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Marine Corps Combat Development Command Quantico

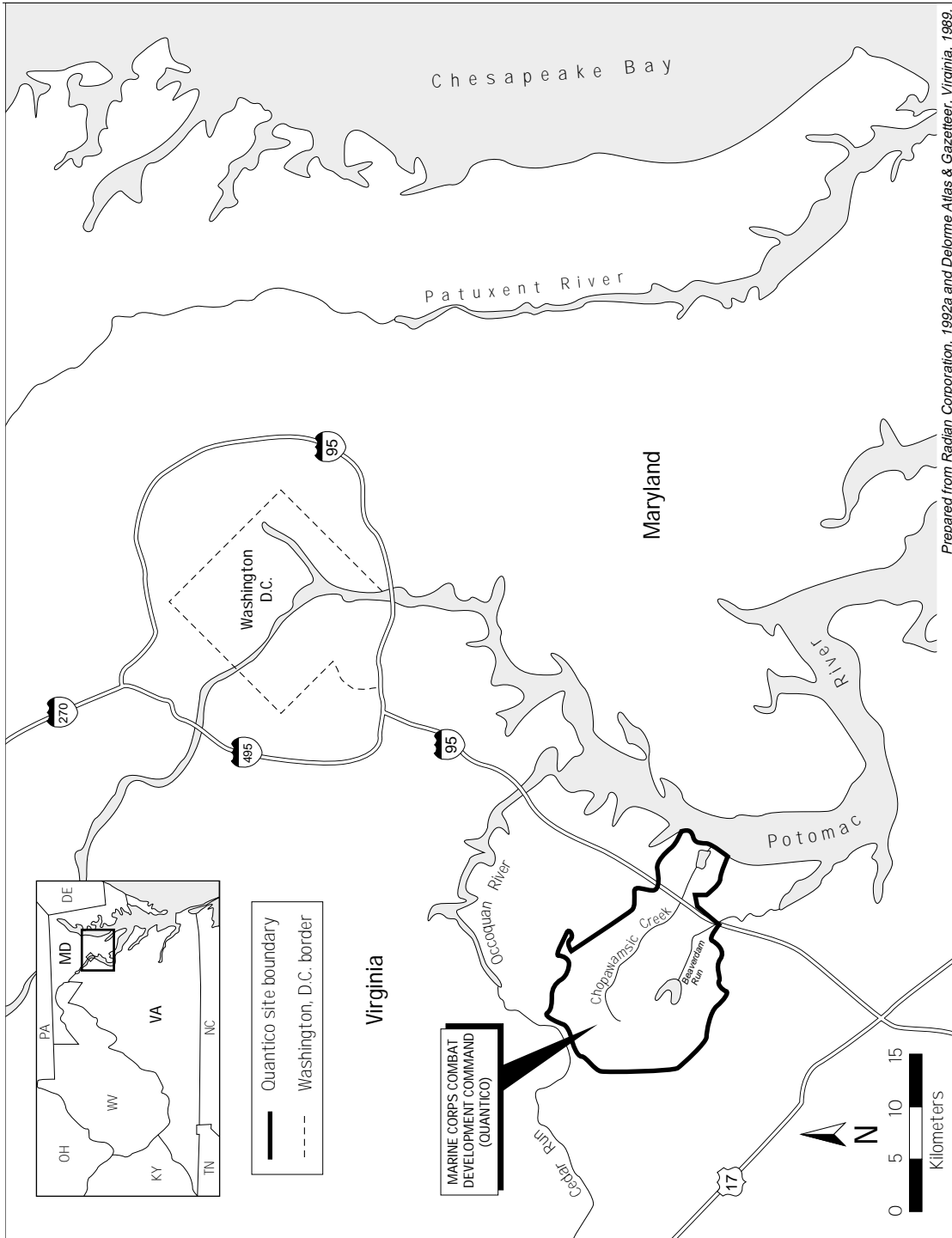
Quantico, Virginia
CERCLIS #VA1170024722

