Alternatives to Secondary Containment Lining

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EPA

Statistics

- 500,000 AST Facilities
- 1.8 Million ASTs
- 80% Without Low-Permeability Secondary Containment

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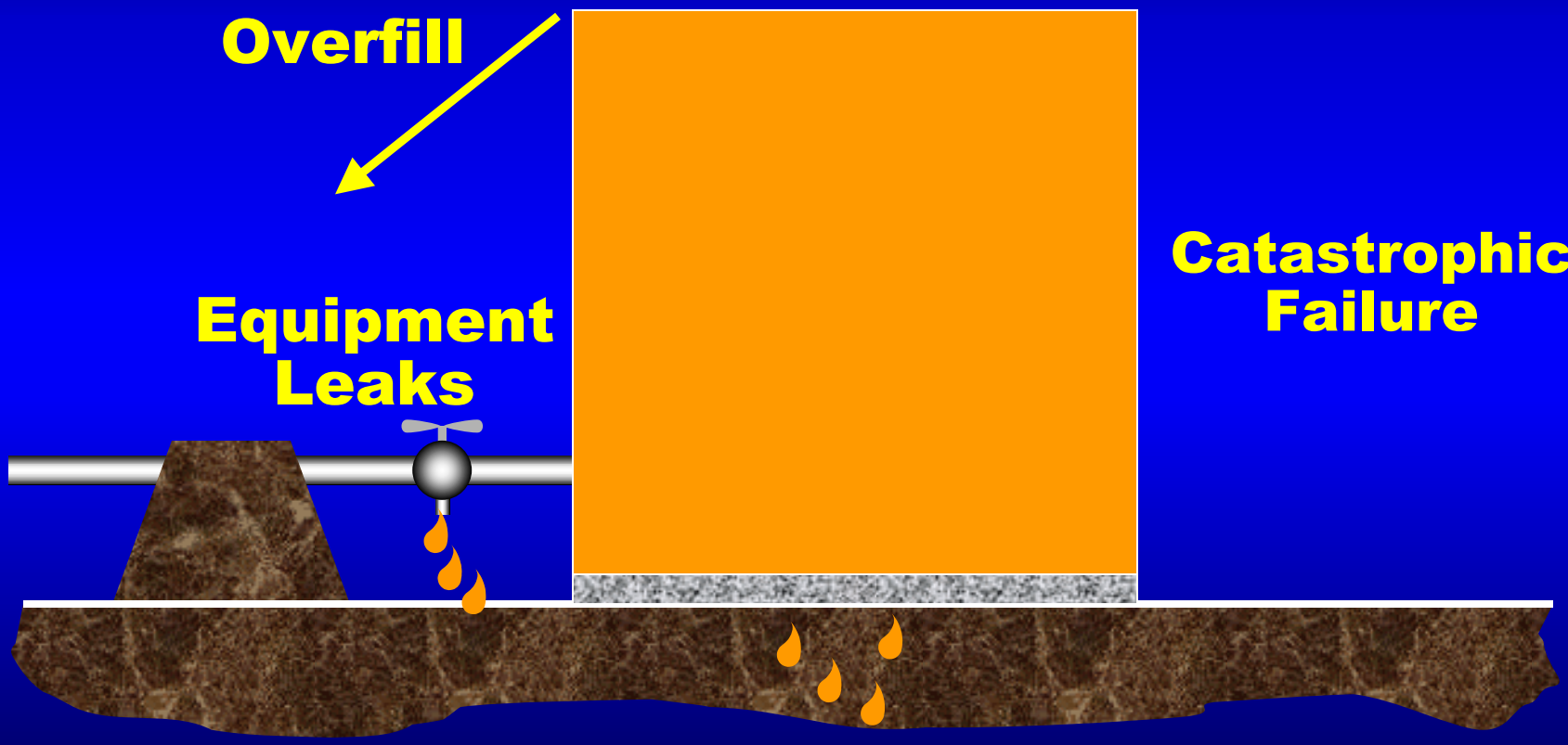
AST Releases




Pinhole

Secondary Containment

- Purpose Is to Control, Contain a Spill Until Clean-up
- Historically, Concern Has Been Lateral Spreading of Spill

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2954


1993
DIESEL


DIESEL

Secondary Containment

- Design Concerns
  - Provide Adequate Volume (largest tank plus precipitation)
  - Allow Operation and Maintenance

