Characterizing Munitions Constituents from Artillery and Small Arms Ranges

Institute of Public Health
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Background

- Conducted assessments of Army training and testing ranges in U.S.
  - Determined if munitions constituents of concern (MCOC) are elevated at range boundaries
  - Assessed potential impact of elevated MCOC on ecological or human receptors off-range
- 13 installations
  - 24 small arms sample locations
  - 48 impact area sample locations

Predicted MCOC

Artillery Impact Areas

- Explosives
  - RDX
  - TNT
  - 2, 4-DNT,
  - 2,6-DNT
- Perchlorate
- Metals

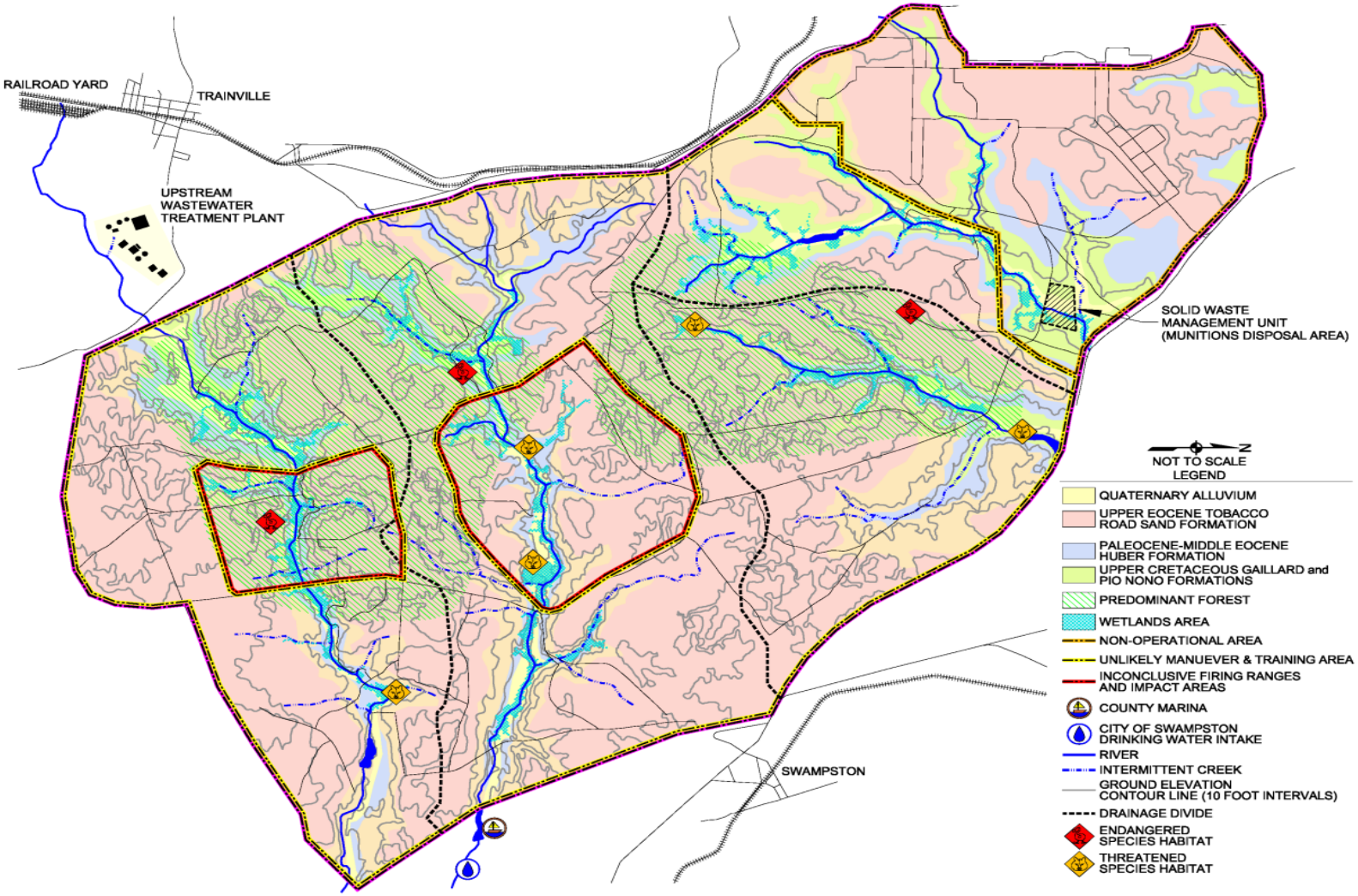
Small Arms Ranges

- Metals
  - Copper (Cu)
  - Lead (Pb)
  - Zinc (Zn)
  - Antimony (Sb)

MCOC Sampling Process

- 1st -determine if sampling necessary
  - MCOC source
  - Pathway
    (surface water system)
  - Receptor
- 2nd - sample to measure MCOC at range boundary and reference (background)

Example Surface Water System Conceptual Site Model



Sample Collection Strategy

- Surface water drainage pathways
  - Upstream/downstream of ranges
  - Wet/dry seasons
  - Clear /storm conditions
  - Composite or grab sample
- Both surface water and sediment collected

Data Results

- Compare data averages statistically
  - Upstream (background)
  - Downstream (range boundary)

- Types of MCOC found above background:
  - Explosives: RDX
  - Metals: Sb, Cu, Pb, Zn

