Overview of Oil & Gas Construction and Inspection for Pits and Impoundments

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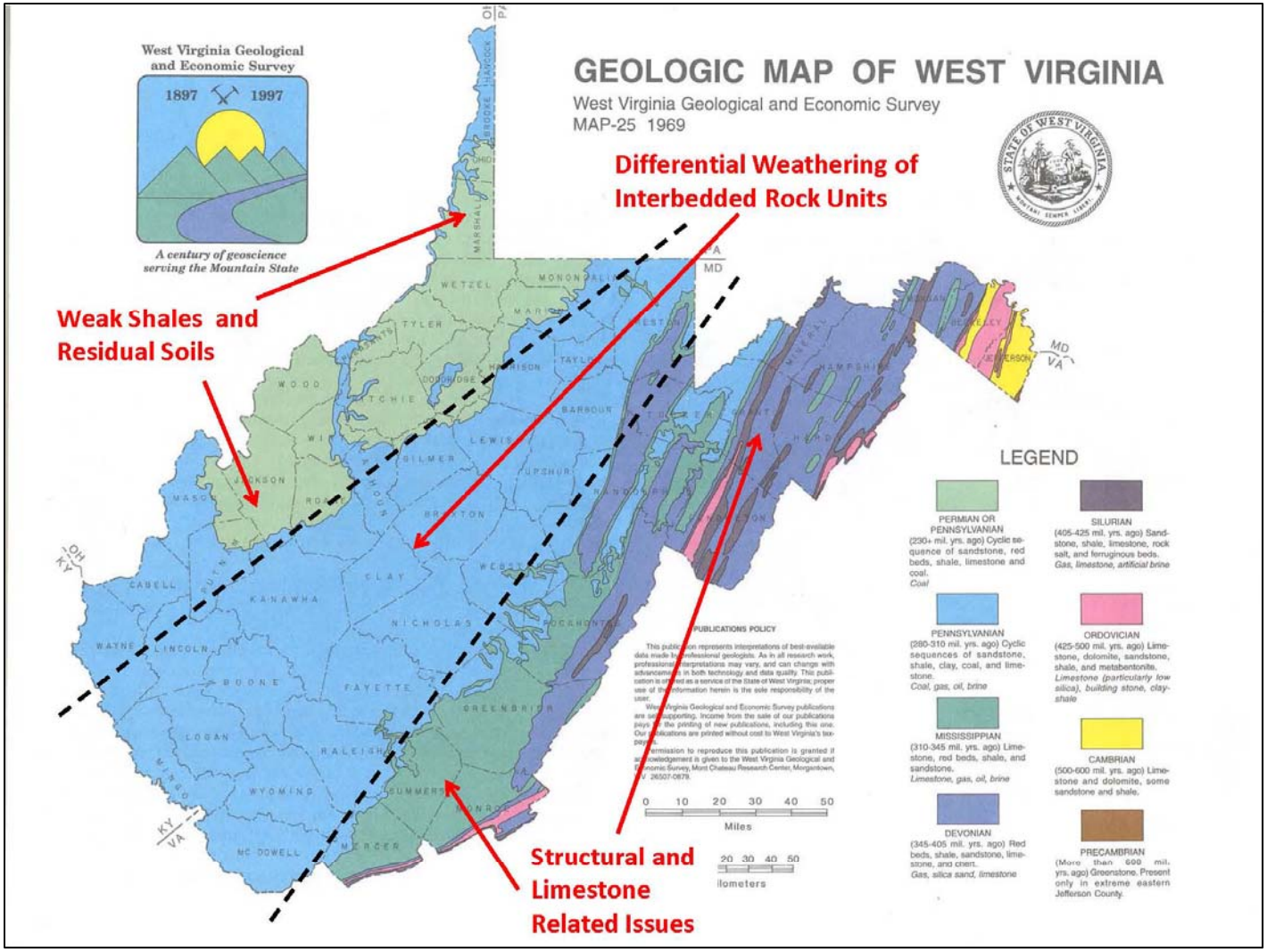
Discussion Points

- WV Geology and Precipitation
- Construction Practices
  - Compaction
  - Seepage and Erosion
- Inspection
  - Crest
  - Pool and Upstream Face
  - Containment
  - Downstream Face and Toe
  - Pipelines and Roadways
- Emergency Action Plans (EAPs)
- Liability (important items to consider)
- Conclusions

West Virginia Geology



NOAA Average Annual Precipitation

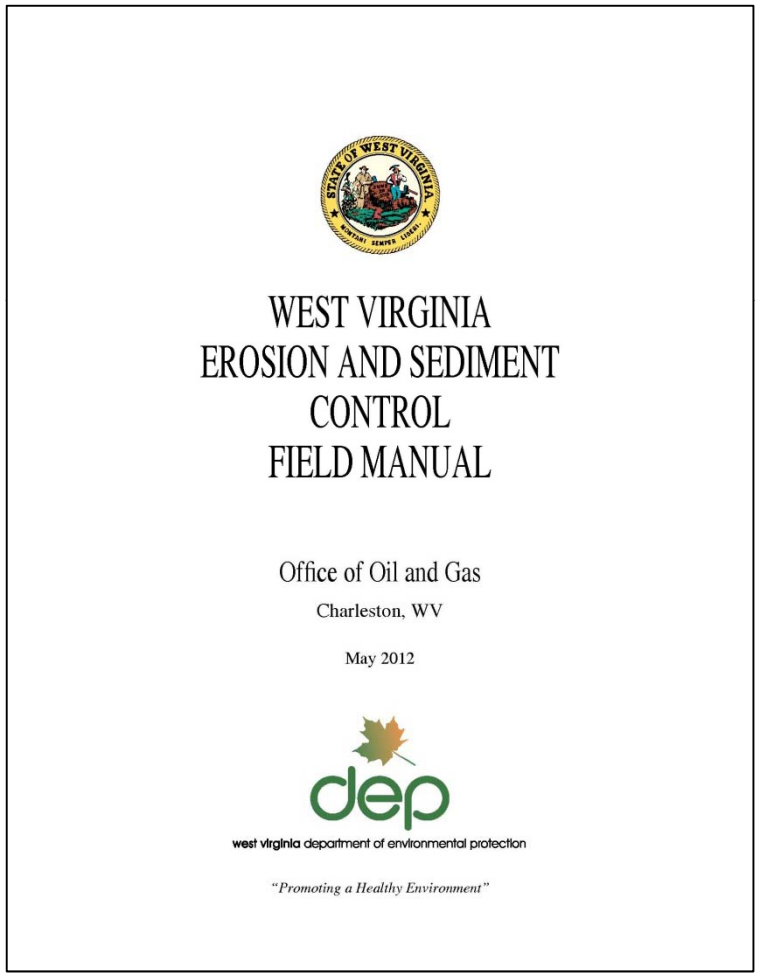
STATE	INCHES	RANK
West Virginia	45.2	17
Pennsylvania	42.9	21
Ohio	39.1	28
Oklahoma	36.5	30
Texas	28.9	34

