Marine Corps Installations Command

FINAL

Range Environmental Vulnerability Assessment

5-Year Review
Marine Corps Air Station and Marine Corps Base Camp Pendleton

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Appendix A

Screening Level Analysis Parameters

Table A-1: Climate Data used in the CalTOX Model

Data Type	Value	Reference(s)
Annual Average Precipitation (in/yr)	13.5	MCB Camp Pendleton, 2011a and National Climatic Data Center
Recharge Rate for SW transport (% ppt)[a]	2	Assumption
Annual Average Wind Speed (mph)	5.9	National Climatic Data Center
Annual Average Ambient Environmental Temperature (^{0}F)	63	NOAA, 2008

Note:

in/yr = inches per year

% ppt = percent precipitation

mph = miles per hour

^{0}F = degrees Fahrenheit

[a] Low recharge rate assumed to account for discharge of shallow groundwater back into ephemeral streams thorough lateral flows on top of the bedrock intrusives/aquitards within and downstream of the MC loading areas

Table A-2: Soil Types and Hydrologic Properties at Identified MC Loading Areas

MC Loading Area	Land Cover[a]	Slope (%)[b]	Predominant Soil Type Name and Map Symbol[c]	Soil Description[c]	Soil Water Content	Soil Air Content	Hydrologic Soil Group[c]	Soil Organic Carbon Content (%)[c]	Soil Bulk Density (kg/m^3)[c]	Runoff Coefficient[e]
Kilo 2 Combat Town	Developed, unvegetated	3.4	Fallbrook sandy loam (FaD2) & Diablo clay (DaE)	Sandy loam, loam, clay loam, clay, silty clay loam and weathered bedrock	0.3	0.12	D	0.4	1425	0.52
LFAM 706	Grass land/scrub/chaparral, some forest and few unvegetated areas	7.5	Rough broken land (RuG) & Olivenhain cobbly loam (OhC)	Unweathered bedrock, cobbly loam and very cobbly clay loam	0.34	0.05	D	0.3	1450	0.45
PDL Combat Town	Grass land/scrub/chaparral with some unvegetated areas	0.3	Visalia sandy loam (VaB) & Steep gullied land (StG)	Sandy loam and fine sandy loam	0.24	0.18	B	0.6	1500	0.33
Quebec Impact	Grass land/scrub/chaparral with some unvegetated areas	5.5	Gaviota fine sandy loam (GaF)	Fine sandy loam and unweathered bedrock	0.25	0.14	D	0.4	1555	0.47
Range 104B	Grass land/scrub/chaparral with some unvegetated areas	0.6	Visalia sandy loam (VaC)	Sandy loam and fine sandy loam	0.24	0.18	B	0.6	1500	0.34
Range 108 Demo	Grass land/scrub/chaparral with some unvegetated areas	5.1	Gaviota fine sandy loam (GaF)	Fine sandy loam and unweathered bedrock	0.25	0.14	D	0.4	1555	0.46
Range 109	Grass land/scrub/chaparral with some unvegetated areas	7	Gaviota fine sandy loam (GaF)	Fine sandy loam and unweathered bedrock	0.25	0.14	D	0.4	1555	0.49
Range 201	Grass land/scrub/chaparral with spots unvegetated areas	3.9	Gaviota fine sandy loam (GaF)	Fine sandy loam and unweathered bedrock	0.25	0.14	D	0.4	1555	0.44
Range 202	Unvegetated	7	Linne clay loam (LeE)	Loamy fine sand, clay, sandy clay, loamy coarse sand and weathered bedrock	0.25	0.15	D	0.3	1500	0.57
Range 203	Grass land/scrub/chaparral, some forest and very few spots unvegetated areas	7.6	Gaviota fine sandy loam (GaF)	Fine sandy loam and unweathered bedrock	0.25	0.14	D	0.4	1555	0.49
Range 204B	Grass land/scrub/chaparral, some forest and very few spots unvegetated areas	5.6	Las Flores loamy fine sand (LeD) & Gaviota fine sandy loam (GaF)	Loamy fine sand, clay, sandy clay, loamy coarse sand, fine sandy loam and weathered/ unweathered bedrock	0.25	0.14	D	0.4	1528	0.46
Range 207	Sparsely vegetated with grass land/scrub/chaparral	7	Stony land (SvE)	Unweathered bedrock	0.12	0.24	A	0.4	1487	0.46
Range 208C	Grass land/scrub/chaparral, some forest and few unvegetated areas	8.3	Las Flores loamy fine sand (LeE2) & Terrace escarpments (TeF)	Loamy fine sand, clay, sandy clay, loamy coarse sand, weathered bedrock	0.28	0.11	D	0.3	1500	0.49
Range 210D	Grass land/scrub/chaparral with spots of unvegetated areas	4.7	Altamont clay (AtC, AtE)	Clay, clay loam and weathered bedrock	0.38	0.04	D	0.6	1350	0.47

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MC Loading Area	Land Cover[a]	Slope (%)[b]	Predominant Soil Type Name and Map Symbol[c]	Soil Description[c]	Soil Water Content	Soil Air Content	Hydrologic Soil Group[c]	Soil Organic Carbon Content (%)[c]	Soil Bulk Density (kg/m^3)[c]	Runoff Coefficient[e]
Ranges 210E/210F	Grass land/scrub/chaparral and some forest	5.2	Altamont clay (Atc), Las Flores loamy fine sand (LeD2, LeC)	Clay, clay loam, loamy coarse sand, and weathered bedrock	0.3	0.11	D	0.4	1450	0.43
Range 211	Grass land/scrub/chaparral and forest with some unvegetated areas	8.5	Terrace escarpments (TeF)	Variable	0.3	0.1	D[d]	0.4	1487	0.51
Range 215A	Grass land/scrub/chaparral with very few unvegetated areas	5.4	Las Flores loamy fine sand (LeE , LeD)	Loamy fine sand, clay, sandy clay and weathered bedrock	0.32	0.08	D	0.3	1500	0.46
Range 216 House	Sparsely vegetated with Grass land/scrub/chaparral	2.4	Las Flores loamy fine sand (LeE)	Loamy fine sand, clay, sandy clay and weathered bedrock	0.32	0.08	D	0.3	1500	0.49
Ranges 217/219	Grass land/scrub/chaparral, some forest and spots of unvegetated areas	5	Cieneba very rocky coarse sandy loam (CMrG) & Altamont clay (AtD)	Coarse sandy loam, weathered/ unweathered bedrock, clay and clay loam	0.3	0.11	D	0.5	1450	0.46
Range 218A	Grass land/scrub/chaparral, some forest with very few unvegetated areas	5.9	Huerhuero loam (HrD) & Altamont clay (AtD)	Loam, clay, clay loam, stratified sand to sandy loam	0.34	0.07	D	0.4	1400	0.47
Ranges 221/222	Grass land/scrub/chaparral with some unvegetated areas	7.5	Rough broken land (RuG) & Cieneba very rocky coarse sandy loam (CmRG)	Weathered/ unweathered bedrock and coarse sandy loam	0.22	0.17	D	0.4	1550	0.49
Range 223B	Sparsely vegetated with grass land/scrub/chaparral	3.3	Las Flores loamy fine sand (LeC)	Loamy fine sand, clay, sandy clay, loamy coarse sand and weathered bedrock	0.28	0.14	D	0.3	1500	0.5
Range 227	Grass land/scrub/chaparral with very few spots of unvegetated areas	4.3	Salinas clay loam (SbC) & Las Flores loamy fine sand (LeC)	Clay loam, clay and loam, sand, sandy clay, loamy coarse sand and weathered bedrock	0.27	0.14	D	0.4	1475	0.44
Range 301	Sparsely vegetated with grass land/scrub/chaparral	7.7	Steep gullied land (StG)	Variable	0.3	0.1	D[d]	0.4	1487	0.56
Range 307	Sparsely vegetated with grass land/scrub/chaparral	7.8	Altamont clay (AtE)	Clay, clay loam and weathered bedrock	0.38	0.04	D	0.6	1350	0.5
Range 314 Complex	Grass land/scrub/chaparral with few unvegetated areas	5.9	Carlsbad gravelly loamy sand (CbC) & Olivenhain cobbly loam (OhE)	Gravelly loamy sand, cobbly loam and very cobbly clay loam	0.26	0.13	D	0.3	1550	0.46
Range 407 Complex	Grass land/scrub/chaparral, some forest and very few spots of unvegetated areas	2.2	Las Flores loamy fine sand (LeC, LeE3)	Loamy fine sand, clay, sandy clay and weathered bedrock	0.32	0.08	D	0.3	1500	0.4
Range 408	Forested, some grass land/scrub/chaparral and a few spots of unvegetated areas	5.9	Fallbrook rocky sandy loam (FeE2) & Cieneba very rocky coarse sandy loam (CmE2)	Sandy loam, loam, clay loam, weathered/ unweathered bedrock	0.3	0.1	D	0.4	1525	0.46

Table A-2: Soil Types and Hydrologic Properties at Identified MC Loading Areas

MC Loading Area	Land Cover[a]	Slope (%)[b]	Predominant Soil Type Name and Map Symbol[c]	Soil Description[c]	Soil Water Content	Soil Air Content	Hydrologic Soil Group[c]	Soil Organic Carbon Content (%)[c]	Soil Bulk Density (kg/m^3)[c]	Runoff Coefficient[e]
Range 409A	Grass land/scrub/chaparral, some forest and some minor unvegetated areas	0.8	Fallbrook rocky sandy loam (FeE2), Fallbrook sandy loam (FaC2, FaB)	Sandy loam, loam, clay loam and weathered bedrock	0.3	0.11	C	0.3	1500	0.36
Range 600	Grass land/scrub/chaparral, some forest with very few unvegetated areas	19.7	Cieneba very rocky coarse sandy loam (CMrG) & Fallbrook rocky sandy loam (FeE2)	Coarse sandy loam, weathered/ unweathered bedrock, sandy loam and loam	0.22	0.17	D	0.4	1525	0.55
Whiskey Impact	Grass land/scrub/chaparral with very few unvegetated areas	12.5	Cieneba very rocky coarse sandy loam (CMrG) & Fallbrook rocky sandy loam (FeE2)	Coarse sandy loam, weathered/ unweathered bedrock, sandy loam and loam	0.22	0.17	D	0.4	1525	0.53
Zulu Impact	Grass land/scrub/chaparral, some forest and some unvegetated areas	6.8	Las Flores loamy fine sand (LeC), Cieneba very rocky coarse sandy loam (CMe2) & Fallbrook rocky sandy loam (FeE2)	Loamy fine sand, clay, sandy clay, weathered/ unweathered bedrock and coarse sandy loam	0.32	0.08	D	0.3	1517	0.48

Note:
kg/m^3 = kilograms per cubic meter

[a] GIS data (MCB Camp Pendleton, 2011c)
[b] Based on elevation contour data (MCB Camp Pendleton, 2011c)
[c] USDA NRCS, 2007
[d] Unknown parameter, conservatively assumed
[e] Caltrans, 2006

Table A-3: Parameter Values used to Estimate Soil Erosion

MC Loading Area/Watershed Area	Area (m^2)	R[a]	K[b]	LS[c]	C[d]	P[e]	A ($kg/m^2/d$)
MC Loading Areas							
Kilo 2 Combat Town	51,438	35	0.28	0.59	0.86	1	3.41E-03
LFAM 706	721,341	35	0.32	1.8	0.14	1	1.91E-03
PDL Combat Town	10,945	35	0.2	0.11	0.19	1	9.79E-05
Quebec Impact	199,870	35	0.32	1.2	0.19	1	1.75E-03
Range 104B	993	35	0.2	0.14	0.19	1	1.23E-04
Range 108 Demo	54,756	35	0.32	1.1	0.19	1	1.61E-03
Range 109	2,922	35	0.32	1.7	0.19	1	2.42E-03
Range 201	69,428	35	0.32	0.68	0.15	1	7.88E-04
Range 202	3,223	35	0.37	1.7	0.5	1	7.37E-03
Range 203	211,832	35	0.32	1.8	0.13	1	1.90E-03
Range 204B	69,542	35	0.37	1.2	0.13	1	1.47E-03
Range 207	3,935	35	0.37	1.7	0.48	1	7.12E-03
Range 208C	164,287	35	0.37	2.1	0.14	1	2.53E-03
Range 210D	84,743	35	0.2	0.84	0.15	1	6.06E-04
Ranges 210E/210F	436,078	35	0.37	1.1	0.01	1	9.98E-05
Range 211	9,498	35	0.37	2.2	0.25	1	4.79E-03
Range 215A	436,239	35	0.37	1.2	0.05	1	4.73E-04
Range 216 House	495	35	0.37	0.36	0.48	1	1.53E-03
Ranges 217/219	627,869	35	0.24	1.1	0.21	1	1.30E-03
Range 218A	351,495	35	0.37	1.3	0.09	1	1.11E-03
Ranges 221/222	1,158,893	35	0.24	1.8	0.19	1	1.98E-03
Range 223B	71,694	35	0.37	0.57	0.48	1	2.43E-03
Range 227	364,985	35	0.37	0.75	0.08	1	5.33E-04
Range 301	436	35	0.37	1.9	0.48	1	8.07E-03
Range 307	3,816	35	0.2	1.9	0.48	1	4.44E-03
Range 314 Complex	437,045	35	0.32	1.3	0.09	1	9.63E-04
Range 407 Complex	1,065,353	35	0.37	0.33	0.13	1	3.92E-04
Range 408	1,452,696	35	0.28	1.3	0.19	1	1.68E-03
Range 409A	1,062,149	35	0.28	0.15	0.13	1	1.34E-04
Range 600	2,941,964	35	0.28	8.2	0.09	1	5.24E-03
Whiskey Impact	5,214,386	35	0.28	3.9	0.05	1	1.18E-03
Zulu Impact	6,207,289	35	0.37	1.6	0.25	1	3.51E-03
Watershed Area of Streams Recharging Groundwater Basins							
Las Pulgas Canyon	5.07E+07	35	0.28	2.17	0.43	1	6.28E-03
Piedra de Lumbre Canyon	1.44E+07	35	0.26	1.77	0.36	1	3.87E-03
Santa Margarita River	3.06E+08	35	0.24	2.42	0.36	1	4.96E-03
San Mateo Creek	3.33E+08	35	0.32	2.67	0.28	1	5.76E-03
San Onofre Creek	1.04E+08	35	0.24	2.7	0.43	1	6.88E+05
Trib. of Santa Margrita River[f]	6.63E+06	35	0.3	0.86	0.43	1	2.67E-03
Trib. of Santa Margrita River[g]	5.08E+06	35	0.22	2.41	0.33	1	4.15E-03

Note:

Table A-3: Parameter Values used to Estimate Soil Erosion

A = predicted soil loss
C = cover and management factor
K = soil erodibility factor
$kg/m^2/d$=
LS = topographic factor (influence of length and steepness of slope)
P = erosion control practice factor
R = rainfall and runoff factor

[a] Brady, 1984
[b] USDA NRCS, 2007
[c] Slope length and gradient were used to select LS (USDA ARS, 1997).
[d] Estimated based on vegetation cover (USDA ARS, 1997)
[e] Factor selected based on conservative assumption
[f] Tributary of Santa Margarita River at the middle Santa Margarita groundwater basin
[g] Tributary of Santa Margarita River at the lower section of the middle Santa Margarita groundwater basin

Table A-4: Chemical Properties of TNT

Installation name:	MCB Camp Pendleton
Date:	July, 2011
Munitions Constituent:	TNT

