Dam Safety Regulatory Advisory Panel
Tuesday, October 29, 2024
Department of Environmental Quality
Piedmont Regional Office, Glen Allen, Virginia

TIME AND PLACE

The meeting of the Dam Safety Regulatory Advisory Panel (RAP) took place at 9:00 a.m. on Tuesday, October 29, 2024, at the Department of Environmental Quality's Piedmont Regional Office in Glen Allen, Virginia.

DAM SAFETY REGULATORY ADVISORY PANEL MEMBERS PRESENT

Drew Hammond, Department of Transportation
David Krisnitski, AMT Engineering
Jim Lang, Waterfront Law
Maridee Romero-Graves, Schnabel Engineering
Elfatih Salim, Fairfax County Watershed Planning and Evaluation Branch (Mr. Dipmani Kumar Alternate)
Adrienne Shaner, Hazen and Sawyer
Lisa Ochsenhirt, AquaLaw

DAM SAFETY REGULATORY ADVISORY PANEL MEMBERS NOT PRESENT

John Kirk, alternate for Jacob Compton, Department of Wildlife Resources
Dipmani Kumar, Fairfax County Watershed Planning and Evaluation Branch
Amanda Lothes, Newport News Waterworks

DCR STAFF PRESENT

Darryl Glover, Deputy Agency Director
Brent Payne, Dam Safety Regional Engineer
Andrew Smith, Chief Deputy Director
Christine Watlington-Jones, Policy and District Services Manager
Charles Wilson, District Dam Engineer

OTHERS PRESENT

Wheeler Wood, Consultant, VCU Center for Public Policy

WELCOME

Mr. Glover welcomed members to the meeting. He announced that due to Hurricane Helene activities in Southwest Virginia, the deadline for applications for Round 5 of the Community Flood Preparedness Fund has been extended to January 24, 2025. He also asked members to share with qualified and interested individuals that DCR has openings within Dam Safety for a Chief Engineer and 2 Regional Engineers. Those job descriptions were shared with members via email earlier this week.

A. REVIEW OF CHARGE OF THE REGULATORY ADVISORY PANEL (RAP)

Mr. Glover reviewed the Notice of Intended Regulatory Action (NOIRA) that established this panel and the four areas of focus:

1) Roadways on or below the impounding structure
2) Incremental damage analysis
3) Potential expansion of special criteria low hazard dams
4) Simplifying the emergency preparedness plan requirements

The focus of today's meeting will be items 1 and 2.

B. REVIEW OF "MODIFIED" SOUTH CAROLINA INCREMENTAL DAMAGE ANALYSIS (IDA) METHODOLOGY

Charles Wilson provided an overview of the proposed modifications to the South Carolina methodology that make it more applicable for Virginia. For additional information, please refer to the attachment, "Existing Spillway Risk Evaluation." The goals of an IDA is to ensure compliance by either 1) reducing hazard classification or 2) reducing spillway design requirements.

There is interest in the inflow design flood approach used by FEMA, where the process assumes the dam is at full capacity and classifies the downstream risks for both breach and non-breach scenarios. If the identified risk is acceptable, no additional work is required. If unacceptable, the dam is required to be upgraded to a higher spillway design flood requirement.

Assumptions of the this process are 1) it is an existing dam, 2) a hazard classification is known, and 3) a Dam Break Inundation Zone study (DBIZ) is available.

Mr. Wilson noted the routing limit in the example is the point of convergence in the DBIZ. Additionally, any findings in the low danger zone are considered acceptable risk while any results in either the judgment zone or high danger zone are considered unacceptable.

The steps of the process presented are:

1) Determine the IDF
    a. Controlling Storm Duration
    b. Temporal Distribution
    c. Hydrology and Hydraulic Data (DBIZ study)
    d. Route storms until calculated peak water level in reservoir is equal to top of dam elevation (close as possible).

2) Model Downstream
    a. Route IDF (inflow design flood) thru dam to develop downstream non-breach inundation limits
    b. Routh IDF thru dam to develop downstream breach inundation limits
    c. Ensure the limit of the downstream evaluation is the point of convergence determined by the DBIZ study. If needed, extend the model downstream until the difference between the non-breach and breach IDF model is less than 1.0 foot.

3) Identify all potential damage locations within the breach inundation limits
    a. Review potential damage locations (dwellings, roads, schools, etc.)
    b. Obtain flow depth and flow velocity for non-breach and breach conditions

4) Determine risk
    a. ACER 11
    b. Rule of 7 (structures only)

Mr. Wilson went through examples using existing structures. Of the examples used, the new procedure produced similar results to the existing IDA process with the exception of one, 109 Lucy Lane. After a focused review, it was determined to be a valid variation.

After an initial analysis of the proposed process, it was determined there is potential in applying this in Virginia given its streamlined methodology, ability to use existing data and standard forms and charts, as well as the potential engineering efficiencies.

Brent Payne discussed the potential need to factor in foundations, specifically basements, in the risk classification. He also suggested the scenario where a risk classification of roadways crosses zones (Low, Judgement, High) automatically be classified as an unacceptable risk. There was a discussion about situations where there is a dam downstream from a dam and the correlation of the IDAs; the process will need to consider that situation. Members discussed the minimum threshold for an impact (e.g., two foot impact vs one foot); DSS-Wise is 1 foot.Additional conversations about what would be considered appropriate as well as the opportunities to streamline the process by utilizing the Rule of 7 in place of ACER 11 charts was had.

Given the discussion, it was requested that before the next meeting, members apply the methodology to some of their dams while DCR continuing reviewing additional case studies.

C. PUBLIC COMMENT

None

D. NEXT MEETINGS

The Panel will meet for the last time at 9am on November 12, 2024 at the same location.

E. ADJOURNMENT

Mr. Glover adjourned the meeting at 12 noon.

Existing Spillway Risk Evaluation (IDA Procedure)

Dam Safety Regulatory Advisory Panel

October 29, 2024

Charles Wilson, P.E.; District Dams Engineer

DCR Soil and Water Conservation

What is an IDA

4VAC50-20-52. Incremental damage analysis

- Reduce Hazard Classification
- Reduce Spillway Design Flood

Why do an IDA

- Existing Dam does not safely pass the Regulatory Spillway Design Flood
- Evaluate if the dam poses a danger to downstream structures
- Meet Regulations without costly improvements

Inflow Design Flood (IDF)

The flood flow above which the incremental increase in water surface elevation due to failure of a dam or other water impounding structure is no longer considered to present an unacceptable threat to downstream life or property.

Approach

- Use Inflow Design Flood approach
- Evaluate Existing Dam at full capacity
- Classify the risk of all downstream impacts (Non-Breach and Breach)
- Determine if spillway improvements are required based on identified risks

Assumptions

- Existing Dam
- Hazard Classification
- Dam Break Inundation Zone Study

Step 1 – Determine IDF

A. Controlling Storm Duration (2015 PMP Worksheet)
B. Temporal Distribution (2018 Temporal Distribution Worksheet)
C. Hydrology and Hydraulic Data(DBIZ Study)
D. Route Storms until calculated Peak Water Level in Reservoir is equal to Top of Dam Elevation (as close as possible)

Step 2 – Model Downstream

A. Route IDF thru dam to develop downstream non-breach inundation limits

B. Route IDF thru dam to develop downstream breach inundation limits

C. Limit of downstream evaluation is the point of convergence determined by the approved DBIZ. However, if the difference between the non-breach and breach IDF model is greater than 1.0', the model will be extend downstream until the difference is equal to less than 1.0'

Step 3 – Identify Impacts

A. Identify all potential damage locations with-in the breach inundation limits

B. Potential damage location consists of:

- Occupied Residential Dwelling
- Roads
- Schools
- Hospitals
- Business
- Railroads
- Utilities
- Parks
- Golf Courses
- Public Trails
- Critical Emergency Infrastructures

C. Obtain Flow Depth and Flow Velocity for non-breach and breach conditions

Step 4 – Determine Risk

A. ACER11 Figures (See Examples)
   1) Low Danger Zone = Acceptable Risk
   2) Judgement Zone = Unacceptable Risk
   3) High Danger Zone = Unacceptable Risk

B. Rule of 7 – Structures Only
   1) Incremental (difference in breach and no-breach) change in flooding due to dam breach is not significant.
   2) Water Depth < 2’ and Depth x Velocity <= 7
   3) Acceptable Risk

Result Type 1
All High Risk

- Impact located within the footprint of the non-breach and breach footprint.
- Normal Operation of the dam creates the High Risk.
- Increasing existing spillway capacity will not provide additional downstream protection.
- All increases to spillway capacity would plot in the High Risk Zone

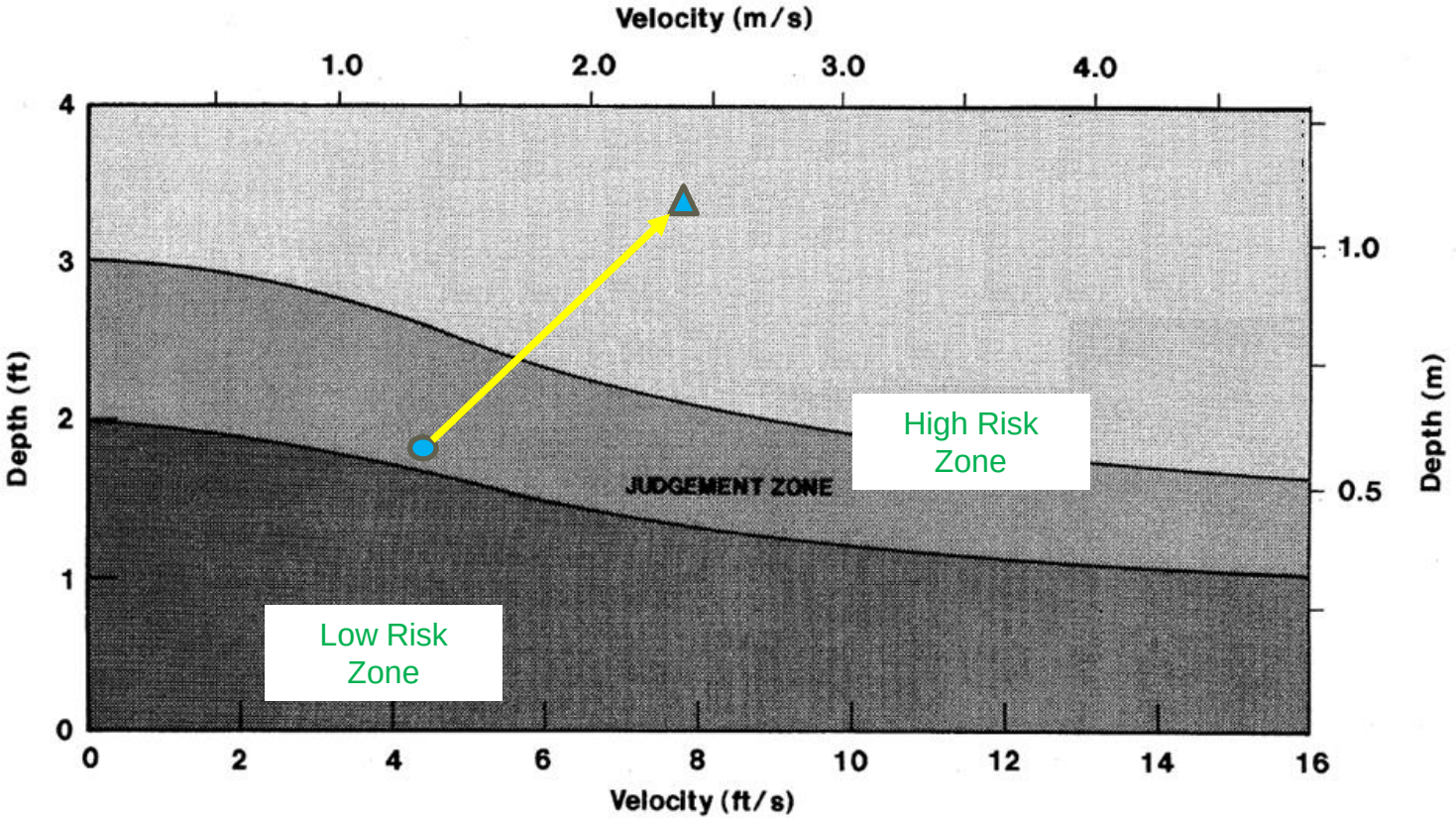


Figure 4. – Depth–velocity flood danger level relationship for passenger vehicles.