■ Site Exposure Potential

The U.S. Marine Corps Combat Development Command (MCCDC) at Quantico, Virginia, borders the Potomac River and occupies more than 24,250 hectares of mainly undeveloped land. The base is spread over several watersheds, including Cedar Run Creek, Quantico Creek, Chopawamsic Creek, Aqua Creek/Beaver Dam Run, and Little Creek, all of which flow into the Potomac River on the eastern border of the site (Figure 1). The base lies between the tidal and estuarine transition zones of the Potomac River, approximately 130 km from the Chesapeake Bay. There are two major organizations at MCCDC

Quantico: the Education Center, which prepares Marine Corps officers for general combat, and the Development Center, which focuses on research and development of Marine Corps equipment.

Seven sites have been identified as areas of concern: the Old Landfill, Old Batch Plant, Recently Closed Landfill, Fire Training Area, Arsenic Burial Area, Aero Club, and Pesticide Burial Area (Figure 2; Radian 1992 a-g). The dates of operation, types and quantities of waste, and pathways to NOAA trust resource habitats for these seven sites are presented in Table 1.



Prepared from Radian Corporation, 1992a and DeLorme Atlas & Gazetteer, Virginia, 1989.

Figure 1. Location of MCCDC, Quantico, Virginia.

Surface runoff from the Old Landfill and the Old Batch Plant enters the Potomac River. Surface water flows from the Recently Closed Landfill and Fire Training Area into Chopawamsic Creek or its tributaries. Information was unavailable in the documents reviewed for surface pathways from the remaining three sites (the Pesticide Burial Area, Arsenic Burial Area, and the Aero Club). Details on surface water pathways are presented in Table 1.

Six of the seven sites of concern are located in the Atlantic Coastal plain. The overlying geology in the Atlantic Coastal plain consists of 1.5 to 2.7 m of sand, gravel, and sandy clay terrace riverine deposits. The coastal plain sediments are a recharge zone for underlying shallow aquifers, and groundwater tends to flow to the southeast, towards the Potomac River (Radian 1992 a-g). Groundwater discharge to the Potomac River is a potential pathway at the Old Landfill site. There is insufficient information to determine whether groundwater is a pathway from the Arsenic Burial Area and Pesticide Burial Area to NOAA trust resources. The Recently Closed Landfill is the one site that lies in the Piedmont Province, where leachate seeps indicate that shallow groundwater is discharging. Groundwater in the Piedmont Province is primarily contained in bedrock fractures, but information was not available on groundwater direction or depth under the MCCDC.

NOAA Trust Habitats and Species

Habitats of primary concern to NOAA are surface water, bottom substrates, associated wetlands of Chopawamsic Creek, and the Potomac River. MCCDC Quantico includes 19 km of tidal Potomac River shoreline. Chopawamsic Creek and the Potomac River provide substantial nursery and adult forage habitat for numerous trust species (Table 2). Quantico Creek and Chopawamsic Creek are relatively shallow, ranging from less than 1 m to 5 m, while the Potomac River averages 5 m deep, except for the deeper water of Shipping Point off the northeastern boundary of MCCDC Quantico (USGS 1986). The reach of the Potomac River near the site is characterized as the Potomac Transition Zone, with tidal influences and varying salinity levels resulting from the convergence of the Potomac River and Estuary (Radian 1992 a-g). Salinity levels range from 3 to 4 ppt. Tidal amplitude near MCCDC Quantico is approximately 0.4 m. Substrate composition in the Quantico area is sandy, loamy clay with abundant silt and sand (Steinkoenig personal communication 1994).