*Annual rainfall plus snowfall range from 1971 to 2000

Compaction, Seepage & Erosion

WVDEP Erosion and Sediment Control Field Manual

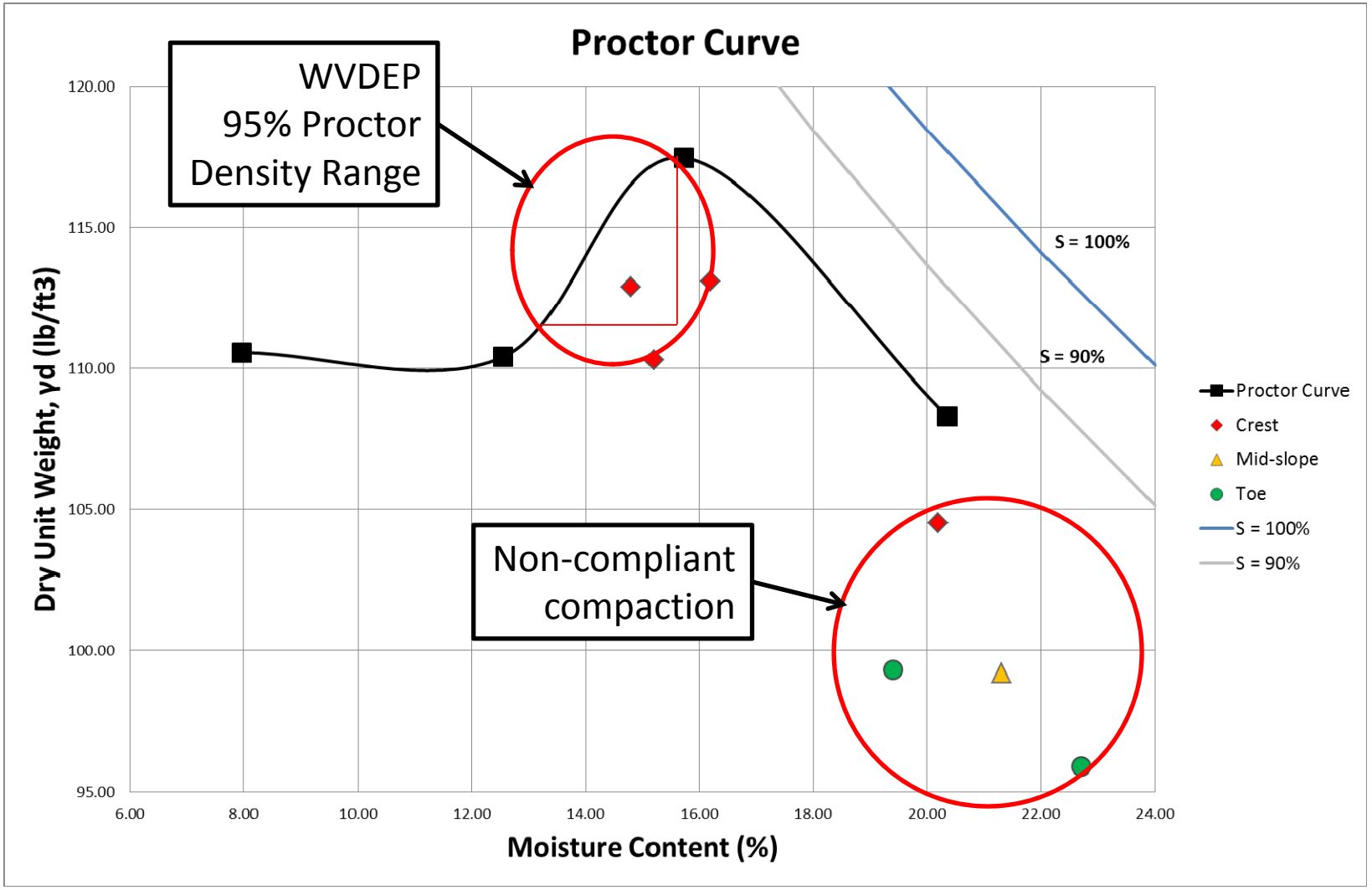
- Each lift compacted by sheepsfoot or pad roller (not both)
- Compaction not exceeding optimum moisture limits
- Each lift compacted to standard Proctor density of 95%
- Fill material free of roots, woody vegetation, stumps, large rocks, etc.
- Lift thickness between 6 and 12 inches
- Terraced bench (minimum 10 feet) for each 50 vertical feet of slope