Regulations/Guidance

- Federal
  - Oil Pollutions Act of 1990 Amends Clean Water Act §311
  - 40 CFR 110 - Discharge of Oil
  - 40 CFR 112 - Oil Pollution Prevention
- National
  - Fire Code (NFPA 30)
- States
  - Departments of Environmental Protection, Quality

Federal

- **40 CFR §112(e)(2)(ii):**
  - ***All bulk storage tank installation should be constructed as that a secondary means of containment is provided for the entire contents of the largest tank plus sufficient freeboard to allow for precipitation. Diked areas should be sufficiently impervious to contain spilled oil.***

State

- No Liner Required: CA, IL, MA
- No Breakthrough Within 72 Hours: VA
- $1x10^{-4}$ cm/sec: MD
- $1x10^{-6}$ cm/sec: PA
- Reasonably Impervious (6” at $1x10^{-7}$ cm/sec): MN

State

- $1x10^{-7}$ cm/sec: ID
- Sufficiently Impermeable: AK and LA
- Impervious: KS and WI
- Liquid Tight: AL and 32 Other States


Goals
•Protect Environment
•Using Effective Methods

Retrofitting Options

LINER OPTIONS		ENVIRONMENTAL/CONTROL OPTIONS	
Surficial Liners	**Enhanced Existing Soil Liner**	**Environmental Controls**	**Prevention and Enhancement**
Geomembrane	Biological Clogging	Slurry Walls	Double Bottoms in Tanks
Geosynthetic Clay Liner	Chemical Clogging	GW Control	Leak Detection Systems
Compacted Clay	Soil Cement		Preventative Measures
Concrete	Chemical Grouting		Backflow Prevention
Asphalt	Soil Bentonite		Overfill Prevention
Spray-On Liners			Operational and Procedural Controls

Retrofitting Options

Site Conditions	Engineering Design	Construction	Operator Issues	Cost
Existing Conditions	Product Compatibility	Constructability	Operation & Maintenance	Capital
Geometry	Desiccation Resistance	Availability of Materials	Operational Flexibility	Maintenance
Penetrations	Freeze-Thaw Resistance	Weather	Storm Water Management	Clean-up
Regulatory Acceptance	Temperature Extremes		Clean-up	Remediation
	Wind Resistance		Subsurface Remediation	
	Ultraviolet Resistance		Trafficability	
	Fire Resistance		Vegetation Control	

Retrofitting Options

GRADE	DEFINITION
A	Satisfactory Performance With Minimal Extra Effort
B	Satisfactory Performance if Specific Design Elements are Implemented
C	Significant Extra Effort May Be Required To Achieve Satisfactory Performance
D	Satisfactory Performance May Not Be Feasible
F	Satisfactory Performance Will Not Be Feasible

Example

- Tank Farm: 7 Tanks
  - Total Area: 140,000 ft^2
  - Open Area: 83,000 ft^2
  - Area of Bottom: 57,000 ft^2
  - Height of Dikes: 5 ft
- Largest Tank:
  - Diameter: 120 ft
  - $H_{Product}$ = 46 ft
  - V = 93,000 bbls

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Example

- Soil:
  - Homogeneous Sand Deposit
  - k = 10-5 m/sec
  - Porosity: 0.35
  - Thickness: 100 ft
  - Groundwater Depth: 5 ft

Evaluation of Options

1. Geomembrane
2. Geosynthetic Clay Liner
3. Spray-On Liners
4. Compacted Clay
5. Concrete
6. Asphalt


Option 1
Geomembrane


Option 2
Geosynthetic Clay Liner


LOT# 960110 PHONE 800-633-5015
UNITHERM

Alternative Option

Install Double Bottoms and Overfill Protection in Tanks and Do Not Install Liner in the Diked Area

