MILITARY MUNITIONS SUPPORT SERVICES

WEBINAR – MAKING DECISIONS

INCORPORATING GEOPHYSICS IN THE FS

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10 July 2017

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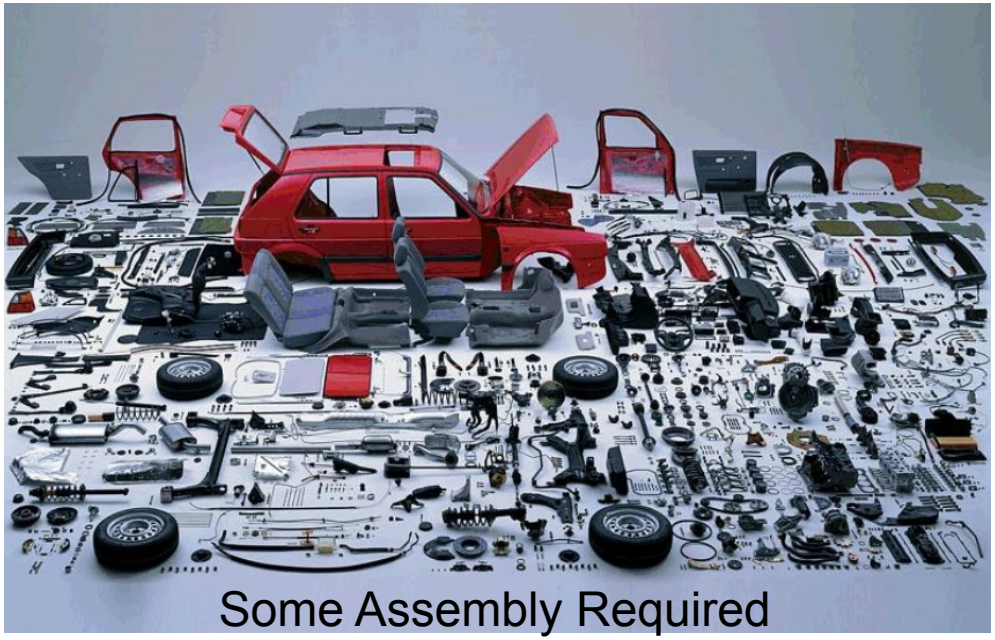
TOPICS

- FS nuts & bolts
- Building Alternatives
- Summary

FS NUTS & BOLTS



Some Assembly Required

CSM: There's a risk

- UXO or DMM suspected
- People use the area
- People might impart energy to an item
- The item might function
- In doing so, harm may come to the user

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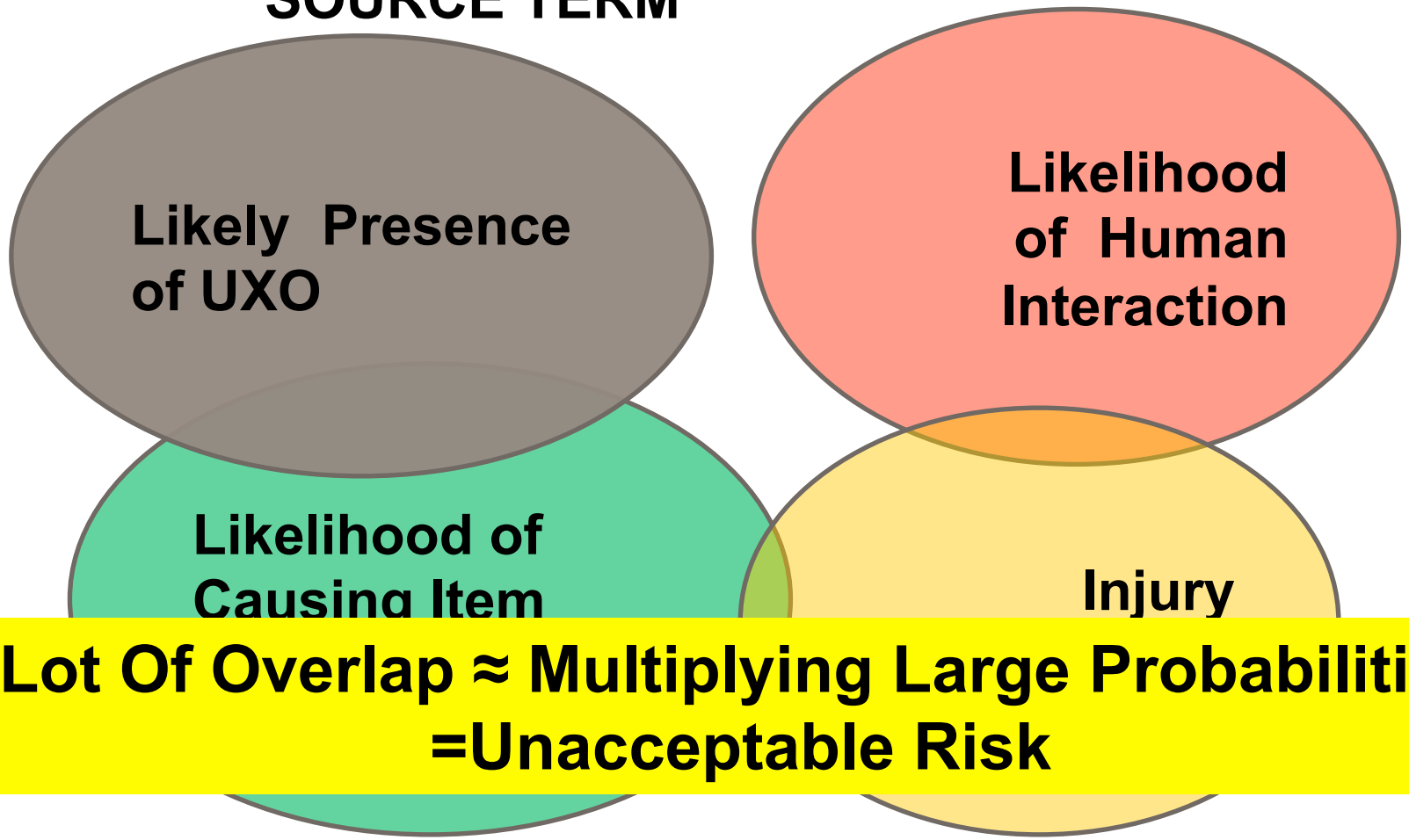
FS NUTS & BOLT

