

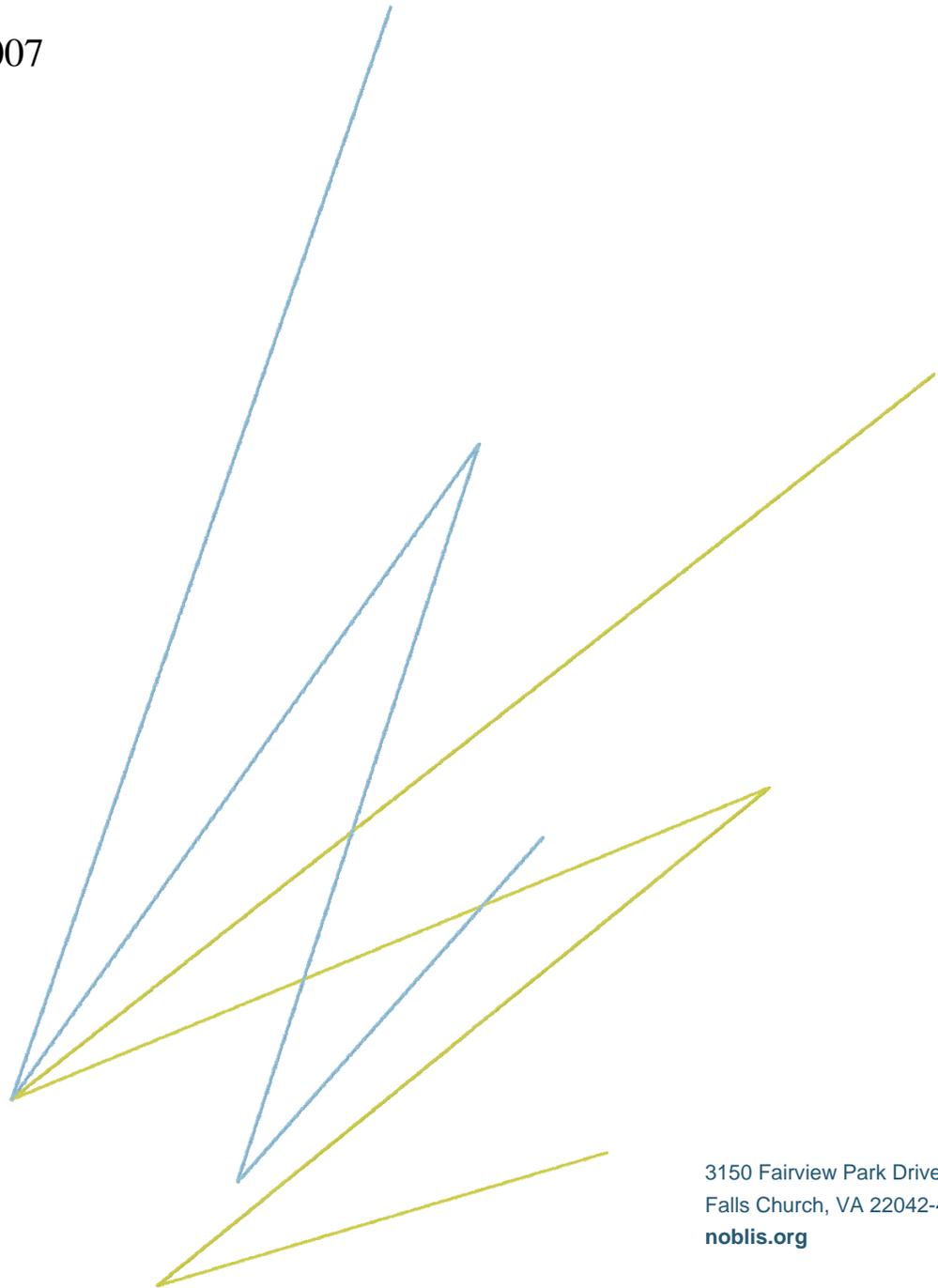
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Noblis Technical Report

Survey of Emerging Contaminants on Department of Defense Ranges

Summary and Analysis of Survey Responses

December 2007



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Summary and Analysis of Survey Responses

December 2007

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Customer:	Developed for: Deputy Under Secretary of Defense (Installations and Environment) Emerging Contaminants Directorate and Range Commanders' Council	Contract No.: FA8900-06-D-9001-002
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Noblis Project Approval:

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Executive Summary

The Office of the Assistant Deputy Under Secretary of Defense (OADUSD) for Installations and Environment and the Range Commanders' Council (RCC) jointly funded a project to assess the risks of emerging contaminants (ECs) to Department of Defense (DoD) test and training ranges and to assist with identifying and recommending risk management options (RMO) for range Commanders. ECs are defined as chemicals or materials that (1) have either a real or perceived threat to human health or the environment and (2) no peer reviewed health standard or an evolving standard. As part of this project, the RCC requested that a survey of its member ranges be conducted to help define the scope of the risks from ECs both now and in the future. The membership comprises ranges with a research, development, testing and evaluation (RDT&E) mission, as well as ranges with a training mission, such as the National Training Center (NTC). In addition, OADUSD requested the inclusion of a limited number of non-RCC ranges in the survey to capture activities on large training ranges. The survey was deemed to be an important step leading to the identification of sources, pathways, and potential receptors for ECs on ranges.

