

# DECISION-MAKING AND FIVE-YEAR REVIEWS

(OR HOW TO MAKE THE REMEDY ASSESSMENT  
PROCESS IN THE FYR EASIER)

U.S. Army Engineering and Support Center, Huntsville  
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# REMEDY ASSESSMENT IN THE FIVE-YEAR REVIEW

There are two important elements of the Decision Document (DD) that play into the determination of protectiveness in a Five-Year Review (FYR)

- The first is the most obvious
  - The selected remedy itself
- The second plays a much bigger role in whether the FYR team has a relatively easy time assessing the remedy or has to struggle
  - Remedial Action Objectives (RAOs)

RAOs are the yardstick against which remedy performance is measured

- Poorly written RAOs make remedy assessment difficult



# REMEDY ASSESSMENT IN THE FIVE-YEAR REVIEW

## Five-Year Review technical assessment

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives at the time of remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The responses to these three questions lead directly to the protectiveness determination in the FYR

- In other words, is the remedy protective or not?



# REMEDY ASSESSMENT FOR A TYPICAL HTRW REMEDY

## Remedial Action Objectives

- Prevent direct contact/ingestion with soil having a benzo(a)pyrene concentration of 0.29 mg/kg (representing  $10^{-6}$  cancer risk for an industrial worker receptor)
- Prevent direct contact/ingestion by an industrial worker with soil having a lead concentration of 800 mg/kg

## Selected remedy

- Soil excavation and off-site disposal
- Land-use controls (fence, signs)



# REMEDY ASSESSMENT FOR A TYPICAL HTRW REMEDY

Question A: Is the remedy functioning as intended by the decision documents?

- Remedy intent is captured in the RAO: prevent contact/ingestion of soil...
  - Soil excavation & disposal
    - Does confirmation sampling demonstrate that soils exceeding cleanup levels were removed?
  - Fence & signs
    - Is the fence in good condition (no gaps, broken sections, or evidence of breaches)?
    - Are the signs in good condition (in place, intact, legible)?



# REMEDY ASSESSMENT FOR A TYPICAL HTRW REMEDY

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

- Exposure assumptions found in the RAO: direct contact/ ingestion of soil by industrial worker
  - Have there been unanticipated changes in land use (different receptors)?
  - Are there plans for incompatible land use (residential development, for example)?



# REMEDY ASSESSMENT FOR A TYPICAL HTRW REMEDY

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

- Toxicity data used to develop risk-based cleanup levels will be found in the risk assessment
  - Has the toxicity of the COCs changed (more toxic, less toxic)?
  - If more toxic, is the cleanup level now above the acceptable risk range of  $10^{-6}$  to  $10^{-4}$ ?
    - If soils not excavated are present with COC concentrations above the acceptable risk range, then cleanup levels are no longer valid



# TERMINOLOGY CROSSWALK BETWEEN HTRW AND MMRP

## Concept

## HTRW example

## MMRP example

COC

Trichloroethene

M31 HEAT rifle grenade

Toxicity

Reference dose, slope factor

Type of explosive, sensitivity of fuze

Cleanup level

6 mg/kg ( $10^{-6}$  ILCR)

Acceptable condition defined by Matrix 4 of risk memo



# REMEDY ASSESSMENT FOR A TYPICAL (HISTORICAL) MMRP REMEDY

## Remedial Action Objective

- Reduce injuries to loggers, construction workers, site visitors and recreational users from explosive hazards associated with surface and subsurface UXO

## Selected remedy

- Surface clearance and partial subsurface removal
- Public education
- Land-use controls (signs)



# REMEDY ASSESSMENT FOR A TYPICAL (HISTORICAL) MMRP REMEDY

Question A: Is the remedy functioning as intended by the decision documents?

- Remedy intent is captured in the RAO: reduce injuries...
  - Surface clearance, subsurface removal, public education & signs
    - Can verify that the number of UXO has been decreased (but over what area and to what depth?)
    - Can assess (through interviews) whether public is aware of hazards
    - But how do you assess whether the remedy is reducing injuries?
      - Does it mean the severity of injuries is less than it would have been (loss of limb instead of loss of life)?
      - Does it mean that without the remedy we would have seen x number of injuries and now we're seeing x-1 injuries?



# REMEDY ASSESSMENT FOR A TYPICAL (HISTORICAL) MMRP REMEDY

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

- Exposure assumptions implied in the RAO: normal activities associated with loggers, construction workers, site visitors and recreational users
  - Have there been unanticipated changes in land use?
  - Are there plans for incompatible land use (residential development, for example)?