THIS TALK: USING GEOPHYSICS TO ADDRESS THE SOURCE TERM



Lot Of Overlap ≈ Multiplying Large Probabilities =Unacceptable Risk

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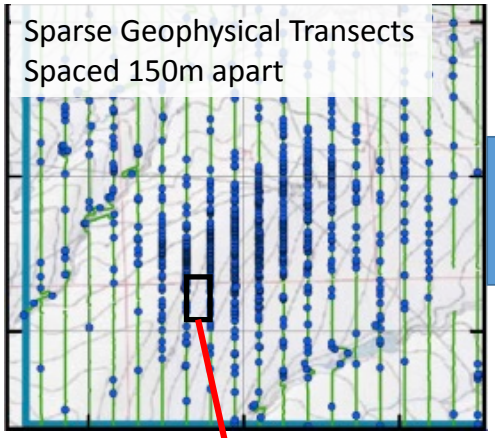
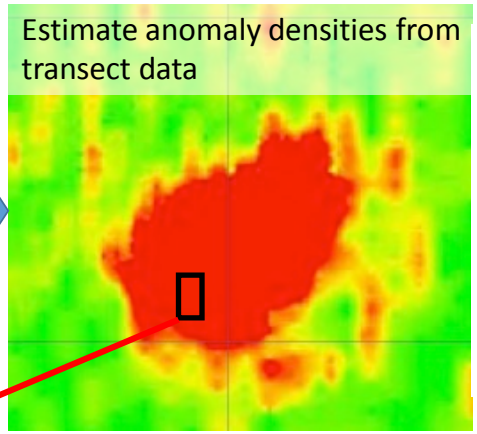
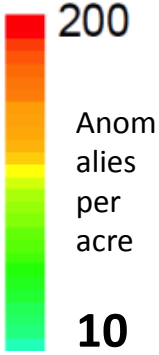
GENERAL RESPONSE ACTION: REDUCE (OR ELIMINATE) THE SOURCE TERM

Example for "The Source Term":



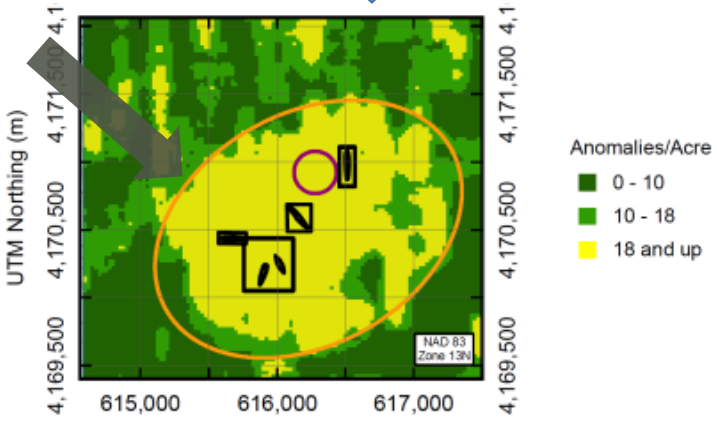
VSP Transect Analysis





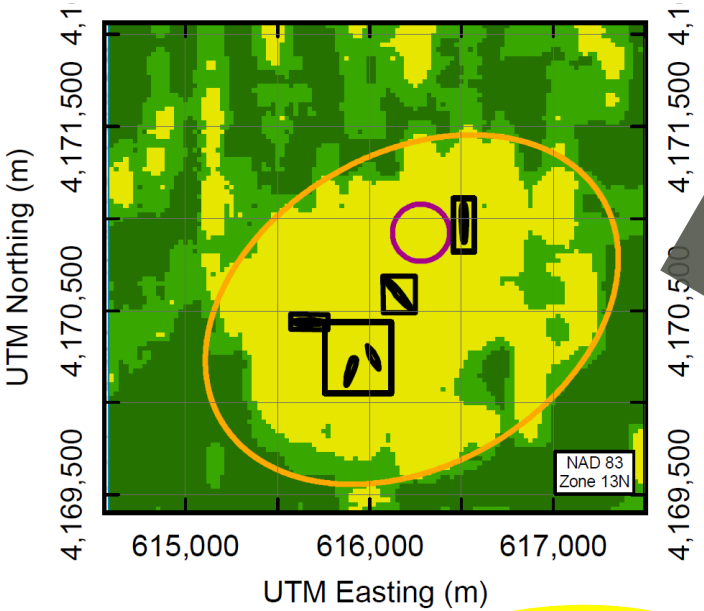
Add all information known and learned about the site