The web-based survey was open for thirty days from April 25, 2007 through May 25, 2007. The questions were developed to query personnel either responsible for, or associated with, various range activities across a broad spectrum of ranges. A breakdown of the potential survey respondents by the applicable Service/Agency is as follows:

- 11 = Army
- 1 = Marine Corps
- 8 = Navy
- 9 = Air Force
- 2 = Non-DoD (i.e., Department of Energy)

Of the thirty-one potential respondents, twenty-three are RCC members and eight are non-RCC members. There was a lower than expected sixty percent response rate to the survey.

Survey responses indicate that activities at training ranges, as well as testing and evaluation ranges, may result in the release of chemicals on the range and that both human and environmental receptors may be exposed to ECs. The survey data identified several of the predominant ECs specific to ranges, with perchlorate, lead, and RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) being the ones identified as most likely to be of concern in the future. Of the ranges surveyed, 55 percent have one or more federal or state listed species of concern (i.e., threatened or endangered) present on the range. Furthermore 16 percent of the respondents answered yes to having a unique natural resource that prevented a mission activity from being performed or a system from being used because the activity or system either releases or may release ECs into the environment. For those that responded yes, references were given to a source water protection area that is protected by an installation land use control policy; a limited use sole source water supply, and a sole source aquifer. In addition, many of the ECs identified by ranges are also of concern for other DoD program activities (e.g., cleanup program, acquisition/RDT&E programs, operations and maintenance activities).

Next steps should include further data analysis of the source terms to better understand the types of chemicals being released and the identification of possible RMO to minimize the release and/or migration of ECs on ranges. DoD policy on responding to releases of ECs on ranges needs to be clarified and communicated, especially policy on programming and budgeting actions. The clarifications should provide clear guidance with regard to the analysis and selection of RMOs, including but not limited to actions to minimize the release, migration, and exposure to ECs. The responses indicate that respondents anticipate that ECs will continue to play an important role in influencing how ranges are managed both now and in the future.

Table of Contents

Section	Page
1 Introduction	1-1
1.1 Background	1-1
1.2 Approach to Developing and Conducting the Survey	1-1
1.3 Limitations of the Survey	1-2
2 Summary of Responses	2-1
3 Findings and Conclusion	3-1
Appendix A Survey Task Memo	A-1
Appendix B Survey Questions	B-1
Glossary	GL-1

List of Tables

Table		Page
2-1	ECs With Demonstrated Regulatory Interest	2-1
2-2	ECs of Future Concern to Survey Respondents	2-5
2-3	ECs Expected at Ranges	2-7
2-4	ECs Sampled at Ranges	2-8
2-5	ECs Detected at Ranges	2-9

Section 1

Introduction

1.1 Background

The Office of the Assistant Deputy Under Secretary of Defense (OADUSD) for Installations and Environment and the Range Commanders' Council (RCC) jointly funded a project to assess the risks of emerging contaminants (ECs) to Department of Defense (DoD) test and training ranges and to develop risk management options (RMOs) for range Commanders. ECs are defined as chemicals or materials that (1) have either a real or perceived threat to human health or the environment and (2) no peer reviewed health standard or an evolving standard. As part of this project, the RCC requested that a survey of its member ranges be conducted to help define the scope of the risks from ECs both now and in the future. The RCC membership is comprised mostly of ranges with a research, development, testing and evaluation (RDT&E) mission. In addition, OADUSD requested the inclusion of a limited number of non-RCC ranges in the survey to capture activities on large training ranges. The survey was deemed to be an important step leading to the identification of sources, pathways, and potential receptors for ECs on ranges. This report summarizes the results of that survey.

1.2 Approach to Developing and Conducting the Survey

Noblis, working with the RCC and OADUSD, developed a survey form that included a total of nine (9) questions, most with multiple parts. The survey questions were briefed to the RCC membership at their meeting at Yuma Proving Ground, AZ, in January 2007. Additional briefings were held with the Services' staff at the Deputy Assistant Secretary level and OADUSD in early 2007. The tasking memorandum for the survey was signed by Mr. Alex Beehler, ADUSD for Environment, Safety and Occupational Health, and Mr. Dan Gardner, Director, Readiness and Training, Policy and Programs. A copy of the tasking memorandum is included as Appendix A.