There are approximately 210 hectares of wetlands along Chopawamsic Creek, Quantico Creek, and the Potomac River near MCCDC. Most aquatic vegetation associated with open-water wetland areas is composed of aquatic hydrilla (*Hydrilla verticillata*) and Eurasian milfoil (*Myriophyllum heterophyllum*). Wetland vegetation associated with on-site wetlands include wild celery (*Valisneria americana*), water-nymph (*Najas* spp.), sago pondweed (*Potamogeton pectinatus*), broad-leaved cattail (*Typha latifolia*), yellow pond

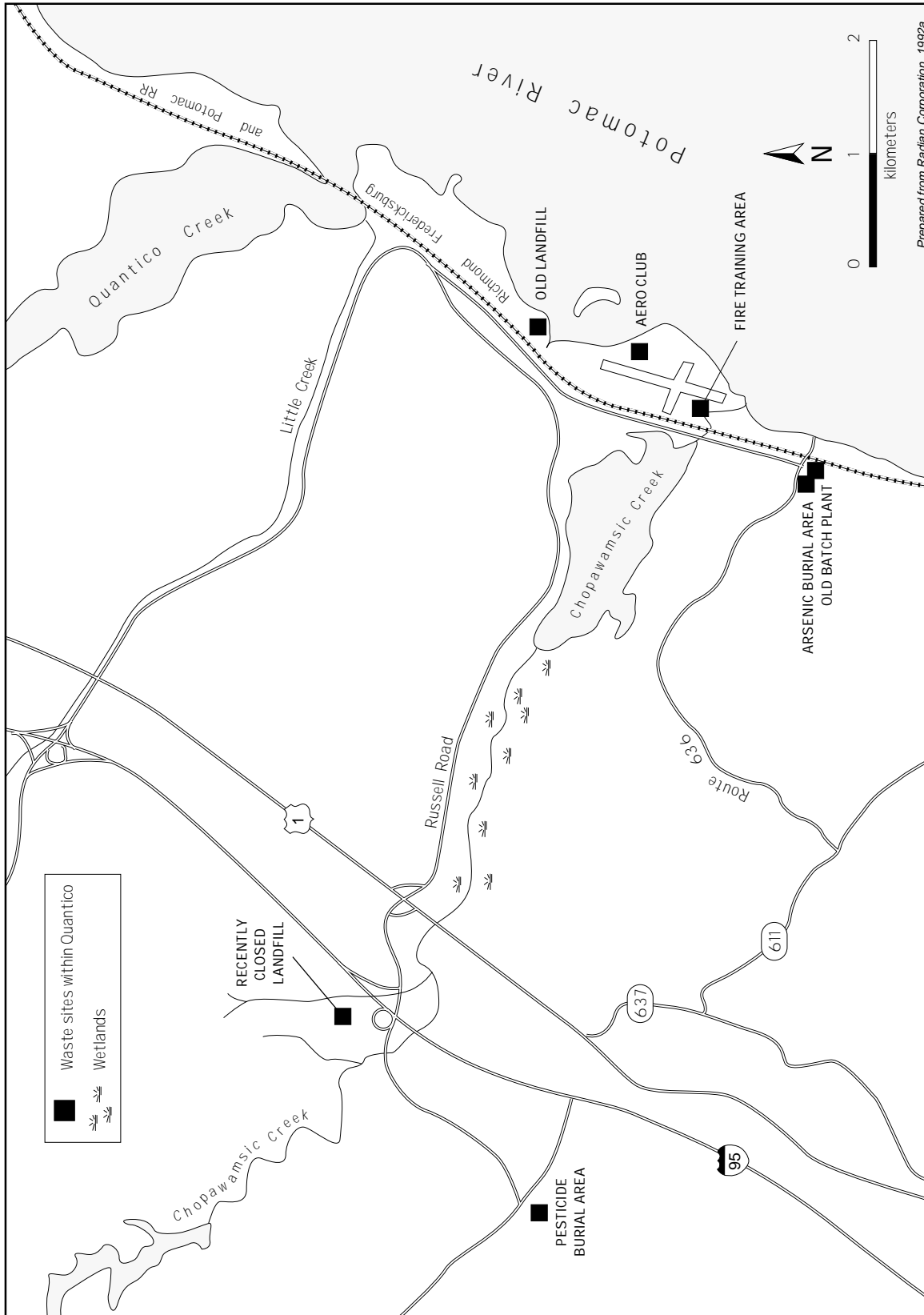


Figure 2. Detail of MCCCDC in Quantico, Virginia.

