ALBUQUERQUE FIELD OFFICE CONTAMINANTS REPORT

ECOLOGICAL SERVICES APRIL 1990

CONTAMINANTS INVESTIGATION OF THE WHITE RANCH ROSWELL NEW MEXICO 1987

FIB AND WILDLIFE SERVICE

U.S. DEPARTMENT OF THE INTERIOR

Assessment of heavy metal contaminant levels in Biota and sediment on the White Ranch

Roswell, New Mexico

1987

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April 1990

ABSTRACT

Sediment, aquatic invertebrates, plants and fish were sampled at nine sites on the White Ranch, at Roswell, New Mexico for a pre-acquisition contaminant survey. Contaminants at the Mite Ranch could originate from a variety of sources including, agriculture, municipal waste and past attempts to desalinate groundwater. Samples consisted of plains lsillifish, mosquitofish, Rio Grande shiner, bluegill, aquatic invertebrates, aquatic plants, muskweed, winter oats, white clover and sediment. The samples were analyzed for heavy metal residues. Separate digestion was done for arsenic, mercury and selenium. Arsenic was analyzed by hydride generation. Mercury was analyzed by a Mercury Hydride System (MHS). The other elements were analyzed by inductively coupled plasma spectrophotometry. Residues of aluminum, barium, beryllium, boron, cadmium, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, silver, thallium, tin and zinc were at or below normal levels and therefore, these elements are not likely to cause any adverse impact . Residues of vanadium and strontium appear to be elevated in aquatic plants; however, the biological significance of these compounds has not been determined. Chromium residues were high in some terrestrial plants and at the moto-cross drainage channel downslope from the salt pond area. Chromium residues, if present in the hexavalent form, may be toxic to wildlife. Arsenic residues are elevated in aquatic plants in the Rio Hondo, a condition that may be associated with high levels of arsenic in the Rio Bondo water. This may be due to disposal of municipal wastewater into the Rio Hondo. Selenium residues at the White Ranch are elevated over what is considered a non-contaminated site and may cause adverse impacts to Interior Trust Resources.

Introduction

Biological samples were collected at the White Ranch addition to Bitter Lake National Wildlife Refuge (Refuge) in 1987 as part of the Fish and Wildlife Service, Environmental Contaminant Assessment Program. Biological collections were done in compliance with the Fish and Wildlife Service policy of evaluating new additions to the National Wildlife System for environmental contaminants prior to purchase.

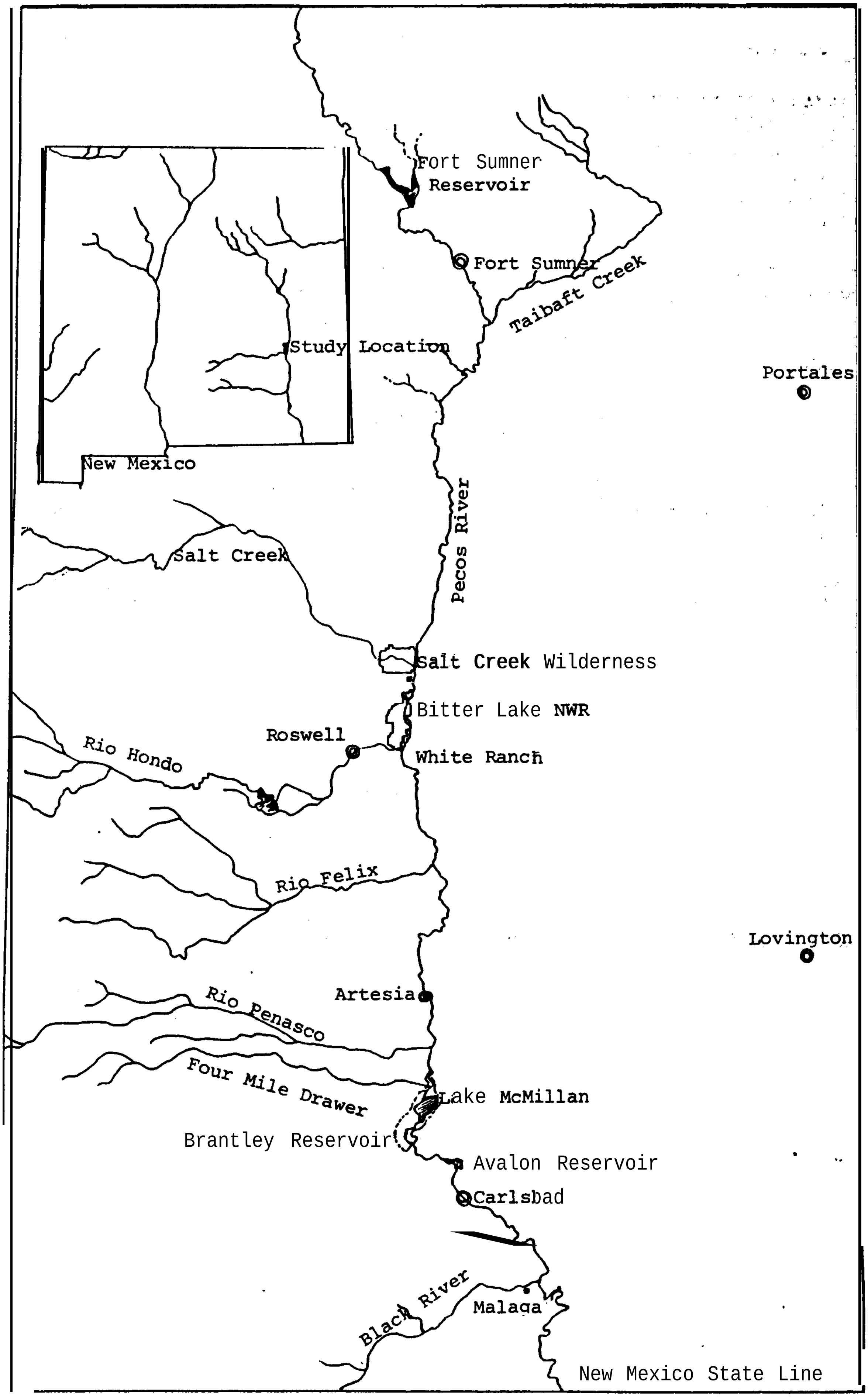
The 1,048-acre White Ranch in Chaves County is located at Township 11 South, Range 25 East, in portions of Sections 4, 5, 8 and 9; New Mexico Principal Meridian. The proposed addition is bounded by U.S. Highway 380 on the north, the Hagerman Canal on the west and south and the Pecos River on the east. The Rio Hondo runs through the property (Map 1).