The questions in the survey were drawn from previous survey questions informally developed by the RCC which focused on EC sources, pathways, and receptors, and policy issues. The survey was designed to elicit top level responses and not identify specific locations/ranges for additional inquiry. Respondents were directed to complete only one survey per installation or range complex even if the installation or complex contains a number of ranges each with distinct functions. A list of chemicals currently considered ECs by DoD was provided with regard to survey question nine. The chemicals considered ECs were those on the EC Action List (AL) and Watch List (WL) as of May 2007. The ECs found on any specific range may be different from those on the AL and WL, and thus the respondents were directed to not limit their responses only to those ECs on the list provided. Respondents were directed to consider the unique circumstances of their range, as well as operational conditions. The survey questions are included as Appendix B.

The web-based survey was open for thirty days from April 25, 2007 through May 25, 2007. The questions were developed to query personnel responsible for, or associated with, various range

activities across a broad spectrum of ranges. A breakdown of the potential survey respondents by the applicable Service/Agency is as follows:

- 11 = Army
- 1 = Marine Corps
- 8 = Navy
- 9 = Air Force
- 2 = Non-DoD (i.e., Department of Energy)

Of the thirty-one potential respondents, twenty-three are RCC members and eight are non-RCC members.

1.3 Limitations of the Survey

The intent of this survey was to conduct a general examination of the potential respondents without challenge, interrogation, or follow-up questions, and report the data as it was provided. To ensure anonymity, specific ranges are not named in this report and conditions, species, and location information are purposefully limited; however, ranges from each of the four military services were included in the survey. It is understood that ranges within the installation or range complex might present issues, with regard to ECs, that are applicable only to their specific range. Furthermore, the survey did not attempt to separate out range activities from associated industrial activities that proximate the range but are on the installation. It is recommended that these specific issues be addressed in a separate survey targeted at specific activities at individual installations and/or range complexes. The primary focus of this survey is to assist in the identification of top level issues that should be considered in further detail by the OADUSD EC Directorate and RCC.

Section 2

Summary of Responses

Responses to the survey questions are summarized in this section. Depending on the specific survey question, the number of responses received ranged from eighteen to twenty.

The first question asked if Federal and/or State regulators, responsible for the environmental oversight of the installations polled, had either discussed or required sampling for ECs, and if so, to provide a list of the applicable chemicals. The majority of the responses, an approximate two-to-one ratio, were positive with a total of thirty-nine chemicals identified, five of which are on the AL and eleven on the WL, as determined by OADUSD. The chemicals, listed in descending order based on the number of responses that mentioned the chemical, are provided in Table 2-1.

Table 2-1. ECs With Demonstrated Regulatory Interest

No.	Chemical	CAS #	Type	Notes	No. of Listings
1.	Perchlorate	14797-73-0	Inorganic	AL	7
2.	N-nitrosodimethylamine (NDMA)	62-75-9	Organic	WL	4
3.	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	Organic	AL	3
4.	Trichloroethylene (TCE)	79-01-6	Organic	AL	2
5.	Tetrachloroethylene (PCE)	127-18-4	Organic	WL	2
6.	Naphthalene	91-20-3	Organic	AL	2
7.	Lead compounds	7439-92-1	Inorganic	WL	2
8.	Dinitrotoluene (DNT)	25321-14-6	Organic	WL	2
9.	1,4-dioxane	123-91-1	Organic	WL	2
10.	Tungsten	7440-33-7	Inorganic	WL	1
11.	Terbufos sulfone	56070-16-7	Organic		1
12.	Polybrominated Diphenyl Ethers (PBDE)		Organic	WL	1
13.	N-nitrosopyrrolidine (NPYR)	930-55-2	Organic		1
14.	N-nitrosomethylethylamine (NMEA)	10595-95-6	Organic		1
15.	N-nitrosodi-n-propylamine (NDPA)	621-64-7	Organic		1
16.	N-nitrosodi-n-butylamine (NDBA)	924-16-3	Organic		1
17.	N-nitrosodiethylamine (NDEA)	55-18-5	Organic		1
18.	Nickel	7440-02-0	Inorganic	WL	1
19.	Metolachlor oxanilic acid (OA)	152019-73-3	Organic		1
20.	Metolachlor ethane sulfonic acid (ESA)	171118-09-5	Organic		1
21.	Metolachlor	51218-45-2	Organic		1
22.	Hexavalent chromium (Cr VI)	18540-29-9	Inorganic	AL*	1