Table 1. Summary of site operations and pathways at the MCCDC Quantico site.

Site	Dates of Operation	Types and Quantities of Waste	Pathways to Trust Resources
Old Landfill	1920s to 1971	Paint (37,850 l), paint thinner and cleaner (22,710 l), lead from paint (13,600 kg), vehicle batteries (20,000 batteries), sludge from Viscosine burning (91 kg), compressor oil (450 l), sludge from paint spray booth (1810 kg), transformer dielectric oils (450 l), and various inert wastes.	Filled area of Potomac River shoreline extending 200-400 m into the river. A drainage ditch and unnamed creek cross the landfill and discharge to the Potomac River. Surface water runoff and associated sediment transport is main pathway. Direct contact and groundwater transport are potential pathways.
Old Batch Plant	1970s	Former location of a concrete batch plant where 34 electrical transformers (23 containing PCBs) were stored.	A creek/drainage system flows approximately 230 m from the site to the Potomac River. Surface water runoff and transport of accumulated sediments in drainage system structures are primary pathways of concern.
Recently Closed Landfill	Main landfill for the base from 1971 to 1983	Paint (27,000 l), paint thinner and cleaner (60,560 l), vehicle batteries (2,800 batteries), sludge from Viscosine (26 l), compressor oil (114 l), sludge from paint spray booths (454 kg), and various inert wastes.	The site is bordered to the east and west by tributaries of Chopawamsic Creek, which flows approximately 6 km from the site to the Potomac River. Leachate seeps have been observed. Surface water runoff and associated sediment transport are pathways of concern.
Fire Training Area	Since the late 1920s.	An estimated 9,000 l/yr of fuel were burned over 25 years, for a total of approx. 227,000 l. The amount of unburned fuel, combustion residuals and overflow products was estimated to be about 22,700 l based on a 90% combustion ratio.	The site is next to Chopawamsic Creek. Surface water runoff and associated sediment transport are the primary pathways of concern.
Pesticide Burial Area	June 1974	Waste pesticides from the Pest Control Shop, including lead arsenate 98% (65.4 kg), sulfur 95% (22.6 kg), dieldrin 15% (49.3 l), Paris Green (11.3 kg), Captan 50% (22.6 kg), and Kelthane 18.5% (228 l) were buried.	Based on the distance to the Potomac River (approximately 7 km), a complete groundwater pathway is unlikely. A removal action was completed and the site was filled with clean soil (Halliburton NUS 1994).
Arsenic Burial Area	Late 1960s or early 1970s	Alleged location of 27 drums of herbicide, but location not confirmed.	Groundwater is a potential pathway; placement of monitoring wells may have missed a groundwater plume.
Aero Club	Not available	Drums of waste oils, lubricants and fuel stored. Based on interviews with Aero Club personnel, approximately 2,100 l of aviation fuel and 950 l of waste oil were spilled.	Insufficient information was available to assess the potential for surface water runoff. Reportedly, there is no surface pathway nor constructed drainage system near the Aero Club.

Table 2. Major trust species that use the Potomac River near MCCDC Quantico.

