# THE FS

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#### ENVIRONMENTAL QUALITY

TECHNICAL GUIDANCE FOR MILITARY MUNITIONS RESPONSE ACTIONS

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ENGINEER MANUAL

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## THE OVERALL PROCESS



- 1. Establish RAOs ✓
- 2. Identify general response actions (GRA) that can satisfy the remediation goals of the RAO
- 3. Identify and screen technologies or process options applicable to each general response action
- 4. Evaluate process options for effectiveness (to achieve one or more remediation goals), implementability, and relative cost
- 5. Assemble technologies/process options into remedial alternatives
- 6. Screen remedial alternatives, if necessary
- 7. Detailed analysis of remedial alternatives, which is divided in to:
  - a. Analyze remedial alternatives against seven of the nine evaluation criteria
  - b. Compare remedial alternatives against each other



# SOME DEFINITIONS IN THE CONTEXT OF AN MMRP FS



- General Response Action
  - What is it we'd be doing/achieving
- Method Of Action
  - Overall grouping of what we have at our disposal
- Technology
  - Label for a group of common clean-up methods; general categories of technologies
- Process Option
  - Specific processes within each technology type

- Containing the MEC"
- "Inspecting the ground surface to locate MEC"

- "Visual inspections", or "Instrument aided visual inspections"
- Person looking for MEC", or "Person looking for MEC aided by a handheld instrument that produces an audio output"



# SOME MORE DEFINITIONS



## Treatment

- Making the MEC go away
- Think "detect/locate" and "remove"

## Containment

- Restricting access to, or otherwise making it difficult to interact with MEC
- Think "Engineering Controls"
- Institutional actions
  - Things we can do in an effort to change people's response to encountering MEC
  - Think "Institutional Controls"
- Land Use Controls (in case I use the term as we go along)
  - All things containment (engineering controls) and institutional actions (institutional controls)
- Protectiveness
  - Meets or does not meet our remediation goals over the long term
- Effectiveness
  - How well we anticipate a given technology or process option will achieve its method of action



### THERE ARE SEVEN GRAS THAT CAN BE ESTABLISHED TO ACHIEVE SITE-SPECIFIC REMEDIATION GOALS FOR AN MRS



			Types of Actions for Terrestrial	Munitions Response Sites	The overall process:
	This is a team effort	Actions	Common Methods	Commonly Associated Outcomes that Contribute to Managing Risk	Starting from the RAO →Identify GRAs
	Treatment actions		Geophysical detection, excavation, MEC disposal	Substantially reduce the quantities of MEC to substantially decrease the number of possible encounters or interactions (note that this method can result in removing all MEC thereby eliminating the possibility of encounters)	<ul> <li>→ Method(s) of Action/GRA</li> <li>→ Technology Types/Method of Action</li> <li>→ Process Options/ Technology Type</li> </ul>
3.	Containment actions Institutional actions	Treatment Actions	Surface geophysical and/or visual detection, MEC disposal	Reduce the quantities of or remove all the surface MEC to decrease the number of possible encounters or interactions (i.e., reduce quantities), or to prevent encounters altogether (i.e., remove all the surface MEC). Note that these actions do not address subsurface MEC.	<ul> <li>→ Screen Tech Types/Options</li> <li>→ Evaluate Tech Types/Options</li> <li>→ Combine Tech Types/Options</li> <li>to achieve the RG</li> <li>→ Each combo = an alternative</li> </ul>
4.	Treatment and containment actions		Geophysical detection in lifts, excavation, MEC disposal	Remove all MEC to preclude encounters (and thereby preclude interactions)	
	$\pm$ $i$ $i$ $i$ $i$ $i$ $i$		Dig in lifts, sift/sort, MEC disposal	Remove all MEC to preclude encounters (and thereby preclude interactions)	
5.	Treatment and institutional actions		Dig in lifts, geophysical detection of excavated material, MEC disposal	Remove all MEC to preclude encounters (and thereby preclude interactions	
		Containment	Restrict or control access (e.g., fencing)	Impede a user's ability to interact with MEC	
6.	Containment and	Actions	Protective cover (usually soil, may include concrete, asphalt, or other material)	Control or preclude a user's ability to interact, either intentionally or unintentionally, with MEC	
	institutional actions		Change behavior via passive measures (e.g., via signage or pamphlets)	Land users take appropriate actions if they encounter MEC	
7	Treatment, containment, and		Change behavior via active measures (e.g., explosives safety training)	Land users take appropriate actions if they encounter MEC	
	institutional actions	Institutional Actions	Manage access via permits or deed restrictions	Manage user's ability to interact with MEC during normal usage activities that do not include intrusive actions	
			Manage exposure via onsite MEC support (e.g., MEC escort, anomaly avoidance)	Active measure to limit user's ability to interact with MEC during normal usage activities that include intrusive actions	
			Periodic evaluations/inspections	Verification that a remedy component remains in place and functional	