Row	Data Type	Description	Source Type	Rationale	Reference(s)	Value/Result		Units	Necessary Actions / Data Gaps
1	Molecular weight	Molecular weight of TNT			Walsh et al., 1995		227.1	g/mol	
2	Solubility	Water solubility of TNT			Walsh et al., 1995	Minimum:		mol/m^3	
						Average:	5.72E-01		
						Maximum:			
3	Vapor pressure	Vapor pressure of TNT			Walsh et al., 1995	Minimum:		Pa	
						Average:	1.47E-04		
						Maximum:			
4	Henry's law constant	Henry's law constant of TNT			HQMC, 2009	Minimum:		atm-m^3/mol	
						Average:	1.10E-08		
						Maximum:			
5	Kow	Octanol-water partition coefficient for TNT			HQMC, 2009	Minimum:		unitless	
						Average:	72.4		
						Maximum:			
6	Koc	Organic carbon partition coefficient for TNT			HQMC, 2009	Minimum:		mL/g	
						Average:	525		
						Maximum:			
7	K_D	Equilibrium distribution coefficient		Values presented in Table D-8		Minimum:		mL/g	
						Average:			
						Maximum:			
8	Diffusion coefficient in air	Diffusion coefficient of TNT in air			HQMC, 2009	Minimum:		cm^2/sec	
						Average:	6.40E-02		
						Maximum:			
9	Diffusion coefficient in water	Diffusion coefficient of TNT in water			HQMC, 2009	Minimum:		cm^2/sec	
						Average:	6.71E-06		
						Maximum:			
10	Half-life in soil	Reaction half-life of TNT in soil		A representative value selected by subjuect matter expert based on a compilation of academic, industrial and government references	HQMC, 2009	Minimum:		days	
						Most likey:	23.1		
						Maximum:			

Table A-5: Chemical Properties of HMX

Installation name:	MCB Camp Pendleton
Date:	July, 2011
Munitions Constituent:	HMX

Row	Data Type	Description	Source Type	Rationale	Reference(s)	Value/Result		Units	Necessary Actions / Data Gaps
1	Source-term to ground surface soil	Yearly load to soil per unit MC loading area (from MC loading analysis)				Minimum:	3.26E-09	Kg/m^2	
						Average:			
						Maximum:	4.89E-09		
2	Molecular weight	Molecular weight of HMX			Walsh et al., 1995		296.2	g/mol	
3	Solubility	Water solubility of HMX			Walsh et al., 1995	Minimum:		mol/m^3	
						Average:	1.69E-02		
						Maximum:			
4	Vapor pressure	Vapor pressure of HMX			Walsh et al., 1995	Minimum:		Pa	
						Average:	4.40E-12		
						Maximum:			
5	Henry's law constant	Henry's law constant of HMX			HQMC, 2009	Minimum:		$atm\text{-}m^3/mol$	
						Average:	2.63E-15		
						Maximum:			
6	Kow	Octanol-water partition coefficient for HMX			HQMC, 2009	Minimum:		unitless	
						Average:	1.15		
						Maximum:			
7	Koc	Organic carbon partition coefficient for HMX			HQMC, 2009	Minimum:		mL/g	
						Average:	3.47		
						Maximum:			
8	K_D	Equilibrium distribution coefficient		Values presented in Table D-8		Minimum:		mL/g	
						Average:			
						Maximum:			
9	Diffusion coefficient in air	Diffusion coefficient of HMX in air			HQMC, 2009	Minimum:		cm^2/sec	
						Average:	6.30E-02		
						Maximum:			
10	Diffusion coefficient in water	Diffusion coefficient of HMX in water			HQMC, 2009	Minimum:		cm^2/sec	
						Average:	6.02E-06		
						Maximum:			
11	Half-life in soil	Reaction half-life of HMX in soil		A representative value selected by subjuect matter expert based on a compilation of academic, industrial and government references	HQMC, 2009	Minimum:		days	
						Most likely:	51.3		
						Maximum:			

Table A-6: Chemical Properties of RDX

Installation name:	MCB Camp Pendleton
Date:	July, 2011
Munitions Constituent:	RDX

Row	Data Type	Description	Source Type	Rationale	Reference(s)	Value/Result		Units	Necessary Actions / Data Gaps
1	Source-term to ground surface soil	Yearly load to soil per unit MC loading area (from MC loading analysis)				Minimum:	2.12E-07	Kg/m^2	
						Average:			
						Maximum:	3.18E-07		
2	Molecular weight	Molecular weight of RDX			Walsh et al., 1995		222.1	g/mol	
3	Solubility	Water solubility of RDX			Walsh et al., 1995	Minimum:		mol/m^3	
						Average:	1.90E-01		
						Maximum:			
4	Vapor pressure	Vapor pressure of RDX			Walsh et al., 1995	Minimum:		Pa	
						Average:	5.47E-07		
						Maximum:			
5	Henry's law constant	Henry's law constant of RDX			HQMC, 2009	Minimum:		$atm\text{-}m^3/mol$	
						Average:	1.20E-05		
						Maximum:			
6	Kow	Octanol-water partition coefficient for RDX			HQMC, 2009	Minimum:		unitless	
						Average:	6.45		
						Maximum:			
7	Koc	Organic carbon partition coefficient for RDX			HQMC, 2009	Minimum:		mL/g	
						Average:	7.76E+00		
						Maximum:			
8	K_D	Equilibrium distribution coefficient		Values presented in Table D-8		Minimum:		mL/g	
						Average:			
						Maximum:			
9	Diffusion coefficient in air	Diffusion coefficient of RDX in air			HQMC, 2009	Minimum:		cm^2/sec	
						Average:	7.40E-02		
						Maximum:			
10	Diffusion coefficient in water	Diffusion coefficient of RDX in water			HQMC, 2009	Minimum:		cm^2/sec	
						Average:	7.15E-06		
						Maximum:			
11	Half-life in soil	Reaction half-life of RDX in soil		A representative value selected by subjuect matter expert based on a compilation of academic, industrial and government references	HQMC, 2009	Minimum:		days	
						Average:	14.2		
						Maximum:			

Table A-7: Chemical Properties of Perchlorate

Installation name:	MCB Camp Pendleton
Date:	July, 2011
Munitions Constituent:	Perchlorate

Row	Data Type	Description	Source Type	Rationale	Reference(s)	Value/Result		Units	Necessary Actions / Data Gaps
1	Source-term to ground surface soil	Yearly load to soil per unit MC loading area (from MC loading analysis)				Minimum:	1.42E-09	Kg/m^2	
						Average:			
						Maximum:	2.13E-09		
2	Molecular weight	Molecular weight of perchlorate			Walsh et al., 1995		99.45	g/mol	
3	Solubility	Water solubility of perchlorate			Walsh et al., 1995	Minimum:		mol/m^3	
						Average:	2.01E+03		
						Maximum:			
4	Vapor pressure	Vapor pressure of perchlorate			Walsh et al., 1995	Minimum:		Pa	
						Average:	3.75E-09		
						Maximum:			
5	Henry's law constant	Henry's law constant of perchlorate		No reported values available; Estmated by CalTOX from vapor pressure and solubility values		Minimum:		atm-m^3/mol	
						Most Likely:	1.85E-17		
						Maximum:			
6	Kow	Octanol-water partition coefficient for Perchlorate			Walsh et al., 1995 Meylan and Howard, 1995	Minimum:		unitless	
						Average:	1.40E-06		
						Maximum:			
7	Koc	Organic carbon partition coefficient for Perchlorate		Estimated by the CalTOX model based on the Kow for perchlorate		Minimum:		mL/g	
						Average:	6.94E-07		
						Maximum:			
8	K_D	Equilibrium distribution coefficient		Values presented in Table D-8		Minimum:		L/Kg	
						Average:			
						Maximum:			
9	Diffusion coefficient in air	Diffusion coefficient of perchlorate in air		No reported values available, input variables used are based on conservative assumptions		Minimum:		cm^2/sec	
						Average:	7.00E-10		
						Maximum:			
10	Diffusion coefficient in water	Reaction half-life of perchlorate in water		No reported values available, input variables used are based on conservative assumptions		Minimum:		cm^2/sec	
						Average:	1.90E-12		
						Maximum:			
11	Half-life in soil	Reaction half-life of perchlorate in soil		No reported values available, input variables used are based on conservative assumptions		Minimum:		days	
						Average:	1.00E+07		
						Maximum:			

Table A-8: MC Equilibrium Distribution Coefficient Values at MC Loading Areas

MC Loading Area	Soil Organic Carbon Content (%)	MC	Koc (ml/g)	K_D (ml/g)[a]
Kilo 2 Combat Town	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
LFAM 706	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.08E-07
PDL Combat Town	0.6	HMX	3.47	2.082
		RDX	7.76	4.656
		TNT	525	315
		Perhlorate	6.94E-07	4.16E-07
Quebec Impact	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.78E-07
Range 104B	0.6	HMX	3.47	2.082
		RDX	7.76	4.656
		TNT	525	315
		Perhlorate	6.94E-07	4.164E-07
Range 108 Demo	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 109	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 201	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 202	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Range 203	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 204B	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 207	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 208C	0.3	HMX	3.47	1.041
		RDX	7.76	2.328

Table A-8: MC Equilibrium Distribution Coefficient Values at MC Loading Areas

MC Loading Area	Soil Organic Carbon Content (%)	MC	Koc (ml/g)	K_D (ml/g)[a]
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Range 210D	0.6	HMX	3.47	2.082
		RDX	7.76	4.656
		TNT	525	315
		Perhlorate	6.94E-07	4.164E-07
Ranges 210E/210F	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 211	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 215A	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Range 216 House	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Ranges 217/219	0.5	HMX	3.47	1.735
		RDX	7.76	3.88
		TNT	525	262.5
		Perhlorate	6.94E-07	3.47E-07
Range 218A	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Ranges 221/222	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 223B	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Range 227	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 301	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 307	0.6	HMX	3.47	2.082
		RDX	7.76	4.656
		TNT	525	315
		Perhlorate	6.94E-07	4.164E-07

Table A-8: MC Equilibrium Distribution Coefficient Values at MC Loading Areas

MC Loading Area	Soil Organic Carbon Content (%)	MC	Koc (ml/g)	K_D (ml/g)[a]
Range 314 Complex	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Range 407 Complex	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Range 408	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Range 409A	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07
Range 600	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Whiskey Impact	0.4	HMX	3.47	1.388
		RDX	7.76	3.104
		TNT	525	210
		Perhlorate	6.94E-07	2.776E-07
Zulu Impact	0.3	HMX	3.47	1.041
		RDX	7.76	2.328
		TNT	525	157.5
		Perhlorate	6.94E-07	2.082E-07

Note:

[a] Evaluated from the product of organic carbon partition coefficient and soil organic carbon fraction

Table A-9: Groundwater Modeling Parameters - Vadose Zone Properties for Range 104B MC Loading Area

VLEACH Parameters			
1) Polygon Data			
Parameter	**Value**	**Rationale**	**Reference(s)**
Area (feet^2)	10,683		
Vertical Cell Dimension (feet)	0.607		
Number of Cells (-)	35		
Height of Polygon (feet)	21.245	Equivalent to the estimated minimum depth to water table at loading area	Stetson, 2001
2) Soil Parameter			
Parameter	**Value**		
Dry Bulk Density (g/cm^2)	1.500		USDA NRCS, 2007
Effective Porosity (-)	0.32	Estimated based on the vadose zone material	McWhorter and Sundada, 1977
Volumetric Water Content (-)	0.24	Estimated based on the vadose zone material	Fetter, 1998
Soil Organic Carbon Content (-)	0.00600	Estimated from organic content of surface soil	USDA NRCS, 2007
3a) Boundary Condition			
Parameter	**Value**		
Recharge Rate (feet/year)	0.190	Estimated value based on average annual precipitation for MCB Camp pendleton	Stetson, 2001; MCB Camp Pendleton, 2011a
Concentration of HMX in Recharge Water (mg/L)	N/A	Not modeled; Loading negligible	
Concentration of RDX in Recharge Water (mg/L)	1.89E-01	Results from the initial groundwater screening analysis	
Concentration of TNT in Recharge Water (mg/L)	1.22E-01	Results from the initial groundwater screening analysis	
Concentration of Perchlorate in Recharge Water (mg/L)	3.07E-03	Results from the initial groundwater screening analysis	
Upper Boundary Vapor Condition (mg/L)	0		
Lower Boundary Vapor Condition (mg/L)	0		
Upper Cell Number (-)	0		
Lower Cell Number (-)	35		
Initial Contaminant Concentration in Cells (µg/Kg)	0		

Table A-10: Chemical Properties of MC used in the VLEACH Vadose zone Model

CHEMICAL PARAMETER	HMX	RDX	TNT	PERCHLORATE
Organic Carbon Distribution Coefficient (mL/g)	3.47	7.76	525	6.91E-07
Henry's Constant (-)	1.10357E-13	0.000504	4.61569E-07	7.74E-16
Water Solubility (mg/L)	5.00578	42.199	129.9012	199894.5
Free Air Diffusion Coefficient (m^2/day)	0.54432	0.63936	0.55296	1.90E-12
Molecular Weight (g/mol)	296.2	222.1	227.1	99.45

Table A-10: Chemical Properties of MC used in the VLEACH Vadose zone Model

Rationale	Reference(s)
HQMC, 2009	HQMC, 2009
equivalent to the Henry's constant divided by the ideal gas constant multiplied by the ambient temperature	HQMC, 2009
Walsh et al., 1995	Walsh et al., 1995
HQMC, 2009	HQMC, 2009

Table A-11: Saturated Zone Modeling Parameters (San Onofre Groundwater Basin)

Site Name:	MC Loading Areas at MCB Camp Pendleton
Date:	July, 2012
Zone:	Saturated Zone - San Onofre Groundwater Basin

	Row	Data Type	Description	Source Type	Rationale	Reference(s)	Value/Result	Units	Necessary Actions / Data Gaps
Flow, Fate & Transport, Model Parameters	1	Material Type		☐ Literature ☑ Site Data ☐ Assumption		Well logs from installation (MCB Camp Pendleton, 2011c)	Alluvial and San Mateo aquifers consisting of sandy loam, coarse sand and gravel, cobbles, coarse gravel, boulders, clay, shale, fine silty sand		
	Advection								
	2	Groundwater velocity		☐ Literature ☐ Site Data ☐ Assumption					
	OR								
	3	Horizontal Hydraulic Conductivity	Hydraulic Conductivity for Alluvial and San Mateo aquifers consisting of sandy loam, coarse sand and gravel, cobbles, coarse gravel, boulders, clay, shale, fine silty sand	☑ Literature ☑ Site Data ☐ Assumption	Ramge of values from aquifer tests conducted at pump wells in basin	Stetson, 2005	254	ft/d	
	4	Hydraulic Gradient	Slope of the Water Table	☐ Literature ☐ Site Data ☑ Assumption	Estimated from surface slope data	MCB Camp Pendleton, 2011b	0.028	ft/ft	
	5	Effective porosity	Effective porosity of Alluvial and San Mateo aquifers consisting of sandy loam, coarse sand and gravel, cobbles, coarse gravel, boulders, clay, shale, fine silty sand	☑ Literature ☐ Site Data ☑ Assumption	Estimated based on material description	MCB Camp Pendleton, 2011c; McWhorter and Sunada, 1977	0.24	unitless	
	Dispersion								
	6	Longitudinal Dispersion	Dispersion in the direction of flow (horizontally)	☐ Literature ☐ Site Data ☑ Assumption			3	ft	
	7	Ratio of Transverse to Longitudinal Dispersion	Dispersion ratio perpendicular to the direction of flow (horizontally)	☐ Literature ☐ Site Data ☑ Assumption			0.1	ft	
	8	Ratio of Vertical to Longitudinal Dispersion	Dispersion ratio perpendicular to the direction of flow (vertically)	☐ Literature ☐ Site Data ☑ Assumption			0.03	ft	
	Retardation								
	9	Bulk Density	Density of Alluvial and San Mateo aquifers consisting of sandy loam, coarse sand and gravel, cobbles, coarse gravel, boulders, clay, shale, fine silty sand	☑ Literature ☐ Site Data ☑ Assumption	Estimated based on material description	Fetter, 1994; MCB Camp Pendleton, 2011c; McWhorter and Sundada, 1977	1624	Kg/m^3	
	10	foc	Fraction of organic carbon (Alluvial and San Mateo aquifers consisting of sandy loam, coarse sand and gravel, cobbles, coarse gravel, boulders, clay, shale, fine silty sand)	☑ Literature ☐ Site Data ☑ Assumption	The minimum organic content estimated for the soil types at MC loading areas	USDA NRCS, 2007	0.003		
	Model Parameters								
	11	Width of model	Larger than width of plume		Does not affect model result	Malcolm Pirnie, 2009	100	ft	
	12	Length of model	Larger than final length of plume		Distance from recharging stream to neaest well - does not affect model result		1,161	ft	
	13	Source thickness	Saturated thickness of aquifer layer			Stetson, 2005	40	ft	

