Years 3-7 should focus on the speed of closure.
- Later years emphasize efficiency
  - Allow flexibility in closing those sites.

Structure Early Discernment into Your Program

- Your most competent staff should see sites early in the process!

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An Effective Suggestion

High-Resolution Site Characterization (HRSC)

EPA's 2023 Study "High Resolution Site Characterization (HRSC) at Petroleum Underground Storage Tank Release Sites – Applicability, Benefits, and Costs"

HRSC

- Can save 9 to 19% in project costs
- Sometimes adds 20% to costs
- It also says it could save 40% on some projects.

Time Savings

- Save 3.3 years vs 10 years (Historically) and 3.7 years on catastrophic release

I'll use these parameters in the Chi-Squared Model

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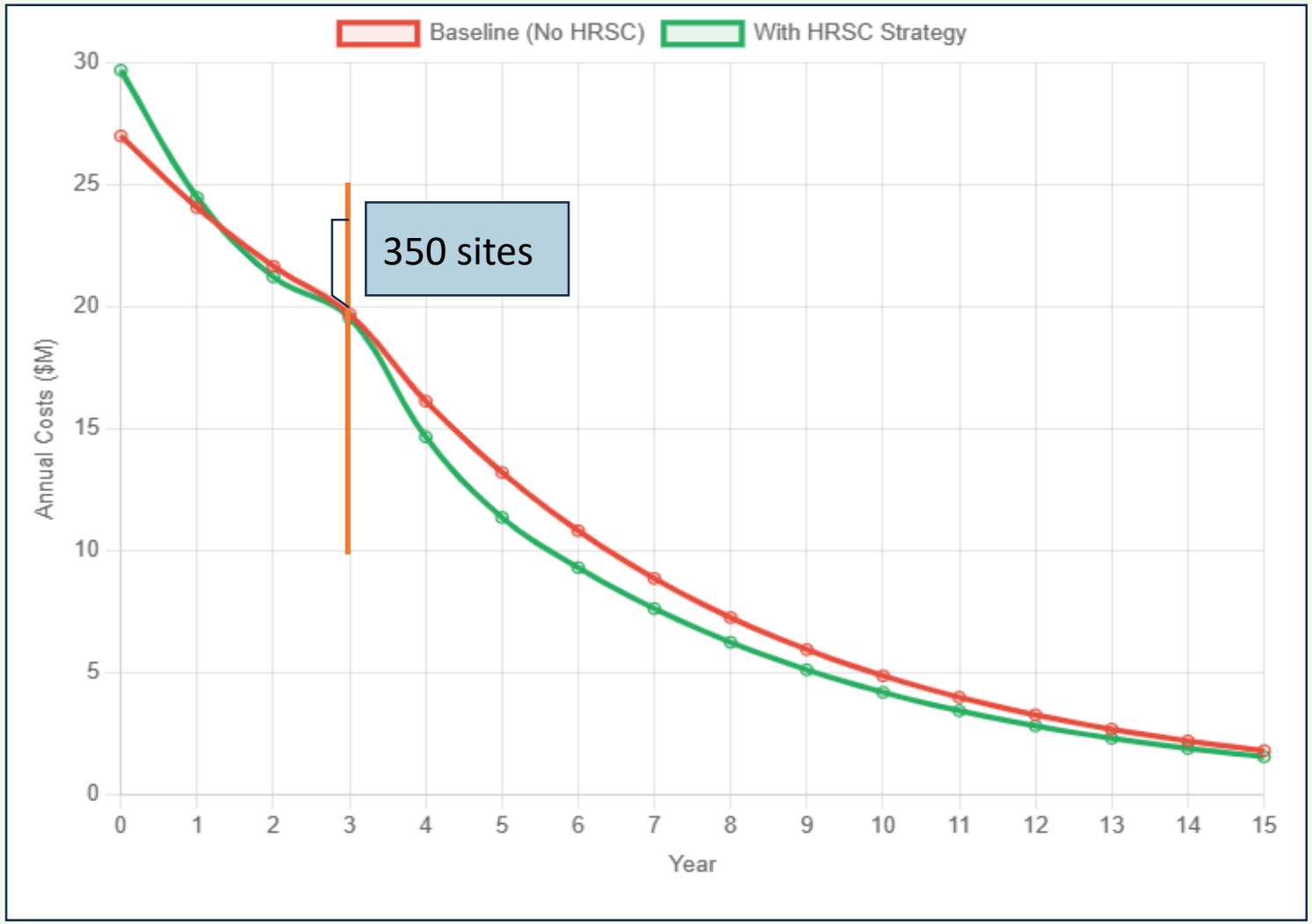
Updating on Chi-Square Model & Project 60K HSRC Spend