No.	Chemical	CAS #	Type	Notes	No. of Listings
23.	Dimethoate	60-51-5	Organic		1
24.	Chromium	7440-47-3	Inorganic	AL*	1
25.	Beryllium	7440-41-7	Inorganic	WL	1
26.	Alachlor OA	171262-17-2	Organic		1
27.	Alachlor ESA	142363-53-9	Organic		1
28.	Alachlor	15972-60-8	Organic		1
29.	Acetochlor OA	184992-44-4	Organic		1
30.	Acetochlor ESA	187022-11-3	Organic		1
31.	Acetochlor	34256-82-1	Organic		1
32.	2,4,6-trinitrotoluene (TNT)	118-96-7	Organic		1
33.	2,2',4,4'-tetrabromodiphenyl ether (BDE-47)	5436-43-1	Organic	WL**	1
34.	2,2',4,4',6-pentabromodiphenyl ether (BDE-100)	189084-64-8	Organic	WL**	1
35.	2,2',4,4',5-pentabromodiphenyl ether (BDE-99)	60348-60-9	Organic	WL**	1
36.	2,2',4,4',5,5'-hexabromodiphenyl ether (BDE-153)	68631-49-2	Organic	WL**	1
37.	2,2',4,4',5,5'-hexabromobiphenyl (HBB)	59080-40-9	Organic		1
38.	1,3-dinitrobenzene	99-65-0	Organic		1
39.	1,2,3-trichloropropane (TCP)	79-01-6	Organic	WL	1

Table Notes:

AL – Chemical on the Action List as of May 2007

WL – Chemical on the Watch List as of May 2007

* - On the AL as hexavalent chromium (chromium was listed as both chromium and hexavalent chromium; hexavalent chromium is on the AL)

** - On the WL as the class of compounds PBDEs

There are two main types or categories of chemicals included in the responses to Question 1: munitions related chemicals and non-munitions related chemicals. The first category is comprised of chemicals present due to the likely denotation of munition items (high order and low order) on the range. For example, in military applications RDX can be used alone as a base charge for detonators or mixed with another explosive such as TNT to form cyclotols, which produce a bursting charge for aerial bombs, mines, and torpedoes. The second category is comprised of chemicals not related to munitions use, but likely present due to range maintenance or historical disposal practices. The second category includes pesticides/pesticide bread-down products and solvents. For example, Terbufos sulfone is an oxidation product of Terbufos, an organophosphate insecticide, and 1,4-dioxane was a stabilizer added to 1,1,1-trichloroethane, a cleaning solvent.

The second survey question asked those responders who had answered positively to the first question and had listed a chemical as part of their response whether there had been any required

environmental response actions or limits placed on their operational ability under any state or federal environmental laws (e.g., Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), National Environmental Policy Act (NEPA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)) as a result of the ECs named in question 1, and if so, what specific activities are the likely source of the ECs.

The responses were overwhelmingly negative (89% No, 11% Yes). For those few that answered Yes, the specific activities listed as being the likely source(s) of the release of ECs on their installations were: 1) use of a permitted, unlined hazardous waste landfill, 2) rocket motor static firing on test stands, 3) open burn/open detonation (OB/OD) practices at a Part B permitted thermal treatment unit, and 4) discharge of liquid wastes containing chemical solvents onto the ground. When asked to list the chemicals responsible for the environmental response actions or operational limitations, the respondents listed perchlorate, tetrachloroethylene (PCE), and trichloroethylene (TCE). It is noteworthy that two of the three chemicals are not related to munitions and thus may be a historical artifact of earlier waste disposal practices.

An additional follow-up to Question 2 asking for the specific legal authority under which a response action was required was left unanswered by all respondents.

The third survey question focused on identifying the potential human receptors, either current or in the future, which are or could be exposed to ECs on or off the installation. The human receptors that could/may be exposed to ECs included reference to both military and civilian personnel and are listed as follows;

- Personnel conducting Range Clearing activities or Target Rebuilding.
- Personnel on the ground performing land maneuvers near target areas.
- Industrial employees located near perchlorate plumes. Specifically, personnel working in the area are exposed.
- Authorized personnel investigating land impacts and indigenous populations of surrounding islets.
- Military personnel conducting training exercise(s) and Civil Service and Contractor personnel performing their assigned duties on the ranges associated with the Range Training Complex.
- Military and civilian workers, recreators, and/or trespassers
- Off-Installation residents living near the fence line or along the shoreline across the bay

Respondents that identified potential human receptors were asked to also provide a description of the complete (or potentially complete) exposure pathways. The pathways listed include inhalation, ingestion, dermal contact and absorption. If in vivo (inside the body) receptor types are considered, then predominately liver enzymes are the most likely sites that would be exposed to ECs.

The fourth survey question sought information on the ecological (plant or animal) receptors that are, or could be, exposed to ECs on the various installations. The respondents were generally consistent in their answers, noting that various flora and fauna, and in some cases wildlife and

marine life, could be or would be potential receptors. Specific examples in each category were provided. The respondents were split approximately 50/50 when asked if any of the ecological receptors was a species of special concern under federal or state law (e.g., a listed endangered species). The exposure pathways listed for these ecological receptors include ingestion, dermal contact and absorption, and inhalation.