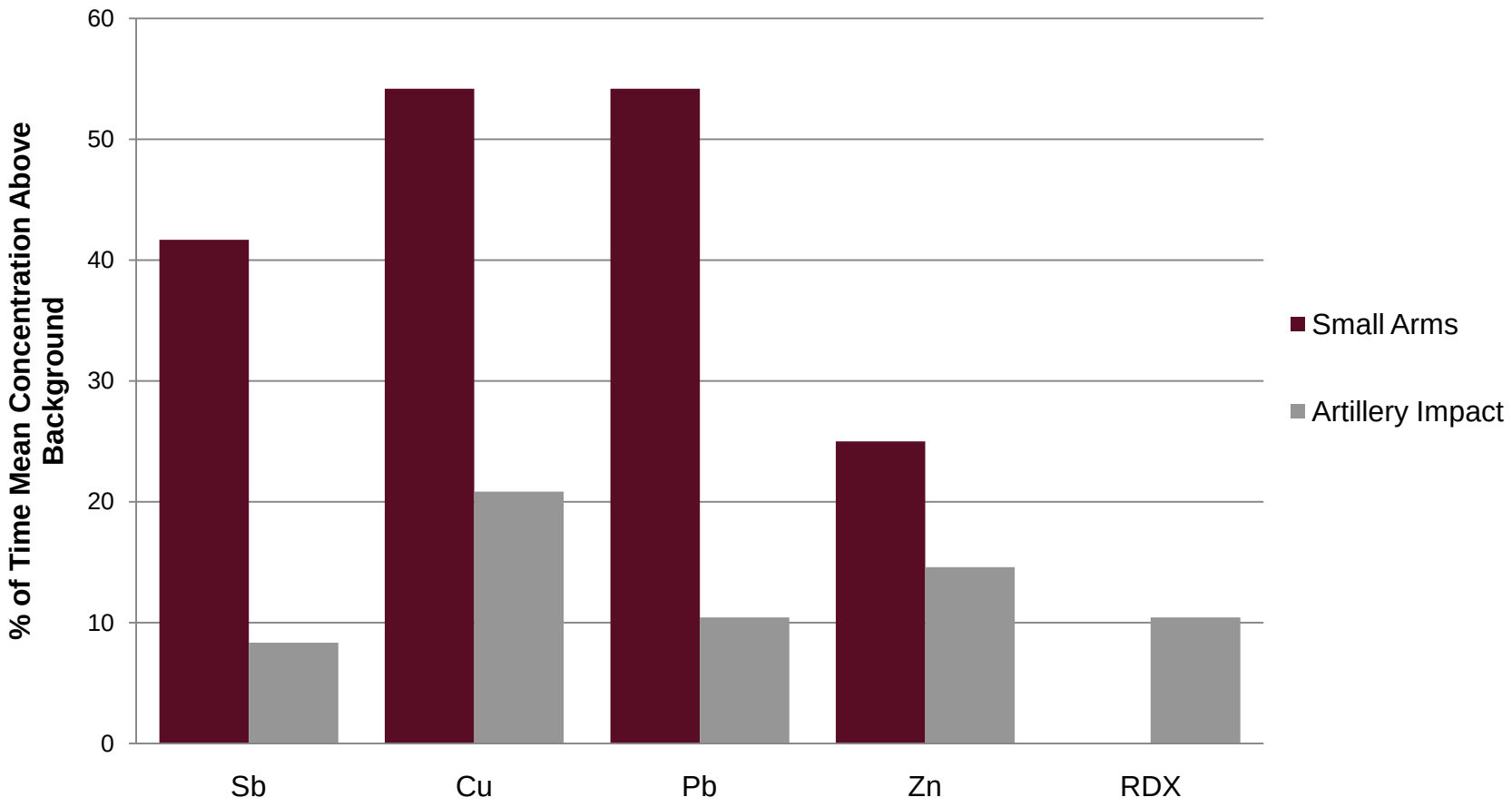
Data Evaluation Method

- Screening value (SV) chosen
  - Department of Defense Range and Munitions Use Subcommittee Workgroup (RMUS)
  - EPA and State standards