In Chaves County, approximately two percent (83,000 acres) of the total land area is cropland, more than 50 percent of which is used for hay production (NM Ag. St. 1986). The majority of the cropland is south of the Refuge on the west side of the Pecos River. Roswell, with a population of 47,000 (1984 census), is situated west of the Refuge and is the only major urban center in Chaves County.

Biological samples at the Bitter Lake National Wildlife Refuge were analyzed in 1986 for organochlorine and heavy metal compounds. In comparison to past analysis pesticide residues in starlings from the National Contaminant Biomonitoring Program (Bunck et al. 1987), samples of birds, fish, plants and sediment taken from Bitter Lake had low levels of organochlorine compounds. Except as noted below, most metal compounds were either not detected on the Refuge or were below environmental concern levels. Chromium and copper residues in carp were elevated in Hunter Marsh and copper residues were statistically higher at Bitter Lake in comparison to the Rio Grande. Chromium residues in sediment, vegetation and tissue were above normal reported levels. Lead residues were detected in sediment (310 parts per million (ppm) dry weight) and mosquitofish (13.0 ppm dry weight) in Hunter Harsh, but were not detected at other locations on the Refuge. Selenium residues were elevated throughout the Refuge, particularly at Unit 15 and Hunter Harsh. Selenium residues in sediment had a maximum value of 4.4 ppm dry weight. Selenium residues in birds are in the mid-range of values reported in literature (14.0 ppm dry weight liver). Selenium residues in fish ranged from 1.4 to 5 ppm dry weight, which are above values known to produce reproductive difficulties. Based on these data, samples at the White Ranch were analyzed only for heavy metal compounds.

Sampling Area

The middle basin of the Pecos River Drainage extends from Sumner Reservoir, 16 miles north of Fort Sumner, New Mexico, to Red Bluff Reservoir on the Texas - New Mexico border. The Pecos River originates above 13,000 feet elevation in the Truchas Peak area of the Sangre de Cristo Mountains of northern New Mexico. From Truchas Peak the river flows through steep canyons and gorges as



Map 1. Study Location, Bitter Lake NWR and White Ranch Addition, Pecos River, Roswell, New Mexico.

it drops to 4,300 feet elevation at Sumner Lake in DeBaca County, New Mexico. At Fort Sumner, the stream gradient and velocity change the river flows south through a broad, rolling floodplain past the Bitter Lake National Wildlife Refuge (elevation 3,525 feet). Main tributaries of the Pecos River above Sumner Reservoir are the Gallinas River and Tecolote Creek. Below the Reservoir the principal tributaries are the Rio Hondo and Rio Penasco both of which originate in the Sacramento Mountains. Areas of significance to agriculture and fish and wildlife resources, downstream from Sumner Reservoir, are Bitter Lake National Wildlife Refuge, McMillan Delta, Lake Avalon and the Brantley Reservoir.

The area of the Pecos River watershed is approximately 44,500 square miles, of which 25,450 square miles are in New Mexico. The Pecos River has an average annual flow of 184,500 acre-feet at Artesia and 272,900 acre-feet at Red Bluff Reservoir. A large, contiguous portion of the watershed, about 11,300 square miles, does not contribute to surface runoff due to the occurrence of sinkholes and scattered playa lakes. In this area, a large volume of surface water infiltrates to underground channels, and some of which reappears as small springs along the river.

The two main areas of wildlife concentration in the basin are the 23,350- acre Bitter Lake National Wildlife Refuge north of Roswell and the McMillan Delta-Brantley Dam area south of Roswell. Established in 1937, the Refuge is situated adjacent to the Pecos River floodplain and consists of two tracts or areas: the Salt Creek Wilderness comprises the north tract: the south tract consists of Bitter Lake and six man-made impoundments formed by dikes across natural seeps in the Pecos River valley. The White Ranch is located south of Highway 380 immediately on the Pecos River and immediately downstream from the Refuge. Bitter Lake, from which the Refuge takes its name, is an alkaline playa lake fed by intermittent springs. The Roswell municipal waste treatment plant discharged treated effluent to Bunter Marsh at the time of this study (USFWS 1986).

The Refuge is managed for migratory waterfowl and sandhill cranes. Two endangered species are found on the Refuge, the Pecos gambusia (Gambusia nobilis) and the interior least tern (Sterna antillarum). The Pecos bluntnose shiner (Notropis simus pecosensis), a threatened species is found in the Pecos River in the vicinity of the Refuge.

Bitter Lake NWR has identified over 30 species of waterfowl in the area. The importance of the Refuge to migratory birds is confirmed by the large numbers of ducks and geese (over 100,000 ducks and 65,000 geese) observed during fall migrations. The Refuge also accommodates over 70,000 lesser sandhill cranes during the fall and winter migration. Hildebrant, Thomas and Ohmart (1982) identified 91 species of passerine and gallinaceous birds, as well as nine species of raptors, utilizing the upland plant communities. Over 30 species of mammals occur in the vicinity of Bitter Lake. Fourteen species of amphibians and 57 species of reptiles have been reported in the Pecos River valley in Chaves and Eddy counties (USDI 1981).