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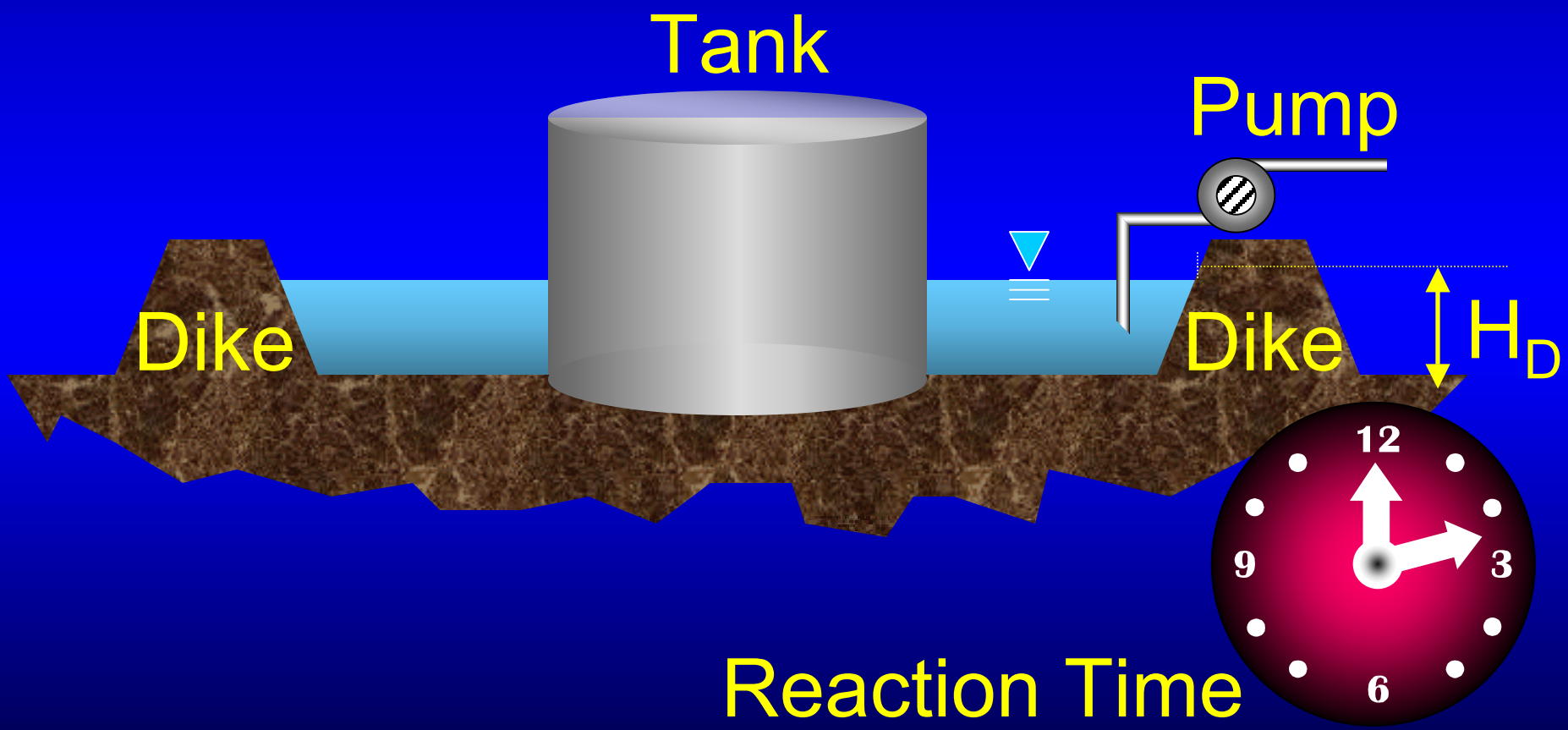
Comparison

Analyze two Scenarios:

1. Liner and Single Bottom
2. No Liner, Double Bottom, Overfill Protection, and Product Removal System

Scenario 2



Comparison

- Compare Volumes of Product Released to the Environment:
  - Leaks
  - Catastrophic Failure
- V_1= Volume Under Scenario 1
- V_2= Volume Under Scenario 2

Performance Ratio

$$PR = \frac{V_1}{V_2}$$

PR > 1 $\Rightarrow$ Scenario 2

PR < 1 $\Rightarrow$ Scenario 1

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Scenario 1

- **Assume Bottom Leak:**
  - **Pinhole d = 0.04 in. (1 mm)**
  - **1 Pinhole / Acre of Bottom**
  - **57,000 ft^2 of Bottoms**
    1.32 Acres
- **V_1 = (Bottom Leakage Rate) (Area of Bottom)(Time)**