The fifth survey question sought information on the presence of unique natural resources (e.g., a sole source aquifer) that would prevent a training activity or system from being on the range because the activity or system either releases, or potentially may release, ECs into the environment. The response was overwhelmingly negative with 84% answering No and 16% answering Yes. For those answering Yes, additional information was requested to describe the resource. All positive responses described land use restrictions on training activities as being related to source area or aquifer protection.

For the sixth survey question, the respondents were asked to look into the future (5 to 10 year time frame) for ranking their top five specific ECs of concern. These could include long-standing contaminants under increasing scrutiny, new constituents from new technologies, or new contaminants resulting from new categories of users. A total of twenty-four chemicals were identified, seven of which are on the WL and three on the AL. Twelve of the chemicals are inorganic (eleven being metals), ten are organics, and two are listed as others. The named chemicals in descending order by the number of times they were listed are provided in Table 2-2.

Table 2-2. ECs of Future Concern to Survey Respondents

No.	Potential Range Related EC	Type	Notes	No. of Listings
1	Perchlorate	Inorganic	AL	15
2	hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	Organic	AL	6
3	Lead compounds	Inorganic	WL	5
4	Trichloroethylene (TCE)	Organic	AL	4
5	Dinitrotoluene (DNT)	Organic	WL	3
6	Tungsten	Inorganic	WL	2
7	Depleted Uranium	Inorganic		2
8	Beryllium	Inorganic	WL	2
9	2,4,6 TNT	Organic		2
10	Zinc	Inorganic		1
11	Uranium	Inorganic		1
12	Total Dissolved Solids	Other		1
13	PCE	Organic	WL	1
14	NDMA	Organic	WL	1
15	Molybdenum	Inorganic		1
16	Mercury	Inorganic		1
17	Hypergolics	Organic		1
18	Hydrazine	Organic		1

No.	Potential Range Related EC	Type	Notes	No. of Listings
19	HMX	Organic		1
20	Dioxins	Organic	WL	1
21	Copper	Inorganic		1
22	Chromium	Inorganic	AL*	1
23	Chem/Bio agent simulants	Other		1
24	Arsenic	Inorganic		1

Table Notes:

WL – Watch List as of May 2007

AL – Action List as of May 2007

* - Chromium is on the AL as hexavalent chromium, the species of chromium was not specified in the response.

The seventh survey question asked if there are any EC policy or procedure issues that are unresolved or of concern. As with Question 6, the majority of the responses were negative (79% answered No). For those that responded Yes, the issues described are not having good policy on the use of perchlorate or lead, and funding availability for implementing associated environmental response actions. There was a specific response related to compliance monitoring and the lowering of state discharge limitations for eighty chemicals that have been deemed particularly deleterious to marine organisms.

The eighth survey question requested additional comments on ECs as they relate to the installation missions. Although a number of respondents answered “None”, specific comments recorded relating to various activities and EC issues are as follows:

- Sampling at the installation will look at a few of the ECs identified in the survey and, if found to be present, will provide their soil concentration. In addition, some of the ECs listed occur naturally in the soil (e.g., perchlorate, lead, tungsten, and others).
- Degrading unexploded ordnance (UXO) may (will) eventually lead to a release of unspent energetic compounds in addition to heavy metals.
- Lead contamination in surface soils from the exhaust from various, historic target/missile launch facilities were investigated in the past, but the areas of concern are confined to the launch pad surroundings, and there are no potential receptors or groundwater concerns associated with these areas.
- Prescribed burns have been on-going around range areas, and from a former incinerator, so the probability of sampling and detecting dioxins is high on the ranges. Tungsten powder may have been used in bullets used on operational ranges so there may be a source area present. Perchlorate (at a former Explosive Ordnance Disposal [EOD] Range) and TCE (in industrial areas) have been found in groundwater plumes on the installation, but there is no expectation that they would be found at operational ranges.
- One responder noted that they expected some revisions in discharge limitations issued to the base, in particular TDS and molybdenum limitations for which they were found in violation. Strict limitations of discharges of zinc to Publicly Owned Treatment Works (POTW) and to surface waters and stormwater conveyances have already been imposed.

With the base reliance on galvanized piping to resist effects of marine weathering, zinc levels have been found to exceed regulatory limitations with regularity.

The last question noted that the Office of the Deputy Under Secretary of Defense (Installations and Environment) developed a list of ECs based on input from various groups. The respondents were asked if they would expect to find any of the chemicals listed on their range(s) (e.g., a constituent of munitions used) and if they have sampled for and/or detected any of the ECs at their installation or range complex. The percentages of the response categories for each chemical, sorted in descending order for those that responded Yes, are provided in Table 2-3 through Table 2-5.