Procedure

Samples of aquatic invertebrates, fish, sediment and aquatic plants were collected in December 1987. Aquatic invertebrates and fish were collected using seines and dip nets; sediment was collected with an **Eckman** dredge or by hand: aquatic plants were collected by hand. Birds were not collected because migratory or resident birds **were** not present on the property in sufficient numbers or duration to make analysis relevant. Sample sites **are shown in Hap 2.** Species of aquatic invertebrates, fish and plants collected at respective sites are listed in Table 1. Species were selected for analysis based upon their **trophic** level and availability.

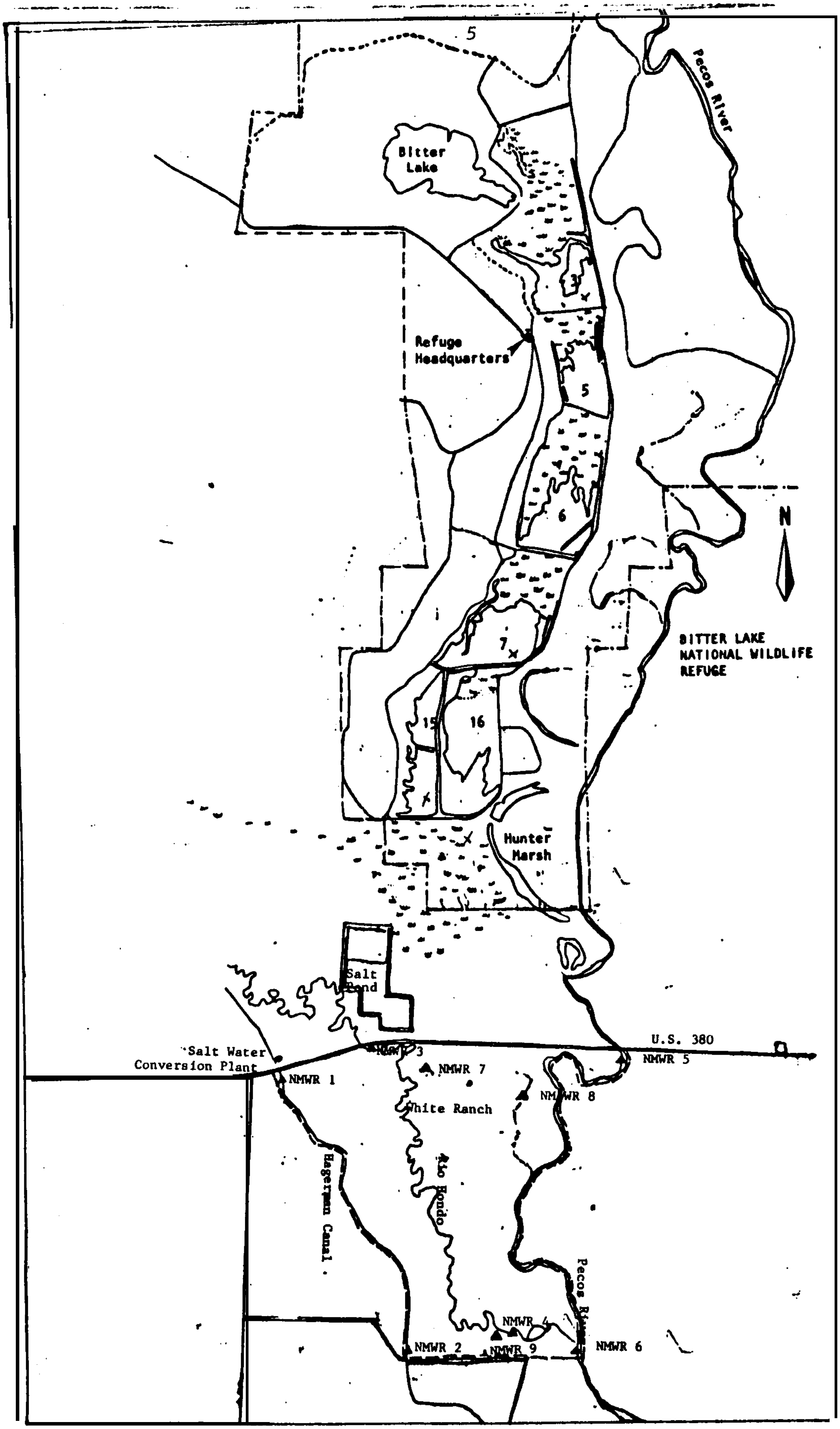
All samples were frozen and shipped to Hazleton Laboratory with **a 15-day** analytical turn-around request **for** heavy metal analysis. **A** separate digestion was performed for trace elements selenium, arsenic and mercury prior to analysis. Arsenic was analyzed by Hydride generation, selenium was **analyzed** by inductively coupled spectrophotometry and mercury levels were determined by **Mercury** Hydride System **(MHS).** Other elements were analyzed by inductively coupled plasma spectrophotometry. Trace elements assayed are shown in Table 2.

Results and Discussions

Table 3 provides a comparison of sediment residue levels between the White Ranch, Bitter Lake **NWR**, and the Rio Grande. The following elements are below concentrations expected to cause a biological impact: aluminum, barium, beryllium, boron, cadmium, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, silver, thallium, tin and zinc. Therefore, there will **be** no further discussion **of** these elements.

