



**Maryland**  
Department of  
the Environment

# Maryland Biological Stressor Identification Process (2014)

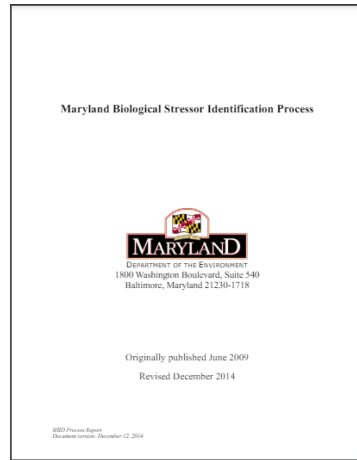
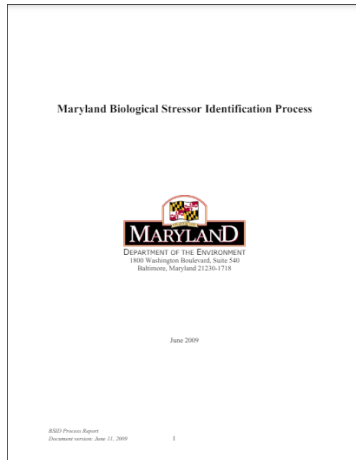
06/05/2024



# MD BSID

## History

- First developed in 2009
- Updated in 2014
  - [Studies published](#) around 2016