- 95% upper confidence level of the mean compared to SLs
- Determine if potential risk

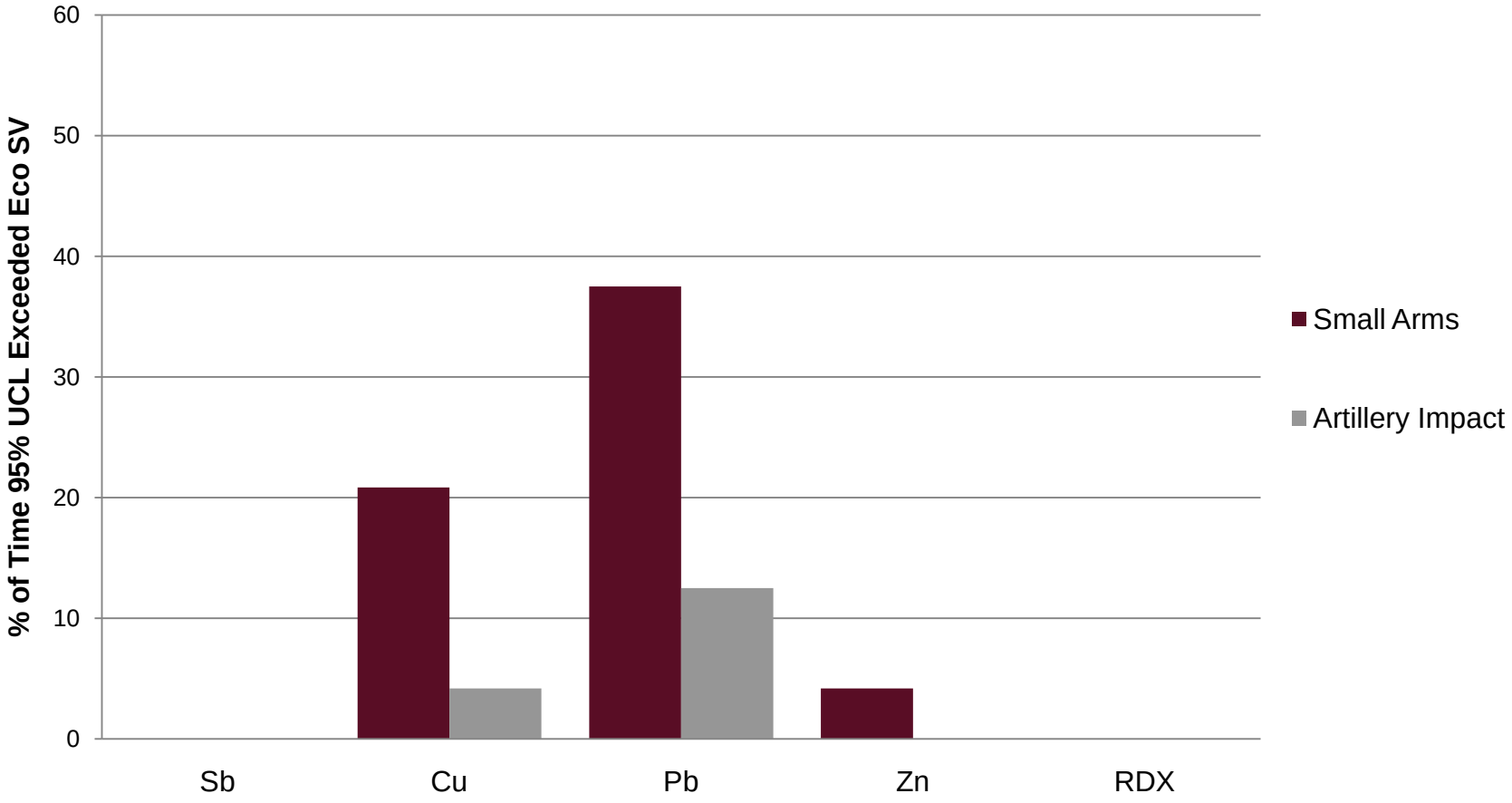
Range of Ecological and Human SVs Used in the Analysis