Species		Habitat			Fisheries	
Common Name	Scientific Name	Spawning	Nursery	Adult Forage	Comm.	Recr.
<u>ANADROMOUS /CATADROMOUS SPECIES</u>						
Atlantic sturgeon*	<i>Acipenser oxyrinchus</i>			♦		
Blueback herring	<i>Alosa aestivalis</i>		♦	♦	♦	♦
Alewife	<i>Alosa pseudoharengus</i>		♦	♦	♦	♦
American shad	<i>Alosa sapidissima</i>		♦	♦	♦	
American eel	<i>Anguilla rostrata</i>		♦	♦	♦	
White perch	<i>Morone americana</i>	♦	♦	♦	♦	♦
Striped bass	<i>Morone saxatilis</i>		♦	♦	♦	♦
<u>ESTUARINE /MARINE FISH</u>						
Bay anchovy	<i>Anchoa mitchelli</i>		♦	♦	♦	
Atlantic menhaden	<i>Brevoortia tyrannus</i>		♦		♦	
Sheepshead minnow	<i>Cyprinodon variegatus</i>	♦	♦	♦		
Killifish	<i>Fundulus</i> spp.	♦	♦	♦		
Mummichog	<i>Fundulus heteroclitus</i>	♦	♦	♦		
Gobies	<i>Gobiosoma</i> spp.	♦	♦	♦		
Channel catfish	<i>Ictalurus punctatus</i>	♦	♦	♦	♦	♦
Spot	<i>Leiostomus xanthurus</i>		♦	♦	♦	♦
Silversides	<i>Menidia</i> spp.	♦	♦	♦		
Atlantic croaker	<i>Micropogonias undulatus</i>		♦	♦	♦	♦
Yellow perch	<i>Perca flavescens</i>	♦	♦	♦	♦	♦
Northern pipefish	<i>Syngnathus fuscus</i>	♦	♦	♦		
Hogchoker	<i>Trinectes maculatus</i>	♦	♦	♦		
<u>INVERTEBRATE SPECIES</u>						
Blue crab	<i>Callinectes sapidus</i>		♦	♦	♦	♦

*: Federally threatened species.

lily (*Nuphar variegatum*), pickerelweed (*Pontederia cordata*), wild rice (*Zizania aquatica*), arrow arum (*Peltandra virginica*), sword grass (*Scirpus americanus*), willow (*Salix* spp.), and bur-reed (*Sparganium eurycarpum*; Steinkoenig personal communication 1994).

The Potomac River is an important migratory corridor for numerous anadromous populations: five species of anadromous fish use the Potomac River near MCCDC Quantico for spawning,

nursery, and adult forage habitat. These include alewife, American shad, blueback herring, striped bass, and white perch. Atlantic sturgeon, a Federal threatened species, uses the Potomac River near the site for nursery and adult forage habitat. Abundant estuarine and marine species include bay anchovy, Atlantic menhaden, killifish, silverside, and mummichog. Channel catfish, spot, yellow perch, and hogchoker are common species, with sheepshead, goby, Atlantic croaker, and Northern pipefish occurring less frequently.

Blue crab are the most abundant species of invertebrates near the site (Stone et al. 1994).

The catadromous American eel is also a common species in the area. The Chopawamsic Creek has been classified as a nursery both for commercially valuable fish and sport fish (Steinkoenig personal communication 1994).

The Potomac River supports important commercial and recreational fisheries. NOAA trust species commercially harvested near the site include blueback herring, alewife, catfish, white perch, and yellow perch. There are also extensive commercial fisheries for blue crab and American eel. Recreational fishing is heavy in the spring on the Potomac River and creeks next to MCCDC Quantico. The primary species caught recreationally include alewife, channel catfish, blueback herring, hickory shad, white perch, yellow perch, striped bass, and blue crab. Oyster and American eel are also harvested recreationally in limited quantities (Steinkoenig personal communication 1994). A recent statewide moratorium on shad fishing restricts all 1994 harvests. There are no health advisories or restrictions for the consumption of fish from the Potomac River or surface water surrounding MCCDC Quantico (Steinkoenig personal communication 1994).

The State of Virginia stocks walleye (*Stizostedion vitreum*) at the Lunga Reservoir on the base, and MCCDC Quantico stocks trout in Chopawamsic and Quantico creeks. Neither of these two species is a NOAA trust resource.

■ Site-Related Contamination

Data collected during the remedial investigation indicated that sediment, soil, groundwater, and surface water at the base are contaminated with pesticides, PCBs, trace elements, and PAHs (Radian 1992 a-g). Contaminant data indicated that the Old Landfill had the most widespread contamination, the highest concentrations, and the most contaminants of concern (Radian 1992e).