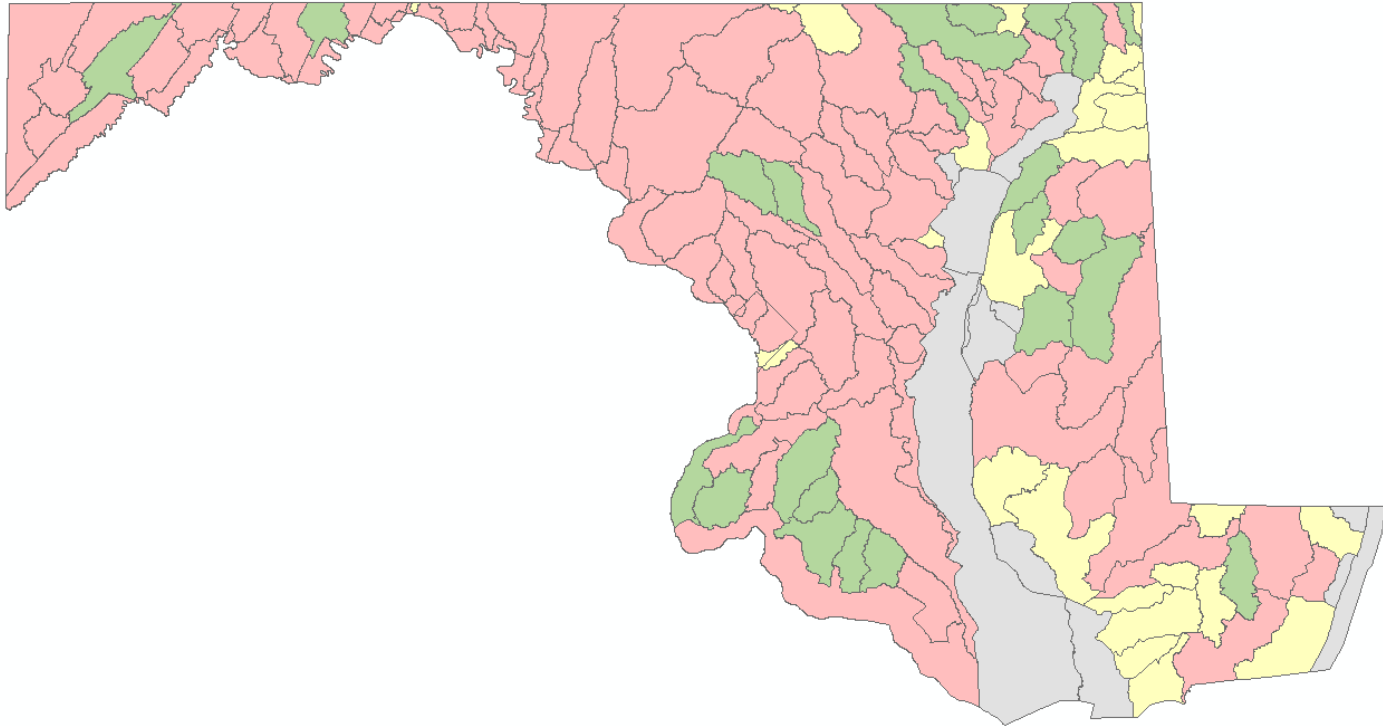
## Data

- Maryland Biological Stream Survey:
    - 1<sup>st</sup> to 4<sup>th</sup> order non-tidal streams
    - Benthic macroinvertebrates
    - Fish
    - Water chemistry
    - Instream habitat
    - Riparian habitat
  - Altitude
  - Land use
  - Impervious surface
  - State Roads
- n = 1,284**



# 2014 Biological Assessment Results

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# MD BSID

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## Goal

- Compare biology to stressor levels
- Using case-control statistics: Mantel-Haenszel Odds Ratios
- Samples are categorized into groups, then numbers in each group are compared
- Sites are categorized by:
  - Biology: 😊 or ☹️
  - Stressor: ↑ or ↓
  - Physiographic region and stream order

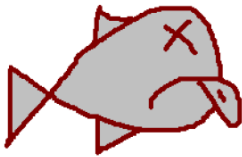
Data from R2 (2000-2004)  
and R3 (2007-2009)



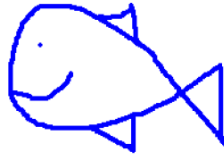
# Biology Categories

## Cases vs. Controls

FIBI < 3



FIBI ≥ 3



BIBI < 3



BIBI ≥ 3



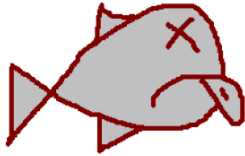
Narrative Rating	IBI Score Range
Good	4.0 – 5.0
Fair	3.0 – 3.9
Poor	2.0 – 2.9
Very Poor	1.0 – 1.9