MCOC	Human	Ecological	
	Potable Water (ppb)	Water (ppb)	Sediment (ppm)
Sb	14 - 15	5.6 - 160	2 - 12
Cu	1300 - 1500	0.9 - 24	16 - 34
Pb	15	0.08 – 13	31 - 47
Zn	9100 - 11000	7.8 - 304	120 - 150
RDX	0.61 - 2	190	0.013

Surface Water Mean Downstream Concentrations Above Background Concentrations



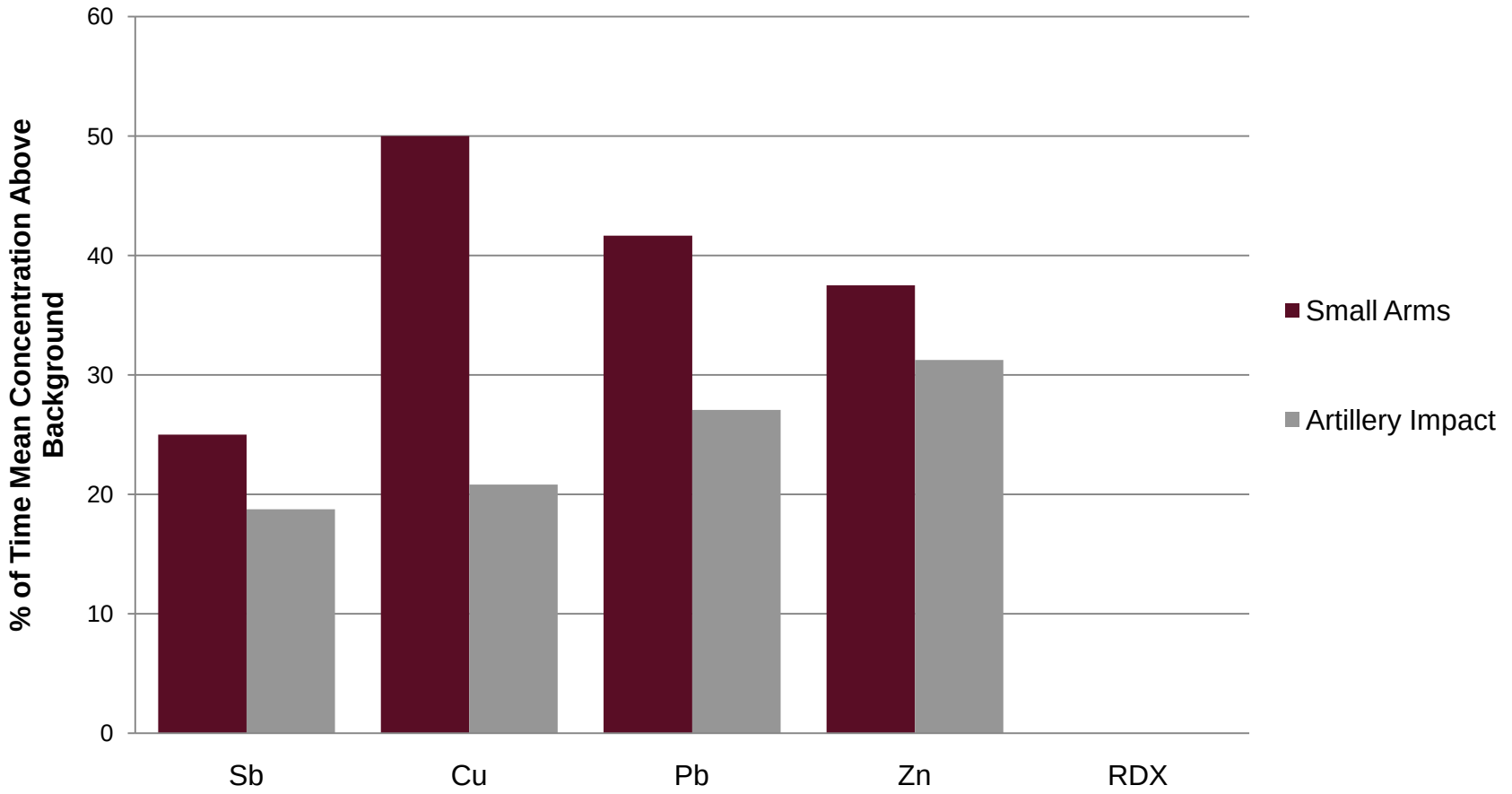
Surface Water 95% UCL of Mean Downstream Concentrations Exceed Ecological SVs



Summary – Surface Water

- Human SV exceedances
  - Pb - small arms range
- Ecological SV exceedances
  - Cu and Pb – both range types
  - Zn – small arms