## GRAS $\rightarrow$ METHODS OF ACTION $\rightarrow$ TECHNOLOGY TYPES



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	Media	Example of Generalized RAO	General Response Actions	Method Of Action		The overall process: Starting from the RAO $\rightarrow$ Identify GRAs $\rightarrow$ Method(s) of Action/GRA	
				Inspections of the ground surface	Visual in Instrume Systema	→ Technology Types/Method of Action → Process Options/	
					Systema	Technology Type → Screen Tech Types/Options	
		RAOs where prevention of exposure is the goal: "The	Treatment Actions (sometimes referred to as	Subsurface geophysical detection & excavation	Uncontr	<ul> <li>→ Evaluate Tech Types/Options</li> <li>→ Combine Tech Types/Options</li> </ul>	
		ASSESSMENT AREA(S)	"physical removals")		Sensor F	to achieve the RG	
		is(are) anticipated to have CONTAMINATION (MEC			Excavati	→ Each combo = an alternative	
		Types) in MEDIA throughout		Dig & sift/sorting	Sift/Sort		
		the assessment area(s), with MEC expected to exist within DEPTH PROFILE(S). RECEPTORS in the assessment area could be exposed to MEC		Disposal	Intentional Detonation Engineering Solutions		
				Restrict or control access			
I	Soil		Containment Actions	Protective Covers	~		
	$\mathbf{N}$		Institutional Actions		Public Awareness Mechanisms		
		via EXPOSURE PATHWAY(S)		Change Behavior	education mechanisms		
I		to EXPOSURE DEPTH(S). The		Restrict or control access	Legal Mechanisms		
		remediation goal for the assessment area(s) is(are) to			Administrative Mechanisms		
		PREVENT RECEPTORS from	Treatment & Containment Actions	Treatment Component Methods	Same as above		
l		TYPE OF EXPOSURE with		Containment Component Methods	Same as		
		MEC. The remedy is subject to	Treatment & Institutional Actions	Treatment Component Methods	Same as		
l		the following CONSTRAINTS."		Institutional Component Methods	Same as		
l		_	Containment & Institutional Actions	Containment Component Methods	Same as above		
				Institutional Component Methods	Same as		
			Treatment & Containment & Institutional	Treatment Component Methods Containment Component Methdos	Same as above		
			Actions	Institutional Component Methods	_		
L				institutional Component Methods	Same as above		



# **TECHNOLOGY TYPES TO PROCESS OPTIONS**



Method of Action	Common Technology Types	Common Process Options					
Inspections of the ground	Visual inspection	Person looking for MEC					
		Person using hand-held instruments w/ audio output and looking for MEC					
	Systematic geophysical systems	Dynamic AGC					
		Advanced geophysical classification					
		Airborne mag					
Subsurface		Land borne mag man-portable					
a a a la racio a l		Land borne magnetometer towed array					
excavation		Airborne non-AGC DGM array					
		Land borne non-AGC DGM man-portable					
		Land borne non-AGC DGM towed					
	011	Hand-held instruments w/ audio or needle deflection output					

Method of Action	Common Technology Types	Common Proc	The overall process: Starting from the RAO →Identify GRAs				
	Sensor Positioning	RTK-DGPS LiDAR-SLAM RTS	→ Method(s) of Action/GRA → Technology Types/Method of Action				
Subsurface		Line & Fiducia	→ Process Options/ Technology Type				
geophysical detection & excavation		Manual Mechanized-rol Mechanized-op	<ul> <li>→ Screen Tech Types/Options</li> <li>→ Evaluate Tech Types/Options</li> <li>→ Combine Tech Types/Options</li> </ul>				
Excavation & recovery	Excavation & recovery	Electro-magnet	to achieve the RG				
covery		Rake & separat.	$\rightarrow$ Each combo = an alternativ				
		Mechanized-robotic					
		Mechanized-operator					
		Conveyor line-manual sort					
Dig &	SILUSUL	Conveyor line-electromagnet					
sift/sorting		Rotary Sift					
		Shaker Sift					
		BIP					
		BIP with engineering controls (e.g., open front					
	Intentional Detonation	barricade) Consolidated detonations					
Disposal		Contained detonation chamber					
Disposai		Thermal neutral	ization				
	Engineering Solutions	Cut & Capture					
	Engineering Solutions	Explosively gen	erated plasma jet neutralization				
		Shredding					