# Biology Categories

Cases vs. Controls

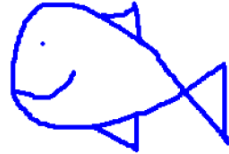
FIBI < 3



BIBI < 3



in 8-digit watershed

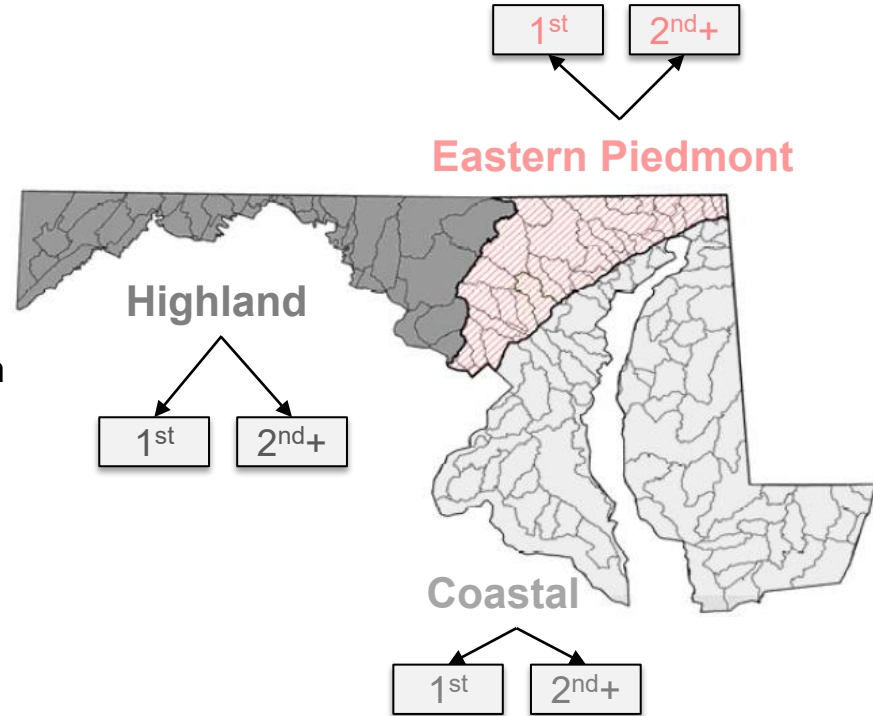


FIBI ≥ 3



BIBI ≥ 3

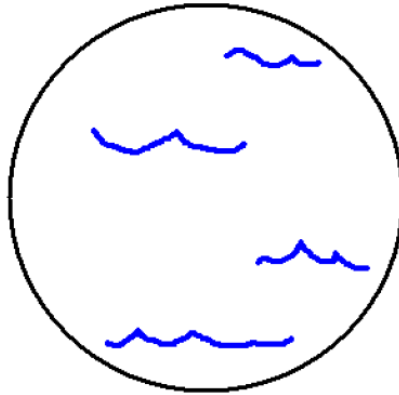
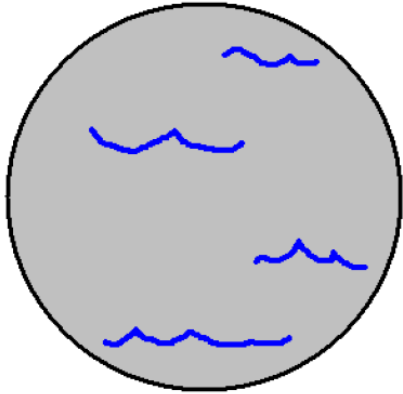
in physiographic region





# Stressor Categories

Stressor above limit vs. Stressor below limit



- Source:
  - Acidity
  - Agricultural
  - Anthropogenic
  - Impervious
  - Urban
- Stressor:
  - Sediment
  - Habitat (instream & riparian)
  - Chemistry (inorganic, nutrients, and pH)



# Parameter Thresholds

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Each parameter was assigned a stressor threshold per eco-region, based on:

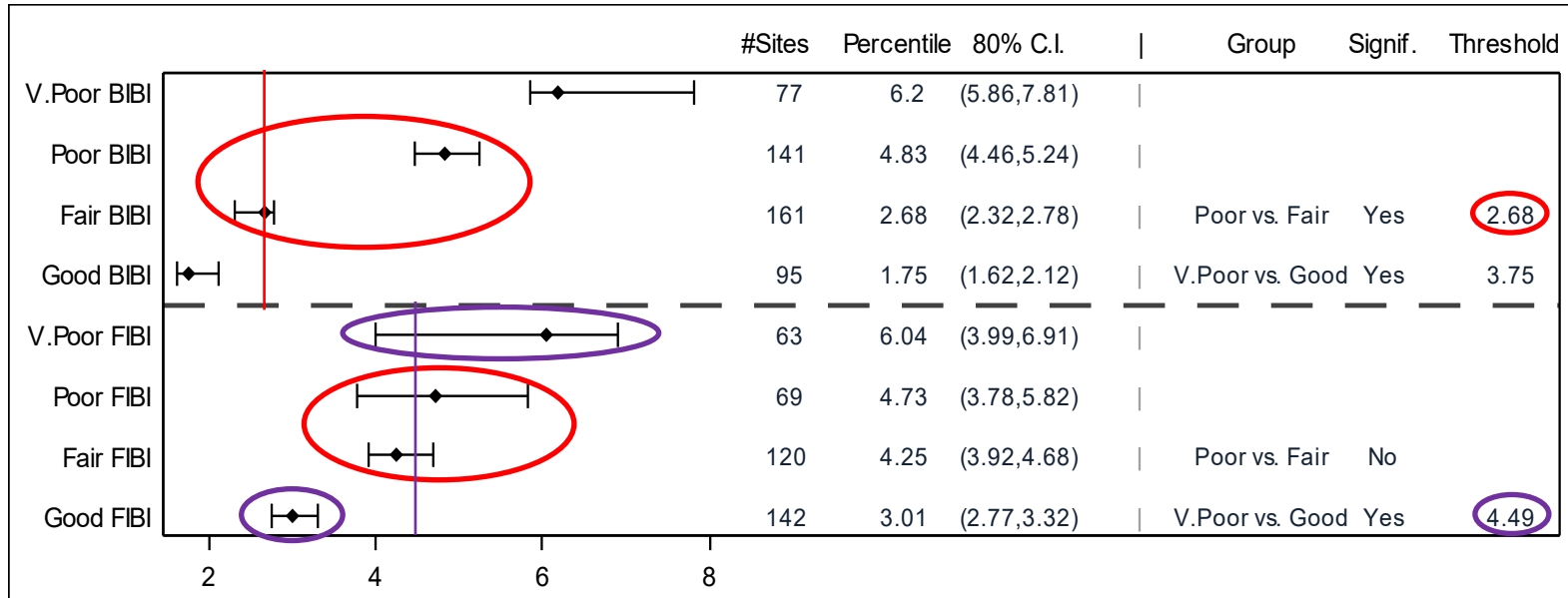
- Existing guidelines: COMAR, literature, MDDNR MBSS
- Statistical analysis on grouped responses → indicate levels above which degradation to biological communities is likely to occur
  - Compared stressor levels among different biological conditions: sites pooled into each narrative IBI category and stratified by ecoregion
  - Graphs displaying 80% confidence intervals of grouped percentile distributions and statistical significance tested









# Parameter Thresholds

## High Total Nitrogen, Highland





# MD BSID – Contingency Tables

	Case	Control
Stressor above limit	a 	b 
Stressor below limit	c 	d 

Two-way contingency table for every:

- Stressor
- Watershed



# MD BSID – Odds Ratio

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$$\text{Odds Ratio} = \frac{ad}{bc} = \frac{\begin{array}{cc} \text{Red fish with X} & \text{Blue fish} \\ \text{Grey background} & \text{White background} \end{array}}{\begin{array}{cc} \text{Red fish with X} & \text{Blue fish} \\ \text{White background} & \text{Grey background} \end{array}}$$

If >1, the result is significant, and stressor is likely to be impacting biology



# MD BSID – Attributable Risk

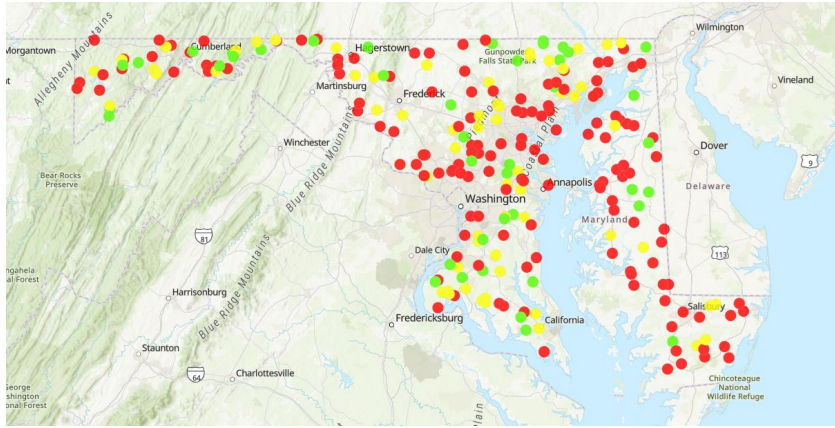
The portion of the sites with poor to very poor biological conditions as a result of the stressor

$$AR = \left( \frac{\text{Poor fish and benthos icon}}{\text{Poor fish and benthos icon}} \right) - \left( \frac{\text{Good fish and benthos icon}}{\text{Good fish and benthos icon}} \right)$$

