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## **FINAL OPERATIONAL RANGE ASSESSMENT PROGRAM REPORT FORT CARSON, COLORADO**

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To meet Department of Defense (DoD) requirements and support the United States (U.S.) Army's Sustainable Range Program, the Army is conducting assessments to determine whether a release or substantial threat of release of munitions constituents of concern (MCOC) from an operational range to an off-range area creates a potentially unacceptable risk to human health or the environment. The initial assessment—Phase I—was a qualitative evaluation of whether (a) a MCOC source existed on the operational range footprint, (b) there is a potential migration mechanism and (c) human or sensitive ecological receptors are present. For the operational range footprints having a potentially complete source-receptor pathway, the Army conducted a Phase II, a quantitative assessment of potentially complete pathways of MCOC. This ORAP Phase II Report presents evaluation of source-receptor pathways at Fort Carson, Colorado. EA Engineering, Science and Technology, Inc. (EA) conducted this evaluation under contract W912DR-05-D-0018 to the U.S. Army Corps of Engineers (USACE)-Baltimore District.

Initially, the ORAP Phase II establishes whether the source-receptor pathway identified during Phase I is complete or new information has been identified that would impact the Phase I's conclusions. To determine whether MCOC are potentially leaving an operational range footprint by an identified pathway (e.g., groundwater or surface water) and pose a potential risk to off-site receptors, the Phase II considers existing and any new sampling data. The ORAP team may accomplish Phase II through reevaluating existing literature (e.g., prior sampling and/or reports), modeling, and/or collecting additional samples. In Fort Carson's Phase II report, available information was used to establish a weight-of-evidence case that determines whether there has likely been release from the operational range footprint that may pose a potentially unacceptable risk to an off-range receptor.

Fort Carson occupies 157,995 acres and is situated in south-central Colorado and currently utilizes 229 operational ranges totaling 149,557 acres. These operational ranges include 62 maneuver/training areas, 79 firing ranges, 80 multi-use ranges, five impact areas, and three demolition ranges. The remaining 8,438 acres consist of the non-operational area (including the cantonment area).

The Phase I was completed for Fort Carson in 2009. All 229 operational ranges were evaluated under the Phase I Assessment. The ranges were categorized as either "Unlikely" (MCOC are unlikely to migrate to off-range receptors at concentrations that pose an unacceptable risk), or "Inconclusive" (a determination could not be made based on readily available information).

The Phase I concluded that all three components may exist for 49 operational ranges and categorized them as Inconclusive for evaluation under the Phase II. Following a re-evaluation of the Phase I Inconclusive ranges, 20 operational ranges were re-categorized as Unlikely, based on distances to off-range areas, limited MCOC source areas, and Resource Conservation and Recovery Act (RCRA) permitting (RCRA permitted ranges are excluded under ORAP). Therefore, 29 operational ranges totaling 29,504 acres remained Inconclusive and were evaluated under the Phase II.

The Phase II multi-season field sampling was conducted during April 2011 and September 2011. Samples were collected at various locations on Fort Carson. Surface water and/or sediment samples were collected from five locations in the Fountain Creek watershed: three locations downstream of potential MCOC source areas and two locations upstream. Groundwater samples were collected from ten existing

monitoring wells: seven locations downgradient of potential MCOC source areas and three upgradient locations.

Dry and wet season surface water and sediment sampling was conducted to identify potential seasonal variations in water quality transport characteristics. Diurnal variations in surface water quality were accounted for using 24-hour composite samples for most of the samples. Sediment samples were collected as composited grab samples from all surface water sampling locations. Groundwater samples were collected following purging using low-flow methods when water levels were sufficient.

In 2011, the Fort Carson region was experiencing a prolonged drought which impacted the availability of sufficient surface water to sample at several locations. During the wet season sampling event both surface water reference locations were dry and could not be sampled. Only sediment samples were collected from these locations during the wet season. One downstream surface water location did not contain flowing water during the wet season sampling event and grab surface water samples were collected in place of the 24-hour composite samples. During the dry season sampling event one reference location was dry and could not be sampled. Only sediment samples were collected from this location during the dry season. The same downstream surface water location that did not contain flowing water during the wet season sampling event also did not contain flowing water during the dry season sampling event. Grab surface water samples were again collected in place of the 24-hour composite samples.

The drought also impacted groundwater sampling. One downgradient monitoring well was dry and could not be sampled. Water levels in one upgradient well could not support low-flow purging, purged dry, and was instead sampled using a ¾-inch bailer after sufficient groundwater recharge occurred.

Surface water samples were analyzed for explosives, perchlorate, and metals (i.e., antimony, copper, lead, and, zinc); and water quality parameters. Sediment samples were analyzed for explosives, metals, and total organic carbon. Groundwater samples were analyzed for explosives, perchlorate, and metals (antimony, copper, lead, zinc, and tungsten). Uranium samples were also collected at select locations based on potential historical use of depleted uranium (DU) containing munitions.

No explosives were detected in any surface water, sediment, or groundwater samples. Low levels of perchlorate ( $\leq 0.5 \mu\text{g/L}$ ) were observed at several downgradient monitoring wells, one downgradient surface water location, and one reference surface water location. The highest detection of perchlorate was  $1.3 \mu\text{g/L}$  in a monitoring well located upgradient of the MCOC source areas. The detection of perchlorate in upgradient and reference locations suggests that the observed concentrations are not attributable to munitions usage in the Inconclusive range area.