# MORE EXAMPLES OF GRA, TECHNOLOGY TYPES, AND PROCESS OPTIONS



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	_	E	xample of a GRA		The overall process: Starting from the RAO →Identify GRAs	
Common Process Options Fencing	GRAs	Method Of Action	Common Technology Types	Commo	$\rightarrow$ Method(s) of Action/GRA	
 Cover / fill	-		Human visual assisted	Person walking a pa w	→ Process Options/ Technology Type	ntiono
Signage Pamphlets		Inspections of the ground surface	Systematic geophysical systems	AGC Person-port	<ul> <li>→ Screen Tech Types/Op</li> <li>→ Evaluate Tech Types/Op</li> <li>→ Combine Tech Types/</li> <li>to achieve the RG</li> <li>→ Each combo = an alter</li> </ul>	Options Options
Internet Information web site	IJ	Geophysical detection & excavation	Systematic geophysical systems	· · · · · · · · · · · · · · · · · · ·	non-AGC DGM ble or towed by person	
School programs	Actio		Sensor Positioning		SLAM	
Town meetings	ıtional		Excavation & recovery	Manual or sma	RTS all mechanized excavator	
Anomaly Avoidance	Treatment & Institutional Actions		Intentional Detonation	BIP, BIP w/ engine	eering controls, consolidated letonations	
On-Call UXO support	atment	Disposal	Engineering Solutions	Explosively genera	ated plasma jet neutralization	
Local ordinances Restricitive Covenants	Trea	vior	Public Awareness Mechanisms	Signage, pam	phlets, internet web site	
Deed restrictions		Change Behavior		School progr	rams & Town meetings	
		lange	Education mechanisms	Anon	naly Avoidance	
Use permits				On-Ca	all UXO support	
Public Notices		Restrict or control access	Adminstrative Mechanisms	Monitori	ng & public notices	

Common Technology TyPhysical Barriers MechanismsPhysical Barriers MechanismsPhysical Barriers MechanismsPublic Awareness Mechanisms **Common Technology Types** Ш GRA Education mechanisms = Institutional Actions Legal Mechanisms GRA Adminstrative Mechanisms



# SCREENING DECISION PROCESS



- Screening should be constrained to Technical Implementability
- Who should be involved?
  - Decision makers (i.e., everyone)
    - Not just the contractor!
    - Getting the team on board now saves time later
- When should it be done?
  - After the draft FS? NO!
  - BEFORE the FS is drafted
- Discussions may result in revisions of Remediation Goals
  - Might need to be more complex
  - Might actually be able to simplify





## SCREENING TECHNOLOGY TYPES & PROCESS OPTIONS



0.3.4							
	Example of Generalized Remediation Goal	General Response Actions	Method Of Action	Technology Types	Process Options	Description	The overall process: Starting from the RAO $\rightarrow$ Identify GRAs $\rightarrow$ Method(s) of Action/GRA
			Inspections of the ground surface	Visual inspection Instrument aided visual inspection Systematic geophysical systems	-		<ul> <li>→ Technology Types/Method of Action</li> <li>→ Process Options/ Technology Type</li> </ul>
		Treatment Actions (sometimes referred to as "physical removals")	Subsurface geophysical detection & excavation	Systematic geophysical systems Uncontrolled geophysical systems Sensor Positioning Excavation & recovery	For each Technology Type, list all the Process Options (e.g., technology methods) that are available for remedial actions. See Table I-7	Describe what they could achieve at the MRS.	<ul> <li>→ Screen Tech Types/Options</li> <li>→ Evaluate Tech Types/Options</li> <li>→ Combine Tech Types/Options</li> <li>to achieve the RG</li> <li>→ Each combo = an alternative</li> </ul>
	See			excavation & recovery Sift/Sort	-		
	RAO		Disposal	Intentional Detonation Engineering Solutions	4		
	Table Handout	Containment Actions	Restrict or control access	Physical Barriers Mechanisms	For each, list the Process Options available for remedial		If "Potentially Applicable", state any pros and/or cons as they relate to the remediation
			Protective Covers	Physical Barriers Mechanisms	actions. See Table I-7	achieve at the MRS.	goals. If not feasible or viable, provide brief justification.
		Institutional Actions		Public Awareness Mechanisms education mechanisms		Describe what they could	If "Potentially Applicable", state any pros
				Legal Mechanisms Adminstrative Mechanisms	actions. See Table I-7	achieve at the MRS.	and/or cons as they relate to achieving the remediation goals. If not feasible or viable, provide brief justification.
			Treatment Component Methods	Same as above	Same as above	Same as above	If "Potentially Applicable", state any pros
			Containment Component Methods	Same as above	Same as above	Same as above	and/or cons as they relate to the remediation goals. State how Treatment and Containment components work in concert to achieve the remediation goals