Pesticides and PCBs were found at concentrations exceeding screening guidelines in sediment and surface water (Tables 3 and 4). Concentrations of PCBs and DDT constituents in Old Batch Plant drainage structure and creek sediment samples exceeded ERM guidelines. PCBs and DDT constituents in sediments exceeded ERM concentrations in the Old Landfill drainage ditch and creek, and also in the Potomac River next to the site. Concentrations of PCBs (maximum 8.4 µg/l) exceeded the acute AWQC in Old Landfill drainage ditch surface water. Fish tissue samples collected from the Potomac River next to the Old Landfill contained Aroclor 1260 (840 µg/kg), DDE (190 µg/kg), and DDD (460 µg/kg). Detection limits for sediment samples were generally above concentrations known to cause effects, and therefore contamination of the Potomac River was not adequately characterized in the RI. The Old Batch Plant surface water and groundwater sample detection limits for PCBs and DDT constituents were up to two orders of magnitude above the chronic AWQC (Table 4). Detection limits for DDT

Table 3. Maximum concentrations of trace elements (mg/kg) and organic compounds (µg/kg) in sediment and soil of the MCCDC Quantico Old Landfill (Radian Corporation 1992e).

Chemicals	Sediment					Soil	
	Drainage channel	Unnamed Tributary	Potomac River	ERL ¹	ERM ¹	Erosional Areas ²	Average US Soil ³
TRACE ELEMENTS (mg/kg)							
Arsenic	27	39	4.7	8.2	70	5.3	5
Chromium	65	44	27	81	370	38	100
Copper	520	180	39	34	270	62	30
Lead	700	160	73	47	220	170	10
Mercury	1.4	0.41	0.72	0.15	0.71	0.44	0.03
Nickel	77	68	29	21	52	44	40
Silver	3.1	41	3.3	1.0	3.7	2.3	0.05
Zinc	1,700	250	140	150	410	460	50
ORGANIC COMPOUNDS (µg/kg)							
Benzo(a)anthracene	<2,600	280	670	260	1,600	1,100	NA
Benzo(a)pyrene	280	170	400	430	1,600	810	NA
Chrysene	360	390	710	380	2,800	1,000	NA
Fluoranthene	590	910	1,400	600	5,100	1,900	NA
Phenanthrene	2,900	1,200	970	240	1,500	480	NA
Pyrene	690	520	1,000	670	2,600	1,400	NA
DDD	300	650	340	NA	NA	85	NA
DDE	220	280	150	2.2	27	66	NA
DDT	<130	180	150	1.6	46	210	NA
Aroclor 1260	190,000	1,700	260	23	180	540	NA
1: Effects Range-Low and Effects Range-Median (Long and MacDonald 1992).							
2: Erosional areas next to the Potomac River.							
3: Lindsay (1979).							
NA: Not available or not analyzed.							
<: Not detected at detection limit shown.							

Table 4. Maximum concentrations of the major contaminants in Old Batch Plant sediment and surface water at the MCCDC Quantico site (Radian Corporation 1992d).

ORGANIC COMPOUNDS	Surface Water (µg/l)			Sediment (µg/kg)				
	Potomac River	Chronic AWQC ¹		Creek	Drainage Structure	Potomac River	ERL ²	ERM ²
Marine	Fresh-water							
PCBs	<1.3	0.03	0.014	550	<2,200	<570	23	180
DDD	<0.13	NA	NA	170	3,900	110	NA	NA
DDE	<0.13	NA	NA	140	700	<57	2.2	27
DDT	<0.13	NA	NA	<78	2,000	<57	NA	NA
Total DDT	NA	0.001	0.001	NA	NA	NA	1.6	46
1: Ambient water quality criteria (U.S. EPA 1993).								
2: Effects Range-Low and Effects Range-Median (Long and MacDonald 1992).								
NA: Not available or not analyzed.								
<: Not detected at detection limit shown.								

were two orders of magnitude above the chronic AWQC.