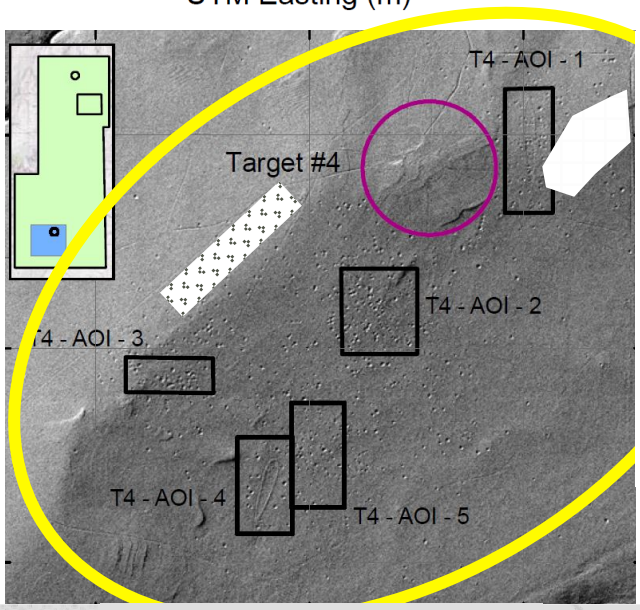
Example of a ship target outline (mounded dirt) and bomb craters from LiDAR imagery COLLECTED within the area identified as a potential bomb target area from VSP transect analysis



Final Characterization: ~800 acre target area, ~55,000 anomalies, some are probably bombs

THE CSM IS CRITICAL





- Where are UXO anticipated?
- What are the access restrictions per technology?

Full Access

Dense Vegetation

Uneven Terrain

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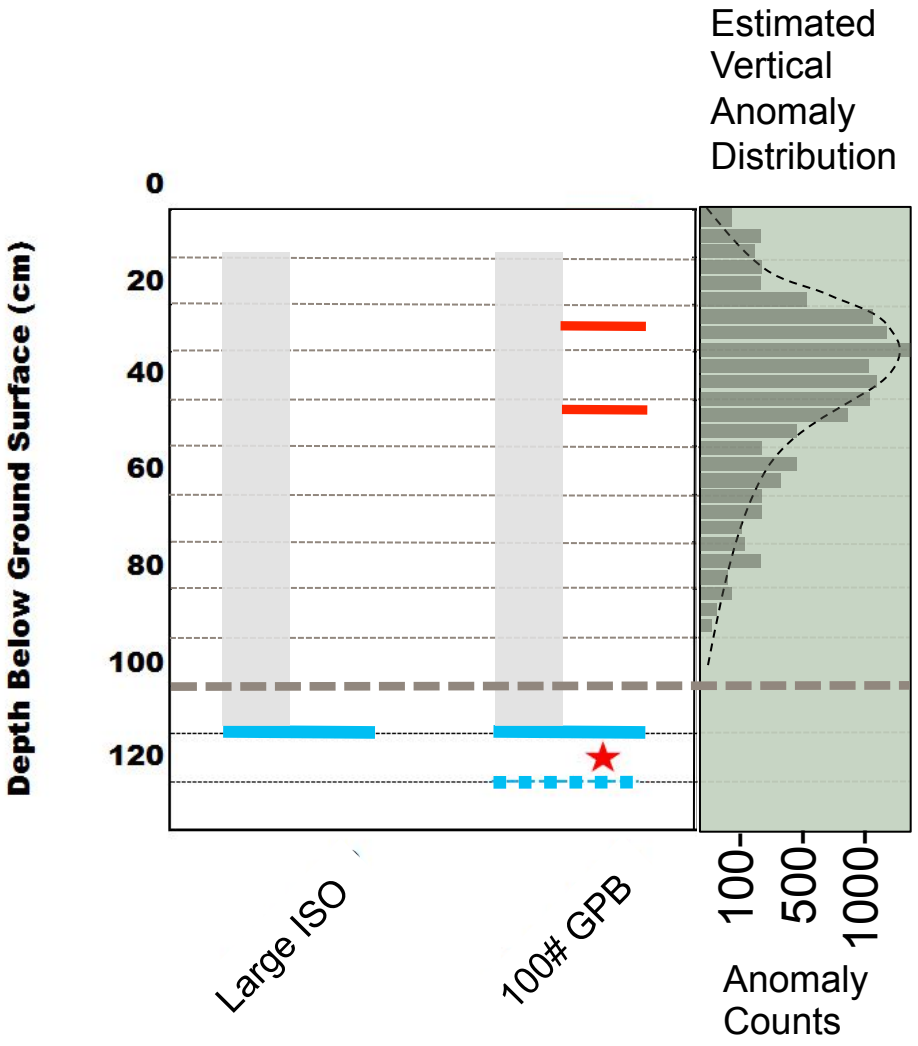
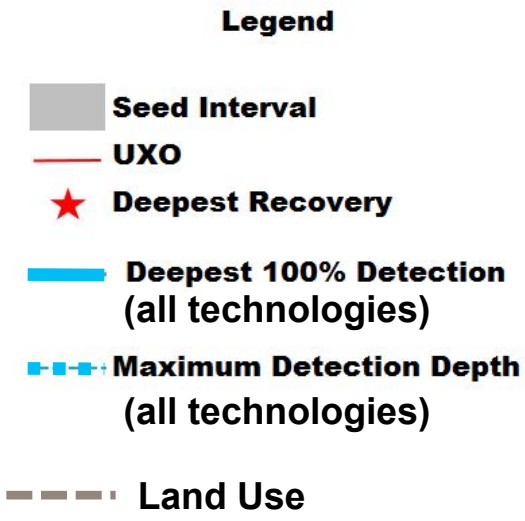
THE CSM IS CRITICAL



- How deep are UXO anticipated?
- What are the Pd performance capabilities per technology?