## SCREENING TECHNOLOGY TYPES & PROCESS OPTIONS



ল			_					The overall process: Starting from the RAO
Medi	Example of Generalized Remediation Goal	General Response Actions		Technololgy Types	Process Options	Description	Sc	
		Treatment &	Methods	Same as above	Same as above	Same as above	If "Potentiall and/or cons a	of Action
		Institutional Action	Institutional Component Methods	Same as above	Same as above	Same as above	remediation and Institution concert to ac	Technology Type
		Containmont &	Containment Component Methods	Same as above	Same as above	Same as above	If "Potentiall and/or cons a	$\rightarrow$ Evaluate Tech Types/Options $\rightarrow$ Combine Tech Types/Options
		Containment & Institutional Actions	Institutional Component Methods	Same as above	Same as above	Same as above	remediation and Institution concert to ac	to achieve the RG $\rightarrow$ Each combo = an alternative
		Tractment 9	Treatment Component Methods	Same as above	Same as above	Same as above		y Applicable", state any pros as they relate to the
		Treatment & Containment &	Containment Component Methdos	Same as above	Same as above	Same as above		goals. State how Treatment, and Institutional components
		Institutional Actions	Institutional Component Methods	Same as above	Same as above	Same as above	work in conc remediation	ert to achieve the goals.



## IT'S NOT COMPLICATED... THERE'S JUST A LOT OF IT



									_	_	_			The overall process:
												•		Starting from the RAO
	Commo	۱								Explaniants generated planna jet protection	1	Patralially applicable		
teth ener	gy Type:		Description	Example Screening Comments	Effectiveness	Implementability	Cost			Shreddina		Hel and officialize day in the anali	UXO ukres a srarsk van serformel, olig applet i kighte effestion, produce minimal v. Only appl	→Identify GRAs
	yinatingentin	Prress lasting for HEC	Description	Hal applicable dae la las many polential	keant offention another endouting wellout due to tall as anoth	railgingleneded	High seals associated with extension oreding					anakees of collected MEC	defeated UXO alerer a search was preformed as	$\rightarrow$ Method(s) of Action/G
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		Airberer ans AGC DGH arras		Hal related day to inability to ankiene defending requirements related to	Ineffective at detecting MEC at this MRS due to usual MEC stars, their potential hurist depths and the high attitude of	ranilg implemented	High much summialed with mukilization and Flight house and the need to ensurable attacted					fur aisilars ar far Irail saisleasar s		
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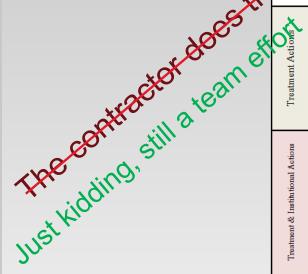
## ...BUT BUILDING ALTERNATIVES BECOMES PRETTY EASY



The overall process: Starting from the RAO →Identify GRAs

- $\rightarrow$  Method(s) of Action/GRA
- → Technology Types/Method of Action
- → Process Options/ Technology Type
- → Screen Tech Types/Options
- → Evaluate *Tech Types/Options*
- → Combine Tech Types/Options
- to achieve the RG
- $\rightarrow$  Each combo = an alternative