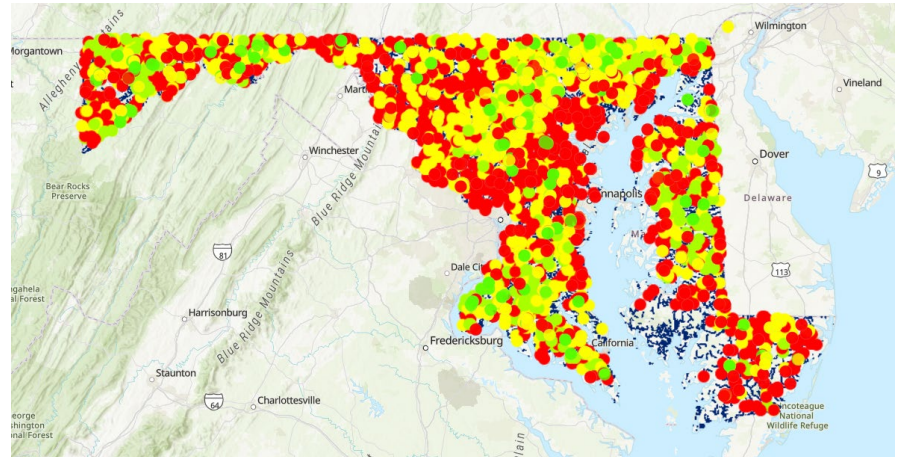
Also combined by categories of stressors and sources.



# MD BSID- Challenges



- Sampling efforts have not remained the same over time
- Sampling methodology has changed



Images:

MBSS- Biological Stream Survey Random Sites (2021-2023)- Top

MBSS- Biological Stream Survey Sites (1995-2023)- Right

<https://maryland.maps.arcgis.com/apps/webappviewer/index.html?id=30ee9336f8d54e4ebf971c3a1a7576ed>



# MD BSID- Challenges

**MBSS SUMMER HABITAT DATA SHEET** Page:  of

Watershed Code:  Segment:  Type:  Year:  Reviewer: First / Second  
 SITE CODE:  Habitat Assessor:

BANK EROSION		HABITAT ASSESSMENT		FLOW		
Left Bank   Right Bank		1. Instream Habitat (0-20).....		Lat. Loc. (m)	Depth (cm)	Velocity (m/s)
Extent (m) [ ] [ ]		2. Epifaunal Substrate (0-20).....		0 0 0 0	0 0 0	0 0 0
Severity (0=none, 1=min, 2=med, 3=severe)		3. Velocity/Depth Diversity (0-20).....				
Average Height (m) [ ] [ ]		4. Pool/Glide/Eddy Quality (0-20).....				
Extent (m) [ ] [ ]		5. Riffle/Run Quality (0-20).....				
BAR FORMATION & SUBSTRATE		6. Embeddedness (%) [ ] [ ]				
Severity (0=none, 1=min, 2=med, 3=severe)		7. Shading (%) [ ] [ ]				
Cobble [ ] [ ]						
Gravel [ ] [ ]						
Sand [ ] [ ]						
Silt/Clay [ ] [ ]						
STREAM CHARACTER						
Braided [ ] [ ]	Gravel [ ] [ ]	Boulder >2m [ ] [ ]				
Riffle [ ] [ ]	Sand [ ] [ ]	Boulder <2m [ ] [ ]				
Run/Glide [ ] [ ]	Silt/Clay [ ] [ ]	Beaver Pond [ ] [ ]				
Deep Pool (>= 0.5m) [ ] [ ]	Cobble [ ] [ ]	Overhead Cover [ ] [ ]				
Shallow Pool (< 0.5m) [ ] [ ]	Bedrock [ ] [ ]	Undercut Bank [ ] [ ]				
		Orange Floc [ ] [ ]				
		Filamentous algae [ ] [ ]				
A = Absent    P = Present    E = Extensive						