The level of trace elements detected in biota and sediment samples are shown in Tables 4 and 5. Table 4 data are presented in ppm dry weight. Wet weight values are shown in Table 5. At the White Ranch, data from residue analysis indicate that many of the trace elements were not detected or are within normal ranges for animal tissue, plants and sediment.

Residues of vanadium in sediment **at** the White Ranch ranged from less than 5 ppm to 13.4 ppm. The range of geochemical baseline values for vanadium in the western United States is 18 to 270 ppm. Vanadium in plant stems and leaves ranged from 0.6 ppm dry weight in clover to 56.2 ppm dry weight in aquatic plants. At Bitter Lake, vanadium values in saltgrass ranged from 1.1 to 21.3 ppm dry weight. The National Academy of Science **(1980)** reported normal vanadium residues of 100 to 150 ppm in sediment and less than 0.5 ppm wet weight in plants. Poultry could tolerate up to 20 ppm vanadium as ammonium metavanadate **(NH_4VO_3)**; however, test animals experienced depressed growth and increased mortality. **Most** of the forage plants for waterfowl at the White Ranch consist **of** wheat and clover which contain 7 ppm or less vanadium; therefore, adverse environmental affects are unlikely.



Map 2. Sample Site Locations, White Ranch - Bitter Lake NWR - Roswell, New Mexico

Table 1. Sample Type and Location for the White Ranch.

Sample I.D. No.	Species	Composite Hatrix	Weight Grams	Location	Percent Moisture
1A1	Plains killifish	Whole Body	182	Kagerman Canal	
3A3	Mosquitofish	Whole Body	210	Rio Hondo north	
4A4a	Rio Grande Shiner	Whole Body	200	Rio Hondo above confluence of Pecos	
4A4b	Mosquitofish	Whole Body	65	Rio Hondo above confluence of Pecos	
R5A5	Rio Grande Shiner	Whole Body	165	Pecos River/Hwy 380	
9A9a	Mosquitofish	Whole Body	68	Rio Hondo Oxbow	
9A9b	Bluegill	Whole Body	30	Rio Hondo Oxbow	
7C7	Aquatic Invertebrates	Whole Body	30	Pond SW corner Sec. 33	
3B3	Aquatic plant: Characeae sp.	Stems, leaves	600	Rio Hondo North	
7B7a	Muskweed	Stems, leaves	850	Pond SW corner Sec. 33	
4B4	Uinter Oats	Stems, leaves and roots	670	Rio Hondo above confluence of Pecos	
7B7b	White Clover	Stems, leaves	148	Field south of pond	
7B7c	Winter Oats	Stems, leaves and roots	452	Field east of pond	
1D1	Sediment	Silt	500	Hagerman Canal/north	
2D2	Sediment	Silt	412	Hagerman Canal/south	
3D3	Sediment	Silt	480	Rio Hondo North	
4D4	Sediment	Silt	476	Rio Hondo above confluence of Pecos	
5D5	Sediment	Silt	568	Pecos River/Hwy 380	
6D6	Sediment	Silt	560	Pecos River below confluence of Rio Honclo	
7D7	Sediment	Si3.t	365	Pond SW corner Sec. 3.3	
8D8	Sediment	Silt	514	Moto-cross drainage	
9D9	Sediment	Silt	536	Rio Hondo Oxbow	

Table 2. Trace elements asssayed for in biota and sediment samples.

Element	Symbol	Element	Symbol
ALUMINUM	Al	MANGANESE	Mn
ARSENIC	As	MERCURY	Hg
BARIUM	Ba	MOLYBDENUM	Mo
BERYLLIUM.	Be	NICKEL	Ni
BORON	B	SELENIUM	Se
CADMIUM	Cd	SILVER	Ag
CHROMIUM	Cr	STRONTIUM	Sr
COPPER	cu	THALLIUM	Ti
IRON	Fe	TIN	Sn
LEAD	Pb	VANADIUM	v
MAGNESIUM	Mg	ZINC	Zn

Strontium residues in dry sediment are lower at the White Ranch (54.95 to 734 ppm) than reported at Bitter Lake (344 to 2,240 ppm). In plants, strontium levels ranged from 55.4 to 1,940 ppm dry weight. The highest concentration was in muskweed collected from the pond at Site 7. The National Academy of Science indicates that animals can tolerate levels of strontium in diet up to 2,000 ppm for extended periods of time. Strontium residues in fish and aquatic invertebrates at the White Ranch ranged from 140 to 249 ppm dry weight. While there is no evidence to indicate a biological hazard to fish and wildlife, elevated strontium levels in some plant samples at the White Ranch and at Bitter Lake indicates a need for research on the effects of strontium.

At the White Ranch, chromium residues in sediment ranged from 2.57 to 15.4 ppm dry weight. The highest concentration in sediment was from the salt pond drainage area at Site 8 (Moto-cross drainage) next to Bitter Lake NWR. The highest level of chromium in sediment at Bitter Lake NWR was 93.33 ppm dry weight at Hunter Marsh. Chromium residues in plants ranged from 1.07 to 13.4 ppm dry weight. Both samples of winter oats had chromium residues greater than 10 ppm. Chromium was not detected in samples of fish and aquatic invertebrates at the White Ranch. Eisler (1986), reported that in biological materials trivalent chromium is usually present rather than the toxic hexavalent form. Normal chromium levels in sediment range from 1 to 49 ppm, which are within the range detected at the White Ranch. Lewis, et al. (1978) indicated the normal range of chromium in plants is from 0.1 to 0.5 ppm, with a maximum value of 2 ppm. Chromium residues detected in winter oats at the White Ranch indicate additional studies should be conducted to identify the type of chromium present in plants and determine biological hazard.