Model Insights

- **Optimal Strategy:** 70% of sites get HSRC at the appropriate time.
- **Savings:** 8 to 15M over 15 years for the 500-site portfolio.
- **Time Saved: ≈ 2.5** years median
- **ROI:** 200-400% return

* Don’t confuse this analysis with the EPA analysis.

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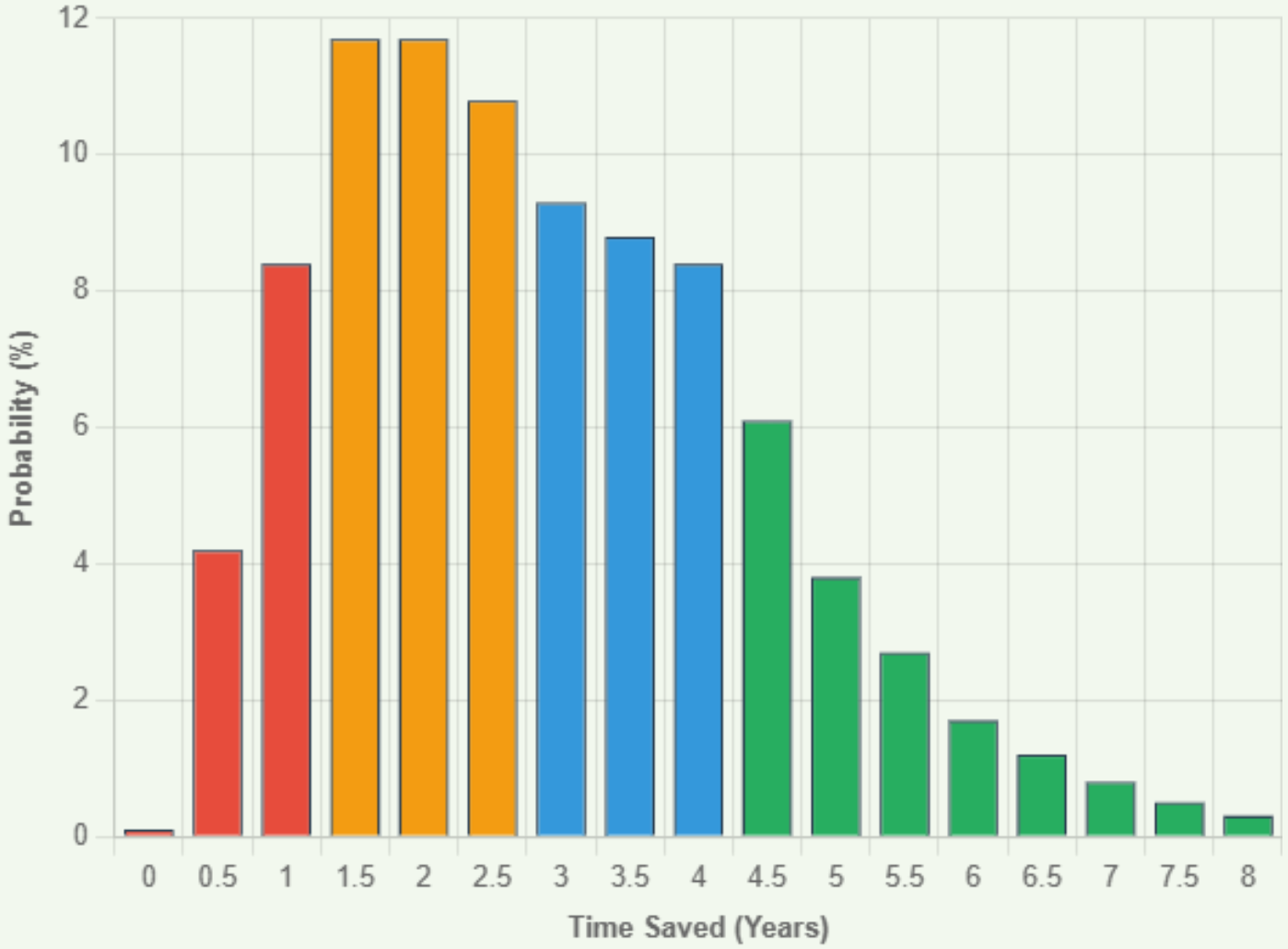
Time Saving Distribution with HSRC