- **Conclusion**: Acceptable RISK – Spillway Improvements not Required.

Result Type 2
Low to High Risk

- Impact located within the footprint of the non-breach and breach footprint.
- Breach of the dam creates the High Risk.
- Increasing existing spillway capacity will reduce the likelihood of a dam breach.

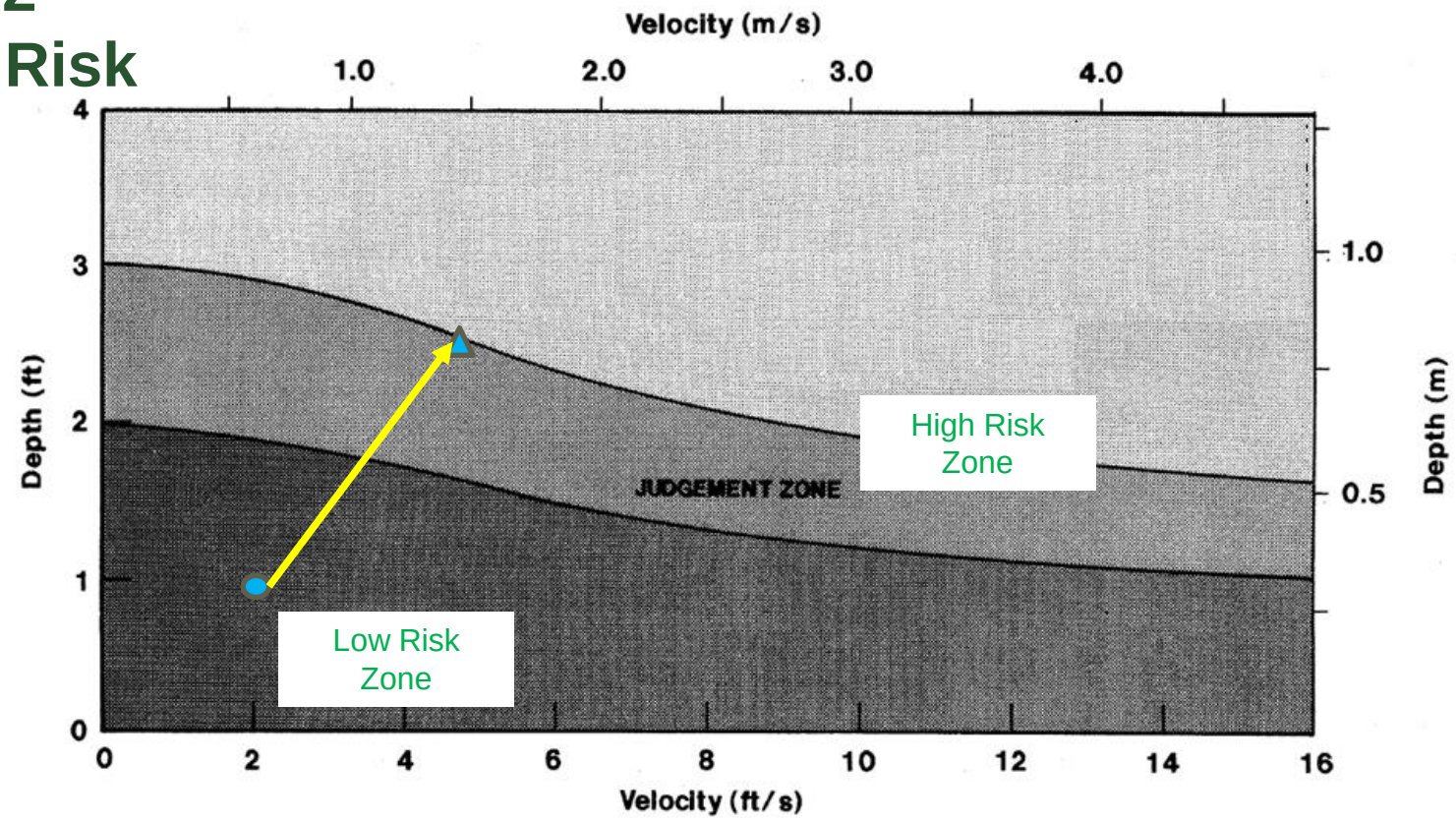


Figure 4. – Depth–velocity flood danger level relationship for passenger vehicles.

- **Conclusion**: Risk NOT Acceptable – Spillway Improvements Required

Result Type 3
No Risk to High Risk

- Impact located within the footprint of the breach footprint but outside of non-breach footprint.
- Breach of the dam creates the High Risk.
- Increasing existing spillway capacity will reduce the likelihood of a dam breach.

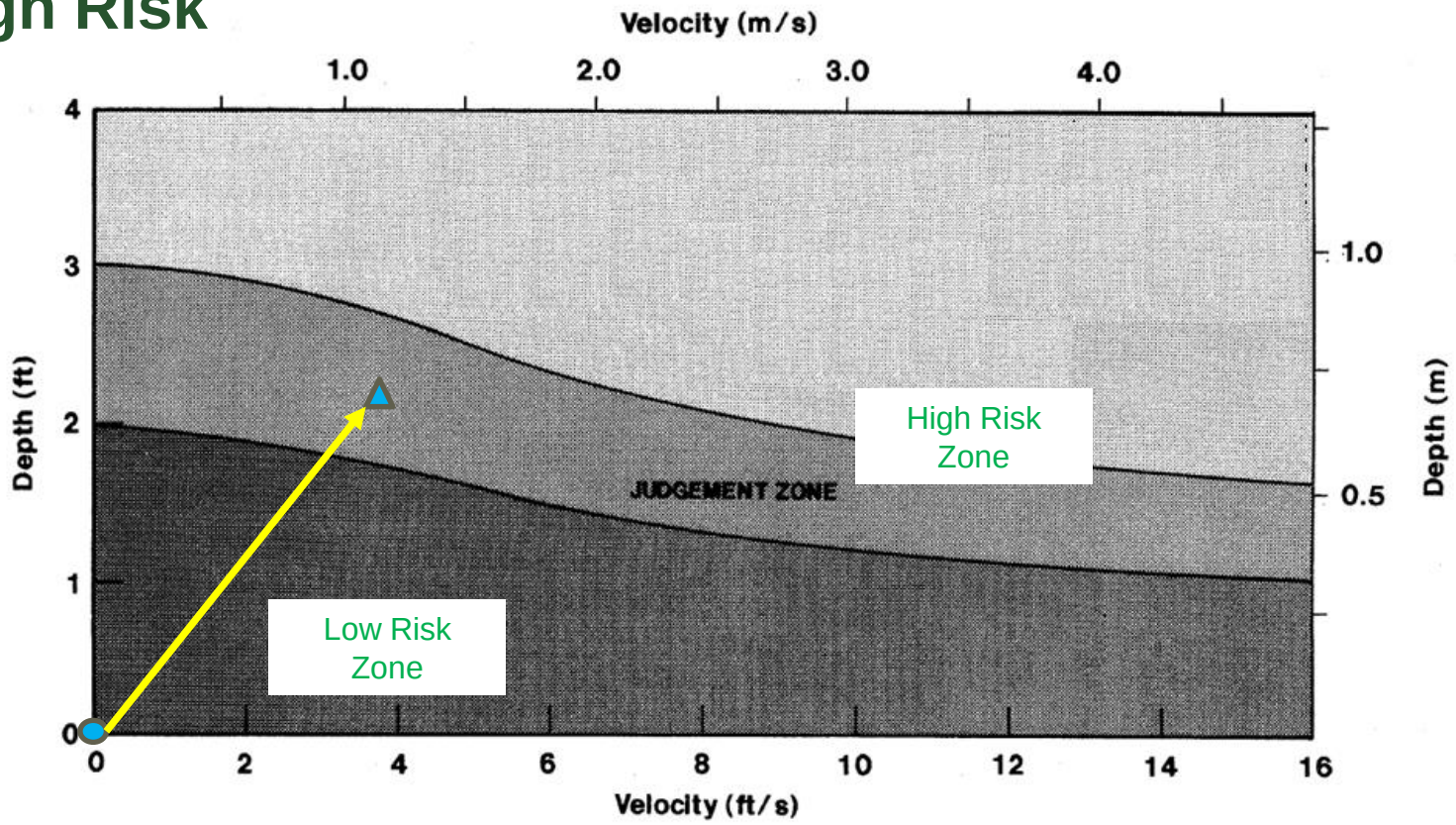


Figure 4. – Depth–velocity flood danger level relationship for passenger vehicles.

- **Conclusion**: Risk NOT Acceptable – Spillway Improvements Required

Result Type 4 – No Danger to Low Risk

- Impact located within the footprint of the breach footprint but outside of non-breach footprint.
- Only Low Risk
- Impact location is protected by existing dam.