TABLE 3. HEAVY METAL RESIDUES IN COMPOSITE SEDIMENT SAMPLES FROM THE WHITE RANCH AND COMPARATIVE GEOMETRIC MEAN VALUES FROM SITES ON THE RIO GRANDE (1-6) AND BITTER LAKE NWR (1-5). RESULTS IN PPM DRY WEIGHT.

	SEDIMENT									GEOMETRIC MEANS		
ELEMENT	SITE1	SITE 2	SITE3	SITE 4	SITE 5	SITE 6	SITE7	SITE 8	SITE 9	WR 1-9	BL1-5	RG1-6
ALUMINUM	6850	10500	8090	moo	2380	3070	4990	14300	109001	6880	6140	3740
ARSENIC	3.05	5.55	2.50	4.43	1.82	2.38	1.41	4.62	4.33 I	3.01	1.30	1.90
BARIUM	102	102	74.5	114	301	317	33.4	221	I.201	125	109	123
BERYLLIUM	ND	ND	ND	ND	ND	No	ND	ND	ND	ND	ND	0.30
BORON	17.0	18.9	14.6	20.0	ND	ND	23.2	34.0	16.8 I	17.8	8.50	2.63
CADMIUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.33	0.240
CHROMIUM	6.91	9.30	7.30	8.15	1.64	4.20	6.10	15.4	10.4 I	7.00	ll.2	4.83
COPPER	7.18	16.3	7.10	8.49	ND	3.50	8.40	17.0	12.7 I	8.19	10.4	5.53
IRON	8920	11500	10900	12000	2790	3550	6280	15400	12100 I	8150	6080	6160
LEAD	ND	ND	ND	ND	ND	No	No	ND	ND	No	16.2	6.74
MAGNESIUM	7980	10200	8210	9230	3380	4030	5640	13100	10200 I	7360	7350	2170
MANGANESE	193	251	259	306	191	212	85.1	550	295 I	234	171	841
MERCURY	ND	ND	No	ND	ND	ND	ND	No	ND	ND	0.948	ND
MOLYBDENUM	ND	No	ND	ND	ND	ND	ND	No	NDI	ND	ND	1.78
NICKEL	7.46	12.6	7.10	7.10	5.94	ND	ND	19.8	11.7 I	9.51	6.55	4.69
SELENIUM	0.301	0.465	1.43	0.57	0.039	0.057	2.39	0.427	0.662 I	0.38	1.49	0.300
SILVER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	No
STRONTIUM	181	261	254	278	55.0	71.3	734	659	26.6 I	177	935	72.7
THALLIUM	ND	ND	ND	ND	No	ND	ND	ND	ND	ND	ND	No
TIN	1.10	No	ND	ND	No	ND	ND	ND	ND	ND	ND	ND
VANADIUM	18.2	19.3	20.4	12.6	ND	ND	13.5	26.2	19.3 I	18.0	ND	No
ZINC	34.7	51.5	48.8	49.6	14.9	21.2	32.5	53.0	55.6 I	36.7	37.6	24.5

TABLE 4. HEAVY METAL RESIDUE IN BIOTA AND SEDIMENT (UNITS IN PPM DRY WEIGHT)
WHITE RANCH ADDITION, BITTER LAKE NATIONAL WILDLIFE REFUGE. DECEMBER 1987.