Notes:
Green highlight = option one for defining the advection term
Blue highlight = option two for defining the advection term
Gray highlight = not applicable

Table A-12: Saturated Zone Modeling Parameters (Las Flores Groundwater Basin)

Site Name:	MC Loading Areas at MCB Camp Pendleton
Date:	July, 2012
Zone:	Saturated Zone - Las Flores Groundwater Basin

	Row	Data Type	Description	Source Type	Rationale	Reference(s)	Value/Result	Units	Necessary Actions / Data Gaps
Flow, Fate & Transport, Model Parameters	1	Material Type		☐ Literature ☑ Site Data ☐ Assumption		Well logs from installation (MCB Camp Pendleton, 2011c)	Alluvial and San Mateo aquifers consisting of clay loam, sand, tight sand, sandy clay, coarse sand, gravel and sand, sany loam, gravel rock, blue shale granite, cobbles, silty clay, clay, sandstone		
	Advection								
	2	Groundwater velocity		☐ Literature ☐ Site Data ☐ Assumption					
	OR								
	3	Horizontal Hydraulic Conductivity	Hydraulic Conductivity for Alluvial and San Mateo aquifers consisting of clay loam, sand, tight sand, sandy clay, coarse sand, gravel and sand, sany loam, gravel rock, blue shale granite, cobbles, silty clay, clay, sandstone	☑ Literature ☑ Site Data ☐ Assumption	Ramge of values from aquifer tests conducted at pump wells in basin	Stetson, 2005; Palmer, 1994	176	ft/d	
	4	Hydraulic Gradient	Slope of the Water Table	☐ Literature ☐ Site Data ☑ Assumption	Estimated from surface slope data	MCB Camp Pendleton, 2011b	0.068	ft/ft	
	5	Effective porosity	Effective porosity of Alluvial and San Mateo aquifers consisting of clay loam, sand, tight sand, sandy clay, coarse sand, gravel and sand, sany loam, gravel rock, blue shale granite, cobbles, silty clay, clay, sandstone	☑ Literature ☐ Site Data ☑ Assumption	Estimated based on material description	MCB Camp Pendleton, 2011c; McWhorter and Sunada, 1977	0.25	unitless	
	Dispersion								
	6	Longitudinal Dispersion	Dispersion in the direction of flow (horizontally)	☐ Literature ☐ Site Data ☑ Assumption			3	ft	
	7	Ratio of Transverse to Longitudinal Dispersion	Dispersion ratio perpendicular to the direction of flow (horizontally)	☐ Literature ☐ Site Data ☑ Assumption			0.1	ft	
	8	Ratio of Vertical to Longitudinal Dispersion	Dispersion ratio perpendicular to the direction of flow (vertically)	☐ Literature ☐ Site Data ☑ Assumption			0.03	ft	
	Retardation								
	9	Bulk Density	Density of Alluvial and San Mateo aquifers consisting of clay loam, sand, tight sand, sandy clay, coarse sand, gravel and sand, sany loam, gravel rock, blue shale granite, cobbles, silty clay, clay, sandstone	☑ Literature ☐ Site Data ☑ Assumption	Estimated based on material description	Fetter, 1994; MCB Camp Pendleton, 2011c; McWhorter and Sundada, 1977	1646	Kg/m^3	
	10	foc	Fraction of organic carbon (Alluvial and San Mateo aquifers consisting of clay loam, sand, tight sand, sandy clay, coarse sand, gravel and sand, sany loam, gravel rock, blue shale granite, cobbles, silty clay, clay, sandstone)	☑ Literature ☐ Site Data ☑ Assumption	The minimum organic content estimated for the soil types at MC loading areas	USDA NRCS, 2007	0.003		
	Model Parameters								
	11	Width of model	Larger than width of plume		Does not affect model result	Malcolm Pirnie, 2009	50	ft	
	12	Length of model	Larger than final length of plume		Distance of recharging stream to closest well		1,056	ft	
	13	Source thickness	Saturated thickness of aquifer layer			Stetson, 2005	30	ft	

Notes:
Green highlight = option one for defining the advection term
Blue highlight = option two for defining the advection term
Gray highlight = not applicable

Table A-13: Saturated Zone Modeling Parameters (Santa Margarita Groundwater Basin from Range 104B MC Loading Area)

Site Name:	Range 104B
Date:	July, 2012
Zone:	Saturated Zone - Santa Margarita Groundwater Basin

	Row	Data Type	Description	Source Type	Rationale	Reference(s)	Value/Result	Units	Necessary Actions / Data Gaps
Flow, Fate & Transport, Model Parameters	1	Material Type		☐ Literature ☑ Site Data ☐ Assumption		Well logs from installation (MCB Camp Pendleton, 2011c)	Alluvial aquifer consisting of muddy quick sand, clay, sand, coarse sand, fine gravel, boulders, sand and gravel, sand with some clay, small cobbles, coarse gravel, hill formation, large rock and conglomerate		
	Advection								
	2	Groundwater velocity		☐ Literature ☐ Site Data ☐ Assumption					
	OR								
	3	Horizontal Hydraulic Conductivity	Hydraulic Conductivity for Alluvial aquifer consisting of muddy quick sand, clay, sand, coarse sand, fine gravel, boulders, sand and gravel, sand with some clay, small cobbles, coarse gravel, hill formation, large rock and conglomerate	☑ Literature ☑ Site Data ☐ Assumption	Ramge of values from aquifer tests conducted at pump wells in basin	Stetson, 2001	323.5	ft/d	
	4	Hydraulic Gradient	Slope of the Water Table	☐ Literature ☐ Site Data ☑ Assumption	Estimated from surface slope data	MCB Camp Pendleton, 2011b	0.0227	ft/ft	
	5	Effective porosity	Effective porosity of Alluvial aquifer consisting of muddy quick sand, clay, sand, coarse sand, fine gravel, boulders, sand and gravel, sand with some clay, small cobbles, coarse gravel, hill formation, large rock and conglomerate	☑ Literature ☐ Site Data ☑ Assumption	Estimated based on material description	MCB Camp Pendleton, 2011c; McWhorter and Sunada, 1977	0.24	unitless	
	Dispersion								
	6	Longitudinal Dispersion	Dispersion in the direction of flow (horizontally)	☐ Literature ☐ Site Data ☑ Assumption			3	ft	
	7	Ratio of Transverse to Longitudinal Dispersion	Dispersion ratio perpendicular to the direction of flow (horizontally)	☐ Literature ☐ Site Data ☑ Assumption			0.1	ft	
	8	Ratio of Vertical to Longitudinal Dispersion	Dispersion ratio perpendicular to the direction of flow (vertically)	☐ Literature ☐ Site Data ☑ Assumption			0.03	ft	
	Retardation								
	9	Bulk Density	Density of Alluvial aquifer consisting of muddy quick sand, clay, sand, coarse sand, fine gravel, boulders, sand and gravel, sand with some clay, small cobbles, coarse gravel, hill formation, large rock and conglomerate	☑ Literature ☐ Site Data ☑ Assumption	Estimated based on material description	Fetter, 1994; MCB Camp Pendleton, 2011c; McWhorter and Sundada, 1977	1610	Kg/m^3	
	10	foc	Fraction of organic carbon (Alluvial aquifer consisting of muddy quick sand, clay, sand, coarse sand, fine gravel, boulders, sand and gravel, sand with some clay, small cobbles, coarse gravel, hill formation, large rock and conglomerate)	☑ Literature ☐ Site Data ☑ Assumption	The minimum organic content estimated for the soil types at MC loading areas	USDA NRCS, 2007	0.003		
	Model Parameters								
	11	Width of model	Larger than width of plume		Does not affect model result		158	ft	
	12	Length of model	Larger than final length of plume		Distance from Range 10B MC Loading area to nearest well		3694	ft	
	13	Source thickness	saturated thickess of aquifer layer			Stetson, 2001	60	ft	

Notes:
Green highlight = option one for defining the advection term
Blue highlight = option two for defining the advection term
Gray highlight = not applicable

Appendix B

Small Arms Range Assessment Protocol Tables

SMALL ARMS RANGE ASSESSMENT

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Introduction 1
Data Collection and Documentation 3
Qualitative Assessment 4
Small Arms Range Assessment Protocol 6
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Best Management Practices for Small Arms Ranges 8

Introduction

The purpose of the Range Environmental Vulnerability Assessment (REVA) is to identify whether there has been a release or there is a substantial threat of a release of munitions constituents (MC) of concern from the operational range or range complex areas to off-range areas. This is accomplished through the use of fate and transport modeling and analysis of the REVA indicator MC based upon site-specific environmental conditions at the operational ranges and training areas at an installation.

Lead is the primary REVA indicator MC for small arms ranges. The fate and transport parameters for lead are based entirely on site-specific geochemical properties, which cannot be determined solely by physical observation. Therefore, small arms ranges associated with the installation are qualitatively reviewed and assessed to identify factors that influence the potential for lead migration at the operational range, including:

- design and layout,
- the physical and chemical characteristics of the area, and
- current and past operation and maintenance practices.

In addition, potential receptors and pathways must be identified relative to the small arms range being assessed. The potential for an identified receptor to be impacted by MC migration through an identified pathway will be evaluated.

MC associated with small arms ammunition commonly used at operational ranges include lead, antimony, copper, and zinc. REVA focuses on lead as the MC indicator for small arms ranges because lead is the most prevalent (by weight) potentially hazardous constituent associated with small arms ammunition. No specific quantitative conclusions can be made regarding the fate and transport of lead since it is unlike any other MC. Lead is geochemically specific regarding its mobility in the environment. Site-specific conditions must be known (i.e., geochemical properties) in order to quantitatively assess lead migration. Site-specific geochemical properties are only identified via sampling and cannot be observed physically. Without site-specific physical and chemical characterization, lead cannot effectively be modeled using fate and transport modeling like the other indicator MC in REVA. The scientific community has established that metallic lead (such as recently fired, unweathered bullets and shot) generally has low chemical reactivity and low solubility in water and is relatively inactive in the environment under most ambient or everyday conditions. However, a portion of lead deposited on a range may become environmentally active if the right combination of conditions exists.

This Small Arms Range Assessment Protocol was developed in lieu of collecting site-specific information for every small arms range. The protocol will help to determine which ranges necessitate data collection of site-specific geochemical properties or further assessment based the range's overall prioritization regarding the potential for an identified receptor to be impacted by potential lead migration through an identified pathway.

Purpose

This protocol is to be used for:

1) Identifying the small arms ranges within the Marine Corps that have the greatest potential for lead migration and impact to identified receptors, and
2) Assessing the need for implementing further actions. Recommended further actions may include, but are not limited to, the following:
    - Sampling surface water, groundwater, and/or soil

- Conducting additional studies
- Implementing best management practices (BMPs)

Data Collection and Documentation

The qualitative assessment process for a small arms range involves first defining and documenting its physical and environmental conditions, as well as how the range is utilized and maintained (including dates of use and types and amounts of small arms ammunition expended). The small arms range data collection form within Section 3 of the REVA Reference Manual is a guide to collecting and documenting the necessary information in order to complete the evaluation forms presented later in this protocol (Tables 1 through 6). It includes a comprehensive list of data elements that are useful in establishing the historical and current physical and environmental conditions, as well as capturing the types of information on conditions that influence lead's potential to migrate from the range. The data collection form is organized by major topics or information areas associated with the operational range, including the following:

- Basic range information
- Current range layout
- Current range operations
- Historical range operations
- Amount of lead potentially deposited
- Environmental characteristics
- Potential receptors
- Surrounding land use
- Environmental activities conducted on the range
- Summary

The data collection form in the REVA Reference Manual can be modified, where needed, to fully capture the major factors that can potentially influence lead's ability to migrate from each specific small arms range.

Qualitative Assessment

The small arms range can be qualitatively assessed once the conditions of the range have been fully understood and documented. The assessment process involves a discussion of possible factors that can influence the potential for lead to migrate off range. Several of these factors are listed below, followed by a detailed discussion:

- Range use and range management (source)
- Surface water conditions
- Groundwater and soil conditions
- Pathways
- Receptors

Range Use and Range Management (Source)

The amount of lead and other MC deposited on a range is a combination of the following factors:

- Duration of use
- Current and historical frequency of range usage
- Amount and types of small arms ammunition expended on the range
- Scope and frequency of any range maintenance activities involving the removal of lead from the range
- Presence and duration of bullet-capturing technologies

Surface Water Conditions

Under specific pH conditions, lead from shot or bullets can slowly dissolve in water. Runoff and groundwater recharge could transport this dissolved lead off range. In addition, lead adsorbed onto sediment can be transported off range in surface runoff. The primary factors influencing the potential for lead to migrate via surface water include, but are not limited to, the following:

- pH of the water
- Duration of water contact with the lead
- Intensity and frequency of rainfall
- Steepness of the slope containing lead

- Amount and type of vegetation on the slope
- Infiltration rate of surface soils
- Presence of engineering controls or BMPs to modify or control surface water runoff

Groundwater and Soil Conditions

The amount of lead that dissolves in water is primarily influenced by the pH of the water and the duration of water contact with the lead. Once lead is dissolved in water, the amount of lead that attaches to the soil and/or enters the groundwater is determined by several factors, including the following:

- Organic carbon content of the soil
- pH of the soil
- Properties of the soil, including porosity, irreducible water content, and hydraulic conductivity
- Amount of recharge percolating through the vadose zone
- Clay content of the soil (lead attaches to clay minerals more than other soil fractions)
- Depth to groundwater

Pathways

The REVA Small Arms Range Assessment Protocol involves developing a conceptual site model (CSM) for the range to identify the range's physical and environmental conditions. The CSM's purpose is to identify if a potential for source-receptor-pathway interaction may exist. Factors that influence the potential for a source-receptor-pathway interaction (e.g., heavy range use, potable water supply wells in proximity to the range), as well as factors that decrease the potential for such interactions, should be discussed in the assessment.

Potential pathways include:

- groundwater used as a source of potable or agricultural water,
- the use of surface water downstream of a range as a source of potable or agricultural water, and

- the use of the soil, surface water, or groundwater by sensitive species.

Receptors

Receptors in REVA can include on-range and off-range personnel and sensitive species and ecosystem areas. Factors considered when assessing the potentially complete exposure pathways for receptors include, but are not limited to, the following:

- The number and proximity of water supply wells relative to the range
- The characteristics of nearby water supply wells (e.g., depth to groundwater, well construction details)
- The uses of the surface water or groundwater (e.g., agriculture, drinking water)
- The locations of nearby sensitive species areas, such as endangered species habitats (i.e., within proximity to the range)

Small Arms Range Assessment Protocol

This Small Arms Range Assessment Protocol is based on evaluating the potential for exposure to receptors by MC. Evaluation rankings for surface water and groundwater conditions are established for each small arms range. The rankings range between high (indicating the highest potentialfor lead to migrate toward identified receptors) and minimal (indicating the lowest potential for lead to migrate toward identified receptors). Possible recommended actions are based on the relative evaluation rankings assigned by the protocol. High rankings necessitate further actions. Further actions may included sampling, additional site-specific studies, and/or BMPs. These actions will be evaluated based on site conditions for each range.

Protocol Instructions

1. For Tables 1 through 5:
   a. Enter the appropriate score for each criteria in the site score column. Use the highest (i.e., most conservative) value if no information is known to complete the score. A designated score may be overridden if it is determined that the value does not adequately represent the site based on site characteristics and constituent loading estimates, , mark the score column appropriately (*) and fill in the notes section at the bottom of the

table with text detailing why the score was adjusted. Sum the site scores in the last row.

2. Transfer the scores from Tables 1 through 5 onto Table 6 in the appropriate rows.
3. Use the scores in Table 6 to determine the surface water and groundwater evaluation rankings.

Evaluation Ranking Designation

Once Table 6 is complete, the protocol finishes with two scores: the sum of surface water elements and the sum of groundwater elements. These scores are used to identify the appropriate evaluation ranking (High, Moderate, Minimal) for surface water and groundwater (as mentioned in step 3 of the protocol instructions).