Woody Debris		Maximum Depth (cm)		Alternative Flow Measurements	
No. of Instream Woody Debris [ ] [ ]		Wetted Width (m) [ ] [ ]		Distance (cm) [ ] [ ]	
No. of Dewatered Woody Debris [ ] [ ]		Thalweg Depth (cm) [ ] [ ]		Depth (cm) [ ] [ ]	
No. of Instream Rootwads [ ] [ ]		0 m [ ] [ ]		Width (cm) [ ] [ ]	
No. of Dewatered Rootwads [ ] [ ]		25 m [ ] [ ]		Time (sec) 1 [ ] [ ]	
		50 m [ ] [ ]		2 [ ] [ ]	
		75 m [ ] [ ]		3 [ ] [ ]	

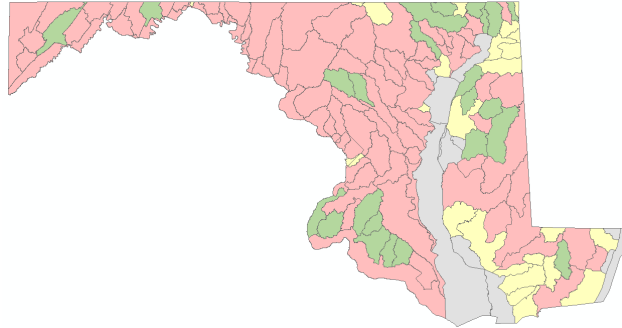
- Subjective parameters
- Additional stressors that are not currently being collected



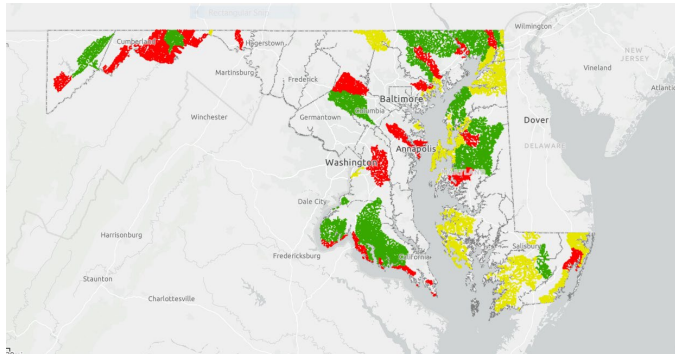


# MD BSID- Challenges

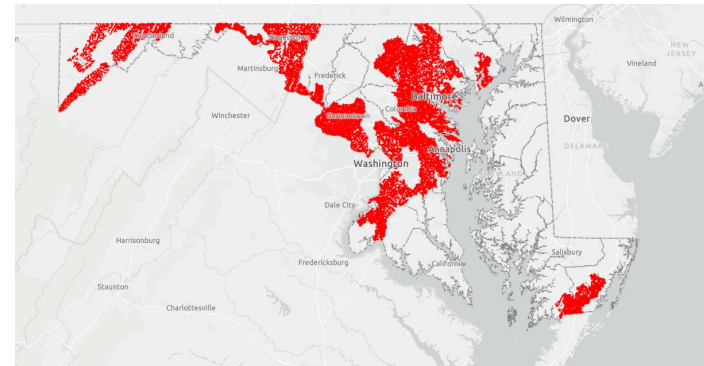
- Scale of the assessment does not help with targeting more degraded areas