Purpose & Benefits of Compaction

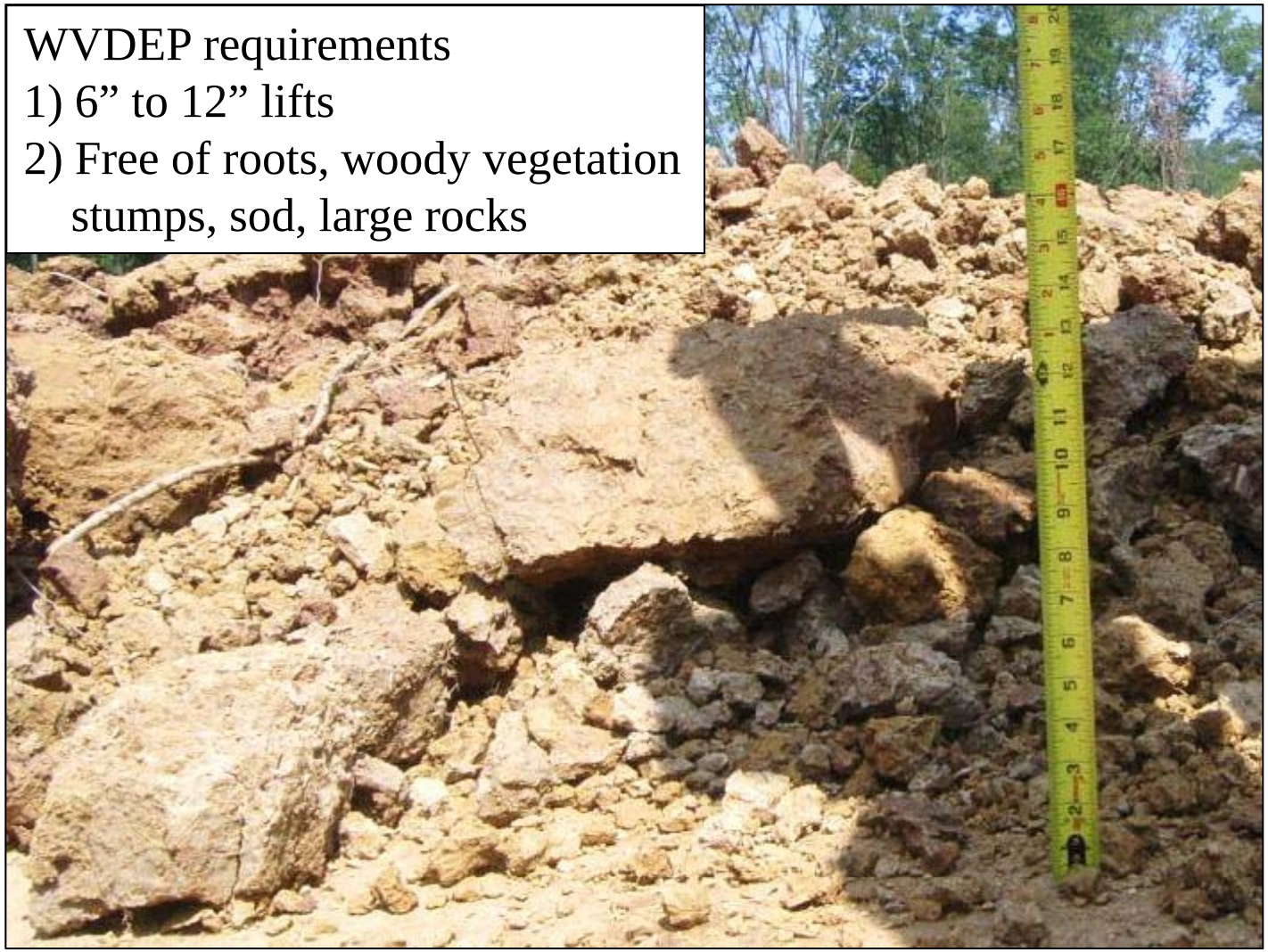
- Compaction increases density of soil, minimizing voids and increasing soil strength
- Laboratory compaction tests performed to obtain relationship of soil weight to moisture; field testing confirms
- Moisture helps to lubricate soil to allow tighter compaction
- Construction needs to produce compaction field results which meet engineering design and WVDEP requirements
- Field compaction performed using applicable vibratory smooth drum or sheepsfoot rollers; verified with nuclear density gauge

Proctor Compaction Curve



Field Soil Compaction Requirements

WVDEP requirements
1) 6” to 12” lifts
2) Free of roots, woody vegetation stumps, sod, large rocks



Compaction Equipment

Vibratory sheepsfoot roller for soils with clays and silts, and clay/sand blends

Compaction Equipment

Vibratory smooth drum roller for sandy soils with low clay or silts

Field Compaction Density Testing

Field Compaction

Seepage & Erosion

- Seepage
  - WVDEP requires:
    1. Compacted/structural fill to be free of roots, woody vegetation, stumps, sod, and large rocks
  - These items prevent proper soil compaction and allow paths for water flow
  - Buried roots, logs, and vegetation rot and create voids for water infiltration
  - Water leads to problems with slope stability

- Erosion
  - WVDEP requires:
    1. Terraced slopes (bench cut) for each vertical 50’ of slope
    2. Terraces (benches) shall be minimum of 10’ wide
    3. Surface diversion ditches for intercepting water
  - Keep slope lengths short, minimize formation of rills and gullies

Field Seepage Problems

WVDEP requires compacted soil to be free of roots.
Purpose: To minimize seepage pathways.

Compacted Debris

WVDEP requires compacted soil to be free of woody vegetation and stumps.
Purpose to minimize voids, water infiltration and seepage pathways.

Erosion

WVDEP requires terraced slopes (bench cut) for each vertical 50 ft.
Purpose: To keep reduce slope lengths, minimize rills and gullies

Gully Formation

Lack of Vegetation/Erosion Control

Field Inspection Methods

- Proper construction and maintenance crucial to site safety
- Proper inspection allows for problem areas to be detected and addressed before large-scale issues arise
- Key areas of inspection
  - Crest
  - Pool and upstream face
  - Containment
  - Downstream Face and Toe
  - Pipelines and Roadways

Evaluation Form & Checklist

- Develop a site inspection form
- Perform inspections routinely
- Maintain inspection records

DATE & TIME		County		Company	
WEATHER		Latitude		Pit Name	
		Longitude		API No.	

A. PERMIT INFORMATION

Pit Width (ft.)		Minimum Berm Crest Width (ft.)		Construction Type	
Pit Length (ft.)		Upstream Slope (H:V)		Liner Type	
Depth (ft.)		Downstream Slope (H:V)		Date Built	
Freeboard(ft.)				Date Reclaimed	

B. FIELD AS-BUILT CONSTRUCTION AND SITE CONDITIONS

Pit Width (ft.)		Berm Crest Width (ft.)		Crest Height (ft.)	
Pit Length (ft.)		Upstream Slope (H:V)		Up Slope Length (ft.)	
Depth (ft.)		Downstream Slope (H:V)		Down Slope Length (ft.)	
Freeboard (ft.)		Water Elevation		Groundwater Elevation	

Is the pit/impoundment in the NFIP 100-yr floodplain?		Is the pit/impoundment within 1000 feet of a public water source?	
Is the pit/impoundment within 500 feet of a dwelling, perennial stream, or private water source?		Is the pit/impoundment within 100 feet of a wetland?	