Table 2-3. ECs Expected at Ranges

Chemical	CAS	Yes	No	Unknown
Lead compounds	7439-92-1	83% (15)	11% (2)	6% (1)
Perchlorate	14797-73-0	56% (10)	22% (4)	22% (4)
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	56% (10)	22% (4)	22% (4)
Trichloroethylene (TCE)	79-01-6	39% (7)	50% (9)	11% (2)
Dinitrotoluene (DNT)	25321-14-6	39% (7)	22% (4)	39% (7)
Tetrachloroethylene (PCE)	127-18-4	33% (6)	33% (6)	33% (6)
Nickel	7440-02-0	33% (6)	39% (7)	28% (5)
Beryllium	7440-41-7	33% (6)	39% (7)	28% (5)
Chromium VI	18540-29-9	32% (6)	42% (8)	26% (5)
Naphthalene	91-20-3	28% (5)	56% (10)	17% (3)
Dioxins	--	28% (5)	39% (7)	33% (6)
N-Nitrosodimethylamine (NDMA)	62-75-9	22% (4)	33% (6)	44% (8)
Dichlorobenzene	25321-22-6	17% (3)	56% (10)	28% (5)
1,4-Dioxane (1,4-Diethyleneoxide)	123-91-1	17% (3)	39% (7)	44% (8)
Tungsten	7440-33-7	11% (2)	44% (8)	44% (8)
Polybrominated diphenyl ethers (PBDE)	--	6% (1)	39% (7)	56% (10)
1,2,3-trichloropropane (1,2,3-TCP)	96-18-4	6% (1)	50% (9)	44% (8)
Perfluorooctanoic acid (PFOA)	335-67-1	0% (0)	39% (7)	61% (11)
Nanomaterials	--	0% (0)	56% (10)	44% (8)

Table 2-4. ECs Sampled at Ranges

Chemical	CAS	Yes	No
Lead compounds	7439-92-1	61% (11)	39% (7)
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	50% (9)	50% (9)
Perchlorate	14797-73-0	61% (11)	39% (7)
Trichloroethylene (TCE)	79-01-6	44% (8)	56% (10)
Beryllium	7440-41-7	44% (8)	56% (10)
Tetrachloroethylene	127-18-4	39% (7)	61% (11)
Nickel	7440-02-0	33% (6)	67% (12)
Dinitrotoluene (DNT)	25321-14-6	33% (6)	67% (12)
Naphthalene	91-20-3	28% (5)	72% (13)
Chromium VI	18540-29-9	22% (4)	78% (14)
N-Nitrosodimethylamine (NDMA)	62-75-9	22% (4)	78% (14)
Dioxins	--	17% (3)	83% (15)
Dichlorobenzene	25321-22-6	28% (5)	72% (13)
1,4-Dioxane (1,4-Diethyleneoxide)	123-91-1	17% (3)	83% (15)
Tungsten	7440-33-7	6% (1)	94% (17)
1,2,3-trichloropropane (1,2,3-TCP)	96-18-4	17% (3)	83% (15)
Polybrominated diphenyl ethers (PBDE)	--	0% (0)	100% (18)
Perfluorooctanoic acid (PFOA)	335-67-1	0% (0)	100% (18)
Nanomaterials	--	0% (0)	100% (18)

Table Notes

1. Numbers in parentheses are the number of listings from the survey.

Table 2-5. ECs Detected at Ranges

Chemical	CAS	Yes	No
Perchlorate1	14797-73-0	44% (8)	56% (10)
Lead compounds	7439-92-1	56% (10)	44% (8)
Cyclotrimethylenetrinitramine (RDX)	121-82-4	50% (9)	50% (9)
Trichloroethylene (TCE)	79-01-6	39% (7)	61% (11)
Beryllium	7440-41-7	33% (6)	67% (12)
Tetrachloroethylene	127-18-4	28% (5)	72% (13)
Nickel	7440-02-0	28% (5)	72% (13)
Dinitrotoluene (DNT)	25321-14-6	28% (5)	72% (13)
Naphthalene	91-20-3	22% (4)	78% (14)
Dichlorobenzene1	25321-22-6	11% (2)	89% (16)
N-Nitrosodimethylamine (NDMA)	62-75-9	17% (3)	83% (15)
Chromium VI	18540-29-9	22% (4)	78% (14)
Dioxins	--	17% (3)	83% (15)
1,4-Dioxane (1,4-Diethyleneoxide)	123-91-1	11% (2)	89% (16)
1,2,3-trichloropropane (1,2,3-TCP)	96-18-4	6% (1)	94% (17)
Tungsten	7440-33-7	6% (1)	94% (17)
Polybrominated diphenyl ethers (PBDE)	--	0% (0)	100% (18)
Perfluorooctanoic acid (PFOA)	335-67-1	0% (0)	100% (18)
Nanomaterials	--	0% (0)	100% (18)

Table Notes

1. Numbers in parentheses are the number of listings from the survey.
2. The survey asked respondents to consider all detections of perchlorate not just those greater than the DoD screening level of 24 µg/L.
3. Numbers in parentheses are the number of listings from the survey.