The surface water evaluation ranking and the groundwater evaluation ranking identify the potential impact for lead migration for each of those pathways at the small arms range. The ranking designations and their descriptions follow:

- High = Small arms range most likely has the potential for lead migration to an identified receptor and requires additional action(s).
- Moderate = Small arms range may have the potential for lead migration to a receptor, most likely indicating that there is no immediate threat to human health and the environment, but actions may be necessary to mitigate future concerns.
- Minimal = Small arms range has minimal or no potential for lead migration, but actions may be necessary to ensure that continuing training activity at the range does not pose a future threat to human health and the environment.

These rankings are used to determine whether additional actions are appropriate. The evaluation ranking (surface water or groundwater), as determined in Table 6, is used to evaluate if further actions are suggested, based on the guidelines for recommended actions (Table 7, provided on Page A-9).

The overall range evaluation rankings should be compared to each range within the installation and to the overall rankings of all ranges across the Marine Corps. These rankings will assist in determining how funding should best be allocated across the Marine Corps to prevent environmental concerns due to small arms ranges.

Assessment Report

Once the Small Arms Range Assessment Protocol has been completed and appropriate actions have been designated and implemented, the assessment should be written into a report that describes the process taken, details the information used to score Tables 1 through 5, outlines the scores and evaluation rankings, and identifies the additional actions taken. The report should detail whether an identified receptor is or is not impacted by lead migration through the identified pathway(s). The completed protocol tables should be included as an appendix to the report.

Best Management Practices for Small Arms Ranges

BMPs are important for all ranges and should be used appropriately to maintain the sustainability of operational ranges. However, this protocol prioritizes which small arms ranges may need BMPs to address specific possibilities of lead migration.

Following the Small Arms Range Assessment Protocol, BMPs may be recommended based on the evaluation ranking. Prior to selecting and implementing BMPs, the management objectives must be established. Depending on the range-specific site conditions and the management objectives, the following BMPs should be considered:

- Bullet and shot containment techniques (e.g., berms, backstops, traps)
- Prevention of soil erosion from berms, aprons, and other range areas
- Soil amendments
- Recovery and/or recycling of lead

Negative impacts of implementation should also be considered when selecting a BMP. For example, using soil amendments may affect water quality of nearby water bodies or modifying surface water runoff may impact nearby habitats.

The prevention of soil erosion can be achieved by implementing one or several of the following practices:

- Maintaining vegetation on berms and drainageways
- Reducing runoff rates by adjusting site drainage patterns

- Providing sediment traps such as a vegetated detention basin or infiltration area
- Preventing the creation of a "point source"

Soil amendments may be an effective BMP by implementing one or both of the following practices:

- Increasing the retentive capacity of soil by adding organic matter, fertilizer, and/or lime
- Maintaining a pH range between 6 and 8 by adding triple superphosphate, bone meal, or other applicable additives

The recovery and recycling of lead from operational ranges should be considered as a way to control the migration of lead. The following should be considered when implementing recovery and recycling practices:

- Focus on safety as the primary concern of the proposed activities
- Avoid practices that appear as treatment activities (e.g. acid leaching, fixation, etc.)
- Dispose lead by using a lead recycler or smelter
- Use residual soil for the original purpose (e.g. berm/target area soil) following lead recovery practices.

Guidelines for Recommended Actions	
Evaluation Ranking	**Recommended Action**
High	Action required. 1) Consider sampling appropriate media (groundwater, surface water, and/or soil). 2) Identify and implement BMPs, if necessary.
Moderate	1) Consider identifying and implementing BMPs, if necessary. 2) Consider sampling appropriate media (groundwater, surface water, and/or soil).
Minimal	1) No further action is needed at this time. 2) Consider identifying and implementing BMPs, if necessary.

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INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Edson Pistol Range

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low and opportunities for surface water transport are limited. However, considerable lead loading is occurring at the Edson Pistol Range and sensitive species have been identified immediately adjacent to the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading occurring at the Edson Pistol Range, there is a lack of potential groundwater receptors. Based on the low potential for lead migration and lack of receptors, the overall groundwater ranking was adjusted to a Minimal score.

MCB Camp Pendleton
Edson Pistol Range

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			13

Notes:

1. The Edson Pistol Range has been in operation since 1990. The Range is currently used as a known distance pistol range for small arms munitions.
2. There are no bullet capturing technologies implemented at the range.
3. The average annual loading rate of lead is 3,255 lb/yr.
4. The earthen berm is resurfaced approximately once every 5 years, though this maintenance does not typically involve significant lead removal.

MCB Camp Pendleton
Edson Pistol Range

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			10

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, the Edson Pistol Range is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate amount of deviation from the horizontal of the berm is 2:1.
4. Overall groundcover between the firing position and the target area consists of asphalt alternating with strips of dirt and grass. The berm is predominantly covered by dry grass and brush. Beyond the backstop berm the vegetation is predominantly grass and brush.
5. The predominant soil type throughout the Edison Pistol Range footprint and beyond the backstop berm is Huerhuero loam. Due to the clay content in these soils, run-off rates are considered to be medium (USDA NRCS, 2007).
6. The range is equipped with a berm and concrete channel that control surface water run-off/run-on. The concrete channel captures water flowing off the berm and directs the water to a discharge point away from the range. Minimal run-on to the range is anticipated from areas beyond the berm due to the top of the berm being graded slightly higher than the surrounding area.

MCB Camp Pendleton
Edson Pistol Range

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in the Aliso watershed. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita alluvial basins which have a depth to groundwater ranging from 3 and 58 feet below ground surface.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range between 7.29 and 7.53 (Stetson, 2008).
4. According to the NRCS Soil Report, the pH of Huerhuero loam ranges from 5.3 to 8.2 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. Huerhuero loam is predominantly composed of clay loams with some sand (USDA NRCS, 2007).

MCB Camp Pendleton
Edson Pistol Range

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. Based on installation GIS data, a designated riparian habitat area overlaps the western edge of the range (MCB Camp Pendleton, 2011b). The INRMP indicates that these habitats may support special status species such as the threatened California gnatcatcher and the endangered arroyo toad (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Edson Pistol Range

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The Edson Pistol Range is not situated in the immediate vicinity of alluvial basins used as source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity the Edson Pistol Range, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Edson Pistol Range

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Surface Water Pathways	2	10
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**36**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**33**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL***

Notes:

*Due to the lack of potential groundwater receptors the groundwater ranking is decreased from Moderate to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Edson Rifle Complex (A, B, C, D)

ASSESSMENT RESULTS:

As Edson Rifle Ranges A, B, C, and D are immediately adjacent to one another and share the same impact berm, the ranges were combined for this SARAP evaluation.

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and opportunities for surface water transport are limited. However, considerable lead loading is occurring at the Edson Rifle Range and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is Moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. Low precipitation contributes to this low groundwater score, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading occurring at the Edson Rifle Range, there is a lack of potential groundwater receptors in this watershed. Given the lack of groundwater receptors, the overall groundwater ranking was adjusted to a Minimal score.

MCB Camp Pendleton
Edson Rifle Complex

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			13

Notes:

1. Based on data collected for the baseline REVA assessment, the Edson Rifle Complex has been operable as a rifle range since 1990.
2. There are no bullet-capturing technologies presently employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead at the four rifle ranges is 42,812 lb/yr. The four rifle ranges at Edson Complex are considered to be among the most used training facilities at MCB Camp Pendleton
4. The range berm is mined for lead once every four years.

MCB Camp Pendleton
Edson Rifle Complex

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			10-12

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, the Edison Rifle Range is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderating score (i.e, 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate amount of deviation from the horizontal of the berm is 2.5:1 to 3:1.
4. Overall groundcover between the firing position and the target area consists of asphalt firing positions alternating with strips of dirt and grass. The berm is predominantly covered by dry grass and brush with large bullet pockets. During the 5-year review site visit, areas beyond the backstop berm had evidence of previous fires, which decreased the vegetation to near zero.
5. The predominant soil type throughout the Edison Rifle Range is Huerhuero loam. Due to the clay content in these soils, run-off rates are assumed to be medium (USDA NRCS, 2007).
6. The rear impact berm is constructed in a manner that reduces surface water run-on across the berm face.

MCB Camp Pendleton
Edson Rifle Complex

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in the Aliso watershed. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita watersheds which have a depth to groundwater ranging from 3 and 58 feet below ground surface.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range between 7.29 and 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the pH of Huerhuero loam ranges from 5.3 to 8.2 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. Huerhuero loam is predominantly composed of clay loams with some sand (USDA NRCS, 2007).

MCB Camp Pendleton
Edson Rifle Complex

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. Based on installation GIS data, a California gnatcatcher habitat is designated approximately 300 feet downstream of Edson Rifle Complex (MCB Camp Pendleton, 2011b). Additionally, the INRMP indicates the presence of riparian habitats further downstream of the range, which may support additional special status species such as the endangered arroyo toad (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Edson Rifle Complex

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The Edson Rifle Complex is not situated in the immediate vicinity of alluvial basins used as a source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity the Edson Rifle Complex, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Edson Rifle Complex

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Surface Water Pathways	2	10-12
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**36-38**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**33**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL***

Notes:

*Due to the lack of potential groundwater receptors the groundwater ranking is decreased from moderate to minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 102 (Wilcox Pistol)

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 102. In addition, sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, low precipitation reduces the potential for lead migration, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. However, there is considerable lead loading and the range is situated over the Santa Margarita alluvial basin used as a source of drinking water for MCB Camp Pendleton. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 102 (Wilcox Pistol)

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 102 (Wilcox Pistol Range) has been operated as a known distance pistol range since February 1, 1961.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the loading calculations conducted for the 5-year review, the average annual loading rate of lead is 15,389 lb/yr.
4. The range berm is periodically raked to remove accumulated lead and rocks that pose a ricochet hazard.

MCB Camp Pendleton
Range 102 (Wilcox Pistol)

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			13-15

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on water quality information collected as part of the Santa Margarita River Hydrologic and Biological Monitoring report, the pH of surface water upstream of Range 102 has a mean pH of 8.2 and a median pH of 8.1 (Stetson, 2008b).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the berm is 2:1.
4. Vegetation within the immediate area of the range consists of brush and grass, but varies in density.
5. The predominant type of soil throughout the range is Visalia sandy loam which is primarily composed of sand, with some clay and silt (USDA NRCS, 2007). Due to the clay content in these soils, run-off rates are anticipated to be medium.
6. The range is not equipped with run-off/run-on controls. According to range personnel, the range is susceptible to flooding during rain events.

MCB Camp Pendleton
Range 102 (Wilcox Pistol)

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			14

Notes:

1. The depth to groundwater in the Santa Margarita alluvial basin ranges from 3 to 58 ft.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of groundwater in the Santa Margarita alluvial basin ranges from 7.23 to 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Visalia sandy loam is 6.5 (USDA NRCS, 2007).
5. Visalia sandy loam is predominately composed of sand and contains some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 102 (Wilcox Pistol)

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Santa Margarita watershed. .
3. Least Bell's vireo habitat and Arroyo Toad habitat have been noted 200 feet downstream of the range. Riparian habitat is also present south of Range 102.

MCB Camp Pendleton
Range 102 (Wilcox Pistol)

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	10
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			12

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 102 is situated over an alluvial basin used as a source of drinking water. Within a one mile radius of Range 102, there are six water wells, four of which are currently used for water production (MCB Camp Pendleton, 2011b). Based on current sampling data from the drinking water system, concentrations of lead do not exceed drinking water standards.
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. Least Bell's vireo habitat has been noted adjacent to the range; however, there are no known springs or other pathways for exposures nearby threatened or endangered species to be exposure to groundwater.

MCB Camp Pendleton
Range 102 (Wilcox Pistol)

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	13-15
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**41-43**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	14
Groundwater Receptors	5	12
Sum of Groundwater Element Scores		**41**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 103 (Wilcox Rifle)

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 103 and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, low precipitation and neutral pH of the groundwater reduce the potential for off-site migration. However, there is considerable lead loading occurring at Range 103 and the range is situated over the Santa Margarita alluvial basin used as a source of drinking water. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 103 (Wilcox Rifle)

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 103 (Wilcox Rifle Range) has been operated as a known distance, weapon familiarization rifle range since 1942.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 25,048 lb/year.
4. The berm at the range is periodically resurfaced to fill in bullet holes, but otherwise receives no regular range maintenance.

MCB Camp Pendleton
Range 103 (Wilcox Rifle)

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			8

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on water quality information collected as part of the Santa Margarita River Hydrologic and Biological Monitoring report, the pH of surface water upstream of Range 103 has a mean pH of 8.2 and a median pH of 8.1 (Stetson, 2008b).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate amount of deviation from the horizontal of the berm is 2:1.
4. Overall vegetation throughout the range footprint is predominately grass, dirt, and low-growing brush.
5. The predominant type of soil throughout the range is Visalia sandy loam which is primarily composed of sand, with some clay and silt (USDA NRCS, 2007). Due to the clay contents of these soils, run-off rates are considered to be medium.
6. The rear impact berm is constructed in a manner that reduces surface water run-on across the berm face.

MCB Camp Pendleton
Range 103 (Wilcox Rifle)

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			14

Notes:

1. The depth to groundwater in the Santa Margarita alluvial basin ranges from 3 to 58 ft.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of groundwater in the Santa Margarita alluvial basin ranges from 7.23 to 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Visalia sandy loam is 6.5 (USDA NRCS, 2007).
5. Visalia sandy loam is predominately composed of sand and contains some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 103 (Wilcox Rifle)

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Santa Margarita watershed.
3. Arroyo toad habitat has been noted on the range, and riparian habitat is present south of Range 103. This riparian habitat could potentially support other threatened or endangered species.

MCB Camp Pendleton
Range 103 (Wilcox Rifle)

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	10
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			12

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 103 is situated over an alluvial basin used as a source of drinking water. Within a one mile radius of Range 103, there are six water wells, four of which are currently used for water production (MCB Camp Pendleton, 2011b). Based on current sampling data from the drinking water system, concentrations of lead do not exceed drinking water standards.
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. Arroyo toad habitat has been noted on the range; however, there are no known springs or other pathways for exposures nearby threatened or endangered species to be exposure to groundwater.

MCB Camp Pendleton
Range 103 (Wilcox Rifle)

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	8
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**36**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	14
Groundwater Receptors	5	12
Sum of Groundwater Element Scores		**41**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 110

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. However, there is considerable lead loading occurring and there are groundwater wells within the same watershed which are used to produce drinking water for the installation. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 110

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 110 has been in operation as a rifle range since 1951. A separate portion of the range accommodated M203 HE use until 2009.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 2,774 lb/yr.
4. There is no regular maintenance for small arms conducted at this range. Recent activities conducted under the operational range clearance (ORC) program did not include removal or cleanup of .50 cal or smaller munitions.

MCB Camp Pendleton
Range 110

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			13

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 110 is situated in the Las Flores watershed. Based on the Final Project Report for the Surface Water Quality Sampling Program, the surface water in the Las Flores watershed had a mean pH of 7.95 and a median pH of 7.99 (Stetson, 2010). During sampling activities conducted as part of the five – year review in September of 2011 and January of 2012, the average pH of surface water collected from within the Las Flores watershed ranged from 7.29 to 7.92.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Training activities at the range fire into a steep hillside (greater than 10 percent slope).
4. The floor of the range has been cleared with just low grasses present. The hillside is predominantly covered by grass. Operations and Training personnel indicated there had been more vegetation prior to activities under the ORC program.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists of fine sand, with some clay and silt (USDA NRCS, 2007). Due to the clay and sand contents of this soil, surface water runoff rates are assumed to medium.
6. Based on the site visit and topographic information, the range is facing a steep hillside. Run-off generated during storm events will flow down the face of the hill and into a natural channel that crosses the range. Stormwater is directed to the western corner of the range where it is anticipated to move as sheet flow off towards Las Flores Creek.

MCB Camp Pendleton
Range 110

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater at the in the Las Flores alluvial basin ranges from 10 to 58 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the Las Flores alluvial basin ranges from 7.29 to 7.34 (Stetson, 2008a). During sampling activities conducted as part of the five – year review in September and October of 2011, the average pH of groundwater collected from within the Las Flores watershed ranged from 6.58 to 7.28.
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from is 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand (USDA NRCS, 2007).