No metals were detected above screening levels in any surface water or sediment samples. In groundwater, total lead ( $33.5 \mu\text{g/L}$ ), in one monitoring well, was observed downgradient of the Inconclusive area which is above the screening level of  $15 \mu\text{g/L}$ . However, a total lead concentration of  $122 \mu\text{g/L}$  was observed in an upgradient well suggesting that the elevated lead concentration observed downgradient is not attributable to munitions usage in the Inconclusive range area.

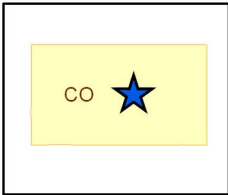
Uranium isotopes were observed in all samples submitted for analysis. The observed uranium isotopic activity ratios ( $\sim 1$ ) in all media are indicative of naturally occurring uranium and not DU associated with the potential use of DU containing munitions.

The results of Fort Carson's Phase II show that MCOC from the operational ranges are not migrating at levels that pose an unacceptable risk to off-range human and or ecological receptors. Therefore, the 29 Inconclusive ranges should be re-categorized as Unlikely and the operational ranges at Fort Carson should be placed into a periodic review program under the ORAP (**Figure 1**).

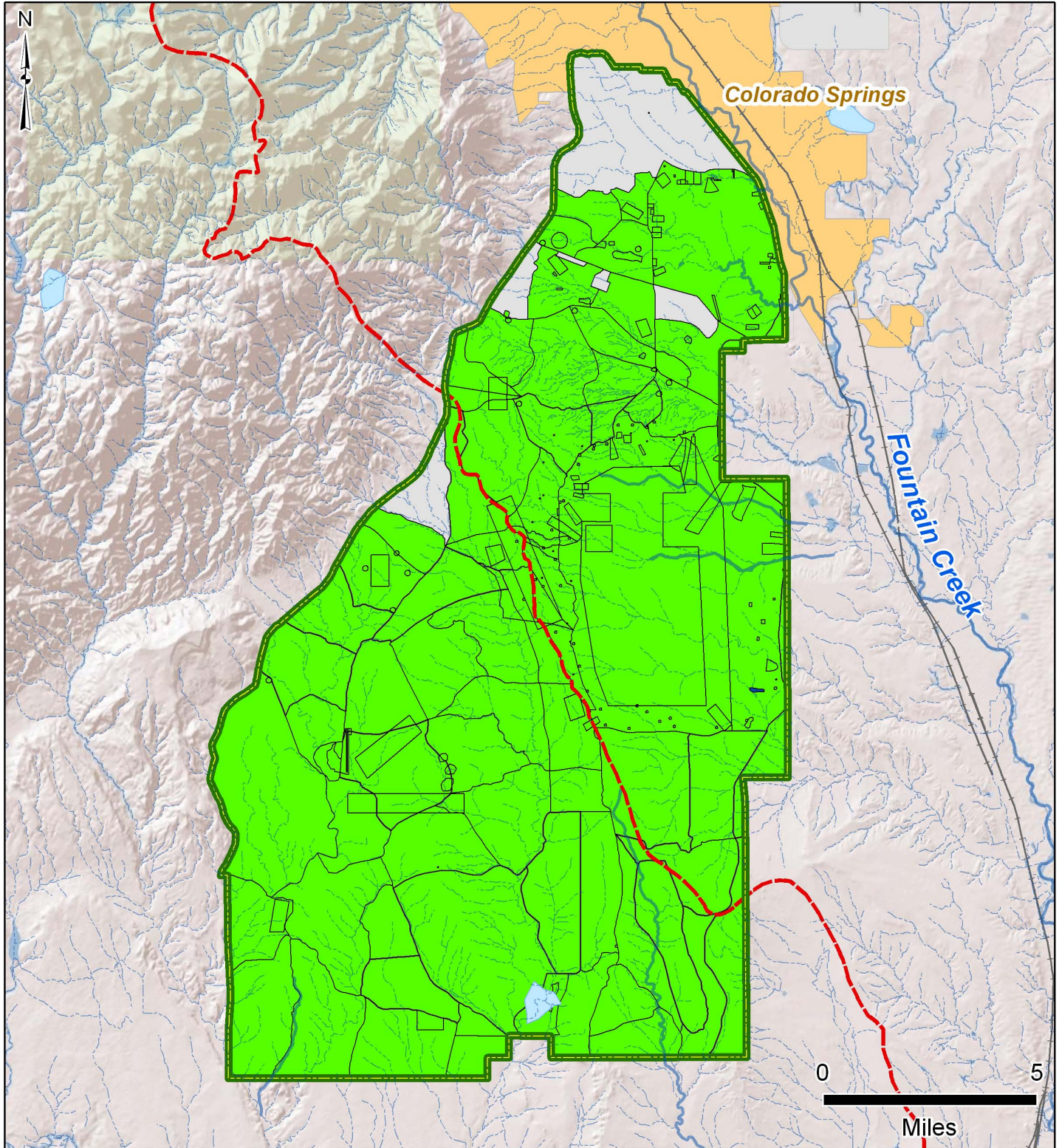
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Operational Range Assessment Program  
Phase II Quantitative Assessment  
Fort Carson, CO



**Figure 1**  
**Summary of Phase II Conclusions**



**Installation Data**

- Installation Boundary
- Non-Operational Area

**Recommendation**

- Operational Range - Periodic Review
- Programmatic Exclusion

**Hydrology**

- Intermittent Stream
- Primary Stream
- Watershed Boundary

Data Sources:  
ARID-GEO 2008, ESRI ArcGIS Online World Shaded Relief 2009

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