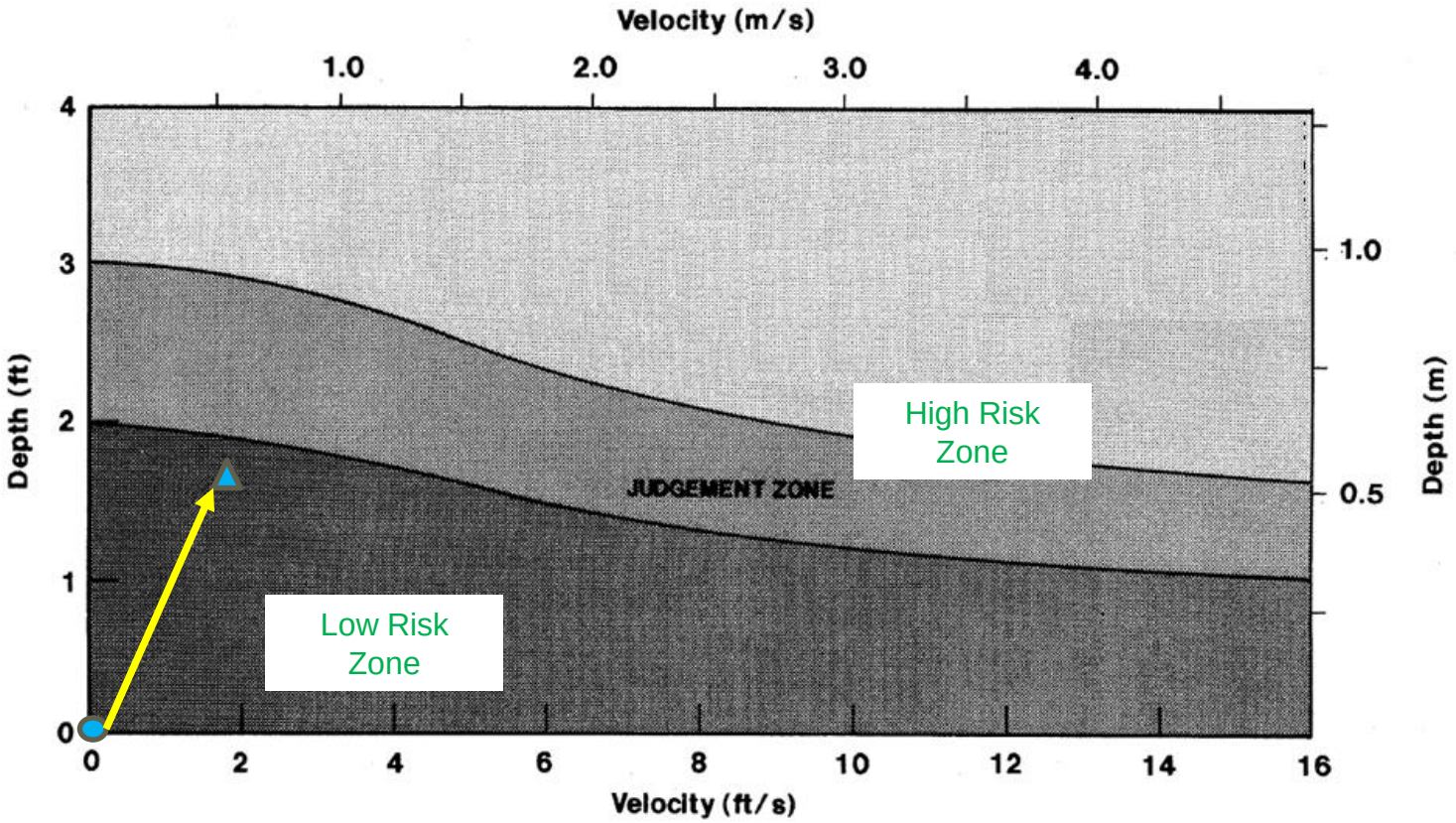


Figure 4. – Depth–velocity flood danger level relationship for passenger vehicles.

- **Conclusion**: Acceptable Risk – Spillway Improvements not Required.

Result Type 5 – All Low Danger

- Impact located within the footprint of the non-breach and breach footprint.
- Only Low Risk
- Impact location is protected by existing dam.

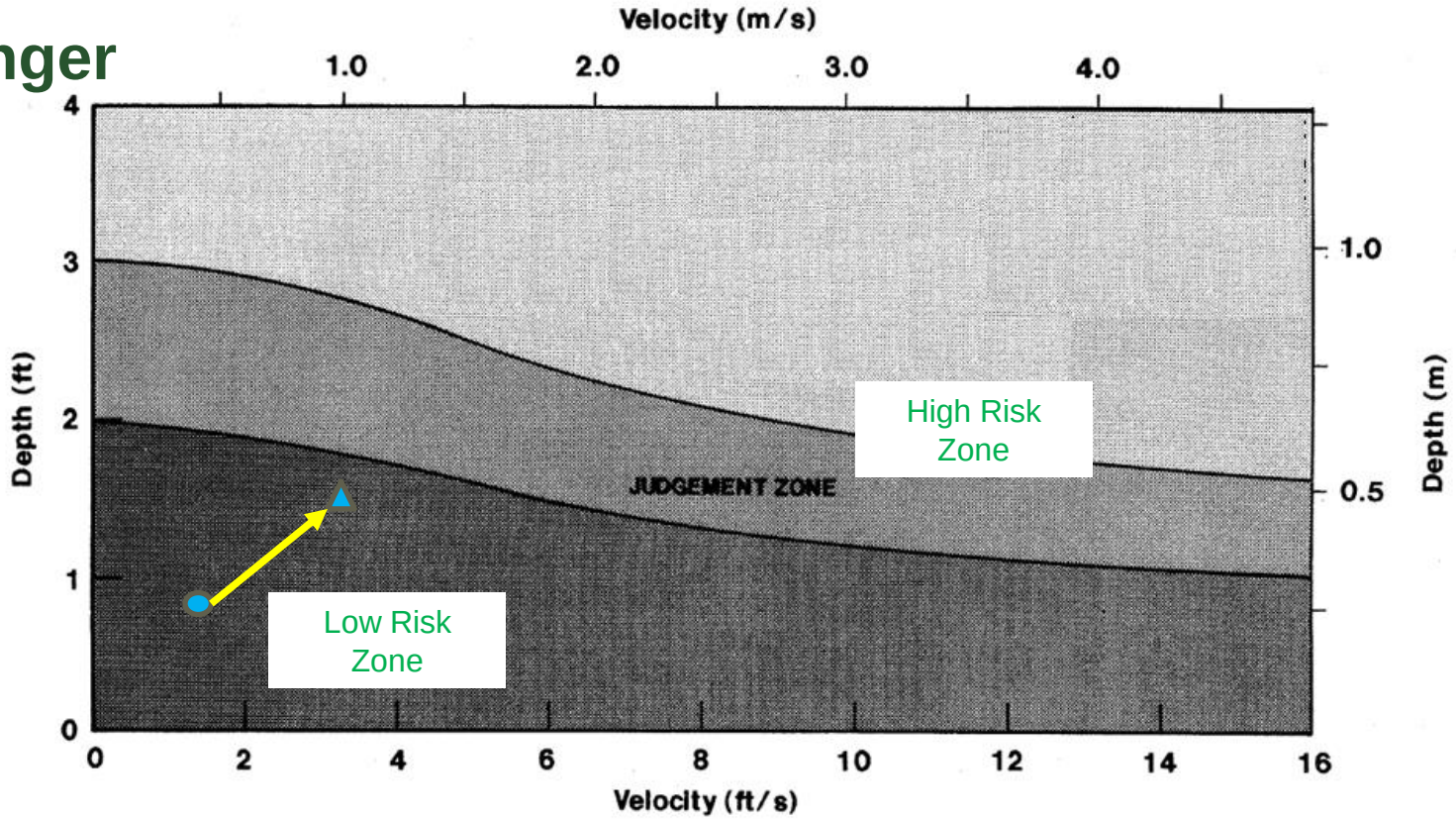


Figure 4. – Depth–velocity flood danger level relationship for passenger vehicles.

- **Conclusion**: Acceptable Risk – Spillway Improvements not Required.

Step 5 - Results

If all downstream impacts are classified as acceptable, then the evaluated IDF becomes the Spillway Design Flood of the dam. Refer to Table 1 "Existing impounding structure" as defined in 4VAC50-20-30 for acceptable values for the reduction of a spillway design flood.

-ELSE-

Spillway improvements are required. Proposed improvements will be evaluated using this analysis until all downstream impacts are classified as acceptable or negligible. This step can be completed as a standalone analysis or as part of an alteration permit.

DCR
Virginia Department of Conservation & Recreation

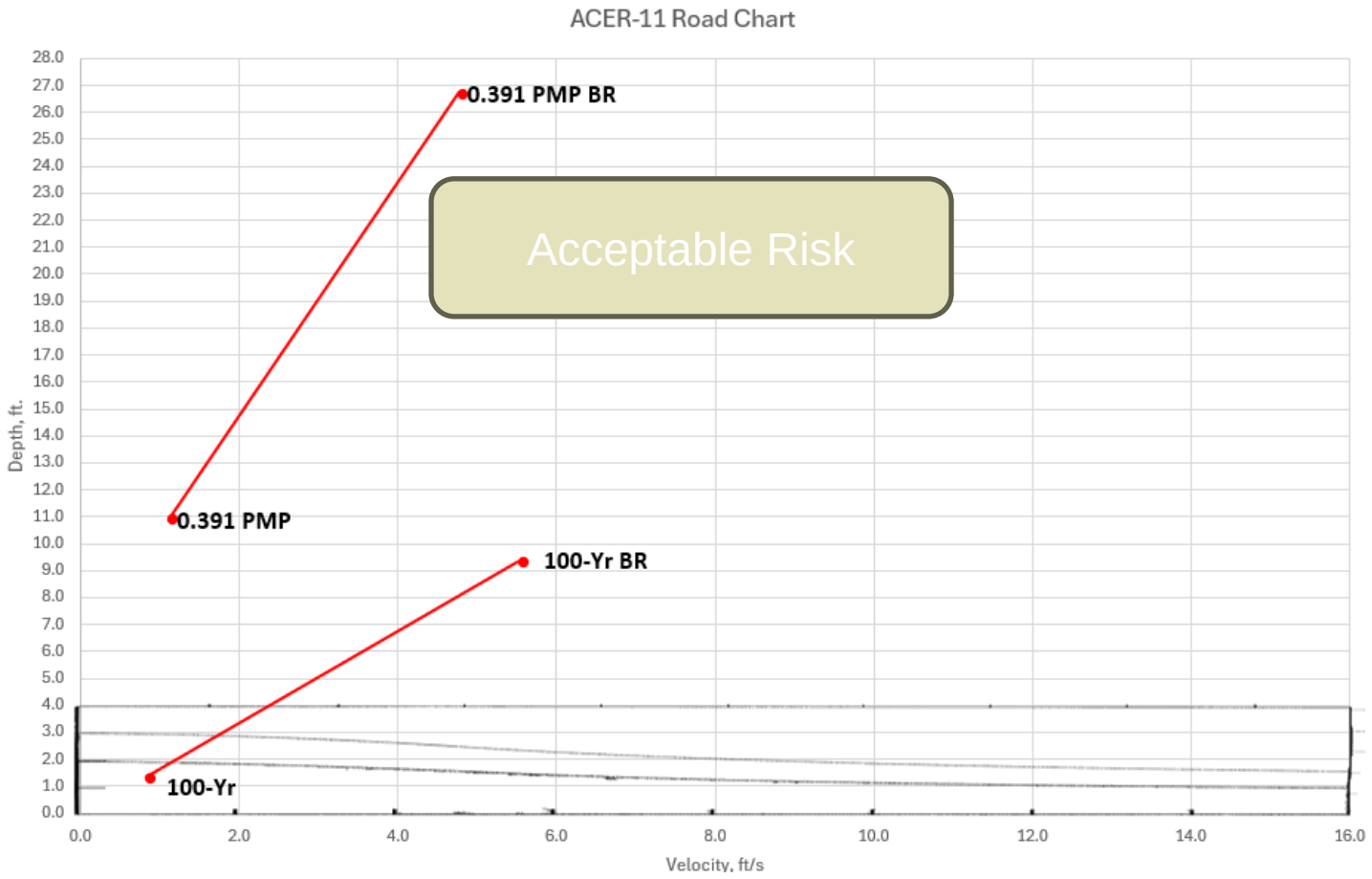
Test Case Disclaimer:

- Original DBIZ used HMR51/52 Values
- New DBIZ/IDA used Virginia PMP Values
- Different Software Versions (HEC1/HEC-HMS/HEC-RAS)
- Updated Soils Information
- Updated LiDAR Data

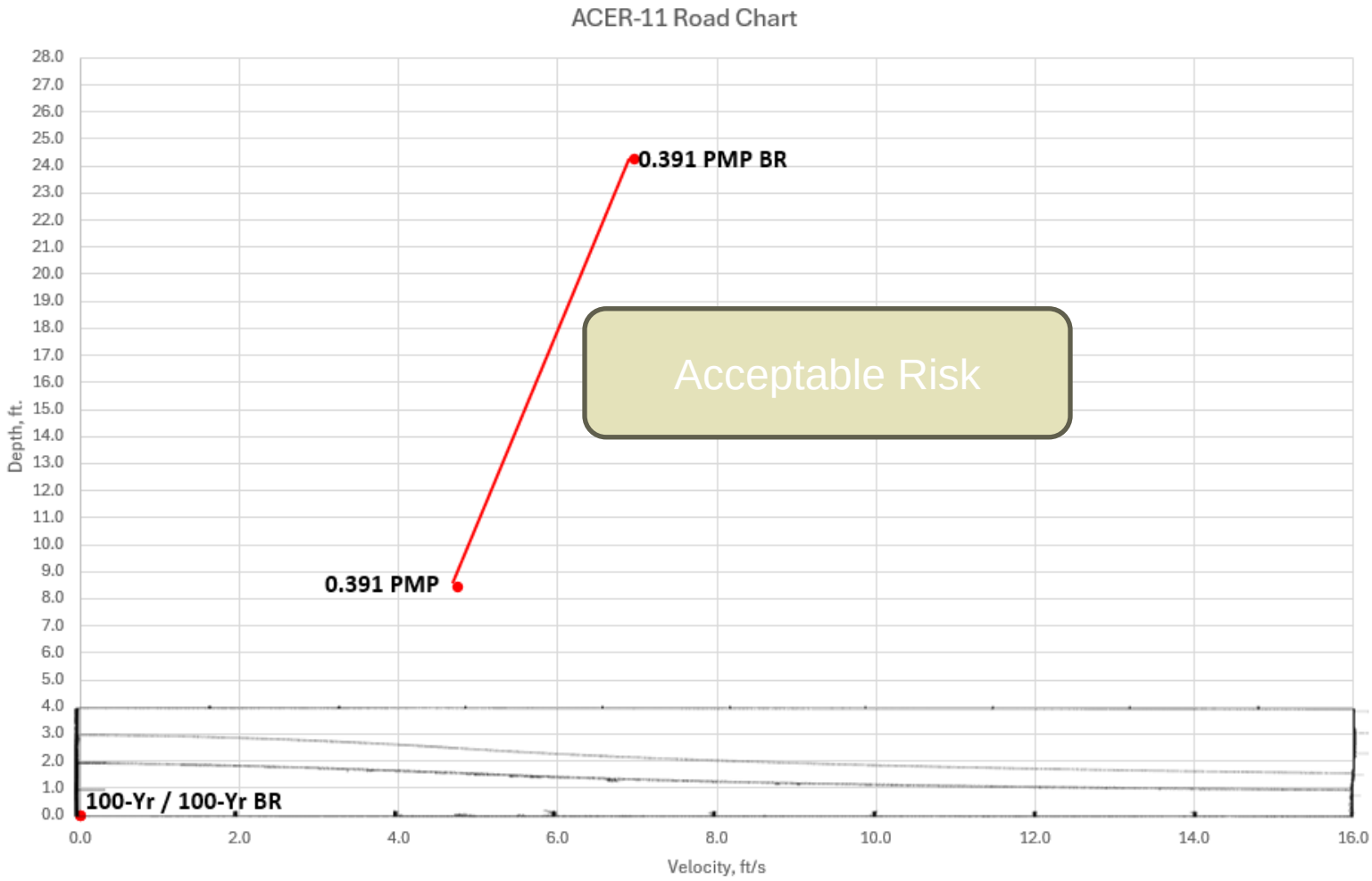
Test Case 1 - South Anna 52B

- Approved DBIZ dated June 2012
- Significant Hazard Dam
- IDA = 100-year Storm Event
- Max Dam Capacity = 0.391 PMP
- No Impacted Structures – No Rule of 7

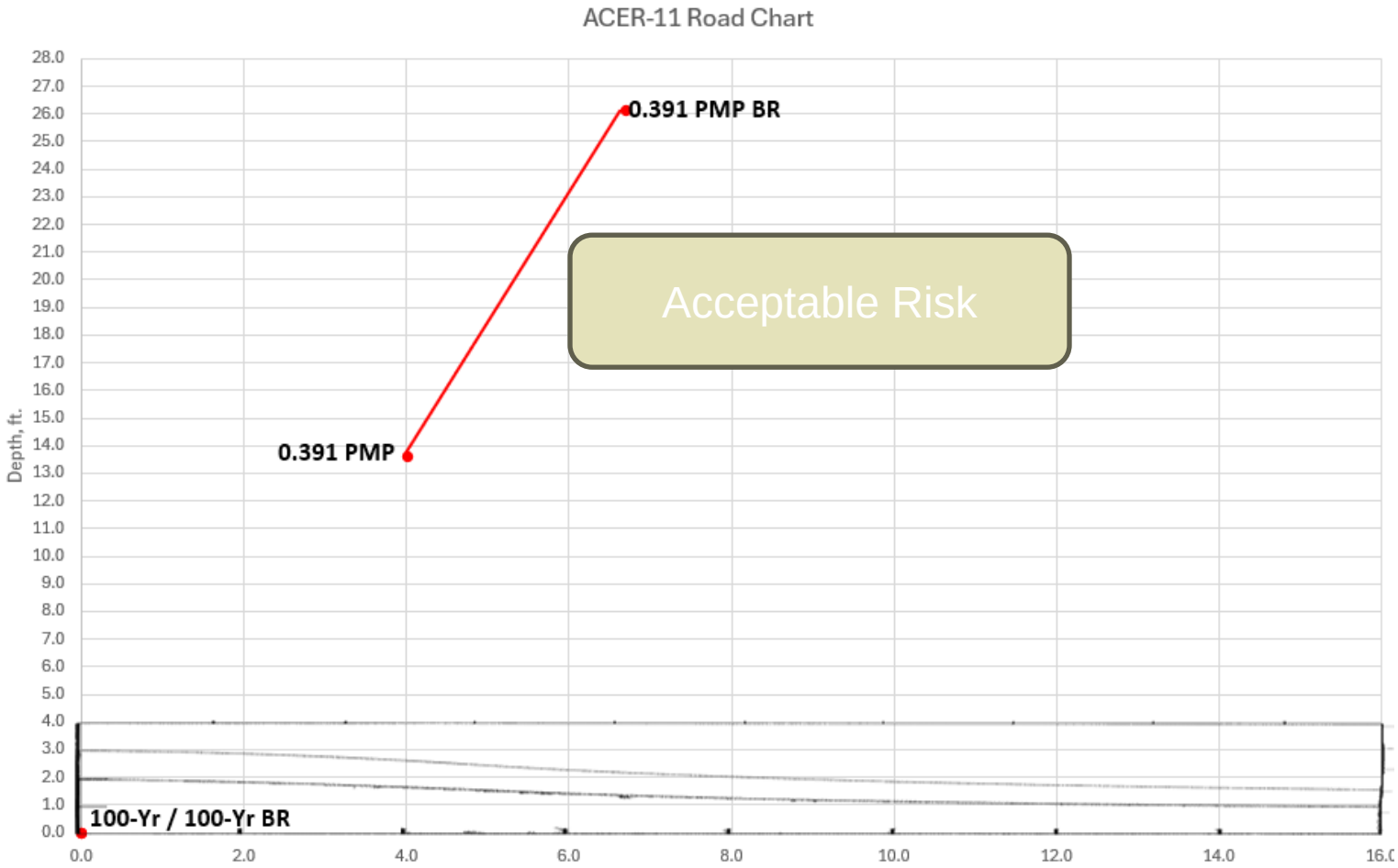
RT676


ACER-11 Road Chart
Depth, ft.
Velocity, ft/s
0.391 PMP BR
0.391 PMP
100-Yr BR
100-Yr
Acceptable Risk
28.0
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