the alter	native						Alternati				
General Response Actions	Method Of Action	Common Process Options	#1 No Action <sup>2</sup>	#2-AGC on trails, surface only in woods <sup>3</sup>	#4-AGC Non-AGC DGM on trails, surface only w/ analog in woods <sup>3</sup>	#3-AGC on trails and in woods <sup>3</sup>	#5 AGCon trails, surface only in woods, Public Awareness & anomaly avoidance <sup>3</sup>	#6-AGC on trails and in woods & Anomaly Avoidance for new trail construction <sup>3</sup>	#7-AGC on trails and in woods & UXO support for new trail construction <sup>3</sup>	#8-AGC on trails and in woods to depth of detection w/Search under tree root balls <sup>4</sup>	#9-Institutional
S	Not	Applicable	×								
Treatment Actions	Surface Removal	Instrument-aided visual inspections		×	×						
<b>O</b> ition	n & al	Advanced geophysical classification		×	x	x				×	
tent A	Geophysical detection & excavation	Land borne non-AGC DGM man-portable (mag or EMI)								×	
satm	det Gec	LiDAR-SLAM		×	×	×				×	
Ē		Manual & Mechanized- BIP or Explosively		X	×	X				×	┣
	Disposal	generated plasma jet		×	×	×				×	
ions	Surface Removal	Instrument-aided visual inspections					×				
Treatment & Institutional Actions	Geophysical detection & excavation	AGC Person-portable or towed by person					×	×	×		
utio	ectic	SLAM					×	×	×		
tinstit	Gec det	Manual or small mechanized excavator					×	×	×		
aent &	Disposal	BIP or Explosively generated plasma jet					×	×	×		
Treatu	Change Behavior	Signage, pamphlets, internet web site					×				
1	Bel	School programs					×				
	ange	Anomaly Avoidance					×	×			
	ปี	UXO support							X		
SUO	ee	Signage, pamphlets, internet web site									:
Acti	Change Behavior	School programs									
nal	5 g	Anomaly Avoidance									
hutic		UXO support									
Institutional Actions	ntro]	Local ordinances Deed restrictions									
	Restrict or control access	Use permits									



<sup>4</sup> Can support UU/UE





# THAT'S THE PROCESS Let's look at some details



# SOME DETAILS WHEN LOOKING AT GRAs



#### The overall process: Starting from the RAO

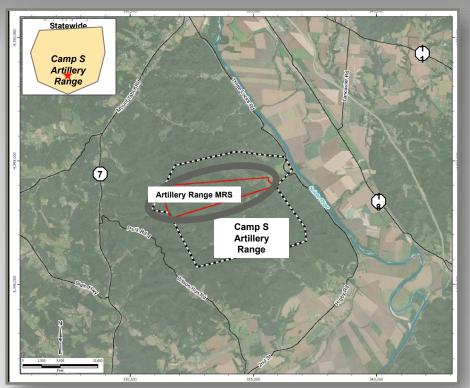
- →Identify GRAs
- → Method(s) of Action/GRA → Technology Types/Method
  - of Action
  - → Process Options/ Technology Type
- → Screen Tech Types/Options
- → Evaluate Tech Types/Options
- $\rightarrow$  Combine Tech Types/Options to achieve the RG
- $\rightarrow$  Each combo = an alternative

## Treatment-only GRAs do not equate to unlimited use/unrestricted exposure

- But they may be able to get you there
- In most scenarios, treatment only (or treatment with interim containment/ICs) is the only way to meet the DERP requirement for a UU/UE alternative



- Projectile, 4.7<sup>°</sup>, HE, Mk4 (to 53cm bgs)
- Projectile, 3", HE and shrapnel (to 60cm bgs)
- Projectile, 37mm, cast iron (to 10cm bgs)



	REMEDIAL ACTION OBJECTIVE												
		REM		GOAL									
	Assessment Area(s)	Receptors and Exposure Pathways	Depth of Exposure	Prevent / Limit?	Type of Exposure	Acceptable Exposures							
/	State Forest Lands: off trail lands HUA	Recreational users: off trail hiking or walking Off-trail use is rare, and is discouraged by the park owner	Surface only	Prevent	Interactions	0							
/	State Forest Lands: off trail lands LUA	Recreational users: hiking, walking Off-trail use is rare, and is discouraged by the park owner	Surface only	Limit	Interactions	2/year							



## SOME DETAILS WHEN SCREENING TECHNOLOGY **TYPES & PROCESS OPTIONS**



The overall process: Starting from the RAO →Identify GRAs → Method(s) of Action/GRA → Technology Types/Method of Action → Process Options/ Technology Type

→ Screen Tech Types/Options

→ Evaluate Tech Types/Options

- → Combine Tech Types/Options to achieve the RG
- $\rightarrow$  Each combo = an alternative