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Section 3

Findings and Conclusion

The OADUSD for Installations and Environment and the RCC jointly funded a project to assess the risks of ECs to test and training ranges and to assist with identifying and recommending risk management options (RMO) for range Commanders. As part of this project, the RCC requested that a survey of its RCC member ranges be conducted to help define the scope of the risks from ECs both now and in the future. The survey was an important step leading to the identification of sources, pathways, and potential receptors for ECs on ranges.

The web-based survey was open for thirty days from April 25, 2007 through May 25, 2007. The questions were developed to query personnel either responsible for, or associated with, various range activities across a broad spectrum of ranges.

The ranges were not asked to perform any additional data collection for the survey. Information for completing the survey was expected to be available to the target audience from one of the following resources:

- Active Range Assessment Program
- Defense Installation Restoration Program
- Compliance monitoring programs
- Range management activities
- Environmental Impact Statements
- State or federal permits
- Personal experience

Data collection efforts are on-going by the Services under the Operational Range Assessment Program. Under the program, all DoD Components are required to establish and implement procedures to assess the environmental impacts of munitions use on operational ranges (DoD Directive 4715.11 and DoD Instruction 4715.14). These additional and on-going data collection efforts may provide additional data that could be used to update the survey in the future.

To ensure anonymity, specific ranges are not named in this report and conditions, species, and location information are purposefully limited; however, ranges from each of the four Services were included in the survey. The potential respondents included seven training ranges and twenty-four RDT&E ranges. The activities associated with the various ranges include:

- Air-to-Air or Surface-to-Air
- Air-to-Ground
- Land Maneuver
- Land Impact Areas
- Land Firing Range
- Command and Control Warfare (C2W)/Electronic Warfare
- Ocean Operating Area

- Military Operations in Urban Terrain (MOUT) Training
- Underwater Tracking Range
- Amphibious Area
- Other

Overall, responses were received from each of the Services, although responses from non-RCC ranges were limited. Survey responses indicate that activities at training ranges, as well as RDT&E ranges, may result in the release of chemicals on the range and that both human and environmental receptors may be exposed to ECs. The survey identified potential ECs that were munitions related (e.g., arsenic, lead) and non-munitions related (e.g., pesticides and solvents). This finding indicates that munitions related chemicals should not be the sole focus of efforts to identify, assess, and manage ECs on ranges. It was noteworthy that two of the three chemicals for which an environmental response was taken are not related to munitions.

There was a lower than anticipated sixty percent response rate to the survey, comprised of eighteen complete responses, eleven no responses, and two partial responses. The low response rate was unusual given the coordination of the draft survey with the RCC membership, and coordination with the readiness and training community by OADUSD. Some ranges may not have responded due to resource or manpower constraints. However, some ranges, e.g., electronic warfare, may have opted out of the survey because they felt operations at the range were not applicable to survey questions.

The survey identified several of the predominant ECs specific to ranges, with perchlorate, lead, and RDX being identified as most likely to be of concern in the future. Of the ranges surveyed, 55% have one or more federal or state listed species of concern (i.e., threatened or endangered) present on the range and 16% have a unique natural resource (e.g., a sole source aquifer) that prevents a mission activity or system from being used because the activity or system either releases, or may potentially release, ECs into the environment. For those that responded yes, references were given to a source water protection area controlled installation land use policy; a limited use sole source water supply, and a sole source aquifer. In addition, many of the ECs identified by ranges are also of concern for other DoD program activities (e.g., cleanup program, acquisition/RDT&E programs, operations and maintenance activities).

Next steps should include further data analysis of the source terms to better understand the types of chemicals being released and the identification of possible RMO to minimize the release and/or migration of ECs on ranges. DoD policy on responding to releases of ECs on ranges needs to be clarified and communicated, especially policy on programming and budgeting actions. The clarifications should provide clear guidance with regard to the analysis and selection of RMOs, including but not limited to actions to minimize the release, migration, and exposure to ECs. The responses indicate that range managers anticipate that ECs will continue to play an important role in influencing how ranges are managed both now and in the future.

Appendix A

Survey Task Memo

Appendix B

Survey Questions

The survey was conducted on-line using a web-based survey tool developed by Noblis and hosted on a Noblis server. The questions were displayed in hypertext markup language (HTML) in a .net environment. The survey data were collected in a Microsoft Access database. Questions with yes/no responses were collected using radial dial buttons and other questions were collected in text boxes. For questions related to specific chemicals, a chemical abstract service (CAS) registry number was requested to ensure that the correct chemical was being identified. In addition the questions presented below, data were collected on the activities performed at the range, the primary purpose of the range, the person completing the survey, and the role of the person at the range. The survey was username and password protected.