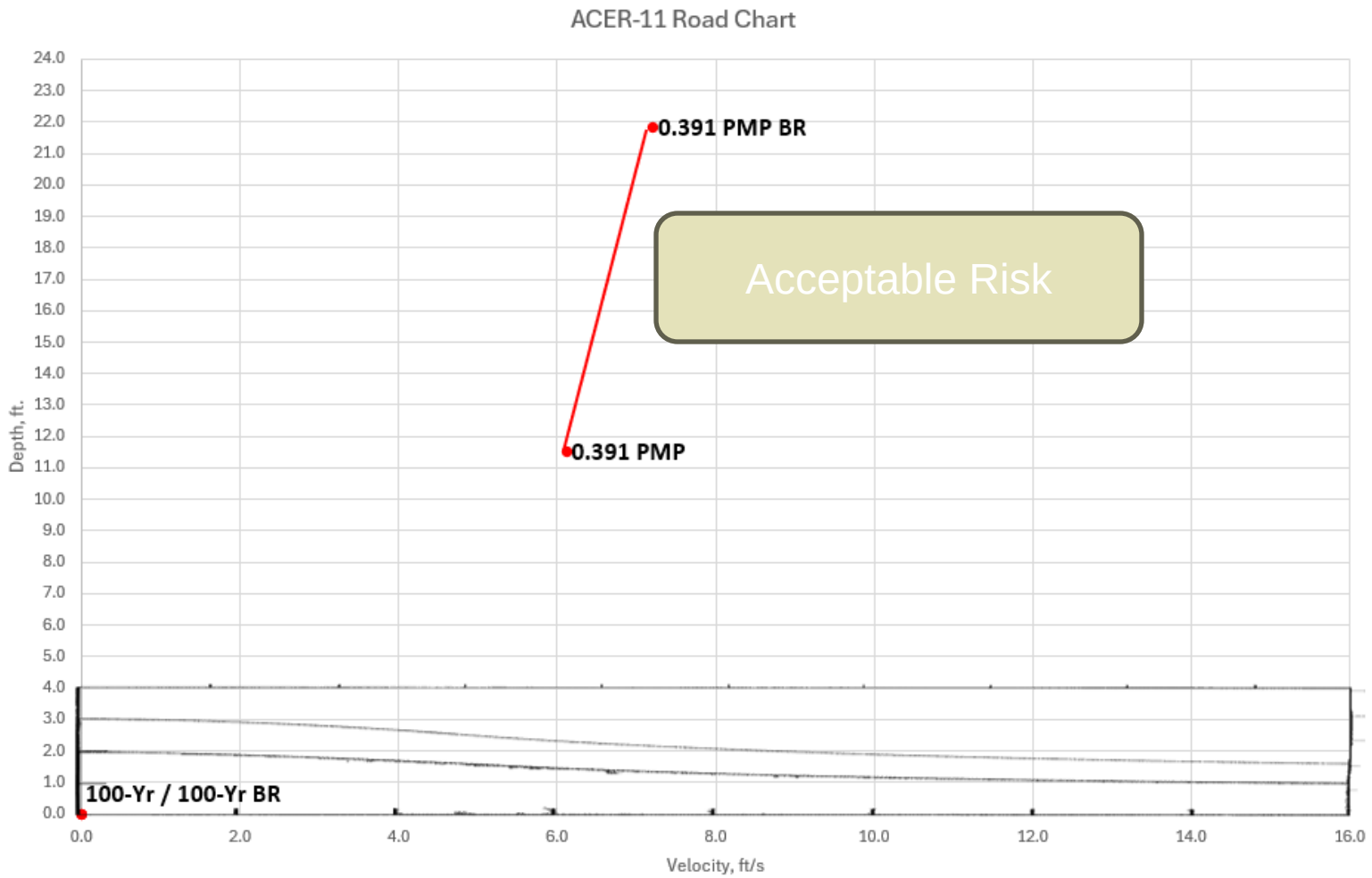
Howard Mills Road



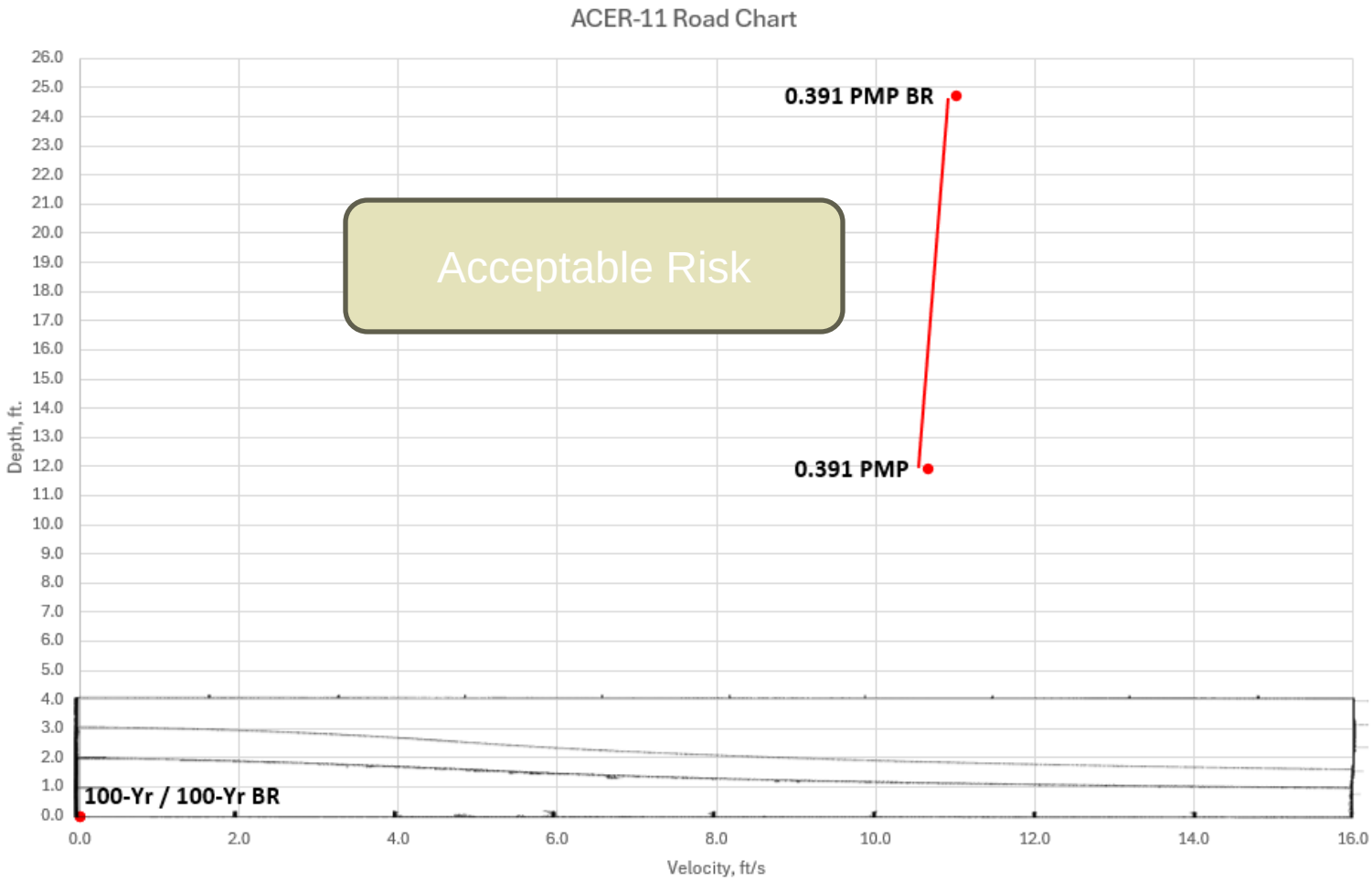
RT675 - Auburn Mill Road



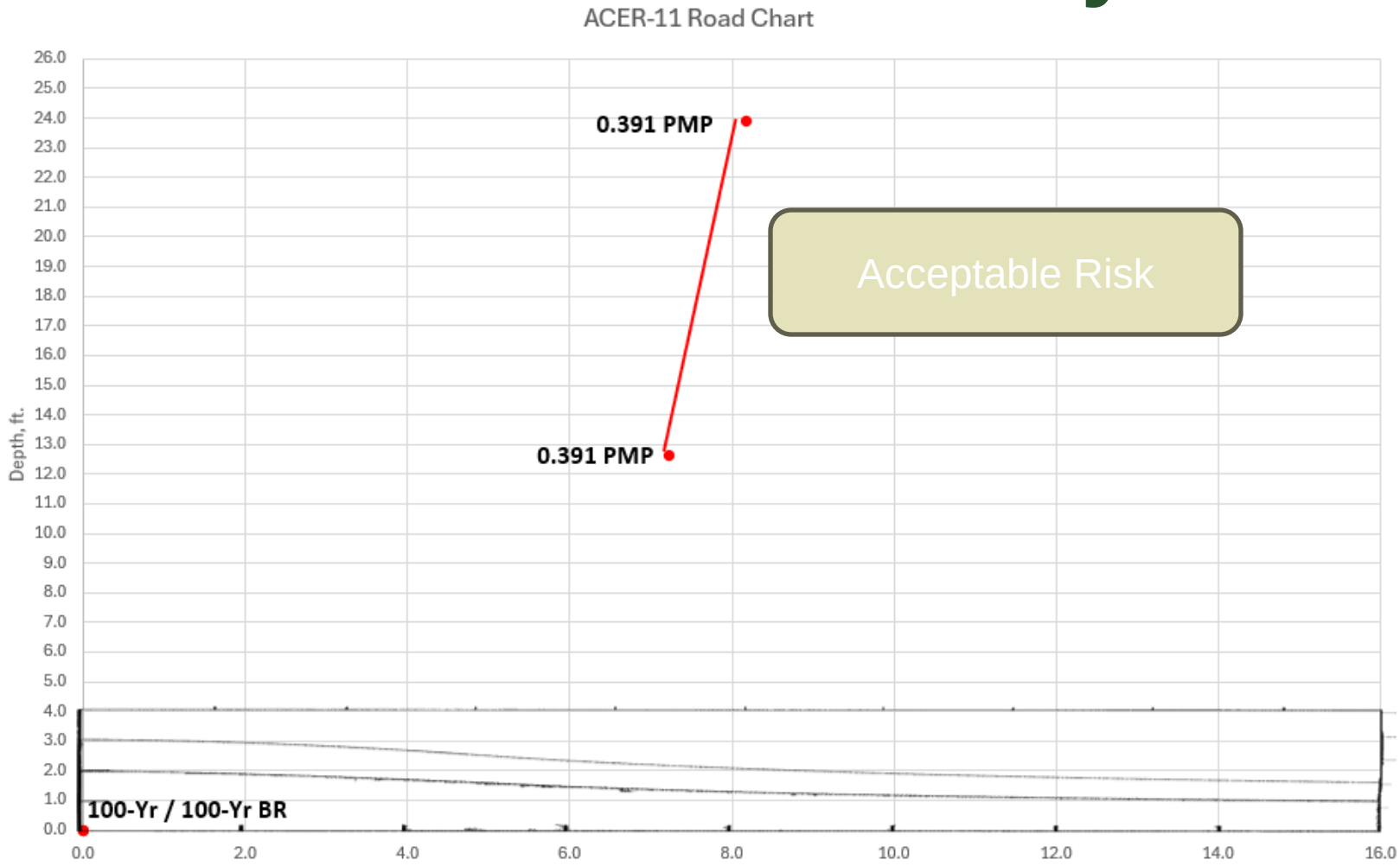
US33 – Mountain Road



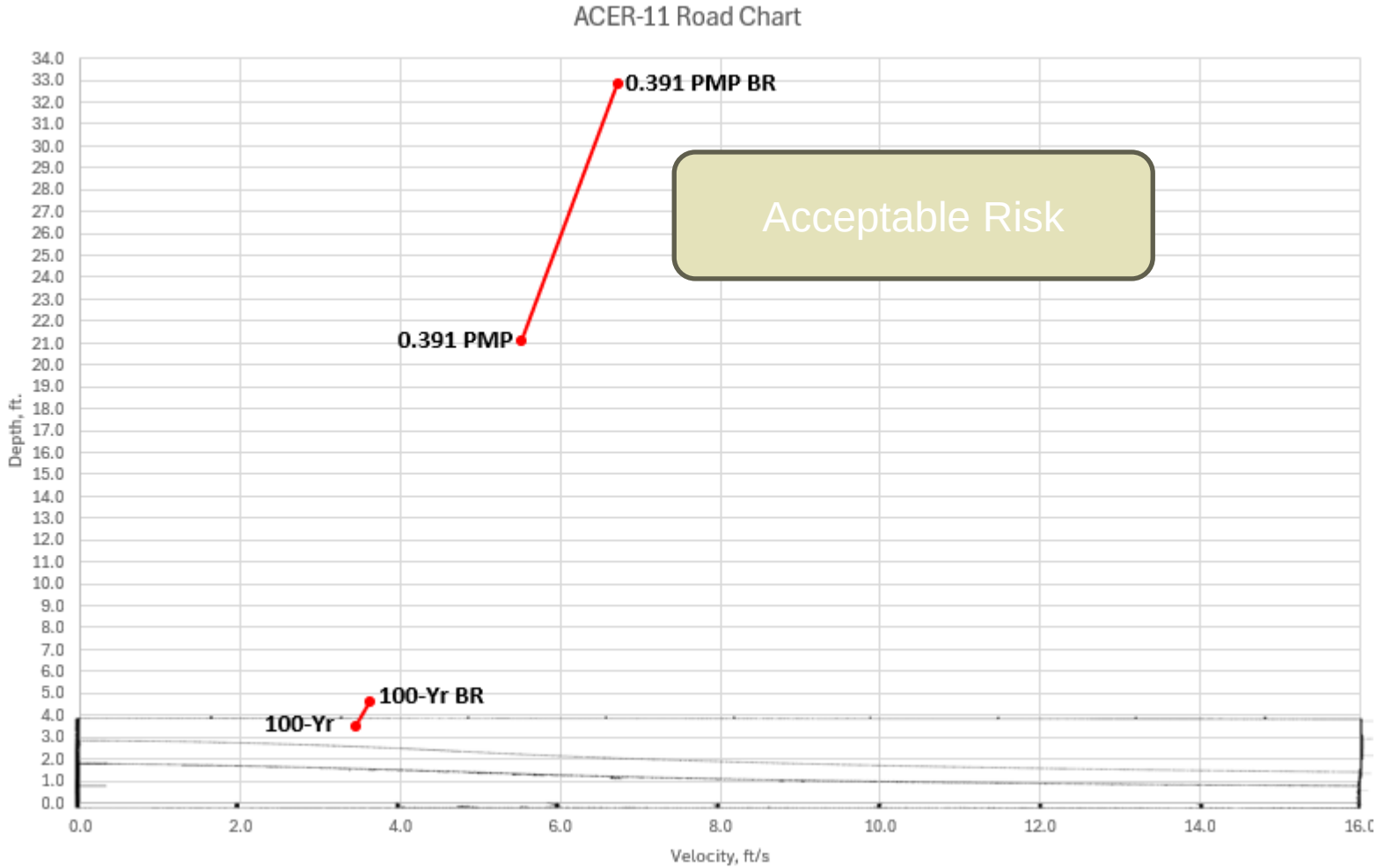
RT657 – Greenwood Church Road



RT54 – W Patrick Henry Road



RT686 – Horseshoe Bridge Road



Test Case 1 – Results

- No Unacceptable Risk Identified
- SDF = 0.391 PMP

Test Case 2 – Willis River 6A

Original DBIZ dated March 2011