Screening should be constrained to Technical Implementability
 "Screen-out process Options or entire technology

- \* RPORT the clean screening or evaluating alternatives \* Difficult to implement of the the time to the total tot types that an Pearly ineffective or unworkable at

  - Difficult to implement does not mean impossible to
  - Look to the Institutional Analysis for constraints to what will be the selected remedy
    - Don't make assumptions —
    - Don't make broad-brush declarations that are not supported in the IA



# Lestoptions \* Each combo = an alternative \* Each combo = an alternative \* How preven and art. Ne pring between \* Implementing statistics to build be proceed by the state of the state



- n-MEC FSs)
- - e regimes for DGM or analog
  - nd additional field data collected
- This is where pot abilitical de This fundamemphasi the fundamemphasi

  - Based on engineering judgment, e.g., high, low or medium relative to other process options

EPA/540/G-89/004, Chapter 4, Section

Choice of process option can present significant differences (think: acres to be mapped & numbers of anomalies to be dug for AGC vs. non-AGC DGM)



## SOME DETAILS WHEN ASSEMBLING ALTERNATIVES



The overall process: Starting from the RAO →Identify GRAs

- $\rightarrow$  Method(s) of Action/GRA
- → Technology Types/Method of Action
- → Process Options/ Technology Type
- → Screen Tech Types/Options
- → Evaluate Tech Types/Options
- → Combine Tech Types/Options to achieve the RG
- $\rightarrow$  Each combo = an alternative

- Combine process options that, when viewed as a whole, address all potential manner of interaction, and if appropriate, all manner of encounter that comprise the MRS exposure profile
  - All else being equal, if choice of process option presents significant effectiveness or cost advantages, present all viable choices as separate alternatives
- Provide detailed, site specific, descriptions
  - Explain how, where, by whom, and as appropriate-when, each process option (or grouping of process options) will be implemented
  - Logic behind assembly of various process options
  - Clean-up goals and anticipated outcomes or products
    - Must see differences among alternatives
    - Which volumes will be treated & which will not
    - Target audience/population/group for each IA process option
    - How each IA process option or group of process options prevents or limits exposure
    - Different detection depth performance = different volumes of soil investigated



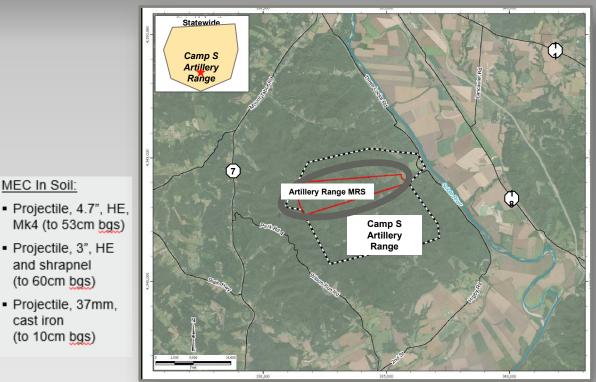
# SOME MORE DETAILS WHEN ASSEMBLING **ALTERNATIVES: MUST BE SITE SPECIFIC**



- The overall process: Starting from the RAO →Identify GRAs → Method(s) of Action/GRA
  - → Technology Types/Method of Action
  - → Process Options/ Technology Type
- → Screen Tech Types/Options
- → Evaluate Tech Types/Options → Combine Tech Types/Options
- to achieve the RG
- $\rightarrow$  Each combo = an alternative

◆ Different treated volumes or different IA/IA groupings = different alternatives

- DERP requires
  - No Action alternative
  - Alternative that incorporates LUCs
    - Does not mean must be LUCs only
  - Alternative that is anticipated to support UU/UE determination
    - In most cases, the clean-up goals will exceed the needs of the RAO



#### **REMEDIAL ACTION OBJECTIVE**

MEC In Soil:

and shrapnel

cast iron

	REM	REMEDIATION GOAL				
Assessment Area(s)	Receptors and Exposure Pathways	Depth of Exposure	Prevent / Limit?	Type of Exposure	Acceptable Exposures	
State Forest Lands: off trail lands HUA	Recreational users: off trail hiking or walking Off-trail use is rare, and is discouraged by the park owner	Surface only	Prevent	Interactions	0	
State Forest Lands: off trail lands LUA	Recreational users: hiking, walking Off-trail use is rare, and is discouraged by the park owner	Surface only	Limit	Interactions	2/year	