Distribution Statistics

- Mean Time Saved: 2.7 years
- Median: 2.5 years
- Standard Deviation: 1.6 years
- Range: 4.8 months to 5.5 years

Costs and Returns 500-sites

- Total expenditure: $16M
- Total savings over portfolio: $139M
- Net savings: $123M

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HRSC Decision Guide

High-Resolution Site Characterization Investment Framework

Site Evaluation for HRSC Investment

HIGH CONFIDENCE

100-200% ROI

- Sites older than 2 years
- Stalled remediation projects
- Catastrophic releases
- Projected costs >$400K
- Complex indicators present

MODERATE RISK

25-75% ROI

- Sites 1-2 years old
- Projected costs $150K-$400K
- Near break-even threshold
- Early complexity signs
- HRSC = 10-15% of total cost

HIGH RISK

Potential Loss

- Sites under 1 year old
- Projected costs <$200K
- HRSC >20% of total cost
- Simple sites (quick closure)
- >70% costs already spent

1

Sites > 2 Years Old

Always use HRSC. No downside risk.
Investment: $40K-$75K
Based on site complexity

2

Sites < 1 Year

Only use HRSC if projected cost > $200K.
Investment: $40K maximum
Proceed with caution

3

Optimal Investment

Spend 15-20% of projected total cost
Capped at $75K
For most effective ROI

4

Break-Even Point

HRSC pays for itself when total site cost **exceeds 3x the HRSC investment**
Use this as minimum threshold

Implementation

Structure Early Discernment into Your Program

- You should have your most experienced and skilled personnel reviewing closures and initiating site characterizations.
- As these very same people will want to work on the most complex sites, a problem arises.
- You may need to set up these evaluations as “special” group projects.
- **Skill is needed early because the dollars are lost and saved early in the process.**

A good beginning predicts a good end.