- SDF= 0.9 PMP

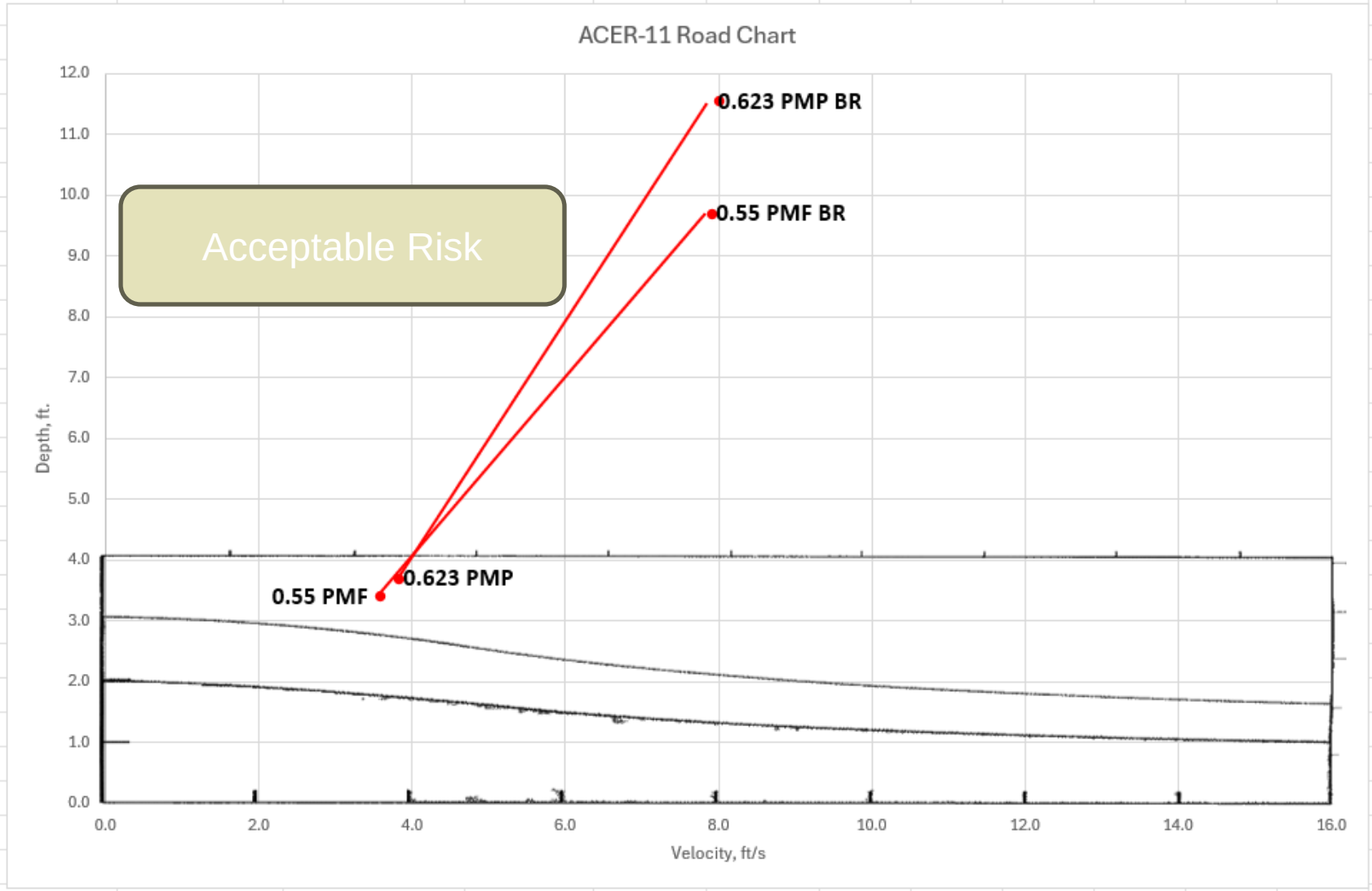
DCR IDA dated August 2018

- DCR IDA = 0.55 PMF

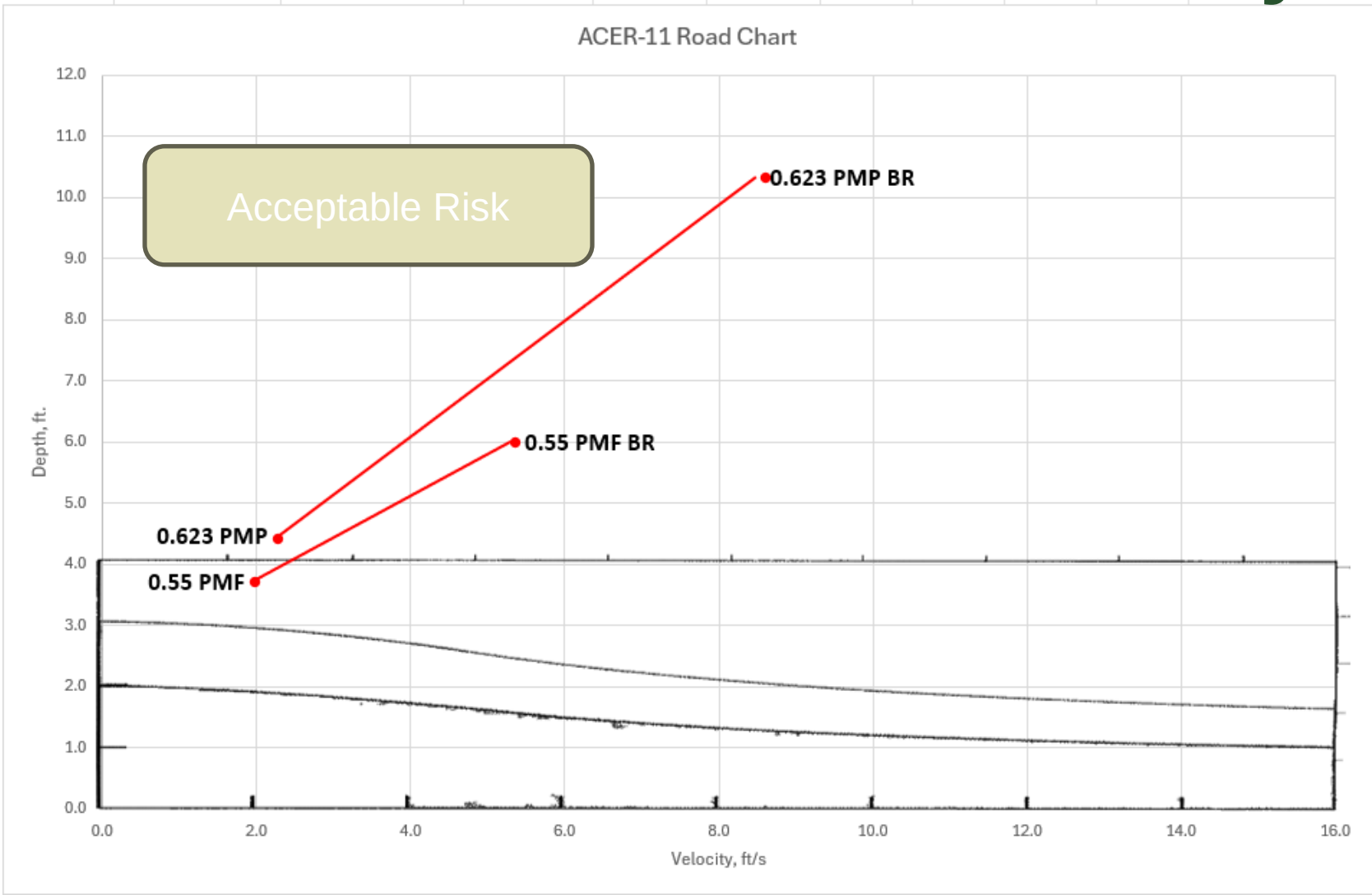
High Hazard Dam

Max Dam Capacity = 0.623 PMP

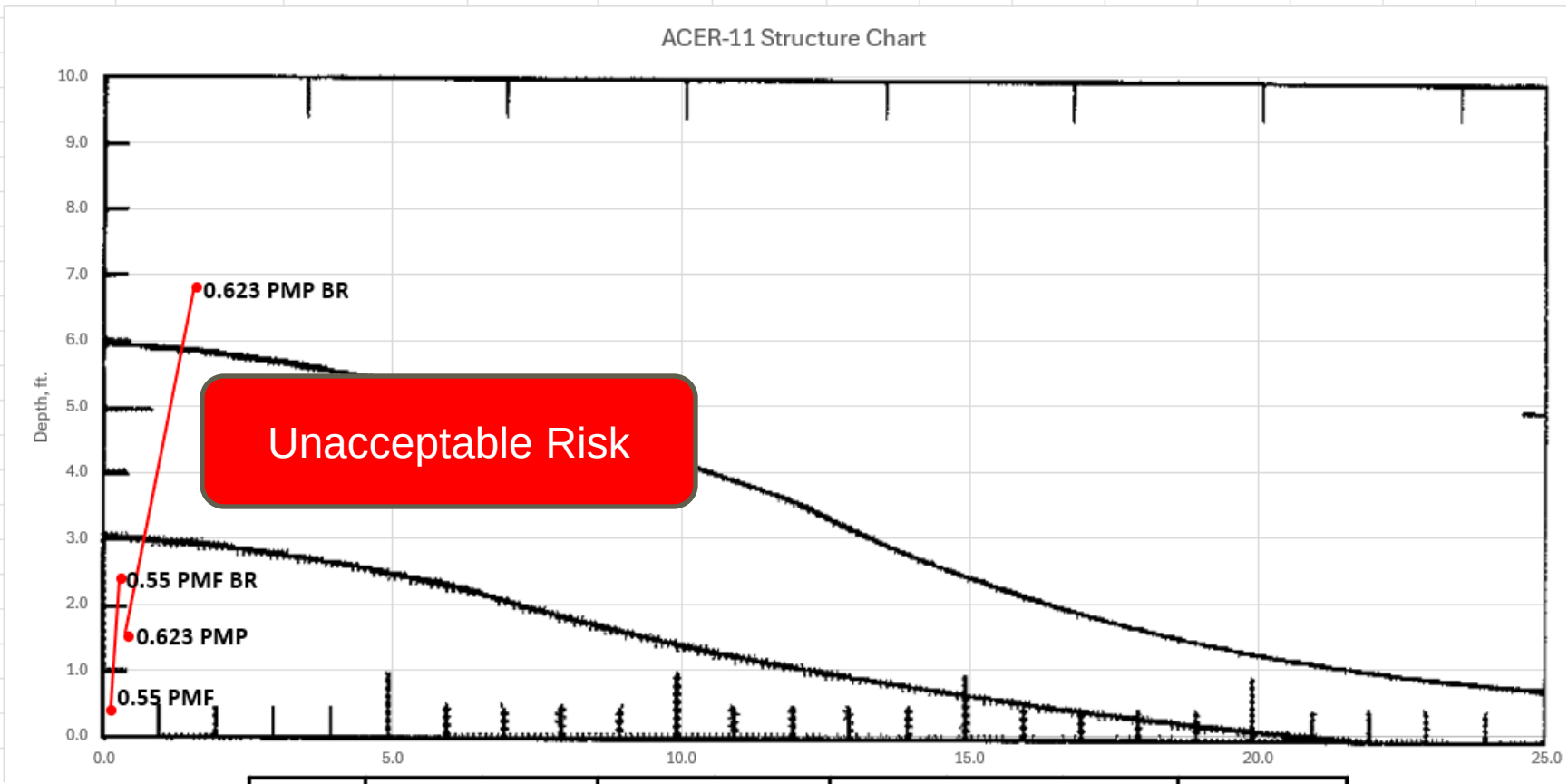
RT608 – Elcan Road



RT15 – James Madison Hwy

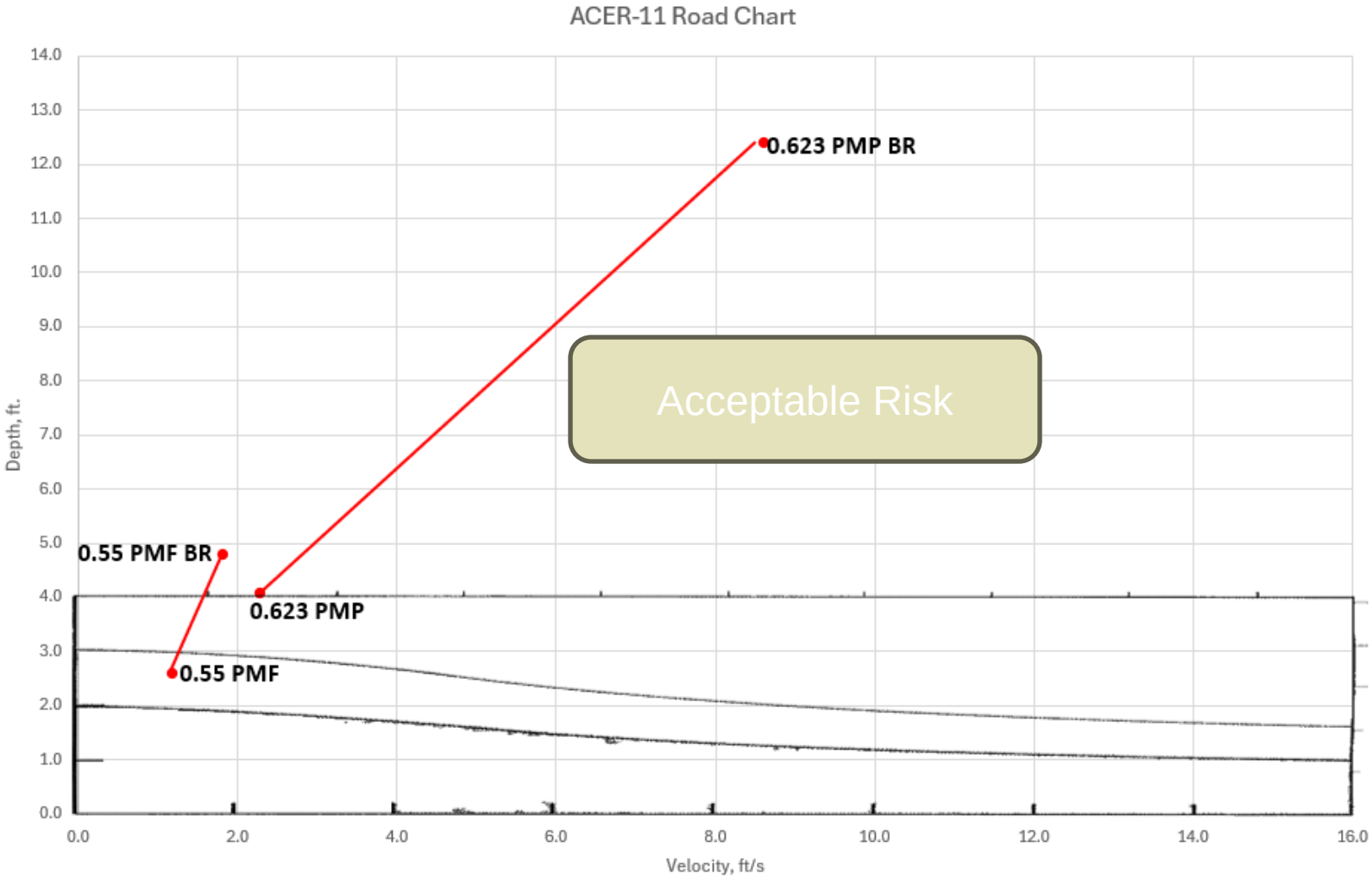


House – 109 Lucy Lane



Rule of 7	Non-Breach		Breach		Incremental			Result
	Depth	Velocity	Depth	Velocity	Depth	Velocity	DV	