MCB Camp Pendleton
Range 110

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Las Flores watershed.
3. Riparian habitat along Las Flores Creek is located approximately 165 feet northwest of the range (MCB Camp Pendleton, 2011b). Sensitive species that could potentially be supported by this habitat include the least Bell's vireo, the Stephen's kangaroo rat, and the California gnatcatcher (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 110

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 110 is not situated in the immediate vicinity of an alluvial basin used as a source of drinking water. The nearest groundwater production well is located approximately 3.5 miles southwest of the range in the Las Flores alluvial basin. No evidence of lead has been noted in the monitoring of those groundwater wells (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no known springs or other groundwater pathways for exposure to nearby threatened or endangered species within the immediate vicinity of the range.

MCB Camp Pendleton
Range 110

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	13
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**41**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**35**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 111

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 111 and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. However, there is considerable lead loading occurring at Range 111 and there are groundwater wells within the same watershed which are used to produce drinking water for the installation. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 111

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 111 has been in operation since February 1, 1961.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 6,606 lb/yr.
4. There is no regular maintenance conducted at this range.

MCB Camp Pendleton
Range 111

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			8-10

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 111 is situated in the Las Flores watershed. Based on the Final Project Report for the Surface Water Quality Sampling Program, the surface water in the Las Flores watershed had a mean pH of 7.95 and a median pH of 7.99 (Stetson, 2010). During sampling activities conducted as part of the five – year review in September of 2011 and January of 2012, the average pH of surface water collected from within the Las Flores watershed ranged from 7.29 to 7.92.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Training activities at the range fire into a steep hillside (greater than 10 percent slope).
4. Vegetation within the range footprint consists of a mix of dirt and grass. The hillside is predominantly covered by grass.
5. The predominant type of soil throughout the range footprint is Las Flores loamy fine sand (USDA NRCS, 2007). Due to the clay contents in these soils, surface water runoff rates are assumed to be medium.
6. Based on the site visit and topographic information, the range is fires into a hillside. Run-off generated during storm events will flow down the face of the mountain and into a well-defined drainage channel that crosses the range. The channel contains riprap and vegetative cover, which may decrease potential transport via surface water. Run-off is directed to the western corner of the range where it is anticipated to move as sheet flow off towards Las Flores Creek.

MCB Camp Pendleton
Range 111

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater at the in the Las Flores alluvial basin ranges from 10 to 58 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the Las Flores alluvial basin ranges from 7.29 to 7.34 (Stetson, 2008a). During sampling activities conducted as part of the five – year review in September and October of 2011, the average pH of groundwater collected from within the Las Flores watershed ranged from 6.58 to 7.28.
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from is 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand (USDA NRCS, 2007).

MCB Camp Pendleton
Range 111

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Las Flores watershed.
3. Riparian habitat along Las Flores Creek is located approximately 200 feet northwest of the range (MCB Camp Pendleton, 2011b). Sensitive species that could potentially be supported by this habitat include the least Bell's vireo, the Stephen's kangaroo rat, and the California gnatcatcher (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 111

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 111 is not situated in the immediate vicinity of an alluvial basin used as a source of drinking water. The nearest groundwater production well is located approximately 3.1 miles southwest of the range in the Las Flores alluvial basin. No evidence of lead has been noted in the monitoring of those groundwater wells (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no known springs or other groundwater pathways for exposure to nearby threatened or endangered species within the immediate vicinity of the range.

MCB Camp Pendleton
Range 111

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	8-10
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**36-38**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**35**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 112A

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 112A and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, precipitation at MCB Camp Pendleton is low, and the average pH of the groundwater is not conducive to lead dissolution. However, there is considerable lead loading occurring at Range 112A and there are groundwater wells within the same watershed which are used to produce drinking water for the installation. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 112A

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			13

Notes:

1. Range 112A has been in operation as pistol and rifle range since 1998. It is primarily used by visiting SONGS security personnel.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 2,351 lb/yr.
4. There is no regular maintenance conducted at this range.

MCB Camp Pendleton
Range 112A

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			15

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 112A is situated in the Las Flores watershed. Based on the Final Project Report for the Surface Water Quality Sampling Program, the surface water in the Las Flores watershed had a mean pH of 7.95 and a median pH of 7.99 (Stetson, 2010).
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the berm is 1.5:1.
4. The floor of the range footprint consists of strips of concrete and gravel. The impact berm is predominantly composed of sand.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists of fine sand, with some clay and silt (USDA NRCS, 2007). Due to the clay and sand contents of this soil, surface water runoff rates are assumed to medium.
6. Based on the site visit and topographic information, the range is equipped with a berm. Stormwater produced during a rain event would likely flow down the berm, behind the targets, and towards the north side of the range. Water will flow towards the northwest, towards a concrete channel. The channel discharges the surface water onto the access road at the north corner of the range.

MCB Camp Pendleton
Range 112A

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater at the in the Las Flores alluvial basin ranges from 10 to 58 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the Las Flores alluvial basin ranged from 7.29 to 7.34 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from is 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand, which is composed of fine sand with some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 112A

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Las Flores watershed.
3. There is riparian habitat along Las Flores Creek located 200 feet northwest of the range (MCB Camp Pendleton, 2011b). Sensitive species that have been noted in this habitat include the California gnatcatcher, least Bell's vireo, and the Stephen's kangaroo rat (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 112A

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**

Notes:

4. Range 112A is not situated in the immediate vicinity of an alluvial basin used as a source of drinking water. The nearest groundwater production well is located approximately 3.1 miles southwest of the range in the Las Flores alluvial basin. No evidence of lead has been noted in the monitoring of this groundwater well (MCB Camp Pendleton, 2011b).

1. Groundwater is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007).

2. There are no groundwater production wells in the immediate vicinity Range 112A, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 112A

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Surface Water Pathways	2	15
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**41**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**33**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 116A

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and opportunities for surface water transport are limited. However, considerable lead loading is occurring at the Range 116A, and sensitive species habitats have been identified on the range. On the basis of the SARAP, there is a moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Minimal score for this range. As noted, low precipitation reduces the potential for erosion and the neutral groundwater pH is not conducive to lead dissolution. Despite the considerable lead loading occurring at Range 116A, there is a lack of potential groundwater receptors.

MCB Camp Pendleton
Range 116A

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 116A has been operable as a rifle range since 1997 but was constructed in the 1940s.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 1,918 lb/yr.
4. The range berm is resurfaced approximately once every 5 years, but lead is expected to remain on the range since lead removal has not been performed since the 1980's.

MCB Camp Pendleton
Range 116A

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	5
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			12

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 116A is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderate score was assigned to this criterion to account for the potential of pH to drop below 6.5
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the berm is 1.5:1.
4. Groundcover within the range footprint consists primarily of dirt and some low dry brush. Directly next to the range is an intermittent stream with lush vegetative cover.
5. The predominant type of soil throughout the range is Salina clay loam which is primarily composed of clay, with some sand and silt (USDA NRCS, 2007). Due to the high clay content in the soil, surface water runoff rates are considered to be medium.
6. The rear impact berm is constructed in a manner that reduces surface water run-on across the berm face.

MCB Camp Pendleton
Range 116A

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Groundwater Pathway Score			10

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in this watershed. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita alluvial basins which have a depth to groundwater ranging from 3 and 58 feet below ground surface.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range between 7.29 and 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Salina clay loam ranges from is 7.2-8 (USDA NRCS, 2007).
5. The predominant type of soil throughout the range is Salina clay loam which consists primarily of clay, with some sand and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 116A

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. Habitat which potentially supports Stephen's Kangaroo Rat is situated within the range footprint. Riparian habitat is noted approximately 4 miles downstream of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 116A

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**

Notes:

1. Range 116A is not situated near an alluvial basin used as a source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells near Range 116A, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 116A

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	12
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**40**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	10
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**29**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 116B

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and opportunities for surface water transport are limited. However, considerable lead loading is occurring at the Range 116B, and sensitive species have been identified directly adjacent to the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score. As noted, low precipitation reduces the potential for lead migration. Additionally, there is a lack of potential groundwater receptors at this range. However, there is considerable lead loading occurring at Range 116B, and available data regarding average pH of the groundwater suggests low to moderate lead dissolution. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 116B

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 116B has been operable since 1997. However, previous small arms ranges have been present in this location since the 1940s. The range is currently used as a known distance pistol and shotgun range.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 4,520 lb/yr.
4. The range berm is resurfaced once every 5 years, though this maintenance does not typically involve significant lead removal.

MCB Camp Pendleton
Range 116B

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			17

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 116B is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderate score was assigned to this criterion to account for the potential of pH to drop below 6.5
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the berm is 1.5:1.
4. Overall groundcover within the range footprint consists of concrete, gravel and minimal vegetation on the berm. During the site visit there was evidence of previous brush and grass fires that had substantially reduced the amount of vegetation in the area.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists of fine sand, with some clay and silt (USDA NRCS, 2007). Due to the clayey sand, the surface water runoff rate is medium.
6. There are no run-off or erosion controls present at the range; there is noticeable erosion on the earthern berms.

MCB Camp Pendleton
Range 116B

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in this area. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita alluvial basins which have a depth to groundwater ranging from 3 and 58 feet below ground surface.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range from 7.29 to 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of the pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which is primarily composed of fine sand, with some clay and silt. (USDA NRCS, 2007)

MCB Camp Pendleton
Range 116B

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. Range 116B is situated within 100 feet of habitat which supports Stephen's Kangaroo Rat. A riparian habitat is also noted downstream of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 116B

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 116B is not situated near an alluvial basin used as a source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells near Range 116B, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 116B

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	17
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**45**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**35**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 116C

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Moderate lead loading has been occurring at this range over a relatively shorter period of time compared to many other small arms ranges at the installation. Precipitation at MCB Camp Pendleton is low, and opportunities for surface water transport are limited. However, sensitive species have been identified downstream of the range, and no containment of small arms munitions was noted. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, moderate lead loading and low precipitation reduce the potential for lead migration, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. Additionally, there is a lack of potential groundwater receptors. Given this lack of groundwater receptors and the low potential for lead migration to groundwater, the overall ranking was adjusted to a Minimal score.

MCB Camp Pendleton
Range 116C

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	3
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			11

Notes:

1. Range 116C has been operable as a multi-target combat pistol and rifle range since 1998. During a site visit, it was noted that the range is only used intermittently due to target malfunctions.
2. There are no current bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is approximately 191 lb/yr.
4. There are no formal maintenance activities performed at this range.

MCB Camp Pendleton
Range 116C

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			15-17

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 116C is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. It is anticipated that small arms munitions used at this range will typically impact into surrounding hillsides set back from the range.
4. Overall groundcover within the range footprint consists of mostly dirt with some concrete. The berm consists of limited grass and brush. Beyond the berm in front of the targets the vegetation is typically covered in grass; however, during the site visit visual evidence of a grass fire was observed. The fire had substantially reduced the amount of vegetation beyond the target area.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists of fine sand, with some clay and silt (USDA NRCS, 2007). Due to the moderate clay contents of the soil, surface water runoff rates are considered to be medium.
6. The range is not equipped with run-off/run-on controls.

MCB Camp Pendleton
Range 116C

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in this area. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita watershed which have a depth to groundwater ranging from 3 and 58 feet below ground surface.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range between 7.29 and 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists primarily of fine sand, with some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 116C

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. A habitat which supports Stephen's Kangaroo Rat is noted approximately 800 feet downstream of Range 116C. Riparian habitat is noted approximately 4 miles downstream of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 116C

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 116C is not situated near an alluvial basin used as a source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells near Range 116C, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 116C

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	11
Surface Water Pathways	2	15-17
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**39-41**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	11
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**31**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL***

Notes:

*Due to the low range use and the lack of groundwater receptors in this basin, the groundwater ranking is decreased from Moderate to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 117A

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. There is a moderate amount of lead loading occurring at Range 117A, which has been occurring at this range over a relatively shorter period of time compared to many other small arms ranges at the installation. Further, precipitation at MCB Camp Pendleton is low, and opportunities for surface water transport are limited. Given these considerations, the overall ranking was adjusted to a Minimal score for surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, low lead loading rates and low precipitation reduce the potential for lead migration, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. Given the lack of groundwater receptors and the low potential for lead migration to groundwater, the overall ranking was adjusted to a Minimal score.

MCB Camp Pendleton
Range 117A

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	3
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			11

Notes:

1. Range 117A has been operable as a sniper range since 1993.
2. There are currently no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is170 lb/yr.
4. There are no formal maintenance activities performed at this range.

MCB Camp Pendleton
Range 117A

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	3
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	1-3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			11-13

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 117A is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the berm is 8 percent.
4. Overall groundcover within the range footprint consists primarily of grass and low brush.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists of fine sand, with some clay and silt (USDA NRCS, 2007). Due to the high clay contents in these soils, surface water runoff rates are considered to be medium.
6. Based on the site visit and topographic information, the range is not equipped with any runoff controls. Stormwater flows of the face of the hill and across the range footprint to an intermittent stream.

MCB Camp Pendleton
Range 117A

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in this area. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita watershed which have a depth to groundwater ranging from 3 and 58 feet below ground surface.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range between 7.29 and 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand and Salina clay loam ranges from 5.8-8.0. (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists of fine sand, with some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 117A

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. Habitat which potentially supports the Stephens' Kangaroo Rat is noted approximately 1,200 feet west of the range (MCB Camp Pendleton, 2011b). However, due to the topography of the area it is unlikely that surface waters from the range would reach this habitat. Riparian habitat is noted approximately 4 miles downstream of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 117A

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**

Notes:

1. Range 116A is not situated near an alluvial basin used as a source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells near Range 117A, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 117A

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	11
Surface Water Pathways	2	11-13
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**30-32**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	11
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**31**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Environmental Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Environmental Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MINIMAL***
Groundwater Evaluation Ranking	**MINIMAL****

Notes:

*Based on the relatively moderate lead loading and reduced potential for transport, the surface water ranking is decreased to Minimal.

**Based on the lack of groundwater receptors and the low use of this range, the groundwater ranking is decreased to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 127

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. There is a very low amount of lead loading occurring at Range 127 (approximately 2 lb/yr), precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. Given these considerations, the overall ranking was adjusted to a Minimal score for surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, the minimal lead loading rates and low precipitation reduce the potential for lead migration, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. Given these considerations, the overall ranking was adjusted to a Minimal score for groundwater.

MCB Camp Pendleton
Range 127

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	1
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			11

Notes:

1. Range 127 has been in operation as a small arms range since 1981.
2. There are no bullet-capturing technologies employed at this range. There were once plans to install wooden baffles at the range, but this has not occurred.
3. Based on the loading calculations conducted for the 5-year review, the average annual loading rate of lead is 2 lb/yr.
4. There is no regular maintenance conducted at this range.

MCB Camp Pendleton
Range 127

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			8-10

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 127 is situated in the Las Flores watershed (MCB Camp Pendleton, 2011b). Based on water quality information, surface water in the Las Flores watershed had a mean pH of 7.95 and a median pH of 7.99 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on installation GIS information and the site visit, the range berm is steep and eroded (MCB Camp Pendleton, 2011b).
4. Overall groundcover within the range footprint consists of dirt with sparse grasses. Behind the impact berm, the hillside is predominately covered by brush and grasses.
5. The predominant soil type throughout Range 127 is Huerhuero loam. Due to the amount of clay in these soils, run-off rates range or considered to be medium (USDA NRCS, 2007).
6. Based on the site visit and topographic information, the range is equipped with a berm that controls run-on of precipitation. There is some evidence of erosion along the toe of the berm (USDA NRCS, 2007).

MCB Camp Pendleton
Range 127

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater at the in the Las Flores alluvial basin ranges from 10 to 58 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the Las Flores alluvial basin ranged from 7.29 to 7.34 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Huerhuero loam ranges from is 5.3-7.2 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant soil type throughout Range 127 is Huerhuero loam which is predominately composed of clay loams with some sand (USDA NRCS, 2007).