EPA/540/G-89/004, Chapter 4, Section 4.2.5



# Example alternatives for Range MRS– recreational area (GRA=Treatment)



ALTERNATIVE	ANTICIPATED END STATE(S)	HOW THE ANTICIPATED END STATE(S) ACHIEVE THE RG
AGC Source	Advanced geophysical classification	Interactions by all users would be prevented everywhere as all
Removal-100%	performed throughout 100% of the	potentially existing MEC within all interaction zones will be detected
of the trails and	areas where most activities occur as	and removed. The assumption is that 100% of areas identified for
entire footprint	well as the whole of the HUA footprint	subsurface removal are searched (e.g., under trees, roads, etc.)
of the HUA	will recover all UXO within the	Potential interactions by recreational users in those portions of the
within the	volume of soil to 45cm.	woods in the LUA would be limited to not more than twice per year
woods; surface	Surface removal will recover all UXO	based on assumptions that a) all surface MEC are removed and that b)
removal all		institutional actions are not necessary to limit encounters for items
remaining		that are no longer present in the interaction zone (i.e., on or protruding
woods		above the surface).
	recovered MEC	



# Example alternatives for Range MRS – recreational area (GRA=Treatment & Institutional Actions)



ALTERNATIVE	ANTICIPATED END STATE(S)	HOW THE ANTICIPATED END STATE(S) ACHIEVE THE RG
AGC Source	Advanced geophysical classification	Interactions by all users would be prevented on trails and in the
Removal-100%	performed throughout 100% of the	woods portion of the HUA as all potentially existing MEC will be
of the trails and	areas where most activities occur as	detected and removed. The assumption is that 100% of areas
entire footprint	well as the whole of the HUA	identified for subsurface removal would be searched (e.g., under
of the HUA	footprint will recover all UXO within	trees, roads, etc.)
	the volume of soil to 45cm	The potential for an interaction in the portions of the woods in the
and Education	3Rs signage at all access points and	LUA would be limited to not more than twice per year (recreational
Actions	at 200m intervals along all trail	use) by the extensive signage warning of the potential dangers of
	systems and along park boundaries	going off-trail (see note).
	will inform users of potential	
	hazards.	





# THOSE ARE SOME DETAILS ABOUT THE PROCESS Let's pause for some questions Now let's look at the detailed analysis





#### Two Major Components

- Individual alternative analysis against the NCP 9 criteria
- Comparative analysis between alternatives against the NCP 9 criteria

It is a presentation of the relevant information needed to allow decision makers to select a site remedy

- It is not the decision-making process itself
- Provide decision makers with sufficient information to compare alternatives, select an appropriate remedy, and demonstrate satisfaction of the CERCLA remedy selection requirements in the ROD

#### The ROD's statutory requirements must be supported by the FS

- Be protective of human health and the environment.
- Attain ARARs (or provide grounds for invoking a waiver).
- Be cost-effective.
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.
- Satisfy the preference for alternatives that use treatment to reduce toxicity, mobility, or volume as a principal element or provide an explanation in the ROD as to why it does not



## Overall Protection of Human Health and the Environment NCP § 300.430(e)(9)(iii)(A)

- This is essentially the answer to the question, "Would the outcome of implementing this alternative result in MEC exposure profiles that are protective of human health and the environment (i.e., achieve the remediation goal(s))?"
- The answer can only be yes or no

# Compliance with ARARs (NCP § 300.430(e)(9)(iii)(B))

- Compliance is a threshold criterion
- Can only be rated as compliant or not compliant
- Must discuss <u>how</u> the alternative will achieve compliance with each identified ARAR







# Long-term Effectiveness and Permanence (NCP § 300.430(e)(9)(iii)(C))

- Treated volumes
  - Generally a permanent solution except treatment via analog geophysical methods
  - Use of some process options can anticipate proving where MEC will no longer exist
- LUCs manage potentially remaining MEC
  - We cannot estimate "residual" MEC quantities
- LUCs effectiveness & permanence over the long term
  - Extent(s)/Quantities
  - Adequacy
  - Reliability