.623 PMP	1.5	0.4	6.8	1.6	5.3	1.2	6.36	Unacceptable
0.55 PMF	0.4	0.1	2.4	0.3	2	0.2	0.4	Acceptable

RT600 – Old Plank Road



Test Case 2 – Results

- Unacceptable Risk Identified
- SDF = 0.9 PMP
- Overturns Previous approved IDA
- Change due to Evaluation of Downstream Structure

Test Case 3 – Buffalo Creek 8

Original DBIZ dated February 2011

- IDA= 0.49 PMF

DCR IDA dated January 2021

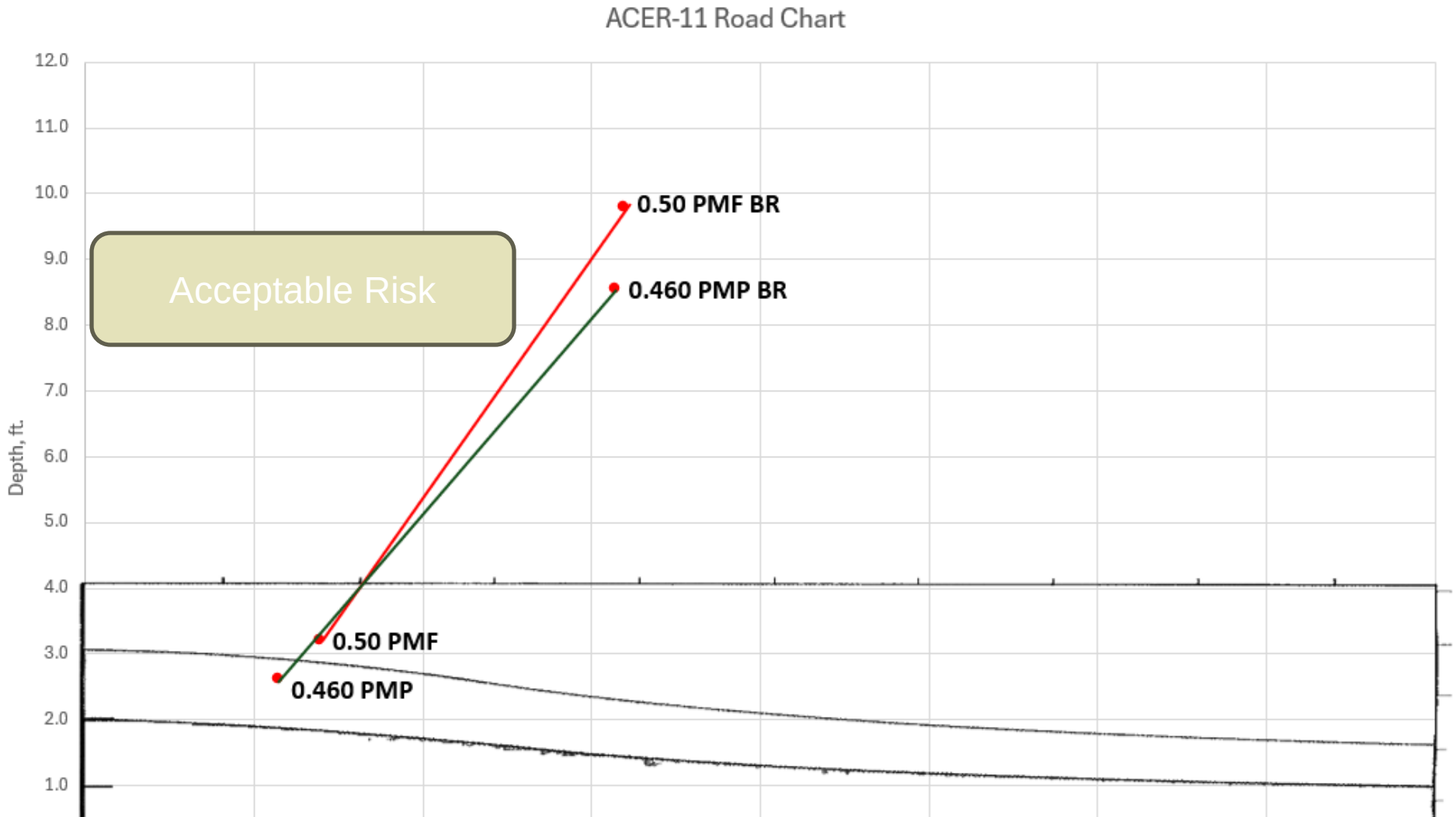
- DCR IDA = 0.50 PMF (No IDA)