COMMON NAME	LOCATION	Al	As	Ba	Be	B	Cd	Cr	Cu	Fe	Pb	Mg	Mn	Hg	Mo	Ni	Se	Ag	Sr	Tl	Sn	V	Zn
PLAINS KILLIFISH	HAGERMAN CANAL	324.0	0.82	<20.70	<2.10	<20.70	<2.10	<4.100	13.60	316.0	<41.30	1400.0	25.20	0.14	<12.40	<16.50	4.92	<4.10	140.00	<41.30	<20.70	<20.70	200.00
MOSQUITO FISH	RIO HONDO NORTH	200.0	0.35	<21.60	<2.20	<21.60	<2.20	<4.300	<10.80	384.0	<43.30	1730.0	39.00	0.20	<13.00	<17.30	4.59	<4.30	245.00	<43.30	<21.60	<21.60	186.00
RIO GRANDE SHINER	RIO HONDO ABOVE PECOS CONFLUENCE	418.0	0.26	<18.30	<1.80	<18.30	<1.80	<3.700	23.40	340.0	<36.60	1650.0	23.10	0.17	<11.00	<14.6	6.19	<3.70	187.00	<36.60	<18.30	<18.30	215.00
MOSQUITO FISH	RIO HONDO ABOVE PECOS CONFLUENCE	269.0	0.34	<18.60	<1.90	<18.60	<1.90	<3.700	<9.30	238.0	<37.30	1640.0	23.50	0.19	<11.20	<14.90	4.18	<3.70	242.00	<37.30	<18.60	<18.60	167.00
RIO GRANDE SHINER	PECOS RIVER/HWY 380	426.0	0.37	<20.50	<2.00	<20.50	<2.00	<4.100	<10.20	380.0	<41.00	1430.0	23.00	0.11	<12.30	<16.40	3.28	<4.10	192.00	<41.00	<20.50	<20.50	183.00
MOSQUITO FISH	RIO HONDO OXBOW	894.0	0.71	<20.40	<2.00	<20.40	<2.00	<4.100	22.40	547.0	<40.80	1840.0	49.40	0.11	<12.20	<16.30	4.53	<4.10	313.00	<40.80	<20.40	<20.40	196.00
BLUEGILL	RIO HONDO OXBOW	278.0	0.51	<19.70	<2.00	<19.70	<2.00	<3.900	<9.80	257.0	<39.40	1700.0	26.40	<0.099	<11.80	<15.70	6.73	<3.90	249.00	<39.40	<19.70	<19.70	176.00
AQUATIC INVERTS.	POND SW CORNER SEC. 33	1330.0	0.68	<24.20	<2.40	<24.20	<2.40	<4.800	13.50	710.0	<48.30	1790.0	22.20	<0.121	<14.50	<19.30	4.35	<4.80	4.35	<48.30	<24.20	<24.20	98.10
AQUATIC PLANT: CHARACEAE SP.	RIO HONDO NORTH	11700	27.10	98.20	0.460	23.80	4.95	9.27	12.40	23600	<9.20	7220.0	15300	<0.230	3.49	8.16	4.24	5.50	564.00	10.60	<4.60	56.20	79.20
MUSKWEED	POND SW CORNER SEC. 33	1100.0	1.02	36.30	<0.20	28.60	0.25	1.07	1.85	831.0	<4.20	7280.0	63.00	<0.103	<1.30	<1.70	1.53	2.34	1940.0	<4.20	2.30	4.73	10.30
WINTER OATS	RIO HONDO ABOVE PECOS CONFLUENCE	4280.0	0.82	36.70	<0.20	5.98	0.63	13.40	11.90	3030.0	3.83	3060.0	194.00	<0.093	3.31	5.61	0.10	<0.40	55.40	<3.72	<1.86	5.20	27.00
WHITE CLOVER	FIELD SOUTH OF POND IN SW CORNER SEC. 33	224.0	0.12	3.72	<0.12	54.40	<0.12	1.81	11.30	243.0	<2.40	2430.0	52.50	<0.060	<2.39	<1.00	0.05	0.43	215.00	<2.40	<1.20	0.38	37.00
WINTER OATS	FIELD EAST OF POND IN SW CORNER SEC. 33	4930.0	0.87	22.40	<0.21	9.07	0.90	10.40	9.17	3450.0	<3.50	3660.0	164.00	<0.087	5.55	6.52	0.12	0.80	67.60	<3.50	<1.80	7.28	44.80
SEDIMENT	HAGERMAN CANAL NORTH	6850.0	3.05	102.00	<0.70	17.00	<0.70	6.91	7.18	8920.0	<13.80	7980.0	193.00	<0.035	<4.20	7.46	0.30	<1.40	181.00	<13.80	1.10	18.20	34.70
SEDIMENT	HAGERMAN CANAL SOUTH	10500	5.55	102.00	<0.90	18.90	<0.90	9.30	16.30	11500	<17.00	10200	251.00	<0.042	<5.00	12.66	0.47	<17.00	261.00	<17.00	<9.00	19.30	51.50
SEDIMENT	RIO HONDO NORTH	8090.0	2.50	74.50	<0.90	14.60	<0.90	7.30	7.10	10900	<16.60	8210.0	259.00	<0.042	<5.00	7.10	1.43	<1.70	254.00	<16.60	<8.30	20.40	48.80
SEDIMENT	RIO HONDO ABOVE PECOS CONFLUENCE	10300	4.43	114.00	<0.90	20.00	<0.90	8.15	8.49	12000	<17.00	9230.0	306.00	<0.042	<5.00	7.10	0.57	<1.70	278.00	<17.00	<8.40	12.60	49.60
SEDIMENT	PECOS RIVER/HWY 380	2380.0	1.82	301.00	<0.70	<6.50	<0.70	1.64	<3.20	2790.0	<13.00	3380.0	191.00	<0.032	<3.80	5.94	0.04	<1.30	54.90	<13.00	<6.50	<6.50	14.90
SEDIMENT	PECOS RIVER BELOW RIO HONDO CONFLUENCE	3070.0	2.38	317.00	<0.70	<6.30	<0.70	4.20	3.50	3550.0	<12.50	4030.0	212.00	<0.032	<3.80	<5.00	0.06	<1.30	71.30	<12.50	<6.30	<7.90	21.20
SEDIMENT	POND SW CORNER SEC. 33	4990.0	1.41	33.40	<1.20	23.20	<1.20	6.10	8.40	6280.0	<22.60	5640.0	85.10	<0.057	<6.80	<9.10	2.39	<2.30	734.00	<22.60	<11.30	13.50	32.50
SEDIMENT	MOTO-CROSS DRAINAGE	14300	4.62	221.00	<1.00	34.00	<1.00	15.40	17.00	15400	<20.00	13100	550.00	<0.049	<6.00	19.80	0.43	<2.00	659.00	<20.00	<10.00	26.20	53.00
SEDIMENT	RIO HONDO OXBOW	10900	4.33	120.00	<0.80	16.80	<0.80	10.40	12.70	12100	<15.50	10200	295.00	<0.039	<4.70	11.70	0.66	<1.60	26.60	<15.50	<7.80	19.30	55.60

TABLE 5. HEAVY METAL RESIDUE IN BIOTA AND SEDIMENT (UNITS IN PPM WET WEIGHT)
WHITE RANCH ADDITION, BITTER LAKE NATIONAL WILDLIFE REFUGE. DECEMBER 1987.