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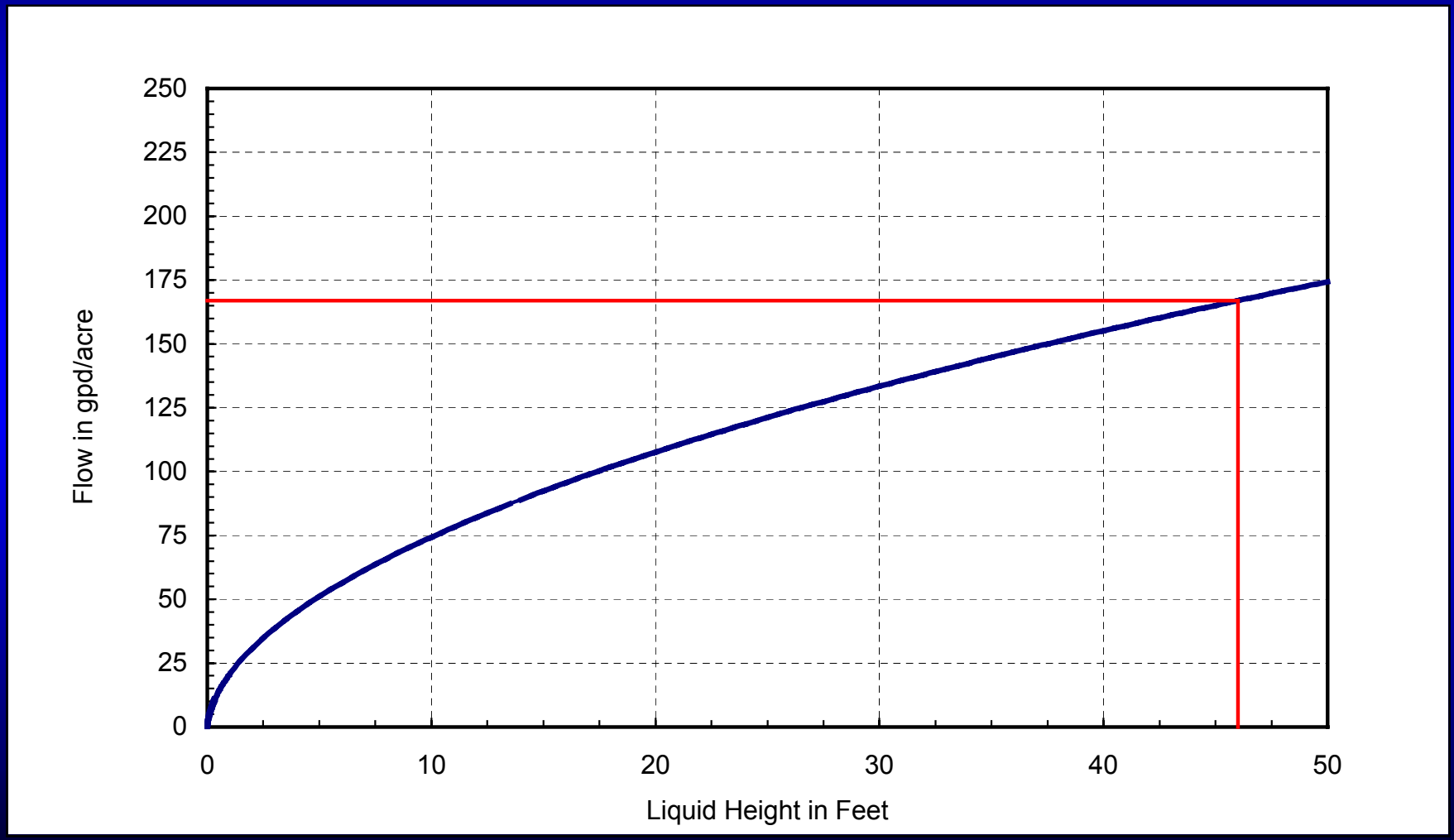
Pinhole Leakage Rate



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Scenario 1

- From Graph Rate = 167 gpd/acre
- V_1 = (167)(57000/43560)(365)(42)

  = 1,899 bbls/yr

Scenario 2

- Assume Catastrophic Failure of Tank
- Assume Leak in Double Bottom
- V_2 = (leakage rate)(area of bottom) (time) + (volume infiltrated in soil following catastrophic failure)