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DETECTION METHODOLOGY PRE-SCREENING
PART 1: SITE ACCESS

Detection Methodology	Full Access	Dense Vegetation	Uneven Terrain
Analog	Yes	Yes	Yes
Handheld DGM	Yes	Yes	Yes
Portable DGM	Yes	Yes	Yes
DGM Array	Yes	No	No
Handheld AGC	Yes	Yes	Yes
Portable AGC	Yes	Yes	Yes
Towed AGC	Yes	No	No

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DETECTION METHODOLOGY PRE-SCREENING PART 2: PERFORMANCE

Detection Methodology	Pd (Anticipated*)	Meets 2000 DOD & EPA MGMT Principles
Analog	90%	No
Handheld DGM	100%	Yes
Portable DGM	100%	Yes
DGM Array	100%	Yes
Handheld AGC	100%	Yes
Portable AGC	100%	Yes
Towed AGC	100%	Yes

*Sources: ESTCP Demonstration Reports, 1998 to present

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SOME ASSEMBLY REQUIRED

To build Alternatives we have:

- Process options (i.e. methods)
- Expected Pd for each
- Where they can be used

Also Need:

- Baseline Risk
- Path to show alternative gets to an acceptable end-state
  - Quick revisit of the four Matrices…

MATRICES 1 & 2

Accessibility Matrix: Likelihood of Encounter		MRS Access Conditions			
		Regular (e.g., daily use, open access)	**Often** (e.g., less regular or periodic use, some access)	**Intermittent** (e.g., some irregular use, or access limited)	**Rare** (e.g., very limited use, access prevented)
Amount of MEC[1] Evidence	• MEC is visible on the surface and detected in the subsurface.	**Frequent**	**Frequent**	**Likely**	**Occasional**
	• The area is identified as a Concentrated munitions Use Area (CMUA) where MEC is known or suspected to be present in surface and subsurface.	**Frequent**	**Likely**	**Occasional**	**Seldom**
	• A DERP response action has been conducted to clear surface MEC, **AND a subsurface response action was performed with a technology capable of achieving up to 90% Pd***	**Occasional**	**Seldom**	**Unlikely**	**Unlikely**
	• A DERP response action has been conducted to clear surface and subsurface MEC (UU/UE not achieved	**Seldom**	**Seldom**	**Unlikely**	**Unlikely**
	• A DERP response action has been conducted to achieve UU/UE.	**Unlikely**	**Unlikely**	**Unlikely**	**Unlikely**

Baseline

*Independent DOD performance evaluation of analog mag&flag has shown a 90%Pd can be achieved for 100# bombs (practice and live).

800 Acre Bomb Target Example

Matrix 2. Severity of Incident

Severity of Explosive Incident, Matrix 2: Severity vs. Likelihood of Encounter		Likelihood of Encounter[11]				
		Frequent: Regular, or inevitable occurrences	**Likely:** Several or numerous occurrences	**Occasional:** Sporadic or intermittent occurrences	**Seldom:** Infrequent, rare occurrences	**Unlikely:** Not probable
Munitions items[12]	**Catastrophic/Critical:** May result in 1 or more deaths, permanent total or partial disability, or hospitalization	A	A	B	B	D
	Modest: May result in 1 (or more) injury resulting in emergency medical	B	B	B	C	D

Baseline

MATRICES 3 & 4

Matrix 3. Likelihood of Detonation

Likelihood of Detonation, Matrix 3: Munitions Sensitivity vs. Likelihood of Energy to be Imparted		Likelihood to Impart Energy on an Item[14]		
		High e.g., areas planned for development, or seasonally tilled	***Modest*** e.g., undeveloped, wildlife refuge, parks	***Inconsequential*** e.g., not anticipated, prevented, mitigated
Sensitivity:[13] Susceptibility to Detonation	***High*** (e.g., classified as sensitive)	1	1	3
	Moderate (e.g., high explosive (HE) or pyrotechnics)	1 Baseline	2	3
	Low (e.g., propellant or bulk secondary explosives)	1	3	3
	Not Sensitive	2	3	3

800 Acre Bomb Target Example

Matrix 4: Acceptable and Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Result From Matrix 2			
		A	B	C	D
Result from Matrix 3	1	Unacceptable Baseline	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

Note: Multiple conditions may exist within an MRS, such that unique baselines risks can be established for the multiple explosive hazards that are present within the same property. Acceptable conditions indicate input factors are collectively determined to support a negligible risk. Project teams shall consider the nature of the specific item within the MRS and the probability to encounter in order to support the selection on the scale.