Significant Hazard Dam

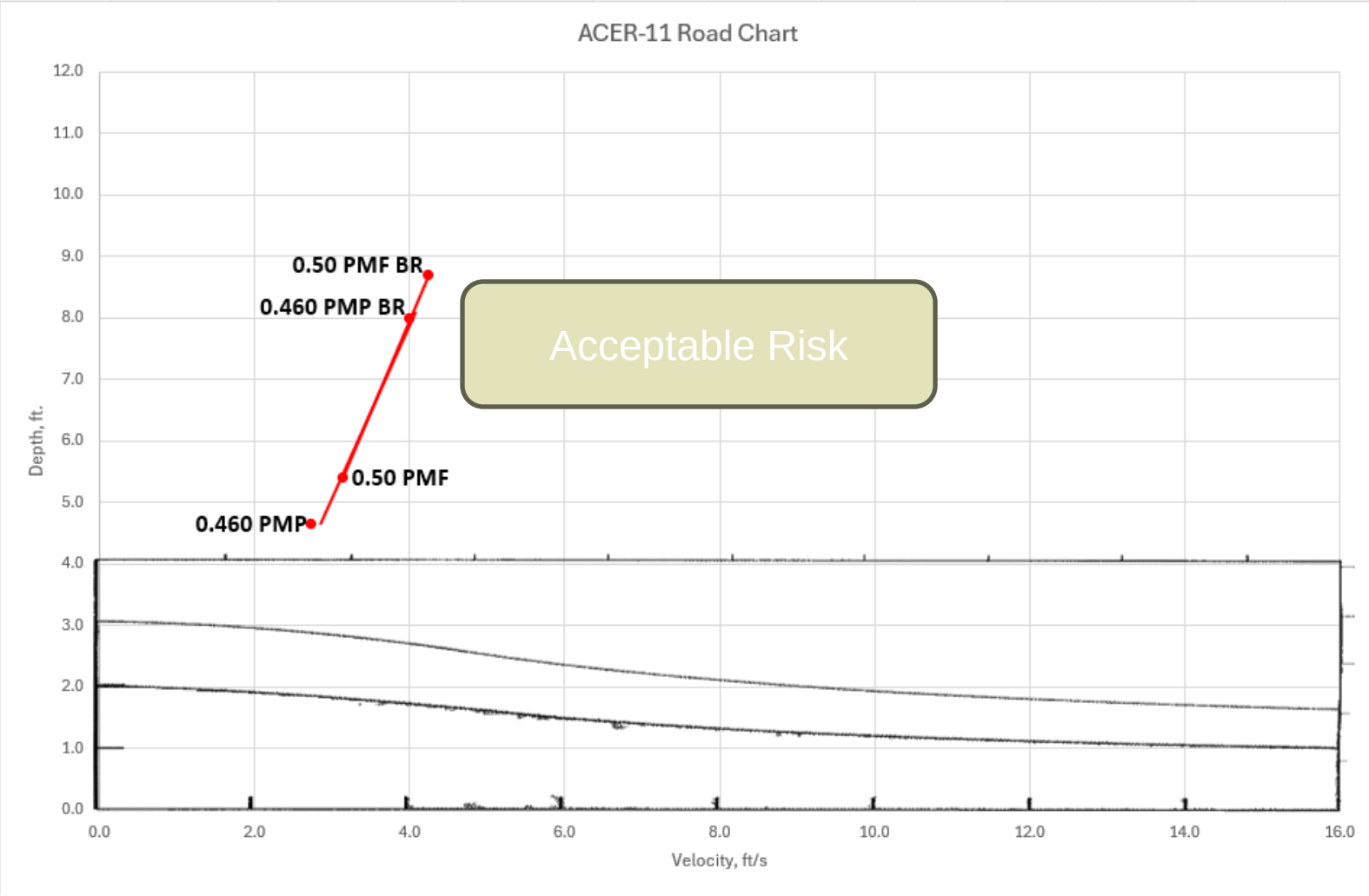
Max Dam Capacity = 0.460 PMP

No Impacted Structures – No Rule of 7

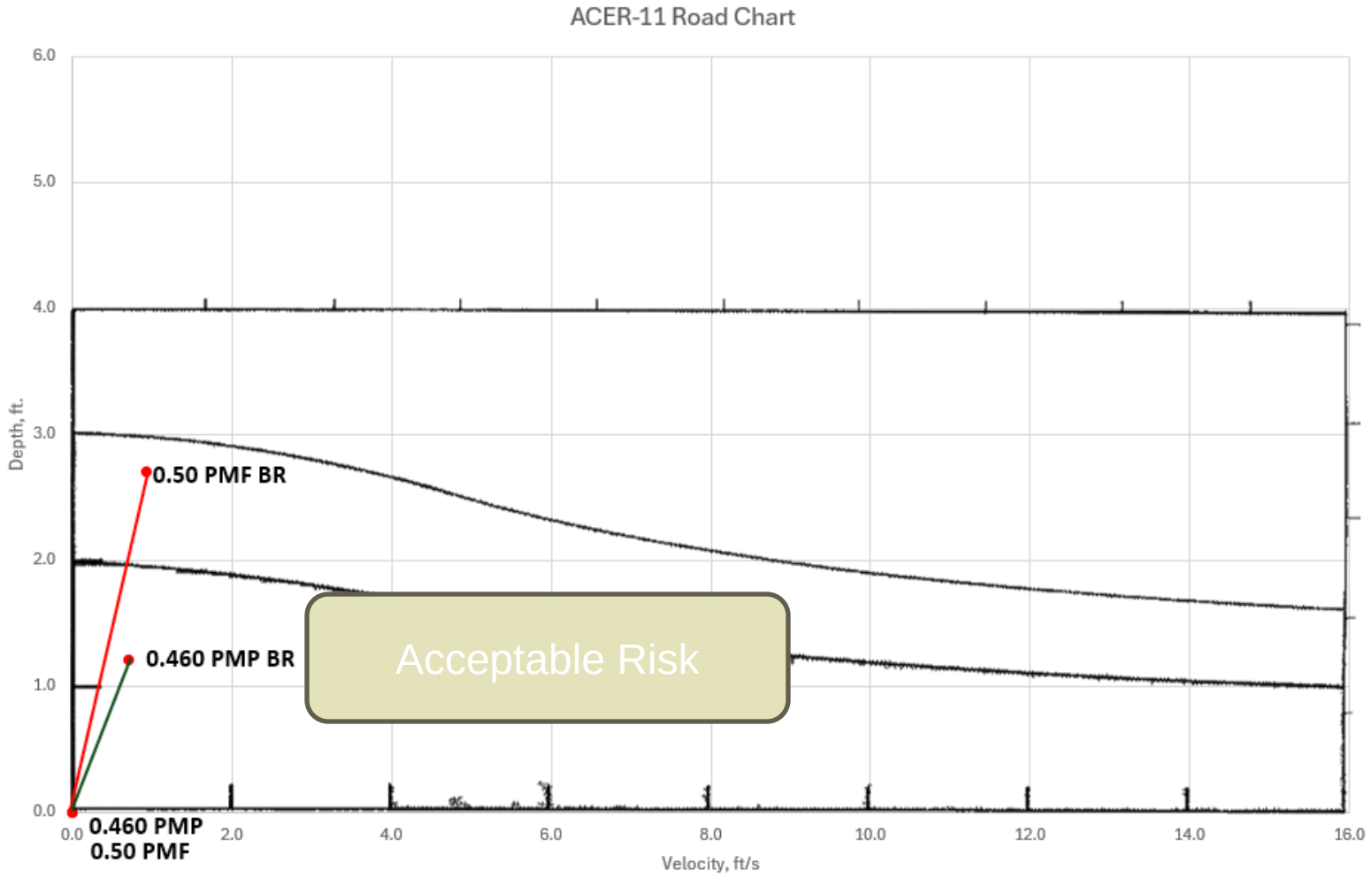
RT699 – Carter Road



RT666 – Douglas Church Road



RT665 – Darlington Heights



Test Case 3 - Results

- NO Unacceptable Risk Identified
- SDF = 0.46 PMP
- No Spillway Improvements Required

DCR
Virginia Department of Conservation & Recreation

Takeaways

- Only Evaluate One Storm Event
- Streamlined Method with less Ambiguity
- Determine the Risk of Existing Dam
- Can use previous DBIZ if Data Exists
- Easy to Determine the Results
- Standardized Form/Chart Needed
- Time Savings

Alternative Evaluation Criteria

DSS-WISE HCOM

Table 4. Definition of potentially lethal flood zones (PLFZs) for different categories (Feinberg, 2017).

Category	Color Code	D_{max} $(ft.)$		DV_{max} (ft^2/s)
Children caught outdoors (tent camping, fishing, hiking, etc.)		≥2	or	≥5.4
Adults caught outdoors (tent camping, fishing, hiking, etc.)		≥4	or	≥6.5
Motor vehicle (compact car) floating	None	≥1	or	≥4.3
Motor vehicle (compact car) sliding/toppling	None			≥5.4
Mobile homes	None	≥2	or	≥30
Typical residential structures	None	≥4	or	≥75

Alternative Evaluation Criteria

DSS-WISE HCOM

Table 3. Potential flood hazard levels for humans caught indoors based on the BC Hydro LSM Building Stability Criteria.

DV_{max}		Color Code	Building Type
(m^2/s)	(ft^2/s)		
≥5	≥54		HZ06: Poorly constructed building
≥10	≥108		HZ07: Well-built timber building
≥15	≥161		HZ08: Well-built masonry building
≥20	≥215		HZ09: Concrete building
≥35	≥377		HZ10: Large concrete building

DCR
Virginia Department of Conservation & Recreation

Alternative Evaluation Criteria

- Modern Criteria and Modern Approach
- Used in FEMA approved Reports
- Classification can be done by Spreadsheet
- GIS can be used to highlight High Risk Zones on Inundation Maps
- Similar too current Rule of 7 Approach

Virginia Department of Conservation & Recreation

Final Thoughts?