Infiltration Following Catastrophic Failure

- Using XSLIM
  - 93,000 bbls
  - 2,500 gpm Pump
  - Pumping Start in 6 hrs
  - Depth of Penetration: 0.54 ft
  - Volume of Product in Soil: (0.54)(83,000)(5.6)(0.35)= 2801 bbls

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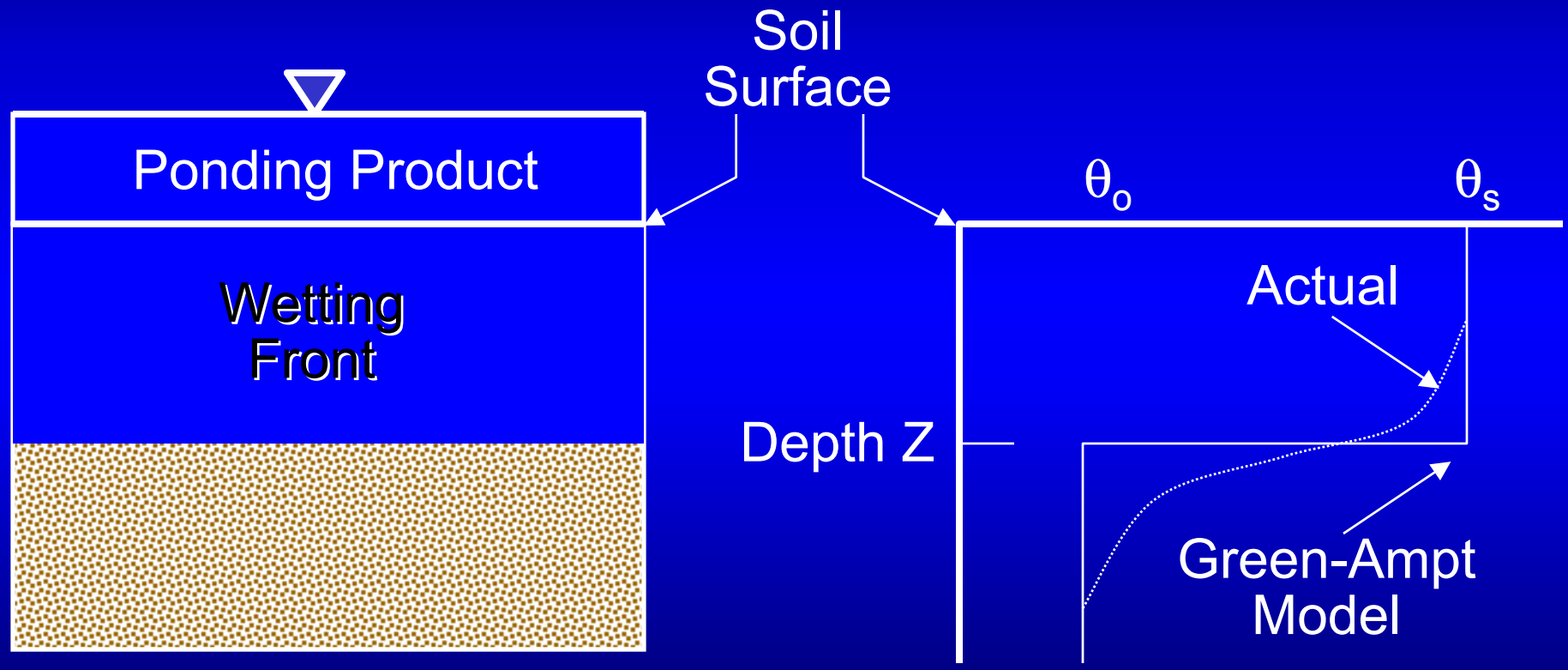
XSLIM - Infiltration Model