MATRICES 3 & 4 – QUICK LOOK AT METHODS

Matrix 3. Likelihood of Detonation

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		High e.g., areas planned for development, or seasonally tilled	***Modest*** e.g., undeveloped, wildlife refuge, parks	***Inconsequential*** e.g., not anticipated, prevented, mitigated
Sensitivity:[13] Susceptibility to Detonation	***High*** (e.g., classified as sensitive)	1	1	3
	Moderate (e.g., high explosive (HE) or pyrotechnics)	Pd<1	2	Pd ~1, =1
	Low (e.g., propellant or bulk secondary explosives)	1	3	3
	Not Sensitive	2	3	3

800 Acre Bomb Target Example

Matrix 4: Acceptable and Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Result From Matrix 2			
		A	B	C	D
Result from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

Pd<1

Pd<1 & IC

Pd ~1

Pd = 1

Note: Multiple conditions may exist within an MRS, such that unique baselines risks can be established for the multiple explosive hazards that are present within the same property. Acceptable conditions indicate input factors are collectively determined to support a negligible risk. Project teams shall consider the nature of the specific item within the MRS and the probability to encounter in order to support the selection on the scale.

ASSEMBLING ALTERNATIVES 800 ACRE BOMB TARGET EXAMPLE

Alternative		Processes			Anticipated Risk Outcome (Matrix 4)
#1	No Action	none			Unacceptable (A1)
#2	ICs	Pamphlets, Mailings, Zoning			Unacceptable (A1)
#3	100% AGC	Open		Towed Single	Acceptable (D3)
		Rough Terrain		Portable	
		Wooded		Handheld	
#4	DGM Mapping & AGC Cueing	Mapping	Open	Towed Array	Acceptable (B3)
			Woods & Rough Terrain	Portable DGM	
#5	DGM Only	Open		Towed Array DGM	Acceptable (B3)
		Woods & Rough Terrain		Portable DGM	
#6	Analog	Handheld magnetometer			Unacceptable (B1)
#7	Analog & ICs				Acceptable (B3)

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COSTING ALTERNATIVES

EACH SYSTEM requires between one and three QC and one and three Validation seeds per day.

DGM Sensor Productivity in Acres/Hour (ac/hr)* Includes AGC Single Sensor Productivity							
Productivity Rate		Flat	Gently Rolling	Heavy Rolling	Flat w/ Gorges	Rolling w/ Gorges	Mountainous
Vegetation ≠ HEAVY	Person Portable	0.29	0.29	0.26	0.26	0.23	0.15
	Array	0.87	0.87	0.78	0.78	0.69	0.45
Vegetation = HEAVY	Person Portable	0.29	0.29	0.26	0.26	0.23	0.15

Analog Sensor Systems (M&F) in Acres/Hour (ac/hr)*						
Productivity Rate	Flat	Gently Rolling	Heavy Rolling	Flat w/ Gorges	Rolling w/ Gorges	Mountainous
ALL SITE CONDITIONS (after site preparation)	0.36	0.36	0.32	0.32	0.29	0.18

*Values used in RACER MEC Remedial Action Models (FY18 version)

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COSTING ALTERNATIVES

Key Points To Getting It Right

- Anomaly Densities play huge role →VSP
- Mapping Rates are mostly terrain dependent
- Huge trade-offs often between mapping rates and cueing/ digging rates
- Vegetation removal: if needed for one method, probably needed for all (some may be less than others) →Geographic Information System
- Terrain conditions rarely homogeneous throughout →GIS and Digital Elevation Models
- Seeding Rates are per system, per day
- “One size” rarely fits the whole MRS

EXAMPLE COST MODEL FOR 800 ACRE BOMB TARGET

	HYBRID MODEL					
	Proportion Of Site AGC Detection	25%				
	Proportion Anomalies in AGC detection area	50%				
	Dynamic DGM related costs	Dynamic AGC related costs	Dynamic + Cued w/ AGC	Cued Only, regular DGM for detection	DGM Only	Mag&Flag Only
Mob/Demob	$25,000		$25,000	$25,000	$25,000	$25,000
Surface Sweep	$800,000		$800,000	$800,000	$800,000	$0
Seed Emplacement	$80,640		$80,640	$80,640	$20,690	$281,250
Mapping costs	$1,710,000	n/a	n/a	$2,280,000	$2,280,000	$802,187
Dynamic MetalMapper Survey and Analysis	n/a	$840,000	$3,360,000	n/a	n/a	n/a
Cued MetalMapper Collection and Analysis	$980,000	$505,680	$995,680	$1,975,680	n/a	n/a
Seeds Dug	$53,760		$53,760	$53,760	$53,760	$75,000
Native UXO Dug	$30,000		$30,000	$30,000	$30,000	$30,000
Clutter Dug**	$1,680,000		$1,680,000	$1,680,000	$6,720,000	$8,400,000
Fixed Costs	$250,000		$250,000	$250,000	$250,000	$250,000
Additional mark-up for AGC QC & accreditation	25%	$1,738,770	$1,550,020	$1,525,020	$0	$0
TOTAL		**$8,693,850**	**$8,825,100**	**$8,700,100**	**$10,179,450**	**$9,863,437**

Key Elements: • RACER for productivity • M&F Digging efficiency
• 5X anomalies for M&F mapping • Seeding is per system
• Premium for DAGCAP

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FS PITFALLS & FAUX PAS

- Pre-screening all digital solutions just because you have a large area MRS
  - Follow the process
  - Decisions require realistic Pd estimates
  - Run the cost models
- Analog methods will require site-specific Treatability Studies for meaningful Pd Estimates
  - Inherently cannot claim 100% because there is **No Traceability**
  - DGM Treatability Studies largely no longer needed
- Get the anomaly counts correct for each technology
  - Analog operators detect and flag up to 10x more than DGM or AGC
- Don't assume Dig and Sift is the only path to UU/UE.
  - Use the vertical CSM
- Estimate seeding costs based on realistic production rates