COMMON NAME	LOCATION	Al	As	Ba	Be	B	Cd	Cr	Cu	Fe	Pb	Mg	Mn	Hg	Mo	Ni	Se	Ag	Sr	Tl	Sn	V	Zn
PLAINS KILLIFISH	HAGERMAN CANAL	78.5	0.20	<5.00	<0.50	<5.00	<0.50	<1.00	3.30	76.6	<10.00	340.0	6.10	0.03	<3.00	<4.00	1.19	<1.00	33.90	<10.00	<5.00	<5.00	48.40
MOSQUITO FISH	RIO HONDO NORTH	46.2	0.08	<5.00	<0.50	<5.00	<0.50	<1.00	<2.50	88.6	<10.00	400.0	9.00	0.05	<3.00	<4.00	1.06	<1.00	56.70	<10.00	<5.00	<5.00	43.10
RIO GRANDE SHINER	RIO HONDO ABOVE PECOS CONFLUENCE	114.0	0.08	<5.00	<0.50	<5.00	<0.50	<1.00	6.40	92.7	<10.00	450.0	6.30	0.05	<3.00	<4.00	1.69	<1.00	51.00	<10.00	<5.00	<5.00	58.70
MOSQUITO FISH	RIO HONDO ABOVE PECOS CONFLUENCE	72.1	0.09	<5.00	<0.50	<5.00	<0.50	<1.00	<2.50	63.7	<10.00	440.0	6.30	0.05	<3.00	<4.00	1.12	<1.00	64.80	<10.00	<5.00	<5.00	44.80
RIO GRANDE SHINER	PECOS RIVER/HWY 380	104.0	0.09	<5.00	<0.50	<5.00	<0.50	<1.00	<2.50	92.7	<10.00	350.0	5.60	0.03	<3.00	<4.00	0.80	<1.00	46.90	<10.00	<5.00	<5.00	44.60
MOSQUITO FISH	RIO HONDO OXBOW	219.0	0.18	<5.00	<0.50	<5.00	<0.50	<1.00	5.50	134.0	<10.00	450.0	450.00	0.03	<3.00	<4.00	1.11	<1.00	76.80	<10.00	<5.00	<5.00	47.90
BLUEGILL	RIO HONDO OXBOW	70.6	0.13	<5.00	<0.50	<5.00	<0.50	<1.00	<2.50	65.2	<10.00	450.0	6.70	<0.025	<3.00	<4.00	1.71	<1.00	63.20	<10.00	<5.00	<5.00	44.80
AQUATIC INVERTS.	POND SW CORNER SEC. 33	276.0	0.14	<5.00	<0.50	<5.00	<0.50	<1.00	2.80	147.0	<10.00	370.0	4.60	<0.025	<3.00	<4.00	0.90	<1.00	45.80	<10.00	<5.00	<5.00	20.30
AQUATIC PLANT: CHARACEAE SP.	RIO HONDO NORTH	1280.0	2.95	10.70	0.050	2.59	0.54	1.01	1.35	2570.0	<1.00	787.0	1670.0	<0.025	0.38	0.89	0.46	0.60	61.50	1.15	<0.50	6.13	8.63
MUSKWEED	POND SW CORNER SEC. 33	270.0	0.25	8.82	<0.05	6.94	0.06	0.26	0.45	202.0	<1.00	1770.0	15.30	<0.025	<3.00	<0.40	0.37	0.57	471.00	<1.00	0.56	1.15	2.50
WINTER OATS	RIO HONDO ABOVE PECOS CONFLUENCE	1150.0	0.22	9.87	<0.05	1.61	0.17	3.62	3.21	815.0	1.03	823.0	52.10	<0.025	0.89	1.51	0.03	<0.10	14.90	<1.00	<0.50	1.40	7.25
WHITE CLOVER	FIELD SOUTH OF POND IN SW CORNER SEC. 33	93.7	0.05	1.56	<0.05	22.80	<0.05	0.76	4.73	102.0	<1.00	1020.0	22.00	<0.025	1.00	<0.40	0.02	0.18	90.20	<1.00	<0.50	0.16	15.50
WINTER OATS	FIELD EAST OF POND IN SW CORNER SEC. 33	1430.0	0.25	6.51	<0.06	2.63	0.26	3.02	2.66	1000.0	<1.00	1060.0	47.50	<0.025	1.61	1.89	0.03	0.24	19.60	<1.00	<0.50	2.11	13.00
SEDIMENT	HAGERMAN CANAL NORTH	4960.0	2.21	74.00	<0.50	12.30	<0.50	5.00	5.20	6460.0	<10.00	5780.0	140.00	<0.025	<3.00	5.40	0.22	<1.00	131.00	<10.00	0.80	13.20	25.10
SEDIMENT	HAGERMAN CANAL SOUTH	6340.0	3.34	61.30	<0.50	11.40	<0.50	5.60	9.80	6910.0	<10.00	6120.0	151.00	<0.025	<3.00	7.60	0.28	<1.00	157.00	<10.00	<5.00	11.60	31.00
SEDIMENT	RIO HONDO NORTH	4880.0	1.51	44.90	<0.50	8.80	<0.50	4.40	4.30	6560.0	<10.00	4950.0	156.00	<0.025	<3.00	4.30	0.86	<1.00	153.00	<10.00	<5.00	12.30	29.40
SEDIMENT	RIO HONDO ABOVE PECOS CONFLUENCE	6180.0	2.66	68.40	<0.50	12.00	<0.50	4.90	5.10	7210.0	<10.00	5550.0	184.00	<0.025	<3.00	4.30	0.34	<1.00	167.00	<10.00	<5.00	7.60	29.80
SEDIMENT	PECOS RIVER/HWY 380	1880.0	1.44	238.00	<0.50	<5.00	<0.50	1.30	<2.50	2210.0	<10.00	2670.0	151.00	<0.025	<3.00	4.70	0.03	<1.00	43.40	<10.00	<5.00	<5.00	11.80
SEDIMENT	PECOS RIVER BELOW RIO HONDO CONFLUENCE	2460.0	1.91	254.00	<0.50	<5.00	<0.50	3.40	2.80	2850.0	<10.00	3230.0	170.00	<0.025	<3.00	<4.00	0.05	<1.00	57.20	<10.00	<5.00	<6.30	17.00
SEDIMENT	POND SW CORNER SEC. 33	2210.0	0.63	14.80	<0.500	10.30	<0.50	2.70	3.70	2780.0	<10.00	2500.0	37.70	<0.025	<3.00	<4.00	1.06	<1.00	325.00	<10.00	<5.00	6.00	14.40
SEDIMENT	MOTO-CROSS DRAINAGE	7330.0	2.36	113.00	<0.500	17.40	<0.50	7.90	8.70	7870.0	<10.00	6670.0	281.00	<0.025	<3.00	10.10	0.22	<1.00	337.00	<10.00	<5.00	13.40	27.10
SEDIMENT	RIO HONDO OXBOW	7070.0	2.80	77.50	<0.500	10.94	<0.50	6.70	8.20	7850.0	<10.00	7230.0	191.00	<0.025	<3.00	7.60	0.43	<1.00	17.20	<10.00	<5.00	12.50	36.00