Question 1.a.

Have state or federal regulators responsible for environmental oversight of your installation discussed or required sampling for emerging chemicals (i.e., those for which there are not clearly defined environmental standards or the standards are evolving)?

Question 1.b.

If yes, please list these chemicals and provide a chemical abstracts service registry number if known.

Question 2.a

Have any of the emerging contaminants you listed in Item 1 forced environmental response actions or limited your operational ability under any state or federal environmental laws (e.g., Resource Conservation and Recovery Act, Safe Drinking Water Act, Clean Water Act, Clean Air Act, National Environmental Policy Act, Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA])?

Question 2.b.

If yes, what are the specific activities and/or systems that were the likely source(s) of the release of emerging contaminants on your installation?

Question 2.c.

If yes, what was the specific legal authority under which a response action was required?

Question 2.d.

If yes, please list these chemicals and provide a chemical abstracts service registry number if known.

Question 3.a.

What are the types of human receptors (now or in the future) who are or could be exposed to ECs on or off your installation?

Question 3.b.

Describe the complete (or potentially complete) exposure pathways for these human receptors.

Question 4.a.

What are the types of ecological (plant or animal) receptors (now or in the future) that are or could be exposed to the emerging contaminants at your installation?

Question 4.b.

Describe the complete (or potentially complete) exposure pathways for these ecological receptors.

Question 4.c.

With respect to specific ecological receptors exposed to ECs, are any of these ecological receptors a species of special concern under federal or state law (e.g., a listed endangered species)?

Question 5.

Are there unique natural resources (e.g., a sole source aquifer) at your installation that prevent a training activity or system from being on your range because the activity or system either releases or may potentially release emerging contaminants into the environment? If yes, please list and describe the resource.

Question 6.

Looking into the future (5 to 10 year timeframe), what would you rank as your top five chemical-specific emerging contaminants of concern? These can be long-standing contaminants under

increasing scrutiny, new constituents from new technologies, or new contaminants because of new categories of users.

Question 7.

Are there any emerging contaminants policy or procedure issues unresolved or of concern? If yes, please describe.

Question 8.

Any additional comments on emerging contaminants as they relate to your installation mission that you would like to make?

Question 9.

The Office of the Deputy Under Secretary of Defense (Installations and Environment) developed a list of emerging contaminants based on input from various groups. Would any of the chemicals listed be expected to be found on your range(s) (e.g., a constituent of munitions used)? Have any of the emerging contaminants been detected at your range? Answer as appropriate below for all chemicals listed.

Chemical	CAS	Expected	Sampled	Detected
Chromium VI	18540-29-9			
Cyclotrimethylenetrinitramine (RDX)	121-82-4			
Naphthalene	91-20-3			
Perchlorate	14797-73-0			
Trichloroethylene (TCE)	79-01-6			
1,2,3-trichloropropane (1,2,3-TCP)	96-18-4			
1,4-Dioxane (1,4-Diethyleneoxide)	123-91-1			
Beryllium	7440-41-7			
Dichlorobenzene ¹	25321-22-6			
Dinitrotoluene (DNT) ²	25321-14-6			
Dioxins	--			
Lead compounds	7439-92-1			
Nanomaterials	--			
Nickel	7440-02-0			
N-Nitrosodimethylamine (NDMA)	62-75-9			
Perfluorooctanoic acid (PFOA)	335-67-1			
Polybrominated diphenyl ethers (PBDE)	--			
Tetrachloroethylene	127-18-4			
Tungsten	7440-33-7			

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Glossary

AL	Action List
OADUSD	Office of the Assistant Deputy Under Secretary of Defense
C2W	Command and Control Warfare
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DoD	Department of Defense
EC	Emerging Contaminant
EOD	Explosive Ordnance Disposal
ESA	Ethane Sulfonic Acid
MOUT	Military Operations in Urban Terrain
NEPA	National Environmental Policy Act
NTC	National Training Center
OB/OD	Open Burn Open Detonation
OA	Oxanilic Acid
OADUSD	Office of the Assistant Deputy Under Secretary of Defense
PCE	Tetrachloroethylene
POTW	Publicly Owned Treatment Works
ppb	Parts Per Billion
ppt	Parts Per Trillion
RCA	Range Condition Assessment
RCC	Range Commanders' Council
RDT&E	Research, Development, Testing, & Evaluation
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RCRA	Resource Conservation Recovery Act
RMO	Risk Management Option(s)
SDWA	Safe Drinking Water Act
TCE	Trichloroethylene
TNT	2,4,6-trinitrotoluene
UXO	Unexploded Ordnance
WL	Watch List