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SUMMARY

FS Informs the Proposed Plan

PP must be informed by:

- Performance (Pd) → what might be missed
- Cost →What is the real cost for better Pd
- Benefit →What is the benefit in using more expensive systems

Andy's philosophy: "The more people understand what to expect from the remedy we recommended in the Proposed Plan, the more likely FUDS will achieve *Response Complete In Our Lifetime*"

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THANK YOU

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DETECTION TECHNOLOGY SCREENING
PART 3: COST

Detection Technology	Mapping & Digging				QC Seeds*	Validation Seeds*
	Open		Wooded			
Analog	$	$$$$ $$$$	$	$$$	$$$$$$	$$$$$$
Handheld DGM	$$	$$$$ $$	$$	$$$	$$	$$
Portable DGM	$	$$$$	$$$	$$$	$$	$$
DGM Array	$	$$$$	n/a	n/a	$$	$$
Handheld AGC	$$$$	$	$$$$	$	$$$	$$$
Portable AGC	$$	$	$$$$	$	$$$	$$$
Towed AGC	$$	$	n/a	n/a	$$$	$$$

*Basis: EM 200-1-15 QC Seeding Requirements & AGC QAPP Template, Ver. 1

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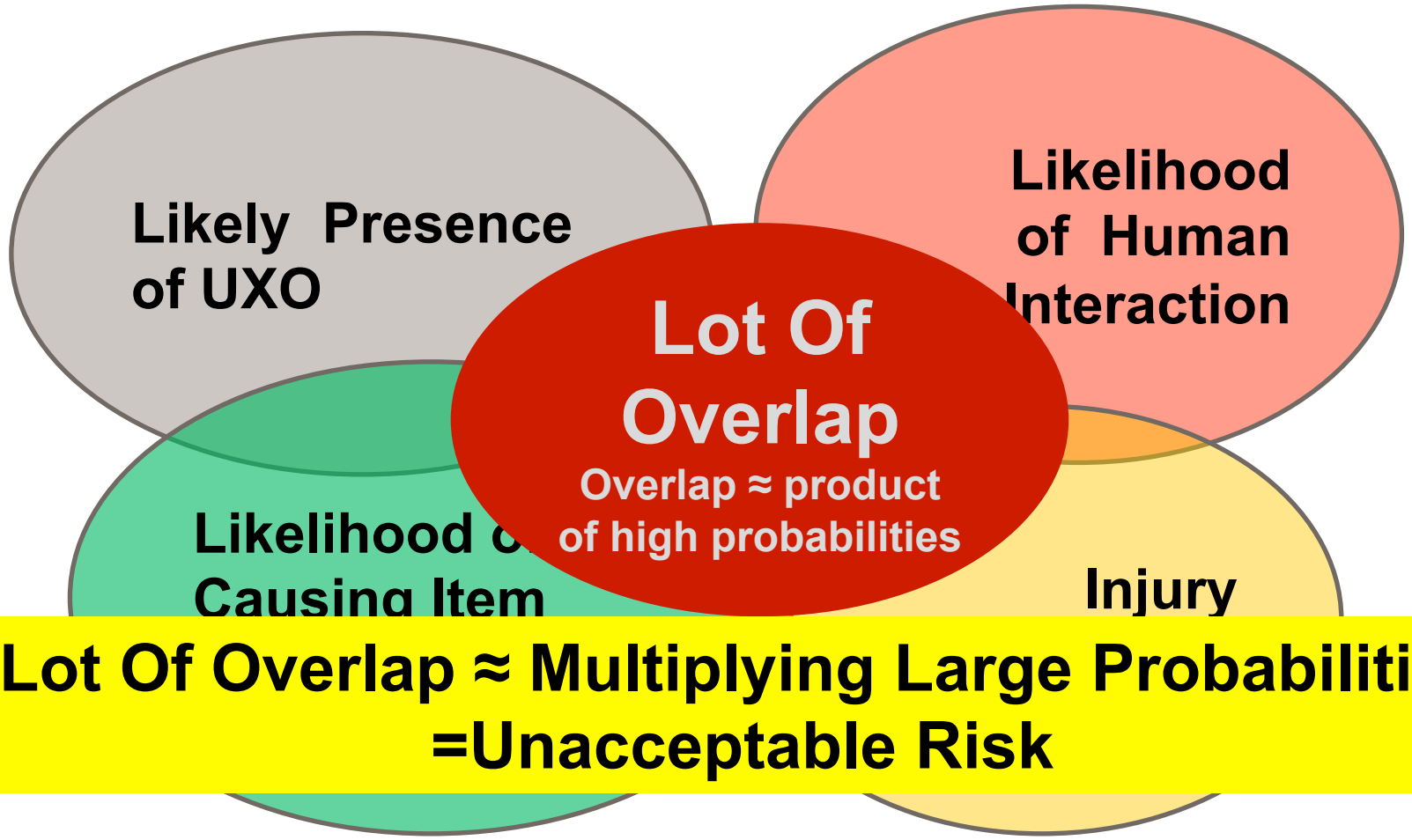
FS NUTS & BOLT
RI RISK SUMMARY



Lot Of Overlap ≈ Multiplying Large Probabilities =Unacceptable Risk

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FS NUTS & BOLTS
REMEDIAL ACTION OBJECTIVE - REVIEW

RI→Baseline Risk→Unacceptable Risk Scenario

This means, Per 40 CFR Part 300.430(e)(i), the Lead Agency established remedial action objectives (RAOs) that *specify:*

- *contaminants and media of concern*
- *potential exposure pathways, and*
- ***remediation goals***"

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AFTER ACTION ASSESSMENT

If Detail Site Model = Conceptual Site Model, Then →Project Complete

If Detail Site Model shallower than Conceptual Site Model, Then →Project Complete, potential candidate for UU/UE

If Detail Site Model exceeds detection capability, Then →Explanation Of Significant Difference, may need additional response via LUCs or removals in lifts.