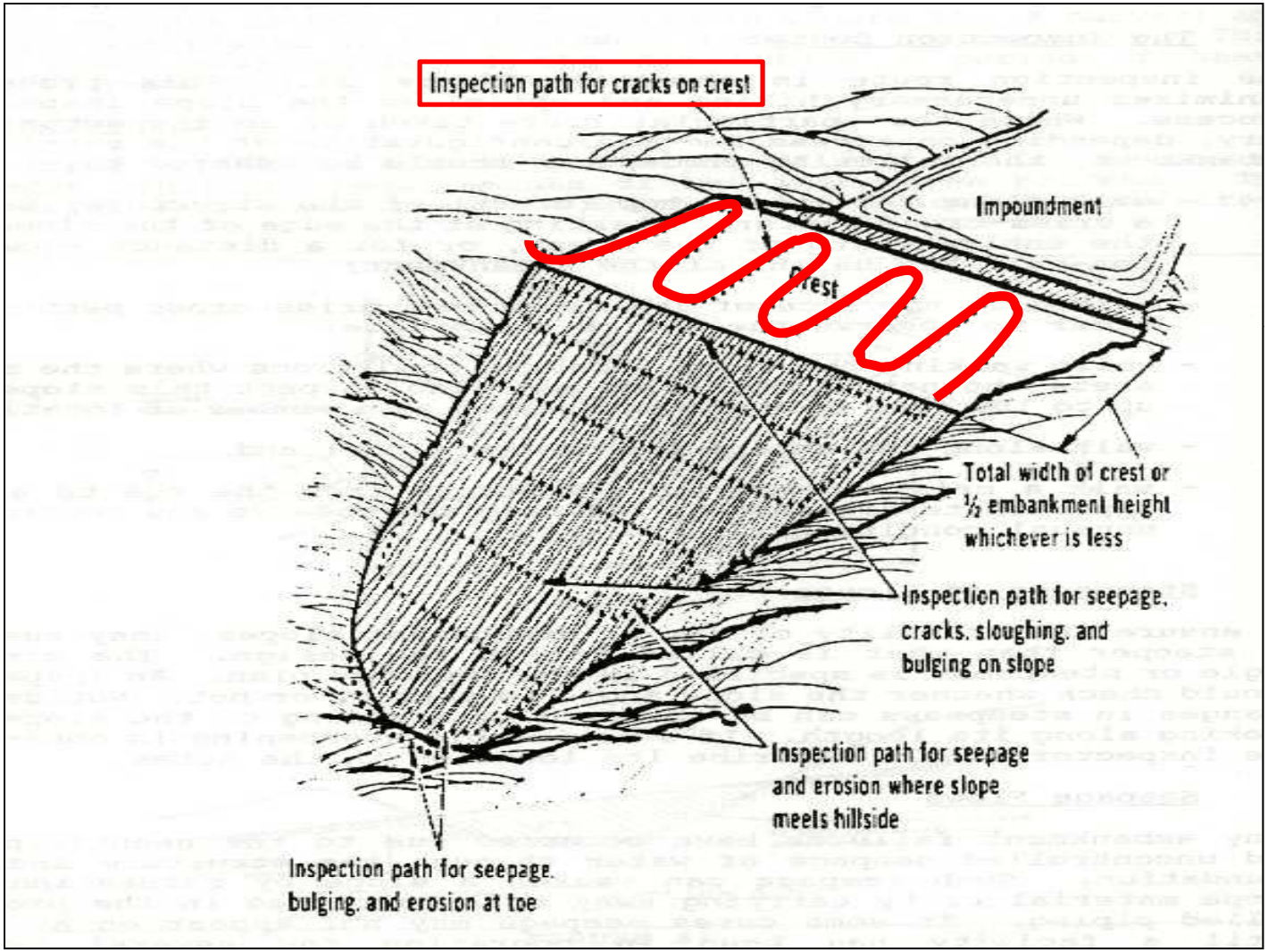
	C. PIT/IMPOUNDMENT	**Existence**	**If YES then Evaluate Significance of Problem**			
		Yes/No/NA	Low < 33%	Moderate 33 - 66%	High > 66%	Remarks
1	Are there any observed surface erosions, cracks, settlements, or scarps?					
2	Are there any slope movements or animal burrows?					
3	Are there any depressions, sinkholes, or slides into the pit present?					
4	Are there any signs of mine subsidence on or adjacent to the embankment?					
5	Are there any observed trees, tall weeds, or other vegetation?					
6	Are there any seeps, wet zones, or losses of soil?					
7	Are there any eddies/whirlpools or other signs of leakage or seeps present?					
8	Are there any liner tears, bulges, holes, wind uplifts, or seam separations?					
9	Are there any areas where the liner is strained?					
10	Are there any areas where the liner has rock or debris on top of it?					
11	Is there any tear potential for the liner?					
12	Are there any deformations, cracks, or settlements around the anchor trench?					
13	Are there any signs of pipe abnormalities (gouge marks, leaks, cracks)?					
14	Are there any areas where the pipe is not properly supported?					
15	Are there any signs of pipes having significant sagging in line?					
16	Are there any signs of obstructions (trees, garbage, etc.)?					
17	Are there any signs of water in ditch associated with pit?					
18	Are there any obstructions around the discharge outlet?					
19	Are there any signs of downstream slope movement into ditch?					

Inspection - Crest

- Inspection Concerns
  - Cracks on the crest
  - Erosion on crest
  - Signs of shallow surface
  - Standing surface water
  - Sinkholes