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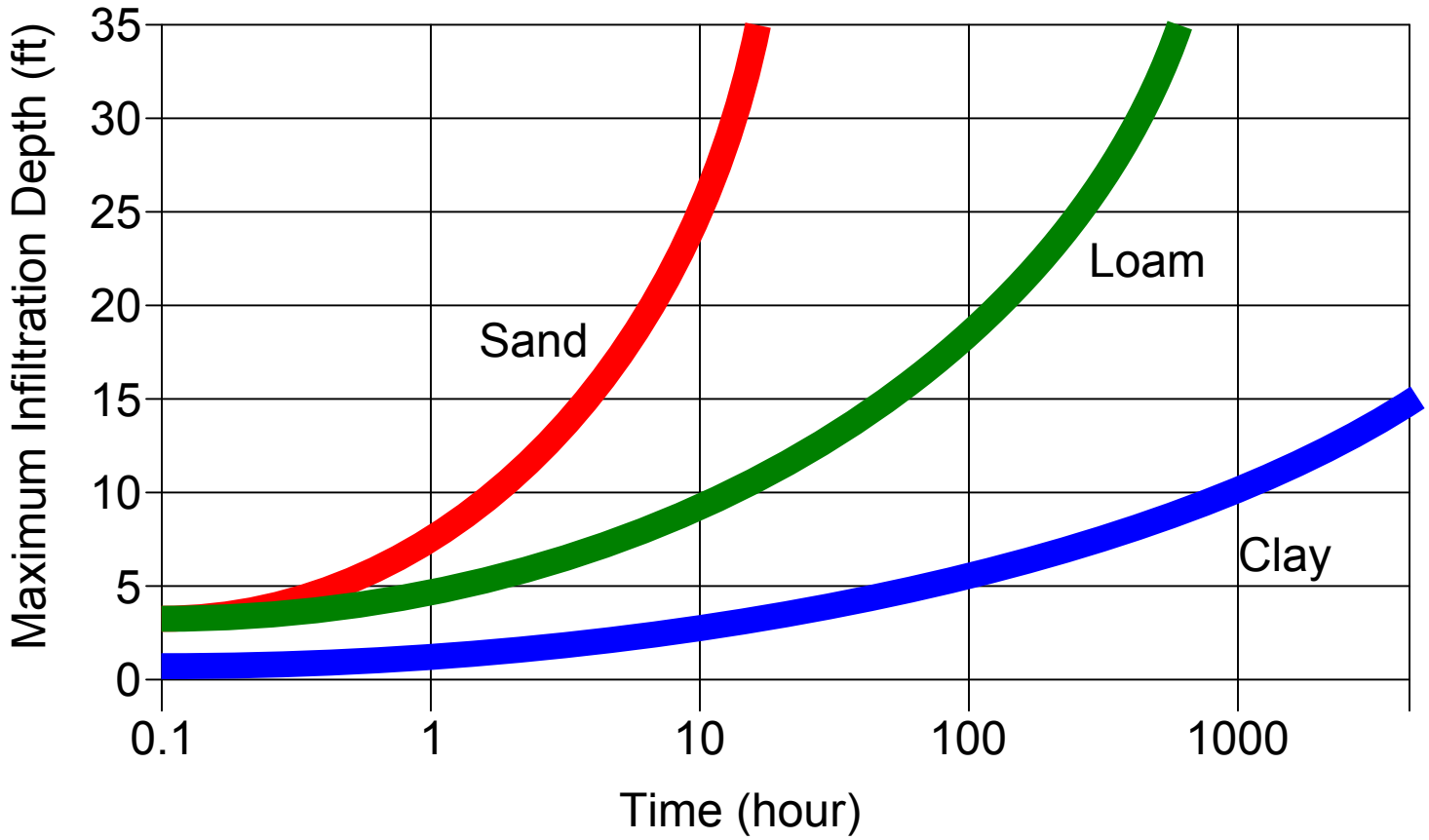
Soil Type


Maximum Infiltration Depth (ft)
35
30
25
20
15
10
5
0
0.1
1
10
100
1000
Time (hour)
Sand
Loam
Clay

Infiltration Following Catastrophic Failure

- Using XSLIM
  - –Depth of Penetration:0.54 ft
  - –Volume of Product in Soil:

(0.54)(83,000)(5.6)(0.35)
2801 bbls

Scenario 2

- From Graph Rate = 2.88 gpd/acre
- V_2 = 2801+ (2.88)(57000/ 43560)(365)/(42)