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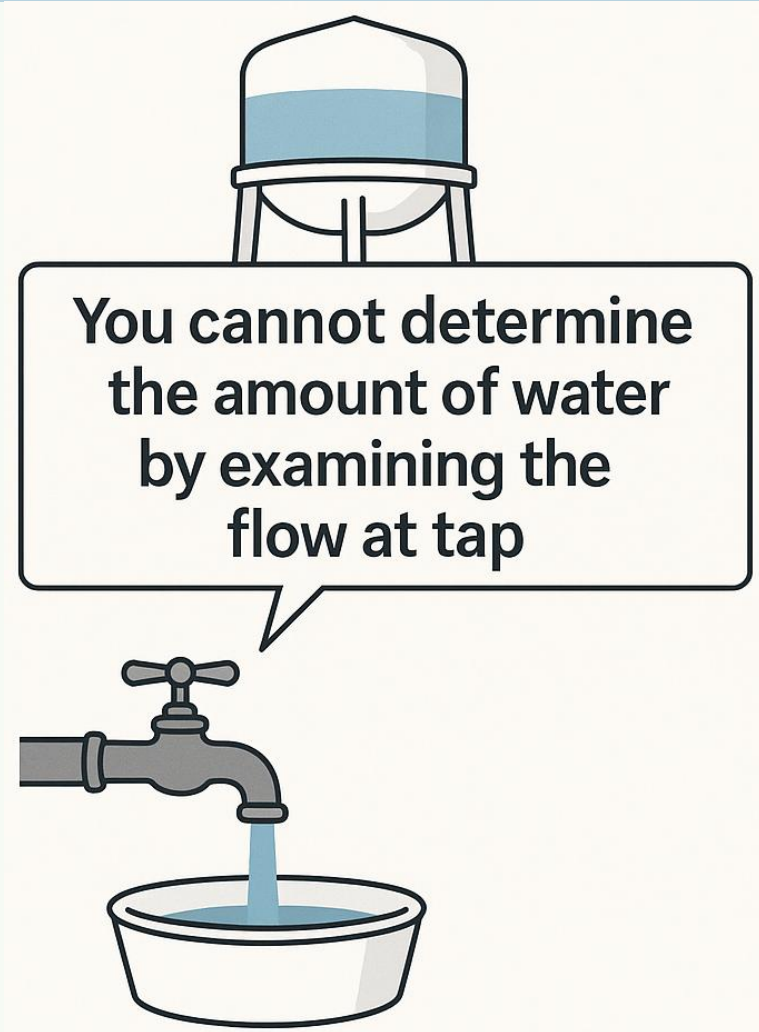
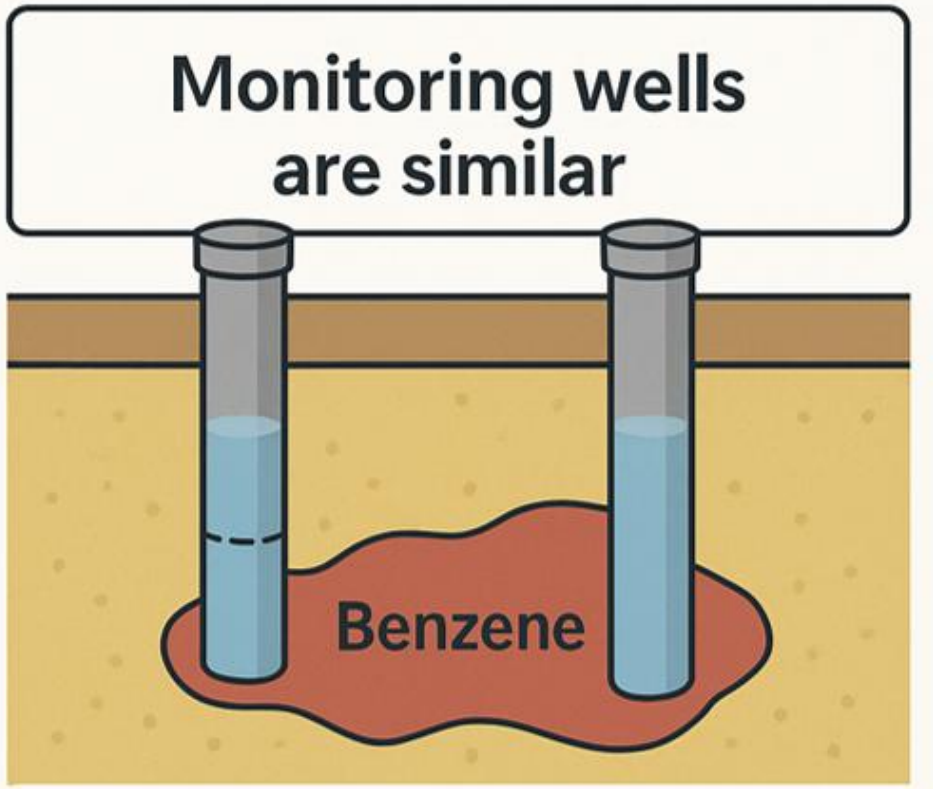
The Analogy of the Water Tower: Find the Mass(es)



