



Headquarters Marine Corps

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FINAL

RANGE ENVIRONMENTAL VULNERABILITY ASSESSMENT

Marine Corps Air Station – Beaufort, South Carolina and the Townsend Range, Georgia

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Executive Summary

The United States (U.S.) Marine Corps (Marine Corps) Range Environmental Vulnerability Assessment (REVA) program meets the requirements of the current Department of Defense Directive 4715.11 Environmental and Explosives Safety Management on Operational Ranges within the United States and Department of Defense Instruction 4715.14 Operational Range Assessments. The purpose of REVA is to identify whether there is a release or substantial threat of a release of munitions constituents (MC) from the operational range or range complex areas to off-range areas. This is accomplished through the use of both conceptual and quantitative screening-level models of the fate and transport of indicator MC.

This report presents the assessment results for the operational ranges and training areas at Marine Corps Air Station (MCAS) Beaufort, South Carolina, and the noncontiguous areas Tactical Air Crew Combat Training System (TACTS) Atlantic Ocean Range and Townsend Air-to-Ground Gunnery Range (Townsend Range), Georgia. This report is the first comprehensive report on MC associated with the operational ranges at MCAS Beaufort and serves as the baseline of environmental conditions of the ranges.

MCAS Beaufort maintains operational ranges, including small arms firing ranges, as part of the training activities conducted at the installation. The operational areas identified at MCAS Beaufort, TACTS Atlantic Ocean Range, and the Townsend Range are listed in Table ES-1.

Table ES-1. Operational Areas Associated with MCAS Beaufort

Name	Status	REVA MC Load Area	Comments
Bore Sight Range	Historical use	Bore Sight Range	Historical use small arms range – Site has been closed longer than 10 years, and site features are no longer visible. Expenditure data were not available.
Pistol Range	Operational	Pistol Range	Small arms range – assessed qualitatively.
Explosive Ordnance Disposal (EOD) Range	Operational	Not applicable (NA)	This range is Resource Conservation and Recovery Act (RCRA) permitted.
Skeet Range	Operational	NA	Recreational range.

Name	Status	REVA MC Load Area	Comments
TACTS Atlantic Ocean Range	Operational	NA	Tactical training range – No MC are deposited; therefore, no modeling was conducted.
Nuclear, Biological, and Chemical Training Area	Operational	NA	Gas chamber – No indicator MC are used at the site; therefore, no was modeling conducted.
Townsend Range	Operational	Target #1: Main Bull (Conventional Circle)	Assessed under REVA.
		Target #2: Surface-to-Air Missile (SAM) Site	Assessed under REVA.
		Scud Site	Assessed under REVA.
		Target #3: Command Post (Control Tower)	Assessed under REVA.
		Target #4: Heavy Weight Target	Assessed under REVA.
		Target #5: High Angle Strafe	Assessed qualitatively.
		Petroleum, Oils, Lubricants (POL) Target	Assessed under REVA.
		Strafe Ranges	Assessed qualitatively.
		Smokey Sam Site	Assessed under REVA.
		Small Arms Range	Small arms range – assessed qualitatively.

Assessment Results

The operational areas were screened under REVA based on whether or not they were covered under another environmental program, MC loading data were available, and indicator MC were used. After this review, it was determined that REVA assessments should be conducted on the small arms range on MCAS Beaufort (Pistol Range), and seven MC loading areas and the small arms range on the Townsend Range. In addition, the strafing ranges at Townsend Range were also assessed. The typical REVA assessment includes a quantitative screening-level modeling for operational ranges and a qualitative analysis of small arms ranges. The Townsend Range loading areas were assessed for RDX, TNT, cyclotetramethylene tetranitramine (HMX), and perchlorate; the Pistol Range at MCAS Beaufort and small arms range and strafing ranges at Townsend Range were qualitatively evaluated for lead. The assessed operational ranges are discussed below.