FS NUTS AND BOLTS
THE REMEDIAL ACTION OBJECTIVE

RAO achieved through one or more General Response Actions to address unacceptable risk:

- **Modify Behavior**
- **Restrict Access**
- **Perform a Physical Removal**

Different processes available for each GRA. Examples:

- **Signage** as an Institutional Control
- **Fencing** as an Engineering Control
- **Geophysical detection and UXO recovery** as a physical removal

Individually or grouped together, GRA processes form the alternatives.

- The nine criteria screen alternatives in the FS

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ASSEMBLING ALTERNATIVES 800 ACRE BOMB TARGET EXAMPLE

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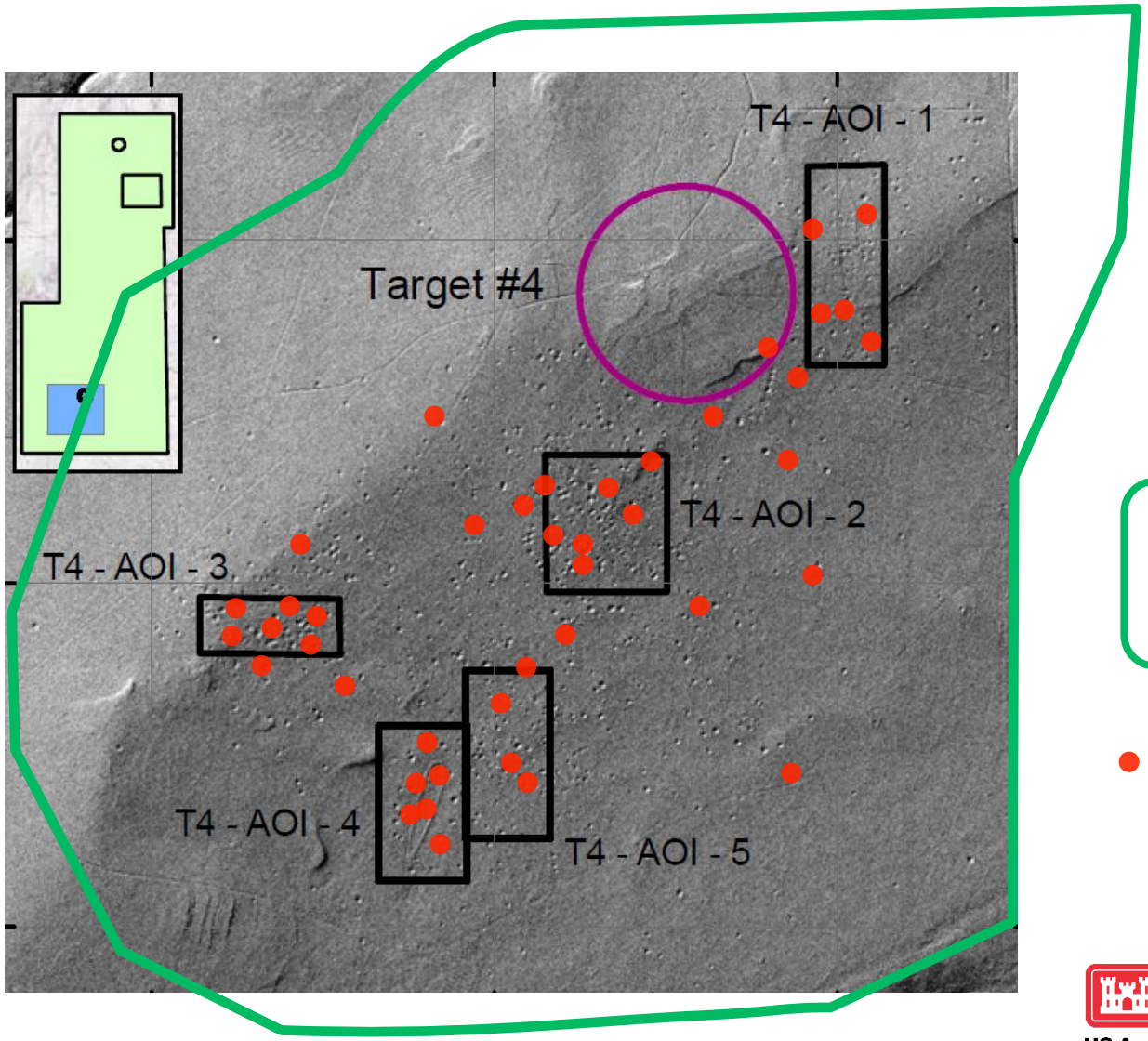
		Rough Terrain		Portable	
		Wooded		Handheld	
#4	DGM Mapping & AGC Cueing	Mapping	Open	Towed Array	Acceptable (**B3**)
			Woods & Rough Terrain	Portable DGM	
#5	DGM Only	Open		Towed Array DGM	Acceptable (**B3**)
		Woods & Rough Terrain		Portable DGM	
#4b #5b	Adding ICs to #4 or #5	Pamphlets, Mailings, Zoning			(Still) Acceptable (**B3**)
#5	Analog	Handheld magnetometer			Unacceptable (**B1**)
#6	Analog & ICs				Acceptable (**B3**)