MCB Camp Pendleton
Range 127

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Las Flores watershed.
3. California gnatcatcher habitat has been identified in brush areas on the southern boundary of Range 127. Additionally, riparian habitat is also noted approximately 1 mile downstream of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 127

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	5
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			7

Table 5: Groundwater Receptors Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 127 is not situated in the immediate vicinity of an alluvial basin. The nearest alluvial basin is the Las Flores basin located approximately 1 mile west of the range which contains three groundwater wells used as a source of drinking water for the installation (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity Range 127, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 127

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	11
Surface Water Pathways	2	8-10
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**32-34**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	11
Groundwater Pathways	3	16
Groundwater Receptors	5	7
Sum of Groundwater Element Scores		**34**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MINIMAL***
Groundwater Evaluation Ranking	**MINIMAL***

Notes:

*Based on the minimal lead loading and reduced potential for transport, the surface water and groundwater ranking is decreased to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 130 Complex (Bays 1 and 2)

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and opportunities for surface water transport are limited. However, considerable lead loading is occurring at the Range 130 bays, and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, low precipitation reduces the potential for lead migration, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. There is considerable lead loading occurring at the Range 130 Complex, however there is a lack of potential groundwater receptors. On the basis of the SARAP, there is a moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 130 Complex (Bays 1 & 2)

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			13

Notes:

1. The Range 130 Complex has several ranges associated with it. This includes two multipurpose small arms ranges, Bay 1 [southern] and Bay 2 [northern]. This SARAP only considers these two bays. Bay 1 and Bay 2 have been operated since 1993.
2. There are no bullet-capturing technologies employed at these ranges.
3. Based on the loading calculations conducted for the 5-year review, the average annual loading rate of lead at the Range 130 Complex is approximately 2,383 lb/yr. Range personnel indicated that almost all of these small arms expenditures are attributable to training activities at the bays.
4. The range berm is resurfaced approximately once every 5 years, though this maintenance does not typically involve significant lead removal.

MCB Camp Pendleton
Range 130 Complex (Bays 1 & 2)

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			15

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, the Range 130 Complex is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the berm is 2 to 2.5:1.
4. Overall groundcover within the range footprint consists predominantly of dirt, gravel and minimal vegetation on the berm.
5. The predominant type of soil throughout the range is Hambright gravelly clay loam which is composed largely of gravel with a small fraction of clay, silt, and fine sand (USDA NRCS, 2007). Due to the high gravel content in the soil, surface water run-off rates are considered to be slow.
6. Based on the site visit and topographic information, the range is equipped with a backstop berm that partially controls stormwater run-on to the two ranges. Bay 1 has a metal roof cover over it. However, it does not protect the backstop berm from direct precipitation. The faces of the berm contain bullet pockets and there is some evidence of migration of bullets in stormwater flows along the western road.

MCB Camp Pendleton
Range 130 Complex (Bays 1 & 2)

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	5
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
Groundwater Pathway Score			22

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in this area. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita watershed which have a depth to groundwater of between 3 and 58 feet below ground surface.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range between 7.29 and 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Hambright gravelly clay loam is 6.3 (USDA NRCS, 2007).
5. The predominant type of soil throughout the range is Hambright gravelly clay loam, which is composed largely of gravel with a small fraction of clay, silt, and fine sand (USDA NRCS, 2007).

MCB Camp Pendleton
Range 130 Complex (Bays 1 & 2)

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. A California gnatcatcher habitat was identified in the brush areas approximately 1.2 miles downstream of the Range 130 Complex (MCB Camp Pendleton, 2007). Riparian habitat is also noted 4.5 miles downstream of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 130 Complex (Bays 1 & 2)

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The Range 130 Complex is not situated in the immediate vicinity of alluvial basins used as source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells near the Range 130 Complex, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 130 Complex (Bays 1 & 2)

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Surface Water Pathways	2	15
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**36**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Groundwater Pathways	3	22
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**39**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 206

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, there is considerable lead loading at Range 206. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading at Range 206, there is a lack of potential groundwater receptors. Due to this lack of potential groundwater receptors, the overall ranking was adjusted to a Minimal score.

MCB Camp Pendleton
Range 206

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 206 has been operable as a small arms range since 1968.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 1,783 lb/yr.
4. There is no known range maintenance on this range.

MCB Camp Pendleton
Range 206

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			15

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information Range 206 is situated in the San Onofre Watershed (MCB Camp Pendleton, 2011b). Based on water quality information for the San Onofre watershed the pH of surface water near Range 210C, had a mean pH of 7.2 and a median pH of 6.98 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the small berm is1.5:1. Beyond the berm is a rocky outcrop/cliff that has substantial bullet marks in it.
4. Overall groundcover within the range footprint consists of mostly sand with some vegetation behind the berm.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which is composed of fine sand, with some clay and silt (USDA NRCS, 2007). Due to the moderate clay content of the soil, surface water runoff rates are considered to be medium.
6. Based on the site visit, there is no evidence of stormwater controls or other devices to prevent erosion from the range or reduce stormwater flows.

MCB Camp Pendleton
Range 206

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			14

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Onofre alluvial basin ranges from 30-43 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Onofre alluvial basin ranged from 6.99 to 7.40 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential for the pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists primarily of fine sand, with some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 206

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Onofre watershed.
3. A riparian habitat is located approximately 0.5 miles north of the range (MCB Camp Pendleton, 2011b). Arroyo toad habitat is also located downstream of the range (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 206

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**

Notes:

1. Range 206 is not situated in the immediate vicinity of any alluvial basins used as a source of drinking water. The nearest groundwater well is located approximately 4.2 miles in the San Onofre alluvial basin (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity of Range 206, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 206

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	15
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**38**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	14
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**33**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL***

Notes:

*Due to the lack of potential groundwater receptors, the groundwater ranking is decreased from Moderate to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 210C

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 210C, and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Minimal score. As noted, precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading occurring at Range 210C, there is a lack of potential groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impacts to the groundwater.

MCB Camp Pendleton
Range 210C

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 210C has been operable as a rifle range since 1971 but was constructed in the 1940s.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 3,219 lb/yr.
4. The range does not receive any regular maintenance.

MCB Camp Pendleton
Range 210C

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	5
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			12

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information Range 210C is situated in the San Onofre Watershed (MCB Camp Pendleton, 2011b). Based on water quality information for the San Onofre watershed the pH of surface water near Range 210C, had a mean pH of 7.2 and a median pH of 6.98 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on the installation GIS information, the slope of the berm is approximately 2:1.
4. Overall groundcover within the range footprint consists of dirt with limited vegetation.
5. The predominant type of soil throughout the range is Altamont clay (USDA NRCS, 2007). Due to the high clay content of the soil, surface water run-off rates are anticipated to be rapid.
6. Based on the site visit and topographic information, the range is equipped with a backstop berm that controls stormwater run-off and run-on.

MCB Camp Pendleton
Range 210C

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Groundwater Pathway Score			8

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Onofre alluvial basin ranges from 30-43 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Onofre alluvial basin ranged from 6.99 to 7.40 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Altamont clay ranges from 6.6-8.0 (USDA NRCS, 2007).
5. The predominant type of soil throughout the range is Altamont clay (USDA NRCS, 2007).

MCB Camp Pendleton
Range 210C

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Onofre watershed.
3. Range 210C is situated within a habitat that supports sensitive species such as the Arroyo Toad. Stephens Kangaroo Rat habitat is also located 1,000 feet west of the range (MCB Camp Pendleton, 2007). Additionally, riparian habitat is located just south (150 feet) of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 210C

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 210C is not situated in the immediate vicinity of alluvial basins used as a source of drinking water. The nearest groundwater production well is located approximately 3.9 miles west of the range in the San Onofre alluvial basin (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity of Range 210C, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 210C

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	12
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**40**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	8
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**27**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 210G

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. There is currently a minimal amount of lead loading occurring at Range 210G; precipitation at MCB Camp Pendleton is low; and the average pH of the surface water is not conducive to lead dissolution. Given these considerations, the overall ranking was adjusted to a Minimal score for surface waters.

The Groundwater Evaluation Ranking resulted in a minimal score for this range. As noted, lead loading associated with this range is anticipated to be low because of restrictions on its use. Precipitation at MCB Camp Pendleton is low, and the average pH of the groundwater is not conducive to lead dissolution. On the basis of the SARAP, there is minimal potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 210G

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	1
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			9

Notes:

1. Range 210G has been in operation as a squad defense range since 1998. Training may involve live-fire rushes of the first line of targets.
2. There are no bullet-capturing technologies employed at this range.
3. Range 210G is not used regularly due to its orientation which conflicts with operations at surrounding ranges. No use of the range is noted in expenditure data for 2010 or 2011. Due to the lack of information and the limited range use, the MC loading rate has been assigned a low score for its MC loading rate.
4. There is no regular maintenance conducted at this range.

MCB Camp Pendleton
Range 210G

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	3
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	5
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			8

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information Range 210G is situated in the San Onofre Watershed (MCB Camp Pendleton, 2011b). Based on water quality information for the San Onofre watershed, the pH of surface water near Range 210G had a mean pH of 7.2 and a median pH of 6.98 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. There is no impact berm located at Range 210G. The overall slope of the range is approximately 7 percent (MCB Camp Pendleton, 2011b).
4. Overall groundcover within the range footprint consists of grass and brush with some dirt areas.
5. The predominant type of soil throughout the range is Altamont clay (USDA NRCS, 2007). Due to the high clay content in the soil, the surface water runoff rate is anticipated to be rapid.
6. Based on the site visit and topographic information, the range is equipped with drainage ditches behind each target line which may control surface water runoff; each drainage ditch appeared to contain a couple thin, low-lying bands of riprap.

MCB Camp Pendleton
Range 210G

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Groundwater Pathway Score			8

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Onofre alluvial basin ranges from 30-43 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Onofre alluvial basin ranged from 6.99 to 7.40 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Altamont clay ranges from 6.6-8.0 (USDA NRCS, 2007).
5. The predominant type of soil throughout the range is Altamont clay (USDA NRCS, 2007).

MCB Camp Pendleton
Range 210G

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Onofre watershed.
3. Range 210G is situated within a habitat that supports the Arroyo Toad and the Stephens Kangaroo Rat (MCB Camp Pendleton, 2007). Riparian habitat is located 500 feet west of the range (MCB Camp Pendleton, 2011b).

MCB Camp Pendleton
Range 210G

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 210G is not situated in the immediate vicinity of alluvial basins used as a source of drinking water. The nearest groundwater production well is located approximately 3.9 miles west of the range in the San Onofre alluvial basin (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity of Range 210G, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 210G

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	9
Surface Water Pathways	2	8
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**30**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	9
Groundwater Pathways	3	8
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**21**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MINIMAL***
Groundwater Evaluation Ranking	**MINIMAL**

Notes:

*Based on the minimal lead loading and reduced potential for transport, the surface water ranking is decreased to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 212A

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 212A, and sensitive species have been identified directly adjacent to the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score. As noted, low precipitation reduces the potential for lead migration, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading occurring at Range 212A, there is a lack of potential groundwater receptors. Due to this lack of potential groundwater receptors the overall ranking was adjusted to a Minimal score.

MCB Camp Pendleton
Range 212A

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 212A has been operable as a rifle range since 1971.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 2,772 lb/yr.
4. The range does not receive any regular maintenance.

MCB Camp Pendleton
Range 212A

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			13-15

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information Range 210C is situated in the San Onofre Watershed (MCB Camp Pendleton, 2011b). Based on water quality information for the San Onofre watershed the pH of surface water near Range 210C, had a mean pH of 7.2 and a median pH of 6.98 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the small backstop berm is 1.5:1.
4. Overall groundcover within the range footprint consists of compacted dirt with limited vegetation. Vegetation increases beyond the impact berm. During the site visit evidence of previous grass fires was evident.
5. The predominant type of soil throughout the range is Visalia sandy loam which is primarily composed of sand, with some clay and silt (USDA NRCS, 2007). Due to the clayey sand, surface water run-off rates are considered to be medium.
6. Based on the site visit and topographic information, the range is equipped with a backstop berm; however, it provides limited erosion control. An intermittent stream runs just behind and adjacent to the range footprint.

MCB Camp Pendleton
Range 212A

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			12

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Onofre alluvial basin ranges from 30-43 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Onofre alluvial basin ranged from 6.99 to 7.40 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Visalia sandy loam is 6.5 (USDA NRCS, 2007).
5. Visalia sandy loam is predominately composed of sand and contains some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 212A

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Onofre watershed.
3. Riparian habitat is located approximately 2,000 feet south of the range (MCB Camp Pendleton, 2011b). Additionally, rare plant species may be present in areas south of the range (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 212A

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 212A is not situated in the immediate vicinity of alluvial basins used in the production of drinking water. The nearest alluvial basin is the San Onofre basin located approximately 4 miles from the range (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity Range 212A, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 212A

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	13-15
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**36-38**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	12
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**31**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL***

Notes:

*Due to the lack of potential groundwater receptors, the groundwater ranking is decreased from Moderate to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 213 (Horno Pistol)

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 213, and rare plant species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Minimal score. As noted, low precipitation contributes to this low score, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading occurring at Range 213, there is a lack of potential groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 213 (Horno Pistol)

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 213 has been operable as a pistol range since 1968.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 8,819 lb/yr.
4. The range berm is resurfaced approximately once every 5 years, though this maintenance does not typically involve significant lead removal.

MCB Camp Pendleton
Range 213 (Horno Pistol)

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	5
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			10-12

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information Range 213 is situated in the San Onofre Watershed (MCB Camp Pendleton, 2011a). Based on water quality information for the San Onofre watershed the pH of surface water near Range 213, had a mean pH of 7.2 and a median pH of 6.98 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the hillside berm is 2:1.
4. Overall groundcover within the range consists of concrete, asphalt, and dirt with limited vegetation. Vegetation increases beyond the impact berm.
5. The predominant type of soil throughout the range is Steep gullied land which is primarily composed of sand and gravel, however, due to the steep nature of the slopes there is little soil (USDA NRCS, 2007). Based on the overall lack of soil in these areas, the surface water run-off rate is very rapid.
6. The range is equipped with a hillside berm that is constructed in a manner that reduces surface water run-on across the berm face. There are no engineered run-off controls.

MCB Camp Pendleton
Range 213 (Horno Pistol)

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Groundwater Pathway Score			8

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Onofre alluvial basin ranges from 30-43 ft.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Onofre alluvial basin ranged from 6.99 to 7.40 (Stetson, 2008a).
4. The average pH of Steep gullied land is not provided in the NRCS report. Based on adjacent soil types the pH of the soil in Range 213 is assumed to be in the 6.5 to 8.5 range (USDA NRCS, 2007).
5. Steep gullied land is predominately composed of sand and gravel; however, the layers are overlying rock thus infiltration is limited (USDA NRCS, 2007).

MCB Camp Pendleton
Range 213 (Horno Pistol)

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Onofre watershed.
3. A riparian habitat is located approximately 3,500 feet downstream of the range (MCB Camp Pendleton, 2011b). Rare plant species may be present in areas south of the range (MCB Camp Pendleton, 2007)

MCB Camp Pendleton
Range 213 (Horno Pistol)

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 213 is not situated in the immediate vicinity of alluvial basins used as a source of drinking water. The nearest alluvial basin is the San Onofre basin located approximately 4.5 miles from the range (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity of Range 213, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 213 (Horno Pistol)

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	10-12
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**33-35**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	8
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**27**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 214 (Horno Rifle)

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 214 (Horno Rifle) and rare plant species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, precipitation is low and the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading occurring at Range 214, there is a lack of potential groundwater receptors. Based on the low potential for lead migration and lack of potential groundwater receptors, the overall ranking was adjusted to a Minimal score.

MCB Camp Pendleton
Range 214 (Horno Rifle)

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 214 has been operable as a rifle range since 1961.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 14,246 lb/yr.
4. The range berm is resurfaced approximately once every 5 years, though this maintenance does not typically involve significant lead removal.

MCB Camp Pendleton
Range 214 (Horno Rifle)

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			8

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information Range 214 is situated in the San Onofre Watershed (MCB Camp Pendleton, 2011b). Based on water quality information for the San Onofre watershed the pH of surface water near Range 210C, had a mean pH of 7.2 and a median pH of 6.98 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the berm is 2:1.
4. Overall groundcover within the range footprint consists of dirt with moderate vegetation. Vegetation increases beyond the impact berm.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which is primarily composed of fine sand with some clay and silt (USDA NRCS, 2007). Due to the moderate clay content of this soil, surface water runoff rates are anticipated to be medium.
6. Based on the site visit and topographic information, the range is equipped with a backstop berm that controls stormwater run-on. Channels and sub-surface drainage pipes are also used to control run-off.