Sediment Mean Downstream Concentrations Above Background Concentrations



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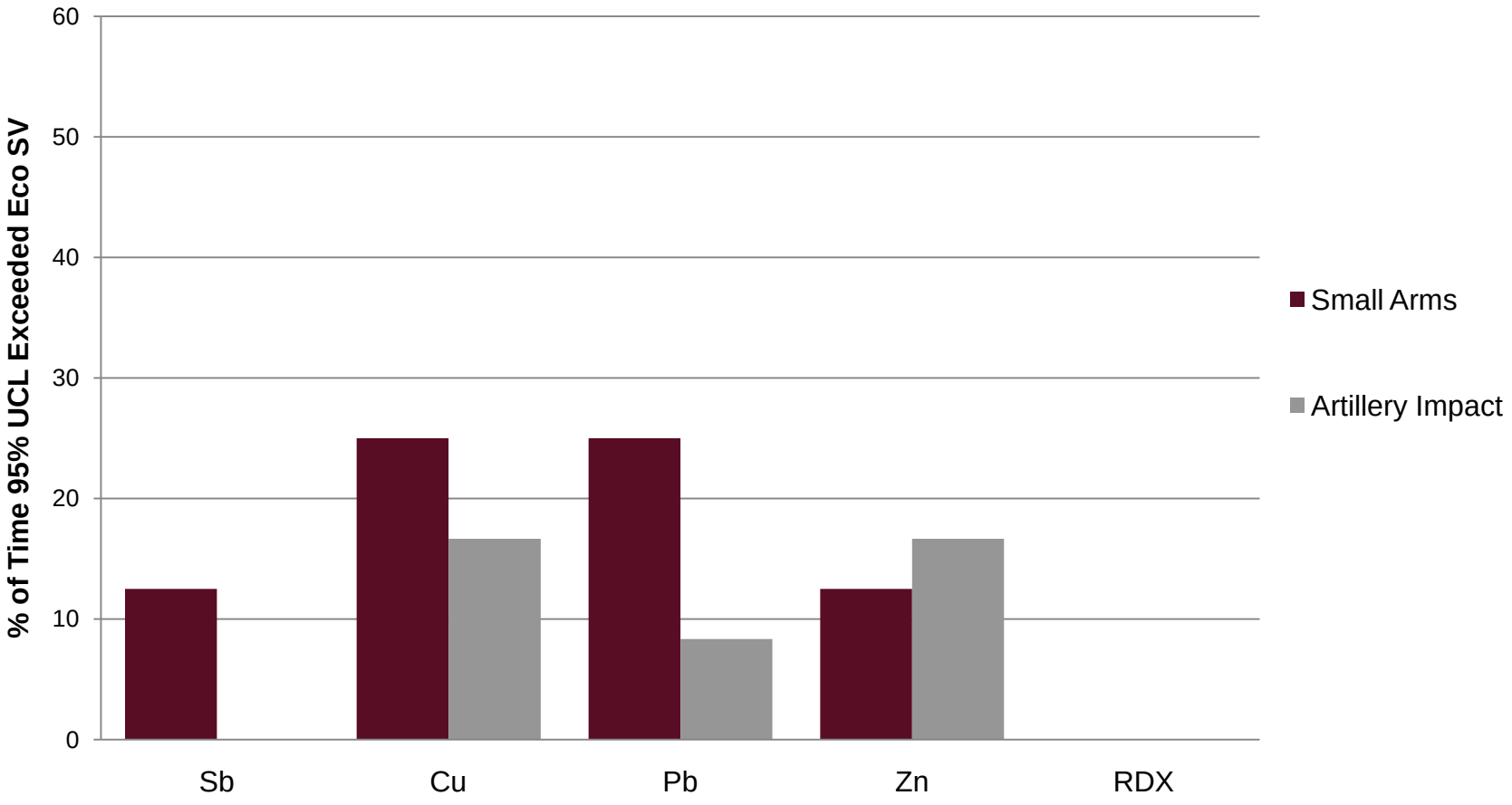

Summary – Sediment

- Pb and Cu – most often exceeded at small arms
- No explosives found at small arms or artillery impact areas

Range Data Summary

Artillery range

- No explosives elevated above SVs
- Metals elevated above SVs <20% of time
  - Surface water – Cu, Pb (Sb and Zn 0%)
  - Sediment – Cu, Pb, Zn (Sb 0%)

Small arms ranges

- No explosives
- Metals elevated above SVs <40% of time
  - Surface water
    - Sb and Zn <10%
    - Cu and Pb <40%
  - Sediment
    - Sb and Zn <15%
    - Cu and Pb <30%

Potential MCOC Impact

- Presence of MCOC above SV does not equate to negative effects occurring
  - bioavailability important
  - benthic macroinvertebrates used to assess stream health
- Ecological/Human health risk assessments may be completed to clarify whether a risk is present

Conclusions

- Explosives
  - not migrating from ranges at elevated levels
- Metals
  - more likely at small arms ranges at elevated levels
- Human health
  - not at unacceptable level of risk