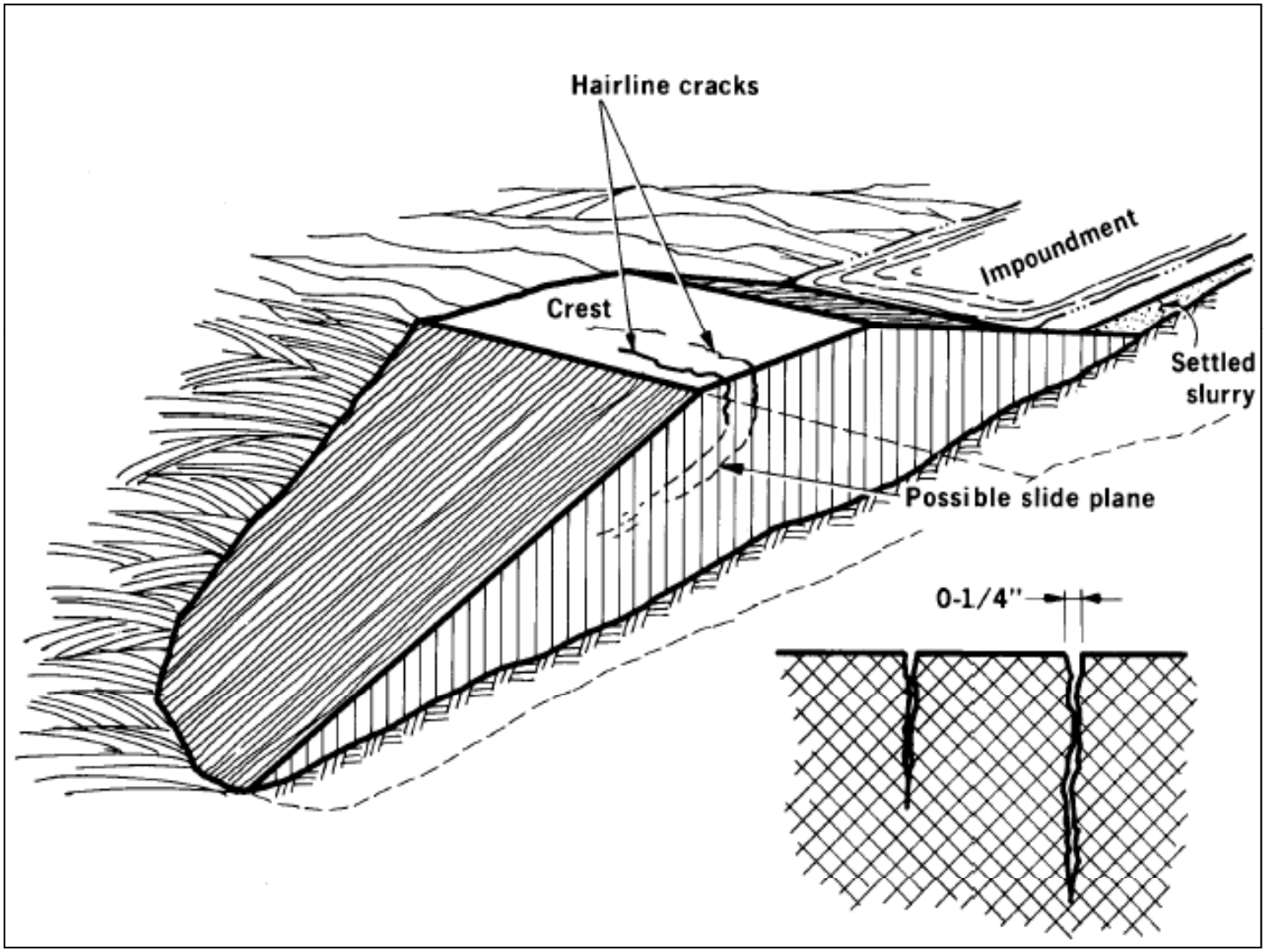
- Items to be recorded
  - Location of cracks, erosion, and/or surface water
  - Length and opening size of cracks
  - Vertical displacement across cracks

Inspection - Crest

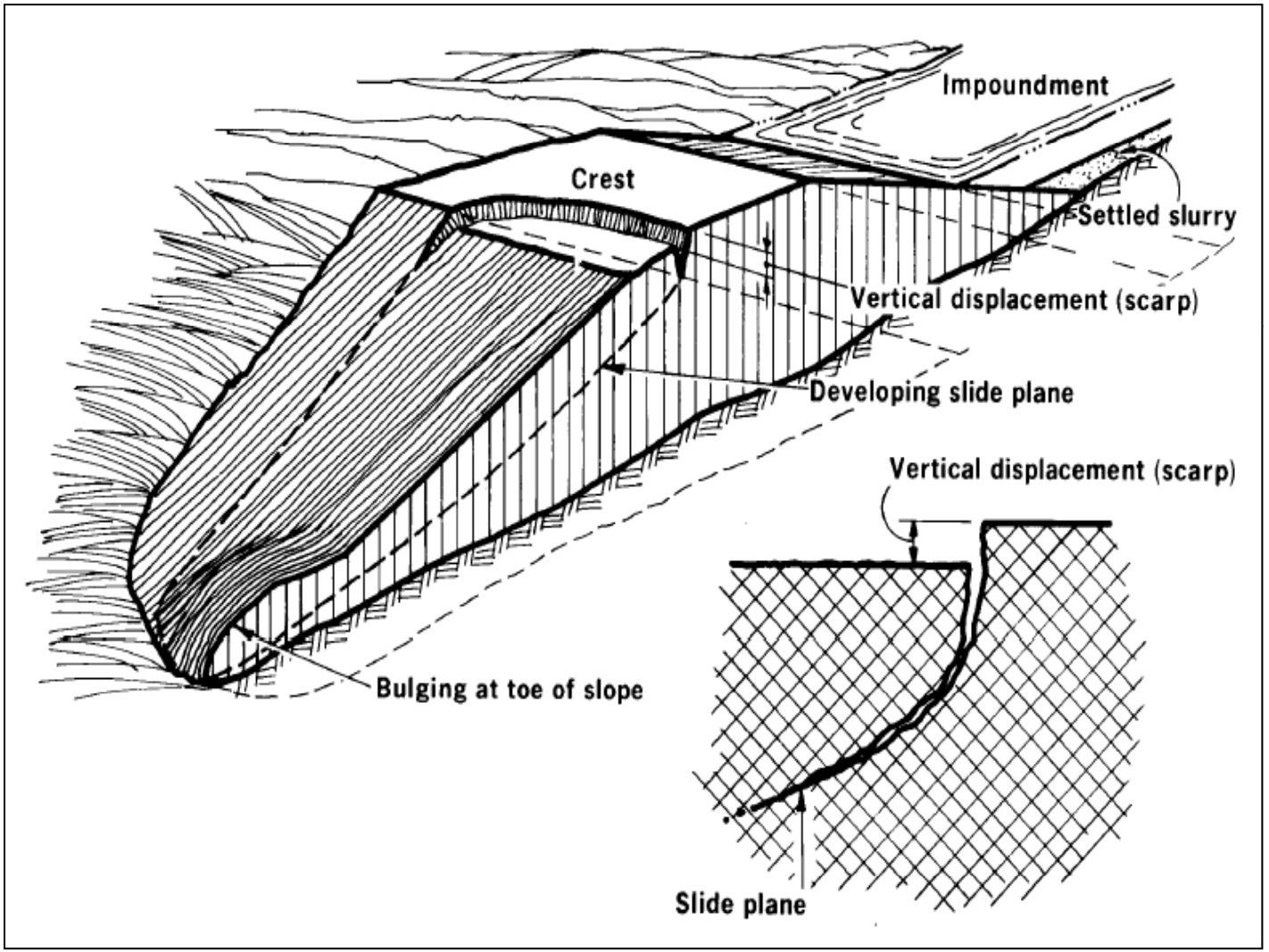


Cracks on Crest

Cracks on Crest



Cracks on Crest



Erosion on Crest

Standing Water on Crest

WVDEP requires surface water be diverted away from pit.
Purpose: To minimize water infiltration into slope.