Sediments and biota were collected by the U.S. Fish and Wildlife Service from the Quantico embayment of the Potomac River for a human health risk assessment (Pinkney 1995). Eleven of the 28 sediment samples from the Quantico embayment had concentrations of total PCBs that exceeded their ERM concentration. Eight of these 28 sediment samples had DDT concentrations that exceeded the ERM. Table 5 summarizes the maximum concentrations of total PCBs and total DDT in sediment and selected biota from the Quantico embayment (Pinkney et al. 1995).

exceeded ten times the AWQC. Trace elements are the primary contaminants of concern at the Recently Closed Landfill (Table 6), and concentrations of arsenic, copper, and silver in tributary sediments were detected above ERL guidelines. Surface water, leachate seeps, and filtered groundwater at the Old Landfill exceeded the chronic AWQC for lead, nickel, silver, and zinc. Fire Training Area soils are contaminated with trace elements with concentrations of lead (283 mg/kg), copper (56.6 mg/kg), and zinc (133 mg/kg) above the average found in U.S. soils.

Table 5. Maximum concentrations (mg/kg) of total PCBs and total DDT in sediments and selected biota from the Quantico embayment of the Potomac River (Pinkney et al. 1995).

Contaminants	Sediment			Tissue	
	Site	ERL	ERM	Carp	American Eel
PCBs	2.3	0.0027	0.18	3.6	2.4
DDT	1.1	0.0016	0.046	1.5	2.6

Sediment concentrations of trace elements in Old Landfill drainages generally exceeded ERL guidelines (Table 3). Copper, lead, mercury, nickel, and silver exceeded ERL guidelines in the Potomac River. Surface water samples collected from the Old Landfill drainage channels had concentrations of cadmium, chromium, lead, nickel, silver, and zinc that exceeded the chronic AWQC, while copper exceeded its acute AWQC. Trace elements were ubiquitous in Old Landfill groundwater, with copper, lead, mercury, silver, and zinc the most prevalent, although none

Several PAHs in sediment samples from Old Landfill drainages and the Potomac River exceeded ERL concentrations (Table 3). PAHs were also detected in low concentrations in Chopawamsic Creek sediments collected next to the Fire Training Area. However, the Fire Training Area sediment samples were collected using a hand trowel, a method that tends to lose fine-grained material. Therefore, Chopawamsic Creek sediments were probably inadequately characterized.

Table 6. Maximum concentrations of trace elements in Recently Closed Landfill sediment, surface water, and groundwater at the MCCDC Quantico site (Radian Corporation 1992g).

TRACE ELEMENTS	Water (µg/l)				Sediment (mg/kg)		
	Surface Water	Leachate Seeps	Ground-water	AWQC ¹ Chronic	Tributaries	ERL ²	ERM ²
Arsenic	16.6	20	2.4	190	84.	8.2	70
Chromium	<300	85	31	210/11*	19	81	370
Copper	6.9	1,100	55	12	41	34	270
Lead	84	57	15	3.2	15	47	220
Mercury	0.13	0.1	ND	0.012	0.12	0.15	0.71
Nickel	430	2,400	280	160	15	21	52
Silver	7.1	7.3	12	0.12	2.6	1.0	3.7
Zinc	1,400	2,700	560	110	65	150	410

1: Ambient water quality criteria (U.S. EPA 1993).
2: Effects Range-Low and Effects Range-Median (Long and MacDonald 1992).
NA: Not available or not analyzed.
*: Cr +3/Cr+6
<: Not detected at detection limit shown.

■ Summary

The Potomac River, Chopawamsic Creek, and other watersheds in the area of MCCDC Quantico provide substantial nursery and adult forage habitat for numerous trust species. Surface water, sediment, soil, and groundwater are contaminated to varying degrees with trace elements, pesticides, PCBs, and PAHs. The Old Landfill and the Old Batch Plant pose the most substantial threats to NOAA trust resources due to elevated contaminant concentrations, short pathways, and proximity to NOAA habitats.

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