A QUICK LOOK AT AFTER-ACTION ASSESSMENT 800 ACRE BOMB TARGET EXAMPLE

The current and future land use at this MRS is residential farming with plans to build new houses

DD selects an alternative based on AGC methods

DETAILED SITE MODEL HORIZONTAL DISTRIBUTIONS



Area of 100% coverage

42 UXO Recovered

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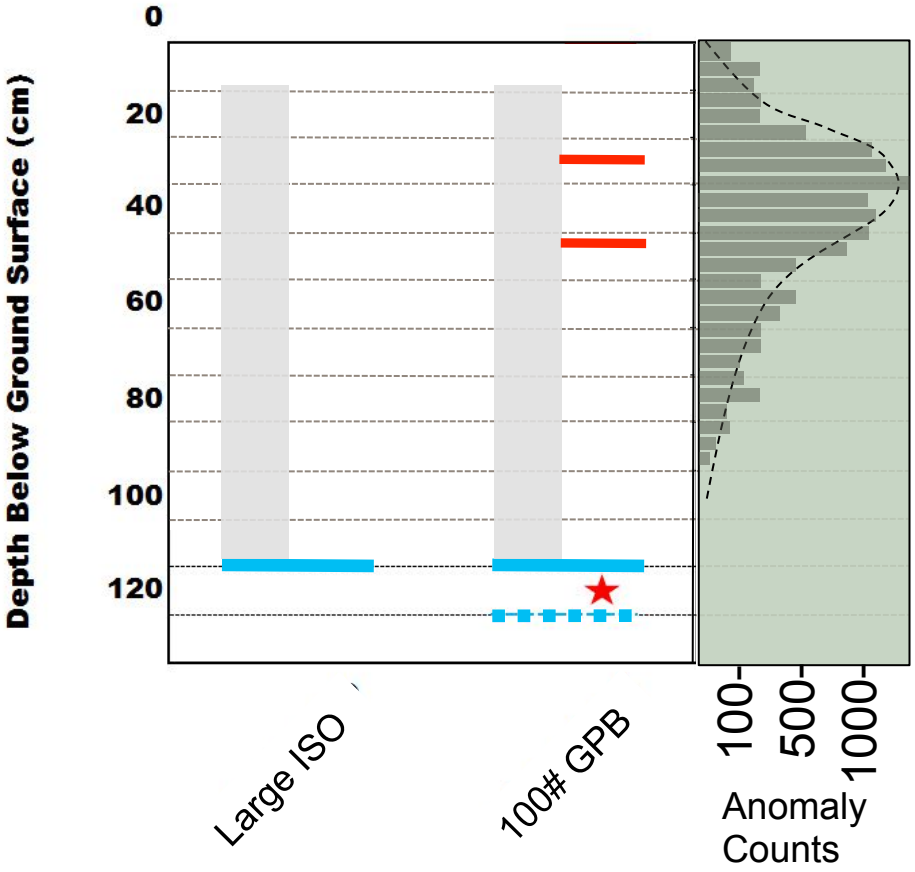
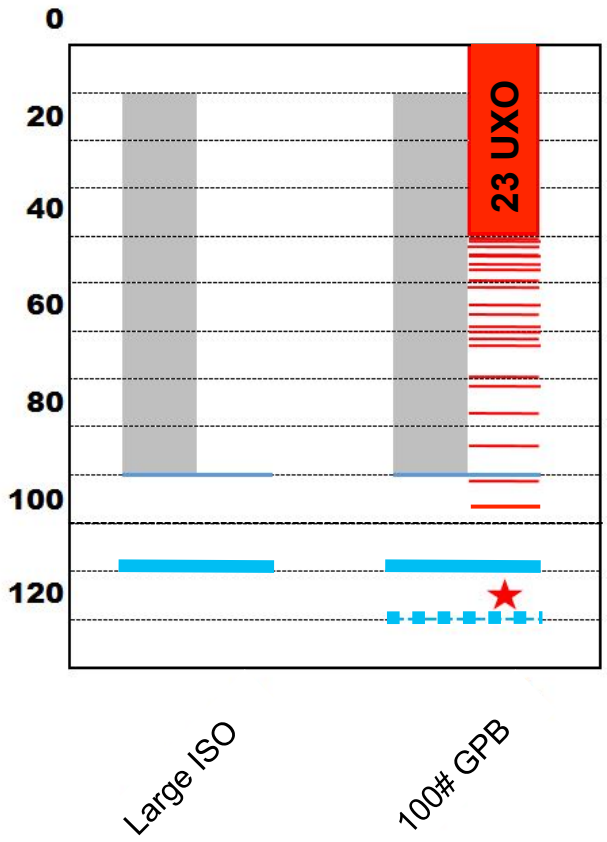
CONCEPTUAL SITE MODEL VERTICAL DISTRIBUTIONS



DETAILED SITE MODEL VERTICAL DISTRIBUTIONS



Legend

- UXO Recovery
- Deepest UXO
- Seed Interval
- Deepest Detection Capability
- 100% Detection Capability (any orientation)

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