Sinkholes

Inspection - Pool and Upstream Face

- Inspection Concerns
  - Water level monitored to ensure adequate freeboard
  - Eddy currents in the pool
  - Obstructions (trees, garbage, etc.)
  - Depressions, sinkholes, or slides into pool

- Items to be recorded
  - Water level
  - Seep presence and location
  - Presence and severity of obstructions
  - Presence of slope movements and location

Water Level/Freeboard

Obstructions

Slide on Upstream Face

Inspection - Containment

- Inspection Concerns
  - Liner tears, bulges, holes, wind uplifts, or seam separations
  - Liner strain or tear potential
  - Rock or debris on liner
  - Deformations, settlements, or cracks around anchor trench
  - Anchor trench improperly embedded

- Items to be recorded
  - Liner deficiencies
  - Rock and/or debris presence and location
  - Anchor trench exposure and/or uplift

Liner Bulges

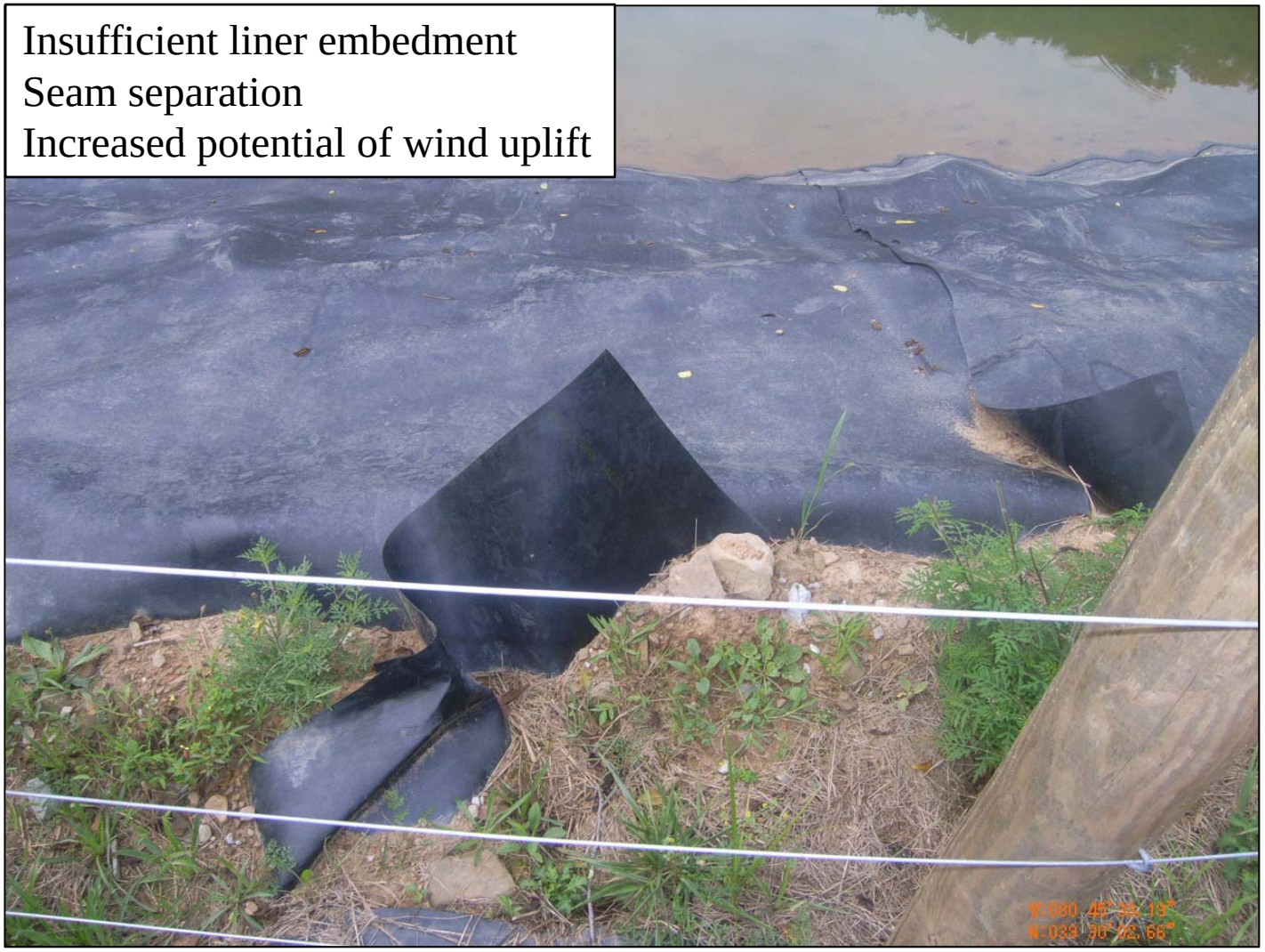
Liner Strain/Tear Potential

Rock/Debris on Liner

Cracks in Anchor Trench

Anchor Trench Exposed

Insufficient liner embedment
Seam separation
Increased potential of wind uplift

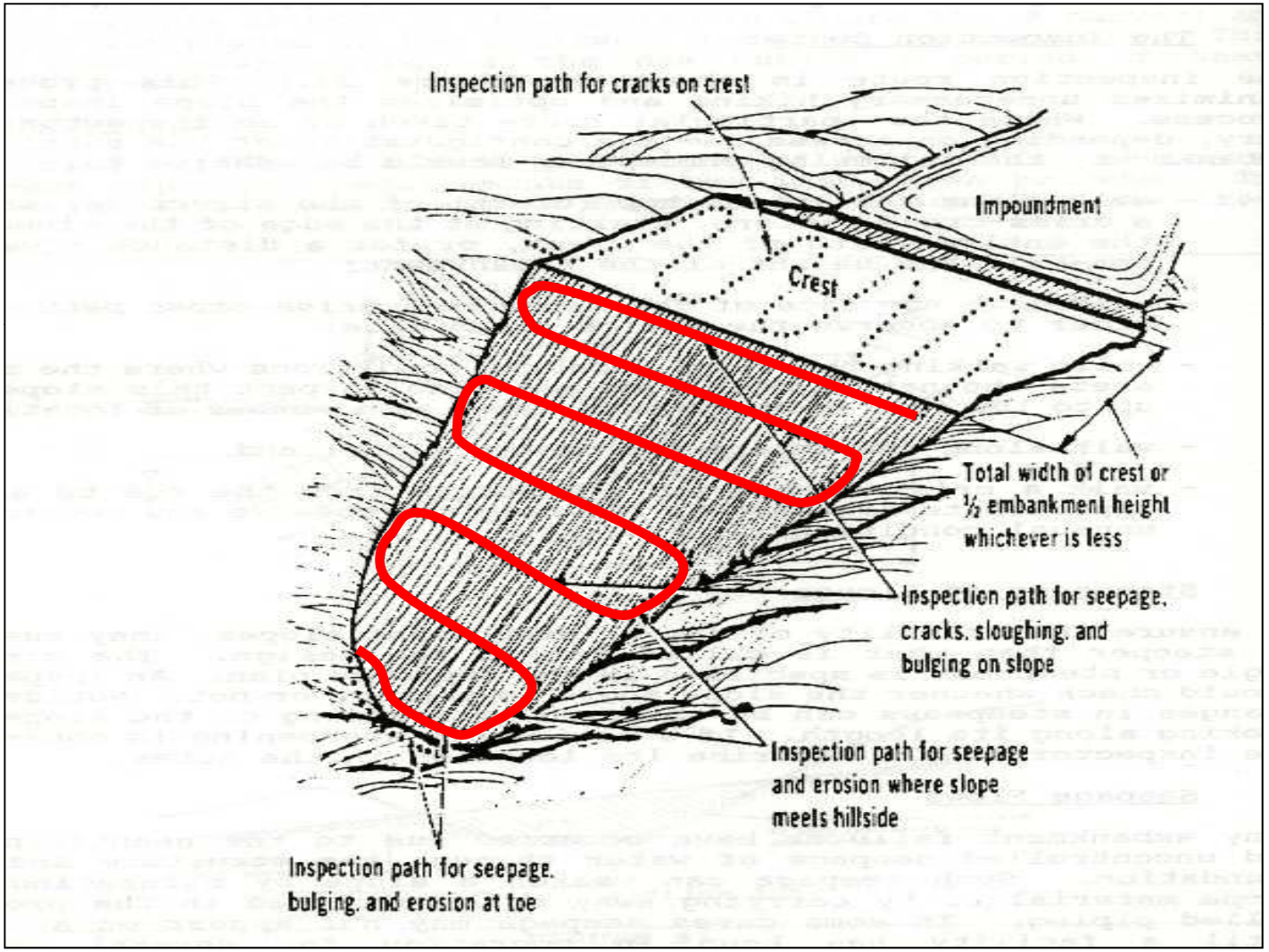


Inspection - Downstream Face and Toe

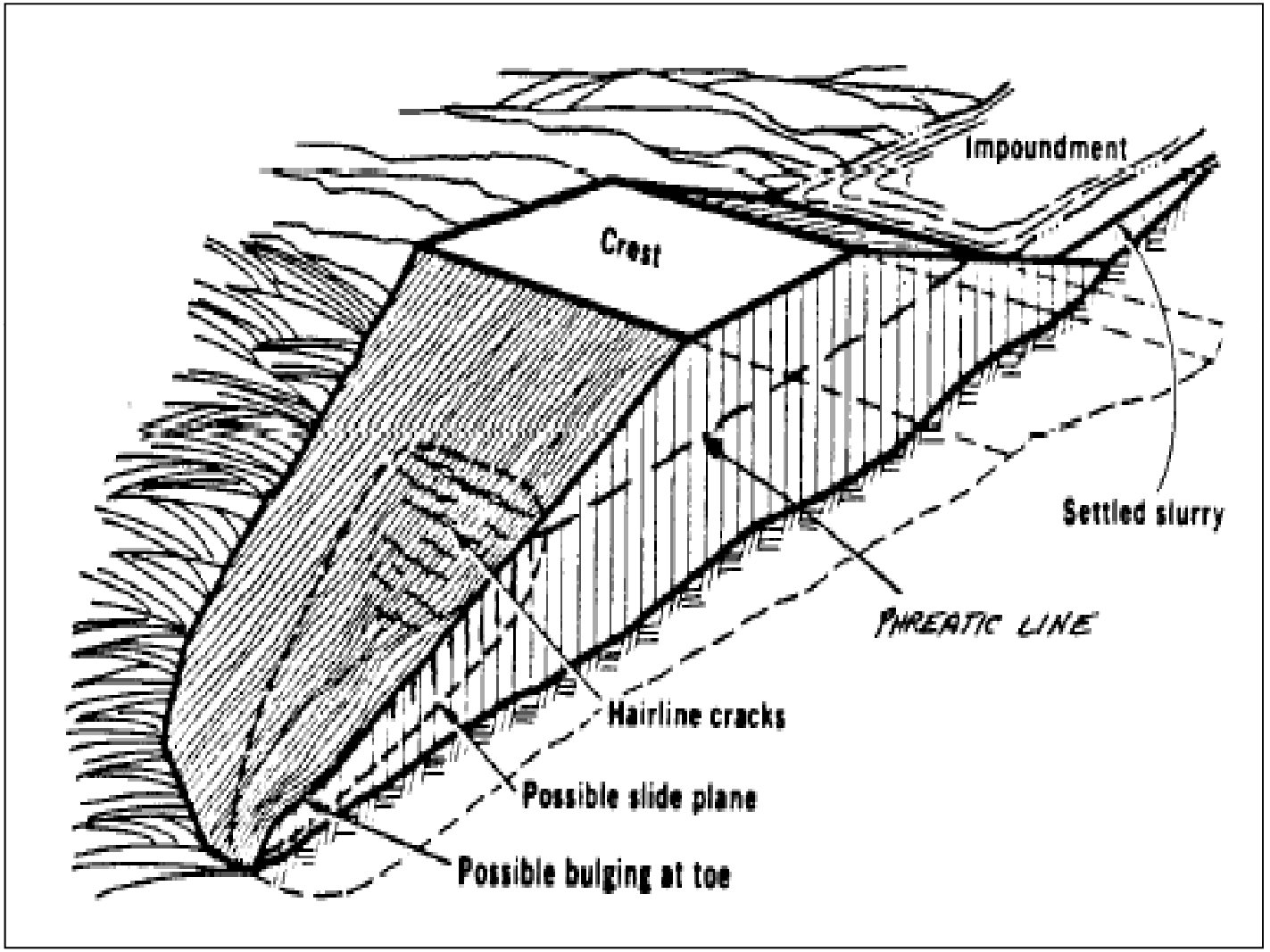
- Inspection Concerns
  - Surface erosions, cracks, settlements, or scarps
  - Animal burrows
  - Observed woody debris, tall weeds, or other vegetation
  - Seeps, wet zones, or losses of soil
  - Slope movements into drainage ditch