# REMEDY ASSESSMENT FOR A TYPICAL (HISTORICAL) MMRP REMEDY

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

- RAO mentions ...explosive hazards associated with surface and subsurface UXO
  - UXO is not specific
    - What type of munitions?
      - What is the severity of injury from encounter with the munitions?
      - What is the sensitivity of the munitions?
  - Cleanup level (or acceptable condition) has not been defined



# REMEDY ASSESSMENT FOR A TYPICAL (HISTORICAL) MMRP REMEDY

Because the RAO did not define the type of munitions, explosive nature and sensitivity of munitions, area and depth of clearance, and acceptable condition post-remediation, it is difficult to answer Questions A and B of the technical assessment

- Subjectivity or ambiguity in the technical assessment leads to a protectiveness determination open to interpretation by regulators and stakeholders



# MMRP REMEDY DEVELOPED USING THE RISK MEMO

## Remedial Action Objective

- Reduce the unacceptable risk due to presence of 155mm HE artillery rounds within the 40 acre MRS to a depth of 4 feet below surface to address likelihood of exposure to recreational users and park employees via typical camping activities (digging fire pits, pitching tents) and trail improvement activities such that an acceptable condition (as defined by Matrix 4) is achieved

## Selected remedy

- Surface clearance and subsurface removal to a depth of 4 feet
- Public education
- Land-use controls (signs)



# PRE-REMEDIAION RISK AS DEFINED IN DD

**Matrix 2. Severity of Incident**

Severity of Explosive Incident, Matrix 2: Severity vs. Likelihood of Encounter		Likelihood of Encounter <sup>11</sup>				
		Frequent: Regular, or inevitable occurrences	Likely: Several or numerous occurrences	Occasional: Sporadic or intermittent occurrences	Seldom: Infrequent, rare occurrences	Unlikely: Not probable
Severity Associated with Specific Munitions Items <sup>12</sup>	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 treatment, without hospitalization	B	B	B	C	D
	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C	D
	Improbable: No injury is anticipated	D	D	D	D	D

"A" indicates conditions most likely to result in determination of an unacceptable risk.  
 "D" indicates conditions most likely to result in determination of an acceptable risk.



**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 <sup>14</sup>		
		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: <sup>13</sup> Susceptibility to Detonation	High (e.g., classified as sensitive)	1	1	3
	Moderate (e.g., high explosive (HE) or pyrotechnics)	1	2	3
	Low (e.g., propellant or bulk secondary explosives)	1	3	3
	Not Sensitive	2	3	3



**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



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# RESIDUAL RISK AFTER REMEDIATION

**Matrix 2. Severity of Incident**

Severity of Explosive Incident, Matrix 2: Severity vs. Likelihood of Encounter		Likelihood of Encounter <sup>11</sup>				
		Frequent: Regular, or inevitable occurrences	Likely: Several or numerous occurrences	Occasional: Sporadic or intermittent occurrences	Seldom: Infrequent, rare occurrences	Unlikely: Not probable
Severity Associated with Specific Munitions Items <sup>12</sup>	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 treatment, without hospitalization	B	B	B	C	D
	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C	D
	Improbable: No injury is anticipated	D	D	D	D	D

"A" Indicates conditions most likely to result in determination of an unacceptable risk.  
 "D" Indicates conditions most likely to result in determination of an acceptable risk.



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Result from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

## Outcome of remedy

- Surface and subsurface clearance reduces the likelihood of encounter
- Signs and public education reduce the likelihood that people will respond inappropriately if they encounter munitions



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# REMEDY ASSESSMENT FOR AN MMRP REMEDY DEVELOPED USING THE RISK MEMO

Question A: Is the remedy functioning as intended by the decision documents?

- Remedy intent is captured in the RAO: Reduce the unacceptable risk...within the 40 acre MRS to a depth of 4 feet...such that an acceptable condition is achieved
  - Surface clearance, subsurface removal, public education & signs
    - Can verify that the number of UXO *within the specified area and to the specified depth has been decreased to a level that residual risk is acceptable*
      - The decision document has defined what level of residual risk is acceptable through use of the matrices in the risk memo
    - Can assess (through interviews) whether public is aware of hazards



# REMEDY ASSESSMENT FOR AN MMRP REMEDY DEVELOPED USING THE RISK MEMO

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

- Exposure assumptions explicitly stated in the RAO: ... exposure to recreational users and park employees via typical camping activities (digging fire pits, pitching tents) and trail improvement activities...
  - Have there been unanticipated changes in land use?
    - Are the users of the property now different than the receptors addressed by the RAO?
    - Are the activities of the receptors different than anticipated?
    - Do actual intrusive activities exceed depth of clearance?
  - Are there plans for incompatible land use in the future (residential development, for example)?



# REMEDY ASSESSMENT FOR AN MMRP REMEDY DEVELOPED USING THE RISK MEMO

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

- Has our understanding of the “toxicity” (explosive severity, sensitivity) of the munitions changed in a manner that the residual risk is no longer acceptable?
- “Cleanup levels” in the RAO: Achieve an acceptable condition (as defined by Matrix 4)
  - Given current and projected land use, depth of clearance, understanding of the nature of the munitions, is the DD-defined acceptable risk still valid?



# CONCLUSION

Using a well-crafted RAO that defines the nature of the explosive hazard, the area and depth addressed by the remedy, the receptors at risk from the hazard, and the acceptable condition after remediation, it is possible to answer Questions A, B, and C of the technical assessment in a Five-Year Review and arrive at a protectiveness determination for the remedy

A poorly-crafted RAO forces the FYR team to infer the intent of the remedy, which adds subjectivity to remedy assessment and opens the door to regulatory and stakeholder criticism and non-concurrence



# QUESTIONS?



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