MDE Biological Assessment 2014



MDE Biological (Cause Unknown) Assessments



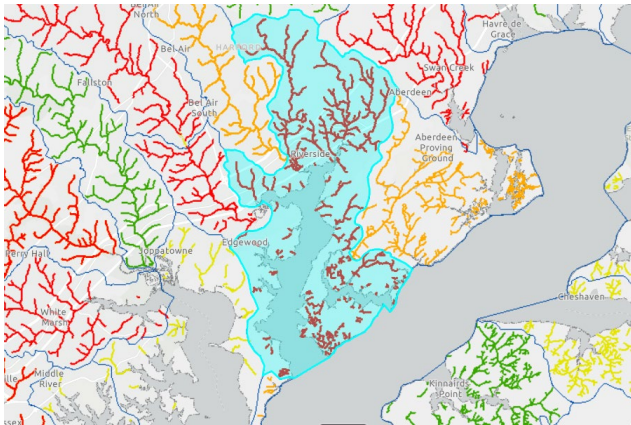
MDE Chloride and Sulfate Impairments





# MD BSID- Challenges

- Updating the Biological Assessment
- Stressors vs. Biology



AU ID	Basin Name	AU Size	Designated Use	Listing Category	Cause	Percent Attributable Risk
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	4c	Habitat Alterations	59.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	4c	Riparian Buffer, Lack of	75.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	5	Total Suspended Solids (TSS)	31.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	5s	Chloride	95.00%
MD-02130701	Bush River	102.81	Aquatic Life and Wildlife	2	Sulfate	





# MD BSID- Next Steps

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Work with ICPRB to update current process:

- Incorporate toxics into methodology
- Evaluate changing the scale

MS4 and DNR work

- Update the Biological Assessment
- Standardize sampling method
- Vet jurisdiction data to incorporate into the assessment



Image from MDE, 2008



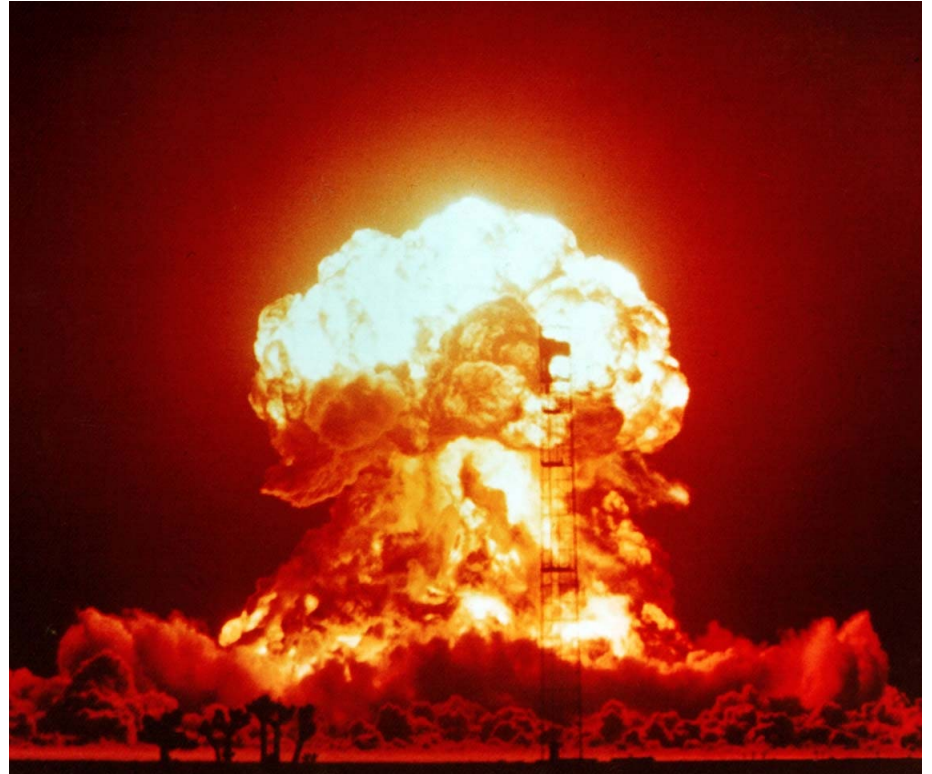
# Remaining Questions

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**We could use your help!**

If we change- does it blow up the process?

- Scale
- Assessment Units
- Updating Assessments
- Delisting
- Random vs. Targeted Sampling
- BSID Threshold Updates
- BSID Changes Over Time





# Questions?

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