- Items to be recorded
  - Location of cracks, bulges, animal burrows, vegetation, etc.
  - Length and opening size of cracks
  - Vertical displacement across cracks
  - Height and approximate size of bulge
  - Seep presence and location

Inspection - Downstream Face and Toe



Slope Movement



Slope Movement

Woody Debris

Seepage

Slope Movement into Stream

Slide on Upstream Face

Inspection - Pipelines and Roadways

- Inspection Concerns
  - Pipe abnormalities (gouges, leaks, cracks, etc.)
  - Areas of unsupported pipe
  - Significant sagging in pipelines
  - Roadway maintenance and safety of travel

- Items to be recorded
  - Location of gouges, cracks, or leaks
  - Estimated discharge from leaks and color of water
  - Locations where pipeline is not anchored
  - Locations of damage caused by excessive pipe movement
  - Locations where pipelines encroach on roadway

Cuts and Scrapes in Pipe

Improperly Supported Pipe

Sagging in Pipeline

Potential Pipeline Roll & Damage

Winter Complications

- Freeze/thaw effects
- Increased seepage from snow melt
- Added weight due to snow loads
- Obscured problem areas
- Site access complications

Winter Complications

Winter Complications

Emergency Action Plans

- EAPs function uniquely as compared with inspections
- Inspections intend to prevent failure; EAP addresses response to failure
  - Minimizing damage
  - Reducing risk to downstream population
- EAPs required for centralized pits constructed after §22-6A regulations
- EAP should address
  - Site accessibility
  - Alternative transportation access and means
  - Access to emergency equipment and resources
  - Staff availability

Emergency Action Plans

- Keep EAP user-friendly with navigational aids
- Customize copies for the intended recipient (operator, sheriff, etc.)
- Six basic elements of an EAP (according to FEMA)
  - Notification Flowchart
  - Emergency Detection, Evaluation, and Classification
  - Responsibilities
  - Preparedness
  - Inundation Maps
  - Appendices

Notification Flowchart

- EAP should begin with one notification flowchart containing
  - Who is responsible for notifying owner(s) and/or emergency official(s)
  - Who is to be notified
  - What is the prioritized order in which individuals are notified

- Notification flowchart should include
  - Names and position titles (**and when to initiate contact**)
  - Office and home telephone numbers
  - Alternative contacts

- Notification list that should be considered
  - Owner
  - Local, state, and federal emergency management authorities
  - Downstream property owners
  - Operators of water-retention facilities

Emergency Conditions

- Early detection and evaluation of situation(s) is crucial
- Procedures for reliable and timely classification are needed
- Example emergency classifications
  - Failure is imminent or has occurred
  - Potential failure situation is developing
  - Non-failure emergency condition

Responsibilities

- EAPs must clearly specify responsibilities to ensure effective, timely action
  - Owner
  - Notification
  - Evacuation
  - On-site monitoring
  - EAP coordinator

- EAP responsibilities for owners include
  - Developing
  - Maintaining
  - Implementing

- State and local emergency management officials are responsible for warning and evacuation

Preparedness

- Actions taken to prevent a failure or reduce effects of a failure

- Preparedness actions involve the installation of equipment or the establishment of procedures for
  - Preventing emergency conditions from developing
  - Limiting impacts in an emergency situation
  - Minimizing extent of damage resulting from emergency situations

- Types of preparedness actions include
  - Surveillance
  - Response during darkness, adverse weather, weekends, and holidays
  - Access to the site
  - Alternative systems of communication
  - Emergency supplies and information

Inundation Maps

- Should be developed by owner in coordination with appropriate state and local emergency management agencies
- Should be developed at an appropriate scale to identify downstream inhabited areas in danger
- Minimum requirements
  - Peak discharge
  - Maximum inundation elevation
  - Flood wave travel time to critical locations
- Should be regularly updated to reflect changes in downstream areas

EAP Appendices

- Contain information supporting and supplementing EAP
- A list of suggested topics that should be covered are
  - Investigation and analyses of floods
  - Plans for training, exercising, updating, and posting EAP
  - Site-specific concerns
  - Approval of EAP
- Separate training and support material from emergency material

Legal Liability

- According to Binder (2002), liability issues to companies through negligence law:
  - Absence of an EAP
  - Inadequacy of EAP
  - Failure to follow EAP

- All employees need to be trained regularly on use of EAP
  - Educate employees on actions to take
  - Identify flaws and problems
  - Validate and improve EAP

- Negligence applies when employees' ignorance/poor training results in
  - Less than 100 percent implementation success of EAP
  - Split-second decisions worsening the situation

Final Thoughts

- Quality assurance and control needed to ensure construction practices adhere to established standards
- Inspections need to identify problem areas and the possible consequences if left unattended
- Development and implementation of EAPs greatly benefits safety of pits, impoundments, and surrounding areas
- Negligence/liability issues exist if proper EAP development and training is not accomplished

References

WV Erosion and Sediment Control Field Manual

http://www.dep.wv.gov/oil-and-gas/Documents/Erosion%20Manual%2004.pdf

Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners
http://www.fema.gov/library/viewRecord.do?id=1672

MSHA Coal Mine Impoundment Inspection and Plan Review Handbook

http://www.msha.gov/READROOM/HANDBOOK/PH07-V-1(1)CoalImpoundmentInspectionHandbook.pdf

Thank You