Pistol Range

The application of the small arms range assessment protocol at the MCAS Beaufort Pistol Range resulted in a minimal threat of environmental concern rating for the surface water



pathway and a moderate rating for the groundwater pathway. The surface water ranking was influenced by the fact that the range was refurbished in 2003; the refurbishment included the installation of berms and sidewalls that limit surface runoff. The groundwater pathway was ranked slightly higher because of the shallow water table, moderate infiltration rate, low organic carbon content of soil, and the low pH of the shallow soil.

Townsend Range MC Loading Areas

The Townsend Range complex contains seven MC loading areas that were quantitatively assessed under the REVA process:

- Target #1: Main Bull (Conventional Circle)
- Target #2: SAM Site
- Scud Site
- Target #3: Command Post (Control Tower)
- Target #4: Heavy Weight Target
- POL Target
- Smokey Sam Site

Assessment of Groundwater Pathway

Each of the MC loading areas initially was screened to determine if the indicator MC (RDX, TNT, HMX, and perchlorate) could infiltrate to the water table. The initial screening method assumes that all MC deposited in the water recharges the groundwater. The resulting MC concentrations were compared to the REVA trigger values. This method overpredicts the concentrations that would infiltrate because it includes MC that would be partitioned to other pathways, such as dissolved in the surface water runoff or portioned to organic carbon and clay minerals. The initial screening indicated that sufficient perchlorate is applied to the ground surface at Main Bull and Heavy Weight Target sites to result in perchlorate in the infiltrating water above the REVA trigger value of 0.98 µg/L.

When this initial screening shows concentrations in the infiltrating water above the REVA trigger values, the second level of screening, a vadose zone model, is applied to determine if the MC can reach the water table at a concentration above the trigger values. VS2DTI was the model used at this site for the screening-level analysis of MC transport through the vadose zone. Conservative parameters were used to ensure that the model overpredicted the MC concentration at the water table. Both Main Bull and Heavy Weight Target were predicted to have perchlorate concentrations above the trigger value at the water table.

When the vadose zone modeling shows concentrations above the trigger values reaching the water table, the final screening-level step is a saturated zone model to determine the

likelihood that the MC will travel horizontally down gradient toward a human health or ecological receptor. For both Main Bull and Heavy Weight Target, the nearest down gradient receptor is Churchill Swamp. BIOCHLOR (see *REVA Reference Manual* for model description) was used with conservative parameters to predict the arrival of MC at the swamp. Although BIOCHLOR predicted that perchlorate could arrive at Churchill Swamp, the travel time was significantly greater than the time that has passed since MC loading began.

Surface Water Screening Model

The REVA Phase I Surface Water Screening-Level Analysis method was used to obtain conservative estimates of MC concentrations in surface water runoff from MC loading areas at the Townsend Range and also at a potential receptor just outside of the installation. The receptor location of interest was Snuff Box Swamp on the southern border of the installation. The water in Snuff Box Swamp originates from the Snuff Box Canal on the Townsend Range and flows southeasterly off the range boundary, where it becomes Churchill Swamp. All of Main Bull, SAM Site, Scud Site, Command Post, Heavy Weight Target, and POL Target drain to this point. Snuff Box and Churchill swamps are potential receptors to federally and state protected ecological species, including mammals, birds, fish, reptiles, amphibians, and plants.

Main Bull and Heavy Weight Target MC loading areas were predicted to potentially contribute approximately equal proportions of RDX, TNT, and perchlorate mass to Snuff Box Swamp at the Townsend Range installation boundary. The other loading areas were predicted to contribute low proportions of the total MC mass reaching receptors.

The screening-level analysis predicted that average annual concentrations of RDX and TNT could be detectable (i.e., above REVA trigger values of 0.16 and 0.08 µg/L, respectively) in runoff at the edge of each individual MC loading area. Perchlorate concentrations were predicted to be detectable in runoff at the edge of Main Bull and Heavy Weight Target MC loading areas; concentrations predicted in runoff at the edges of SAM Site, Scud Site, Command Post, and POL Target MC loading areas were below detectable limits. These results are shown in Table ES-2.