MCB Camp Pendleton
Range 214 (Horno Rifle)

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			14

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Onofre alluvial basin ranges from 30-43 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Onofre alluvial basin ranged from 6.99 to 7.40 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. Las Flores loamy fine sand is primarily composed of fine sand with some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 214 (Horno Rifle)

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Onofre watershed.
3. A riparian habitat is located approximately 3,000 feet south of the range (MCB Camp Pendleton, 2011b). Rare plant species have been noted in areas south of the range (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 214 (Horno Rifle)

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 214 is not situated in the immediate vicinity of alluvial basins used in the production of drinking water. The nearest groundwater basin is the San Onofre basin located approximately 4.5 miles from the range (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity of Range 214, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 214 (Horno Rifle)

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	8
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**31**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	14
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**33**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL***

Notes:

*Due to the lack of potential groundwater receptors the groundwater ranking is decreased from Moderate to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 216 BZO

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, sensitive plant species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Minimal score for this range. Precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. Additionally, there is a lack of potential groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 216 BZO

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	3
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			13

Notes:

1. Range 216 has been operable as a range since 1952. It is currently used as a battle sight zero (BZO) range. The facility also includes a small SACON house and a former (i.e. unusable, overgrown with vegetation) machine gun field. Only the BZO facility is evaluated here.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead for all of Range 216 is 409 lb/yr.
4. There are no formal maintenance activities conducted at Range 216 BZO.

MCB Camp Pendleton
Range 216 BZO

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	1-3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			11-13

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information Range 216 BZO is situated in the San Onofre Watershed (MCB Camp Pendleton, 2011b). Based on water quality information for the San Onofre watershed the pH of surface water near Range 216 BZO, had a mean pH of 7.2 and a median pH of 6.98 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the small hillside berm is 2:1.
4. Overall groundcover within the range footprint consists of dirt with some sparse grass and low brush. Brushy vegetation is adjacent to portions of the BZO, including the former machine gun field.
5. The predominant type of soil throughout the range is Visalia sandy loam which is primarily composed of sand, with some clay and silt (USDA NRCS, 2007). Due to the clay contents of this soil, surface water runoff rates are considered to be medium.
6. There are no specific engineering controls to control run-on or run-off from the range. An ephemeral creek runs adjacent to the range.

MCB Camp Pendleton
Range 216 BZO

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			12

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Onofre alluvial basin ranges from 30-43 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Onofre alluvial basin ranged from 6.99 to 7.40 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Visalia sandy loam is 6.5 (USDA NRCS, 2007).
5. The predominant type of soil throughout the range is Visalia sandy loam which is primarily composed of sand, with some clay and silt (USDA NRCS, 2007).

MCB Camp Pendleton
Range 216 BZO

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Onofre watershed.
3. A riparian habitat is located approximately 2,000 feet south of the range (MCB Camp Pendleton, 2011b). Rare plant species may be present in areas south of the range (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 216 BZO

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 216 BZO is not situated in the immediate vicinity of alluvial basins used as a source of drinking water. The nearest alluvial basin is the San Onofre basin located approximately 4.5 miles from the range (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity Range 216 BZO, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 216 BZO

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Surface Water Pathways	2	11-13
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**32-34**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	13
Groundwater Pathways	3	12
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**29**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MINIMAL**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 223A 200-Yard Range

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at this range, and sensitive species have been identified downstream of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. However, there is considerable lead loading occurring at this range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 223A 200-Yard Range

Table 1: Range Use and Range Management (*Source*) Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 223A has been in operation as a small arms range since the 1960s. The facility also includes a shoot house facility. Only the 200-yard range is evaluated here.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 2,695 lbs/yr.
4. There is no regular maintenance conducted at this range.

MCB Camp Pendleton
Range 223A 200-Yard Range

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			13-15

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 223A is situated in the Las Flores watershed. Based on the Final Project Report for the Surface Water Quality Sampling Program, the surface water in the Las Flores watershed had a mean pH of 7.95 and a median pH of 7.99 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. An impact berm was re-built into the hillside in 2007.
4. Overall groundcover within the range footprint consists of a mostly gravel and dirt. The surrounding berms are covered with grass and low brush.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand which consists of fine sand, with some clay and silt (USDA NRCS, 2007). Due to the clay and sand contents of this soil, surface water runoff rates are assumed to medium.
6. The range is not equipped with run-off/run-on controls.

MCB Camp Pendleton
Range 223A 200-Yard Range

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater at the in the Las Flores groundwater unit ranges from 10 to 58 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the Las Flores alluvial basin ranges from 7.29 to 7.34 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from is 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant type of soil throughout the range is Las Flores loamy fine sand (USDA NRCS, 2007).

MCB Camp Pendleton
Range 223A 200-Yard Range

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	5
Surface Water Receptor Score			8

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Las Flores watershed.
3. A riparian habitat is located approximately 1,000 feet west of the range. Sensitive species that could be potentially supported by this habitat include the least Bell's vireo and the Stephen's kangaroo rat.

MCB Camp Pendleton
Range 223A 200-Yard Range

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 223A is not situated in the immediate vicinity of an alluvial basin used as a source of drinking water. The nearest groundwater production well is located approximately 4.4 miles southwest of the range in the Las Flores alluvial basin (MCB Camp Pendleton, 2011b). No evidence of lead has been noted in the monitoring of those groundwater wells.
2. Groundwater is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no known springs or other groundwater pathways for exposure to nearby threatened or endangered species within the immediate vicinity of the range.

MCB Camp Pendleton
Range 223A 200-Yard Range

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	13-15
Surface Water Receptors	4	8
Sum of Surface Water Element Scores		**36-38**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**35**
The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media: Evaluation Ranking* — Score Range High — 50-65 Moderate — 30-49 Minimal — 0-29 *Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.		
Surface Water Evaluation Ranking		**MODERATE**
Groundwater Evaluation Ranking		**MODERATE**
Notes:		

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 300

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low and the average pH of the surface water is not conducive to lead dissolution. However, considerable lead loading is occurring at Range 300 and multiple sensitive species have been identified within riparian habitat directly adjacent to the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score. Precipitation at MCB Camp Pendleton is low and the average pH of the groundwater is not conducive to lead dissolution. However, there is considerable lead loading occurring at Range 300, and an alluvial basin used as a source of groundwater is situated within one mile of the range. On the basis of the SARAP, there is moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 300

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 300 has been operable as a familiarization range since 1968.
2. There are no bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 2,448 lb/yr.
4. There is no formal maintenance activities performed at this range.

MCB Camp Pendleton
Range 300

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	5
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			17

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 300 is situated in the San Mateo watershed (MCB Camp Pendleton, 2011b). Based on water quality information, the surface water in the San Mateo watershed had a mean pH of 7.35 and a median pH of 7.17 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the target berm is 2:1.
4. Overall groundcover within the range footprint consists of dirt with sparse vegetation. Vegetation increases beyond the impact berm and up the hill side. However, between the range and the San Mateo River there is very little vegetation.
5. The predominant soil type throughout the range is Terrance escarpments which are composed mainly of gravel overlaying rock. Since this gravel overlays rock run-off rate are considered to be rapid.
6. Based on the site visit and topographic information, the range is equipped with a backstop berm that partially controls minor precipitation event's stormwater run-on. There are no stormwater runoff controls and the berm does not contain any vegetation.

MCB Camp Pendleton
Range 300

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	1
Groundwater Pathway Score			10

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Mateo alluvial basin ranges from 12 to 32 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Mateo alluvial basin ranged from 7.03 to 7.18 (Stetson, 2008a).
4. The average pH of Terrance Escarpment is not provided in the NRCS report. Based on the NRCS report, the pH of surrounding soils is approximately 7.5 (USDA NRCS, 2007).
5. The predominant soil type throughout the range is Terrance escarpments which are composed mainly of gravel overlaying rock. Since this gravel overlays rock infiltration is extremely slow.

MCB Camp Pendleton
Range 300

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Mateo watershed.
3. Range 300 is located adjacent to a riparian habitat defined along the San Mateo River (MCB Camp Pendleton, 2011b). The California Gnatcatcher, Arroyo Toad, and some rare plant species are suspected to be present in this area (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 300

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	5
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			7

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 300 is not situated in the immediate vicinity of alluvial basins used as source of drinking water. The nearest alluvial basin is the San Mateo basin located approximately 0.9 miles west of the range. The nearest well dedicated to drinking water production is approximately 1.1 miles from the range (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity of Range 300, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species

MCB Camp Pendleton
Range 300

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	17
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**45**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	10
Groundwater Receptors	5	7
Sum of Groundwater Element Scores		**32**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 303

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Range 303 has been operable for a short period of time with moderate lead loading rates; precipitation at MCB Camp Pendleton is low; and the average pH of the surface water is not conducive to lead dissolution. Given these considerations, the overall ranking was adjusted to a Minimal score for surface waters.

The Groundwater Evaluation Ranking resulted in a Minimal score for this range. As noted, the short operating history and low precipitation contribute to this low score, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. On the basis of the SARAP, there is minimal potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 303

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	1
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	3
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			9

Notes:

1. Range 303 has been operated by the Navy as a BZO and pistol range since April 2009.
2. There are no current bullet-capturing technologies employed at this range.
3. Based on the current loading calculations conducted for the 5-year review, the average annual loading rate of lead is 301 lb/yr.
4. There is no formal maintenance activities performed at this range.

MCB Camp Pendleton
Range 303

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
Surface Water Pathway Score			8

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 303 is situated in the San Mateo watershed (MCB Camp Pendleton, 2011b). Based on water quality information for the San Mateo watershed, surface water in this watershed had a mean pH of 7.35 and a median pH of 7.17 (Stetson, 2010).
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The approximate deviation from the horizontal of the hillside target berm is 3:1.
4. Overall groundcover within the range footprint consists of dirt and low grasses. The target berm is covered with grasses, with only a few bullet pockets. Vegetation increases in areas adjacent to the range; some dirt roads are nearby.
5. The predominant soil type throughout the range is Las Flores loamy fine sand which consists primarily of fine sand with some clays and silts (USDA NRCS, 2007). Due to the clay content of this soil, the surface water run-off rate is medium.
6. There are no constructed surface water drainage controls at Range 303. However, the vegetation in the drainages leading away from the range may slow migration of particles in stormwater run-off.

MCB Camp Pendleton
Range 303

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. The depth to groundwater in the San Mateo alluvial basin ranges from 12-32 ft.
2. The seasonal rainfall at the installation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. Based on water quality information collected between the years 1997 and 2008, the pH of the groundwater in the San Mateo alluvial basin ranged from 7.03 to 7.18 (Stetson, 2008a).
4. According to the NRCS Soil Report, the average pH of Las Flores loamy fine sand ranges from is 5.8-7.3 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. The predominant soil type throughout the range is Las Flores loamy fine sand which consists primarily of fine sand with some clays and silts (USDA NRCS, 2007).

MCB Camp Pendleton
Range 303

Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the San Mateo watershed.
3. Range 303 is located adjacent to riparian habitat (MCB Camp Pendleton, 2011b). The California gnatcatcher, arroyo toad, and some rare plants are suspected to be present in this area (MCB Camp Pendleton, 2007).

MCB Camp Pendleton
Range 303

Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 303 is not situated in the immediate vicinity of alluvial basins used in the production of drinking water. The nearest alluvial basin is the San Mateo basin located approximately 2 miles south of the range. The nearest well dedicated to drinking water production is approximately 2.5 miles from the range (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells in the immediate vicinity of Range 303, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

MCB Camp Pendleton
Range 303

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	9
Surface Water Pathways	2	8
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**30**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	9
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**29**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MINIMAL***
Groundwater Evaluation Ranking	**MINIMAL**

Notes:

*Based on the minimal lead loading and reduced potential for transport, the surface water ranking is decreased to Minimal.

INSTALLATION: MCB Camp Pendleton
LOCATION: Oceanside, California
RANGE: Range 501

ASSESSMENT RESULTS:

The Surface Water Evaluation Ranking resulted in a Moderate score for this range. Precipitation at MCB Camp Pendleton is low, and opportunities for surface water transport are limited. However, there is a considerable amount of lead loading occurring at Range 501, and sensitive species have been noted on the range. On the basis of the SARAP, there is a moderate potential for lead migration and impacts to surface waters.

The Groundwater Evaluation Ranking resulted in a Moderate score for this range. As noted, low precipitation contributes to the low score, as does the fact that the average pH of the groundwater is not conducive to lead dissolution. Despite the considerable lead loading occurring at Range 501 there is a lack of potential groundwater receptors. On the basis of the SARAP, there is a moderate potential for lead migration and impacts to groundwater.

MCB Camp Pendleton
Range 501

Table 1: Range Use and Range Management (*Source*) Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Duration of Range Use	*Length of time the range has been used*	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
Bullet-Capturing Technology	*The presence and duration of bullet-capturing technologies (does not include earthen backstop berms)* *Compare the duration of the range use to the duration of bullet-capturing technologies.*	-3 if range usage duration = bullet capture duration -1 if range usage duration – bullet capture duration = 10 to 30 years 0 if range usage duration – bullet capture duration > 30 years	0
MC Loading Rates	*The amount and types of small arms ammunition expended on the range* *Estimate the MC loading by using a time weighted average of MC loading rates*	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
Range Maintenance	*Frequency of any range maintenance activities involving the removal of lead from the ranges*	5 if lead is removed less than every three years 3 if lead is removed more than every three years but less than annually 1 if lead is removed at least annually	5
Source Element Score			15

Notes:

1. Range 501 has been in operation as a small arms range since 1961.
2. There are no bullet capturing technologies implemented at the range.
3. The average annual loading rate of lead is 1,786 lb/yr.
4. There are no formal, regularly scheduled, maintenance activities currently performed at this range.

MCB Camp Pendleton
Range 501

Table 2: Surface Water Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
Slope of Range	*The amount of deviation from the horizontal for the berm / target area*	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	1
Vegetation	*Approximate vegetation cover within and directly downslope of the surface danger zone*	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	3-5
Soil Type/Runoff Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	3
Runoff/ Erosion Engineering Controls	*The presence of engineering controls or BMPs to modify or control surface water runoff and erosion* *Partial engineering controls include using erosion controls such as a proper groundcover or use of berms for run-on or run-off control. Using a combination of multiple partial engineering controls may create an effective engineering control. Other effective engineering controls include bullet containment technologies.*	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
Surface Water Pathway Score			11-13

Table 2: Surface Water Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Based on installation GIS information, Range 501 is located within the Aliso watershed (MCB Camp Pendleton. 2011b). Limited surface water sampling has been conducted in this watershed. Based on sampling data for other watersheds within the installation, the pH values of surface water for off range areas are assumed to range from 6.24 to 8.07 (Malcolm Pirnie, Inc. 2008). The pH of surface water is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. No impact berm is present at this range. The approximate amount of deviation from the firing line and the target areas is 2 percent (MCB Camp Pendleton, 2011b).
4. Overall groundcover within the range footprint is a mix of dirt, sparse grass and shrubs.
5. The predominant soil type throughout the range footprint is Huerhuero loam (USDA NRCS, 2007). Due to the clay content in these soils, surface water run-off rates are anticipated to be medium.
6. The range is not equipped with any run-off control feature. Storm water will follow the surface topography and drain off the range to the east, south, and west.