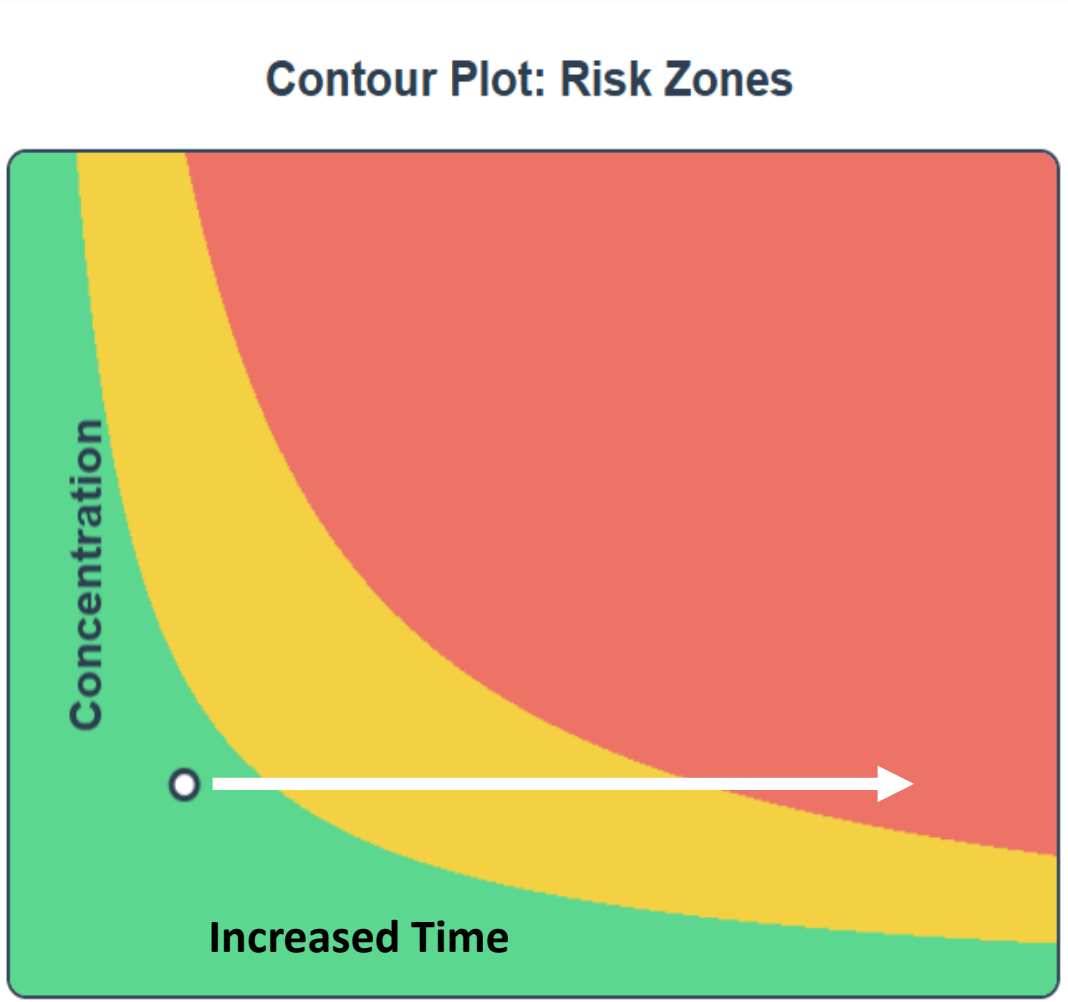


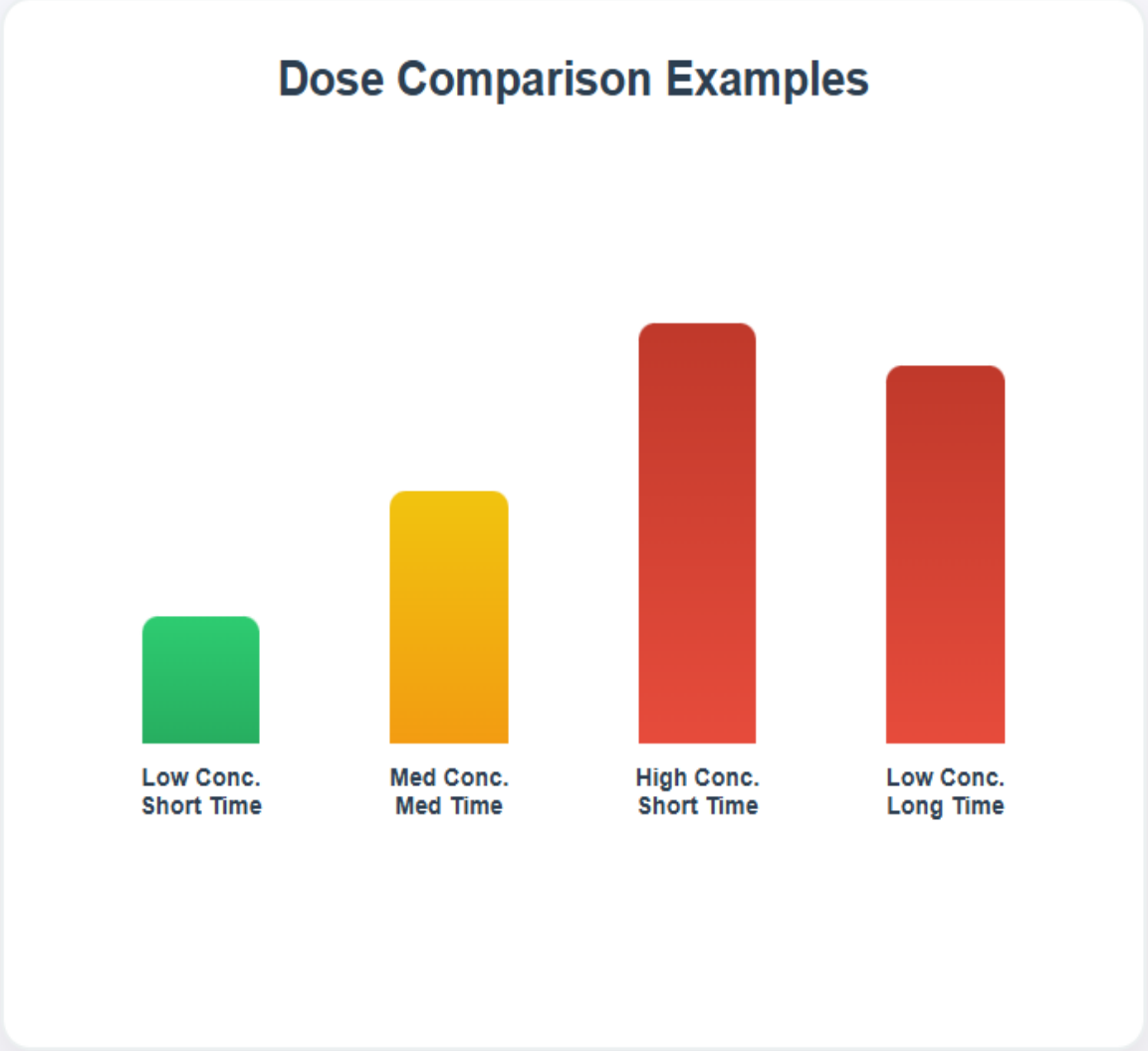
You can sample a well many times, but the concentration of 'benzene' in the water will not tell you mass of contamination in ground.

- **Find the mass(es) of contamination!**
- **Most is associated with soil and aquifer materials.**

Address Mass to Prevent Sustained Exposure

Completed exposure pathway, **sustained** exposure, at a sufficient concentration = Risk Probability.





“Risk-Informed” extends risk-based decisions

- **Risk-informed** focuses on contamination mass & the stratigraphy that retains mass.

  *It avoids chasing dissolved phase plumes in favor of early action at the source.

  *The objective is to reduce the possibility of **sustaining** exposures!

  *Better characterization moves one away from baseline risk assumptions.

- **Risk-informed** prioritizes expenditures that **prevent** sustained exposure**.**
- **Risk-informed** considers

  ***Legislative action to “end the bleeding” – sunset the program.**

  ***What condition do you want the sites to be in when you are forced to walk away?**

- **“Risk-informed”** included the opportunity costs across the portfolio**.**

Lessons and Approaches

- **Spend money early in the characterization process – Basic Lesson!**
  - As directed by the most competent personnel.
  - Even at the risk of spending more on that site than the data ultimately supports, because
  - You can't see the future for a site, but you can see the future of your portfolio if you don't!
- **Focus on the mass(es) of contamination not "the extent of plumes"**
  - Use HRSC to find the mass(es) in three-dimensional space
  - When you don't know what to do, don't direct another round of sampling or install more monitoring wells based on intuition.
    - MW's are expensive over time!!
- **Build into your organization space for acceptable failure** – Because no one can see inside the earth, you can't learn without experience, and tuition is not cheap.