Table ES-2. Screening-Level Estimates of Annual Average Edge-of-Loading-Area MC Concentrations in Runoff

MC	From Main Bull (µg/L)	From SAM Site (µg/L)	From Scud Site (µg/L)	From Command Post (µg/L)	From Heavy Weight Target (µg/L)	From POL Target (µg/L)
RDX	7.1	0.67	0.67	0.67	9.9	0.67
TNT	0.87	0.16	0.16	0.16	1.2	0.16
Perchlorate	1353	0.037	0.037	0.037	1793	0.037

Note: Shading indicates that the concentration exceeds the REVA trigger value.



The analysis was carried further to predict the MC concentrations once the runoff from the loading area mixes with other water entering Snuff Box Swamp. The postmixing concentrations of RDX and TNT were predicted to be below REVA trigger values in Snuff Box Swamp at the Townsend Range boundary. However, the postmixing concentration of perchlorate entering Snuff Box Swamp (2.01 µg/L) was predicted to be slightly above the REVA trigger concentration of 0.98 µg/L. These results are shown in Table ES-3.

The analysis was carried further to predict the MC concentrations once the runoff from the loading area mixes with other water entering Snuff Box Swamp. The postmixing concentrations of RDX and TNT were predicted to be below REVA trigger values in Snuff Box Swamp at the Townsend Range boundary. However, the postmixing concentration of perchlorate entering Snuff Box Swamp (2.01 µg/L) was predicted to be slightly above the REVA trigger concentration of 0.98 µg/L. These results are shown in Table ES-3.

Table ES-3. Screening-Level Estimates of Annual Average MC Concentrations in Runoff Entering Snuff Box Swamp at the Townsend Range Boundary

MC	Postmixing Concentrations Entering Snuff Box Swamp (µg/L)
RDX	0.0014
TNT	0.0112
Perchlorate	2.01

Note: Shading indicates that the concentration exceeds the REVA trigger value.

Potential Ecological Impact Evaluation

Although the groundwater and surface water screening analyses indicate that perchlorate potentially reaches the range boundary at Snuff Box and Churchill swamps at concentrations above the REVA trigger concentration of 0.98 µg/L, the predicted concentration is below levels of concern for ecological species exposed to the water. Snuff Box and Churchill swamps are not used as water supplies; therefore, there are no human receptors of concern. A review of available studies shows that the chronic water quality criteria of 9,300 µg/L for perchlorate is useful for assessing potential ecological impacts at the Townsend Range. This value is higher than the model predictions of the perchlorate concentration leaving the range. The predicted concentration for surface water entering the swamp is also below the no-observed-adverse-effect level for amphibians developed by the U.S. Army Center for Health Promotion and Preventive Medicine (23 µg/L).

Townsend Range Small Arms Range



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The application of the Small Arms Range Assessment Protocol at the Townsend Range small arms range resulted in a moderate environmental concern rating for both the surface water and groundwater pathways. Although the SAR has limited use, the evaluation determined moderate surface water and groundwater ratings because of the shallow depth to groundwater, lack of engineering controls and lead recovery, high precipitation, and low pH of soil and shallow groundwater.

Townsend Range Strafing Ranges

The strafing ranges were assessed to determine if they could be incorporated into the REVA evaluation process. Information received from the MCAS Beaufort personnel indicates that all rounds (20- and 30-millimeter) expended from fixed-wing airframes are steel and that the strafing range target areas are swept each Monday with a magnet. Since the MC assessed under REVA are not expended on the strafing ranges, these ranges were not further assessed.

To view the complete report, please go to:

<https://205.110.170.167/Scripts2/Documents/Beaufort%20Final%20Report.pdf>