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Range 501

Table 3: Groundwater Pathways Characteristics Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Depth to Groundwater	*The potential for impact to the groundwater decreases with an increasing depth to the water table.*	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	5
Precipitation	*Intensity and frequency of precipitation*	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
pH of Water	*pH below 6.5 and above 8.5 increases the rate of lead dissolution.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	1
pH of Soil	*Lead tends to stay dissolved at pH conditions less than 6.5 and greater than 8.5 but tends to attach to soil particles at pH conditions between these levels.*	5 if pH < 6.5 3 if pH > 8.5 1 if pH 6.5 ≤ pH ≤ 8.5	3
Soil Type/Infiltration Conditions	*Soil with a higher porosity (sands/gravels) has more infiltration and less runoff compared to soil with low porosity (silts/clays).*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Clay Content in Soil	*Amount of clay in the soil* *Lead attaches to clay soil more readily than any other soil types.*	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	3
Groundwater Pathway Score			16

Table 3: Groundwater Pathways Characteristics Element
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. There are no known groundwater wells in this area. The depth to groundwater is conservatively assumed to be similar to the depth in the Las Flores and Santa Margarita watershed which have a depth to groundwater of between 3 and 58 feet below ground surface.
2. Precipitation averaged 11.3 inches/year from 2006 to 2011 (MCB Camp Pendleton, 2011a).
3. The pH of groundwater in the Las Flores and Santa Margarita alluvial basins range between 7.29 and 7.53 (Stetson, 2008a).
4. According to the NRCS Soil Report, the pH of Huerhuero loam ranges from 5.3 to 8.2 (USDA NRCS, 2007). The pH of the soil is not anticipated to exceed 8.5; a moderating score (i.e., 3) was assigned to this criterion to account for the potential of pH to drop below 6.5.
5. Huerhuero loam is predominately composed of clay loams with some sand (USDA NRCS, 2007).

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Table 4: Surface Water Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Drinking Water Usage	*Identify if nearby surface water bodies are used as a drinking water source.*	10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown 5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown 2 if low possibility for contamination in the media to be present at or migrate to a point of exposure	2
Agricultural or Other Beneficial Usage	*Identify if nearby surface water bodies are used as an agricultural or other beneficial use, such as recreational (excluding drinking water).*	5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably. 1 if low possibility for contamination in the media to be present at or migrate to a point of exposure	1
Sensitive Species Habitat and Threatened or Endangered Species	*Identify if nearby surface water bodies are downgradient of or nearby any sensitive species habitat or threatened or endangered species.*	10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary 5 if potential for receptors to have access to possibly contaminated media 1 if little or no potential for receptors to have access to possible contaminated media	10
Surface Water Receptor Score			13

Table 4: Surface Water Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Surface water is not the primary source of drinking water; groundwater is the primary source of drinking water in this region.
2. Surface water is not currently being used to support agricultural activities at Camp Pendleton (MCB Camp Pendleton, 2007). The installation may be used for a variety of recreational opportunities by its personnel, and when surface water is present, it is possible such uses are supported in the Aliso watershed.
3. A habitat that potentially supports the Pacific Pocket Mouse is situated within Range 501. Riparian habitat is noted approximately 4,000 feet downstream of the range (MCB Camp Pendleton, 2011b).

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Table 5: Groundwater Receptors Element (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	**Evaluation Characteristics**	**Score Criteria**	**Site Score**
Wells Identified as Potable Water Sources	*Number and location of potable water or potable water supply wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown 5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
Wells Identified for Agricultural or Other Beneficial Usage	*Number and location of agricultural wells relative to the location of the range* *Evaluate well construction / radius of influence data and hydrogeologic setting to assess if wells are potential receptors.*	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown 3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably 1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
Sensitive Species Habitat and Threatened and Endangered Species	*Evaluate of groundwater discharge or usage near areas of sensitive species habitat or areas where threatened and endangered species are located within proximity of the range*	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources 1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
Groundwater Receptor Score			4

Table 5: Groundwater Receptors Element

(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Criteria	Evaluation Characteristics	Score Criteria	Site Score

Notes:

1. Range 501 is not situated near an alluvial basin used as a source of drinking water (MCB Camp Pendleton, 2011b).
2. Groundwater is not currently being used to support agricultural activities or other beneficial uses at Camp Pendleton (MCB Camp Pendleton, 2007).
3. There are no groundwater production wells near Range 501, nor are there any known springs or other pathways for exposure to nearby threatened or endangered species.

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Range 501

Table 6: Evaluation Score
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)

Surface Water		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Surface Water Pathways	2	11-13
Surface Water Receptors	4	13
Sum of Surface Water Element Scores		**39-41**
Groundwater		
Element	**Table**	**Score**
Range Use and Range Management (Source)	1	15
Groundwater Pathways	3	16
Groundwater Receptors	5	4
Sum of Groundwater Element Scores		**35**

The relative evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:

Evaluation Ranking*	Score Range
High	50-65
Moderate	30-49
Minimal	0-29

*Use the Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.

Surface Water Evaluation Ranking	**MODERATE**
Groundwater Evaluation Ranking	**MODERATE**

Notes:

Appendix C

Department of Defense Screening Values

Operational Range Assessment Screening Values

Operational Range Assessment Screening Value Tables

Table 1 - Human Drinking Water Values

MC	CAS #	Screening Value	
		Value (µg/L)	Source
Antimony	7440-36-0	6	EPA RSL Table[a]
Arsenic	7440-38-2	0.045	EPA RSL Table[a]
Barium	7440-39-3	2000	EPA RSL Table[a]
Cadmium	7440-43-9	5	EPA RSL Table[a]
Chromium[1]	7440-47-3	100	EPA RSL Table[a]
Copper	7440-50-8	620	EPA RSL Table[a]
Lead	7439-92-1	15	Region 6[b]
Manganese	7439-96-5	320	EPA RSL Table[a]
Mercury[2]	7487-94-7	0.63	EPA RSL Table[a]
Molybdenum	7439-98-7	78	EPA RSL Table[a]
Nickel	7440-02-0	300	EPA RSL Table[a]
Silver	7440-22-4	71	EPA RSL Table[a]
Vanadium	7440-62-2	78	EPA RSL Table[a]
Zinc	7440-66-6	4700	EPA RSL Table[a]
HMX	2691-41-0	780	EPA RSL Table[a]
RDX	121-82-4	0.61	EPA RSL Table[a]
TNT	118-96-7	2.2	EPA RSL Table[a]
1,3,5-TNB	99-35-4	460	EPA RSL Table[a]
1,3-DNB	99-65-0	1.5	EPA RSL Table[a]
tetryl	479-45-8	63	EPA RSL Table[a]
NB	98-95-3	0.12	EPA RSL Table[a]
2A-4,6-DNT	35572-78-2	30	EPA RSL Table[a]
4A-2,6-DNT	1946-51-0	30	EPA RSL Table[a]
DNT-mixture 2,4/2,6	25321-14-6	0.092	EPA RSL Table[a]
2,6-DNT	606-20-2	15	EPA RSL Table[a]
2,4-DNT	121-14-2	0.20	EPA RSL Table[a]
2-NT (o-)	88-72-2	0.27	EPA RSL Table[a]
3-NT (m-)	99-08-1	1.3	Region 6[b]
4-NT (p-)	99-99-0	3.7	EPA RSL Table[a]
Nitroglycerin	55-63-0	1.5	EPA RSL Table[a]
PETN	78-11-5	16	
Perchlorate	14797-73-0	15	DoD[c]

Notes:
These values are "default" values. Local standards may be more stringent and take precedence.
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
1 - Screening value is for Total Chromium
2 - Screening value is for Elemental Mercury

Sources:

a - EPA Regional Screening Levels (RSL) table – From "Regional Screening Levels for Chemical Contaminants at Superfund Sites" which is an update for Region 3 RBCs, Region 6 MSSLs, and Region 9 PRGs. From: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm (30 May 2012)

b - Region 6 – Region 6 MSSL Values

c - DoD – The Department of Defense has established a screening value for perchlorate of 15 ppb.

Table 2 – Ecological Freshwater Surface Water System Values

		Freshwater Surface Water		Freshwater Sediment	
MC	**CAS #**	**Value (µg/L)**	**Source**	**Value (mg/kg)**	**Source**
Antimony	7440-36-0	30	EPA Region 3[a]	12	EPA Region 4[d]
Arsenic	7440-38-2	150	EPA NRWQC[2,b]	8.2	EPA OSWER*[,c]
Barium	7440-39-3	3.9	EPA OSWER[c]	20	EPA Region 6[f]
Cadmium	7440-43-9	0.25	EPA NRWQC[2,3,b]	1.2	EPA OSWER[c]
Chromium (VI)	7440-47-3	11	EPA NRWQC[2,b]	81	EPA OSWER[c]
Copper	7440-50-8	9	EPA NRWQC[2,3,b]	34	EPA OSWER[c]
Lead	7439-92-1	2.5	EPA NRWQC[2,3,b]	47	EPA OSWER[c]
Manganese	7439-96-5	80	EPA OSWER[c]	460	Ontario Guidelines[k]
Mercury	22967-92-6	0.77	EPA NRWQC[2,b]	0.15	EPA OSWER[c]
Molybdenum	7439-98-7	240	EPA OSWER[c]	4	D.D.MacDonald et al., 1994[g]
Nickel	7440-02-0	52	EPA NRWQC[2,3,b]	21	EPA OSWER[c]
Silver	7440-22-4	3.2	EPA NRWQC[2,3,b]	2	EPA Region 4[d]
Vanadium	7440-62-2	19	EPA OSWER[c]	50	NOAA Screening Tables[h]
Zinc	7440-66-6	120	EPA NRWQC[2,3,b]	150	EPA OSWER[c]
HMX	2691-41-0	150	EPA Region 3[a]	.0047-.47	EPA Region 4[1,d]
RDX	121-82-4	190	EPA Region 4[d]	.013-1.3	EPA Region 4[1,d]
TNT	118-96-7	90	EPA Region 4[d]	.092-9.2	EPA Region 4[1,d]
1,3,5-TNB	99-35-4	11	EPA Region 4[d]	.0024-.24	EPA Region 4[1,d]
1,3-DNB	99-65-0	20	EPA Region 4[d]	.0067-.67	EPA Region 4[1,d]
tetryl	479-45-8	NA		53.4	Nipper et al., 2002[j] (fine grain sediment)
NB	98-95-3	270	EPA Region 4[d]	0.488	EPA Region 4[d]
2A-4,6-DNT	35572-78-2	20	EPA Region 4[d]	NA	
4A-2,6-DNT	1946-51-0	NA		NA	
2,6-DNT	606-20-2	42	EPA Region 4[d]	0.0206	EPA Region 4[d]
2,4-DNT	121-14-2	44	EPA Region 3[a]	0.0751	EPA Region 4[d]
2-NT (o-)	88-72-2	NA		NA	
3-NT (m-)	99-08-1	750	EPA Region 3[a]	NA	
4-NT (p-)	99-99-0	1900	EPA Region 3[a]	NA	
Nitroglycerin	55-63-0	138	EPA Region 3[a]	NA	
PETN	78-11-5	85000	EPA Region 3[4,a]	NA	
Perchlorate	14797-73-0	9300	Dean et al.[e]	NA	

Notes:
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. E.g. for TNT in sediment w/ 5% TOC it would be: 0.46 (5*0.092=0.46)
2 - Value applies to dissolved metals
3 - The value is dependent on the hardness of the water, provided value is for a water hardness of 100 mg/L as CaCO3.
4 – For PETN, EPA Region III values came from TNRCC 2001 & 2000, which are documented sources k & l below.

Sources:
a - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
b - EPA, Office of Water, Office of Science and Technology (4304T), National Recommended Water Quality Criteria,

2006.
c - EPA Office of Solid Waste and Emergency Response Ecotox Thresholds, January 1996
d - EPA Region 4, Ecological Risk Assessment Bulletins – Supplement to RAGS (EPA 2001)
e - Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
f - EPA Region 6, Screening Level Ecological Risk Assessment Protocol, Aug 1999.
g – A Review of Environmental Quality Criteria and Guidelines for Priority substances in the Fraser River Basin, Prepared by D.D. MacDonald, MacDonald Environmental Sciences Limited, March 1994
h - NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages. Buchman, M.F., 1999.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
j - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
k - TNRCC 2000 Texas Surface water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Effective 17, 2000.

Table 3 – Ecological Marine Surface Water System Values

		Marine Surface Water		Marine Sediment	
MC	**CAS #**	**Value (µg/L)**	**Source**	**Value (mg/kg)**	**Source**
Antimony	7440-36-0	30	Suter and Tsao, 1996[e]	2	NOAA 1990[g]
Arsenic	7440-38-2	36	USEPA, 2004[b]	7.24	MacDonald et al., 2000*[,h]
Barium	7440-39-3	4	Suter and Tsao, 1996[e]	NA	
Cadmium	7440-43-9	8.8	USEPA, 2004[b]	0.68	MacDonald et al., 2000[h]
Chromium (VI)	7440-47-3	50	USEPA, 2004[b]	52.3	MacDonald et al., 2000[h]
Copper	7440-50-8	3.1	USEPA, 2004[b]	18.7	MacDonald et al., 2000[h]
Lead	7439-92-1	8.1	USEPA, 2004[b]	30.2	MacDonald et al., 2000[h]
Manganese	7439-96-5	120	Suter and Tsao, 1996[e]	460	Ontario Guidelines[i]
Mercury	22967-92-6	0.94	USEPA, 2004[b]	0.14	
Molybdenum	7439-98-7	370	Suter and Tsao, 1996[e]	NA	
Nickel	7440-02-0	8.2	USEPA, 2004[b]	15.9	MacDonald et al., 2000[h]
Silver	7440-22-4	1.9	USEPA, 2004[b]	0.73	MacDonald et al., 2000[h]
Vanadium	7440-62-2	20	Suter and Tsao, 1996[e]	NA	
Zinc	7440-66-6	81	USEPA, 2004[b]	124	MacDonald et al., 2000[h]
HMX	2691-41-0	330	Talmage et al., 1999[o]	.0047-.47	EPA Region 4[1,a]
RDX	121-82-4	5000	Nipper et al., 2001[k]	.013-1.3	EPA Region 4[1,a]
TNT	118-96-7	180	Nipper et al., 2001[k]	.092-9.2	EPA Region 4[1,a]
1,3,5-TNB	99-35-4	25	Nipper et al., 2001[k]	.0024-.24	EPA Region 4[1,a]
1,3-DNB	99-65-0	180	Nipper et al., 2001[k]	.0067-.67	EPA Region 4[1,a]
tetryl	479-45-8			53.4	Nipper et al., 2002[l] (fine grain sediment)
NB	98-95-3	66.8	USEPA, 2002[c]	27	Talmage and Opresko, 1995[j]
2A-4,6-DNT	35572-78-2	1480	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
4A-2,6-DNT	1946-51-0	NA	NA	NA	
2,6-DNT	606-20-2	1000	Nipper et al., 2001[k]	0.55	Nipper et al., 2002[l]
2,4-DNT	121-14-2	480	Nipper et al., 2001[k]	0.23	Talmage and Opresko, 1995[j]
2-NT (o-)	88-72-2	NA	NA	NA	
3-NT (m-)	99-08-1	NA	NA	NA	
4-NT (p-)	99-99-0	NA	NA	NA	
Nitroglycerin	55-63-0	138	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
PETN	78-11-5	85000	EPA Region 3[2,d]	NA	
Perchlorate	14797-73-0	9300	Dean et al., 2004[f]	NA	

Notes:
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. (e.g. for TNT in sediment w/ 5% TOC it would be: 0.46)(5*0.092=0.46)
2 - EPA Region III for PETN marine water refers to US EPA Region 3's Freshwater Screening Benchmark table for a value. These values came from TNRCC 2001 & 2000, which are documented sources m & n below.

Sources:
a - EPA Region 4, Ecological Risk Assessment Bulletins - Supplement to RAGS (EPA 2001)
b – EPA – USEPA 2009 National Recommended Water Quality Criteria Office of Water and Office of Science and Technology.
c – EPA – USEPA 2002 Ecological Risk Assessment Bulletin 2/11/2002. Waste Management Division, Freshwater Surface Screening Values for Hazardous Waste Sites, February.
d - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
e – Suter and Tsao, 1996 Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 196 Revision. ES/ER/Tm-96/R2.
f – Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
g - The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52. Long, E.R. and L.G. Morgan. 1990.
h - MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology, 39: 20-31.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
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k – Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, K. Miller, and S. Saepoff, 2001. Development of Marine Toxicity Data for Ordnance Compounds, Archives of Environmental Contamination and Toxicology, 41:308-31.
l - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
m – TNRCC 2001 Guidance for Conducting Ecological Risk Assessment and Remediation Sites in Texas, Toxicology and Risk Assessment Section, December.
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o – Talmage, S.S., D.M. Opresko, C.J. Maxwell, J.E. Welsh, M. Cretelia, P.H. Reno, and F.B. Daniel. 1999. Nitroaromatic munition compounds: Environmental effects and screening values. Reviews in Environmental Contamination and Toxicology, 161: 1-156.