## Reduction of Toxicity, Mobility, or Volume Through Treatment (NCP § 300.430(e)(9)(iii)(D))

- Is a statutory preference
- Two key elements to discuss
  - Quantitative discussion on the reduction in total volume of soil potentially contaminated
  - Qualitative discussion on the reduction in the number of MEC within an interaction zone
- Specify where it is anticipated MEC could remain if the alternative were to be implemented
  - Inaccessible locations
  - Deeper than detection capability if supported by the CSM's vertical MEC profile





# Short-term Effectiveness (NCP § 300.430(e)(9)(iii)(E))

- During construction and implementation phase until remedial response is complete
- Protect affected public and response workers
  - Exclusion zones & evacuations
  - Worker safety essentially the same for all treatment
- Nature of or potential for short-term adverse environmental impacts
  - Define "adverse"



## Implementability NCP § 300.430(e)(9)(iii)(F))

- Few unknowns for treatment methods
  - Performance and efficiencies are well documented & understood
- Institutional analysis
  - For all LUCs
  - Owner or local/county/state government willingness





## Cost (NCP § 300.430(e)(9)(iii)(G))

- Three major treatment drivers
  - Total acres
  - Anomaly densities & estimated quantities
  - Vertical profile
- Most other treatment factors apply equally
- Should address 5 elements
  - Capital costs
  - Annual operations and maintenance
  - Accuracy of estimates
  - Present worth analysis
  - − Sensitivity analysis  $\rightarrow$ mostly for treatment options

- State Acceptance (NCP § 300.430(e)(9)(iii)(H))
  - Completed when comments on the RI/FS and the proposed plan are received
- Community Acceptance (NCP § 300.430(e)(9)(iii)(I))
  - Completed when comments to the proposed plan are received





# DETAILED ANALYSIS PRESENTATION



## **Individual Analysis**

- Assess each alternative individually against the first 7 of the criteria
  - Not in relation to other alternatives
- Common elements should be presented before the detailed description of each alternative
- Only elements or combinations of elements that are unique should be discussed individually
  - If a unique element changes an aspect of one of the common element, it must be described

## **Comparative Analysis**

- Identify advantages & disadvantages
  - Identify key trade-offs
- Narrative required
  - Table may be useful
- Focus comparative narrative to:
  - Anticipated treatment performance & which areas will be searched
  - Underlying assumptions of LUCs
  - Contribution of LUCs when paired with treatment compared to treatment only alternative(s)
  - Cumulative cost break-even points

Highlight those elements that are likely to become deciding factors in proposing a preferred alternative



"The jury has found you not guilty, but I'm going to give you 2 years just to be on the safe side."



# PARTING THOUGHTS

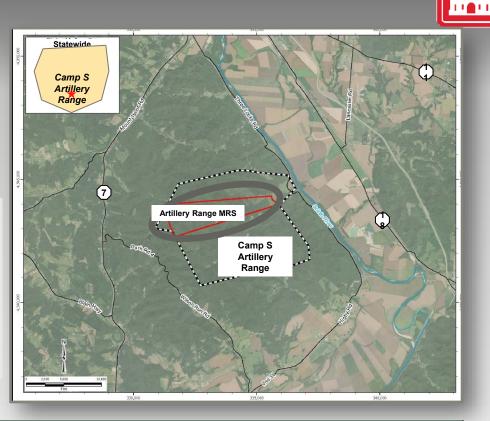
- Both are protective
- Which is more effective?

#### **ALTERNATIVE 1**

AGC Source Removal-100% of the trails and entire footprint of the HUA within the woods; surface removal all remaining woods ALTERNATIVE 2 AGC Source Removal-100% of the trails and entire footprint of the HUA within the woods; and Education Actions

#### MEC In Soil:

- Projectile, 4.7<sup>\*</sup>, HE, Mk4 (to 53cm bgs)
- Projectile, 3", HE and shrapnel (to 60cm bgs)
- Projectile, 37mm, cast iron (to 10cm bgs)



REMEDIAL ACTION OBJECTIVE								
POTENTIAL EXPOSURE PATHWAY(S)				REMEDIATION GOAL				
Assessment Area(s)	Receptors and Exposure Pathways	Depth of Exposure	Prevent / Limit?	Type of Exposure	Acceptable Exposures			
State Forest Lands: off trail lands HUA	Recreational users: off trail hiking or walking Off-trail use is rare, and is discouraged by the park owner	Surface only	Prevent	Interactions	0			
State Forest Lands: off trail lands LUA	Recreational users: hiking, walking Off-trail use is rare, and is discouraged by the park owner	Surface only	Limit	Interactions	2/year			