=2,801 + 32.8 bbls/yr

Performance Ratio

$$PR = \frac{1{,}899 \text{ bbls/yr}}{2{,}801 + 32.8 \text{ bbls/yr}}$$

PR > 1 $\Rightarrow$ Scenario 2

PR < 1 $\Rightarrow$ Scenario 1

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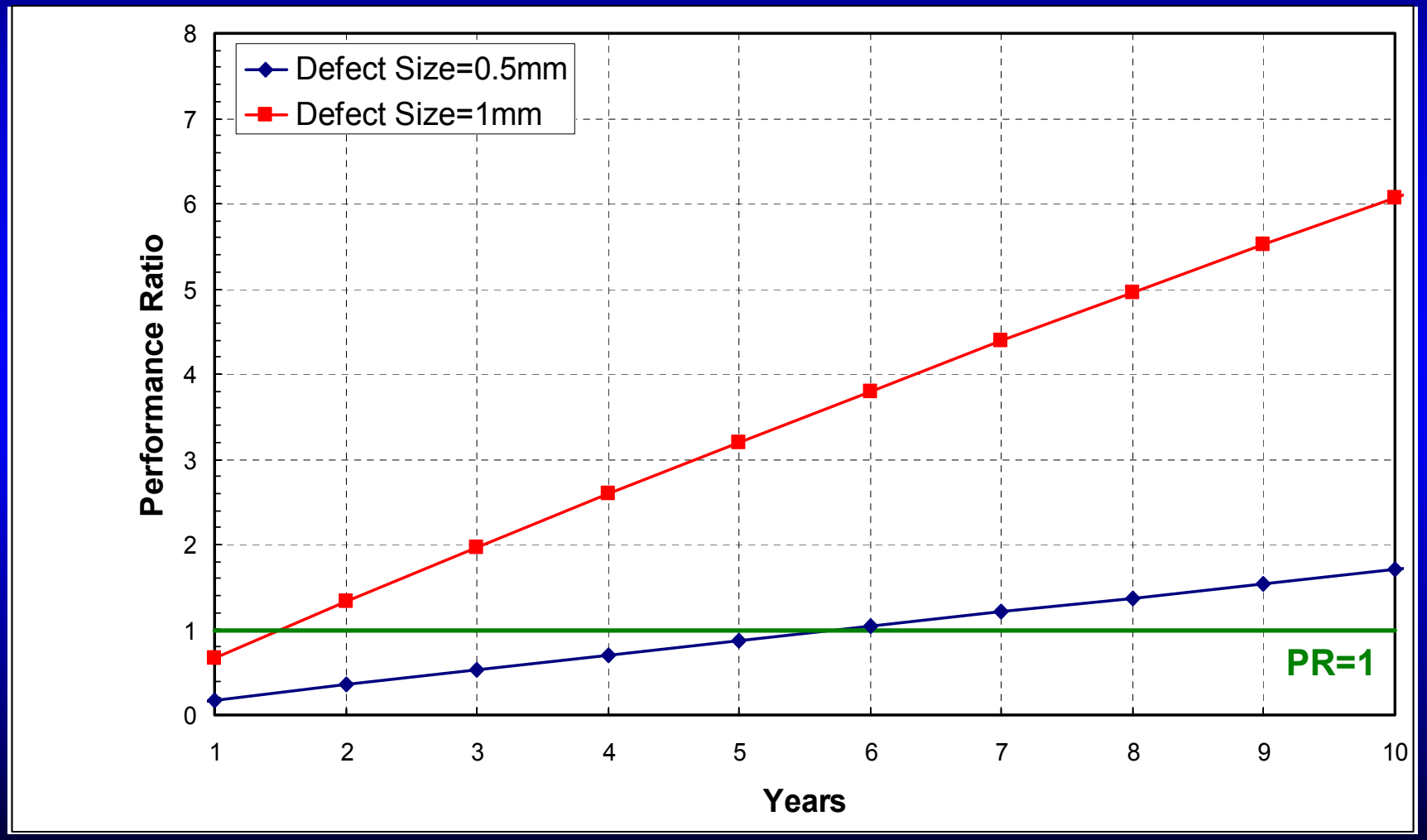
Performance Ratio



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Performance

Unless There Is a Catastrophic Failure Every 6 Years, the 0.5 mm Bottom Leaks Are a Greater Risk to the Environment Than the Catastrophic Failure

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Conclusion

- Select Optimum Alternative for Secondary Containment Based on:
  - Environmental Consequence
  - Multiple Criteria
- In Example, Work on Tank Provide Better Protection