At the White Ranch, arsenic in sediment was detected at levels from 1.41 to 5.55 ppm dry weight. The baseline for arsenic in soils from the western United States ranges from 1.2 to 22 ppm dry weight. An aquatic plant sample at Site 3 had a residue level of 27.1 ppm dry weight, whereas residue'levels in other plants ranged from 0.12 to 1.02 ppm dry weight. There was no correlation between the arsenic levels in aquatic plants at, Site 3 and levels detected in sediment and mosquitofish from the same site. Eisler (1988) reported that aquatic plants in contaminated sites had from 20 to 1,450 ppm arsenic. The fish sample from Site 3 had a residue level of 0.35 ppm dry weight and residues in all fish ranged from 0.26 to 0.82 ppm dry weight. Lowe, et al. (1985) reported arsenic residues in fish from 0.05 to 1.69 ppm wet weight, with a geometric mean of 0.14 ppm wet weight. These values are equivalent to the wet weight residues for fish listed in Table 5. Eisler reported that adverse affects to aquatic life from arsenic compounds occur at concentrations ranging from 19 to 48 ug/l in water. Pierce and Ditmore (1986) reported 5,000 ug/l (5 ppm) arsenic in water samples from the Rio Hondo at the Highway 380 Bridge (Site 3). The other stations they sampled on the Pecos River and at Bitter Lake NWR had concentrations ranging from 12 - 27 ug/l. Existing Environmental Protection Agency (EPA) human health standards for arsenic allows for a maximum concentration in water of 50 ugll. The EPA criteria for protection of aquatic life is 850 ug/l, acutely toxic, chronic exposure limits are 360 ug/l for a one hour average concentration no more than once every three years, and 190 ug/l for a four-day average concentration no more than once every three years. Arsenic residues detected in water samples and aquatic plants from the Rio Hondo are indicative of a contaminated site. A specific determination of the types of arsenic compounds present is needed. Additional studies are needed to determine the source of the arsenic and potential toxicity of arsenic residues to fish in the Rio Hondo.

Residues of selenium in sediment at the White Ranch ranged from 0.039 to 2.39 ppm dry weight and were slightly lower than values reported at Bitter Lake NWR (0.98 - 4.4 ppm dry Weight). A draft Department of Interior Report (1985) indicates that selenium concentrations in sediment in excess of 1.5 ppm dry weight are potentially toxic to biota. Geochemical baseline values for selenium soils in the Western United States range from 0.039 to 1.4 ppm. Sediment in the pond at Site 7 had the highest residue level of selenium (2.39 ppm). There did not appear to be any correlation between selenium levels in sediment and residues in biological samples at the same site.

Selenium residues in plants at the White Ranch were from 0.104 to 4.24 ppm dry weight. The highest detected value was from the sample of aquatic plants of Site 3 at 1.43 ppm.

Eisler (1985) indicated a wide range of selenium concentrations -in plants ranging from 2.0 to 15.0 ppm dry weight in oats, 117 ppm dry weight in wheat, 12 to 68 ppm dry weight in algae and higher aquatic plants. Plants rooted in contaminated soils had selenium concentrations up to 79 ppm.

Aquatic plants in a control area had 0.4 ppm dry weight. Lemley and Smith (1987) reported that in food items, concentrations of selenium from 3 to 8 **mg/kg(ppm)** dry weight represented levels that could cause adverse effects to fish and wildlife.

Residues of selenium in fish at the **White** Ranch ranged from 3.28 to 6.73 ppm dry weight and the aquatic invertebrate sample contained selenium at 4.35 **ppm** dry weight. **At** the White Ranch wet weight values of selenium in fish. (Table 5) are below the 2 to 3 **ppm** wet weight usually considered to cause adverse effects to fish (Baumann **and** Bay 1984). Residue levels are above the 85th percentile value (0.71 ppm wet weight) reported by Lowe, et al. (1985). Based on the analysis **of** aquatic plants and sediment from the Mite Ranch, selenium residues are within the mid-range of values that could **cause** adverse effects to fish and wildlife. Additional studies will be necessary to determine if the area represents any risk to either endangered species or other Interior Trust Resources.

Summary

Host trace elements at the **White** Ranch were within expected ranges or were not detected. Residues of vanadium and strontium appear to be elevated in aquatic plants. High levels of chromium are associated with the moto-cross drainage downslope from the Salt Pond area. The levels **of** chromium reported **at** the White Ranch could be toxic to fish and wildlife if it exists in the hexavalent form.

Arsenic residues in aquatic plants from the Rio Hondo are elevated '(27.1 ppm dry weight) possibly due to high levels **of** arsenic in the water (reported values of 5 **ppm)**. Arsenic residues appear normal in fish and sediment from the Rio Hondo and other sites on the White Ranch. Elevated arsenic levels in Rio Hondo water samples may be associated with wastewater effluent **or** some unidentified source.

Selenium residues in fish and sediment samples from White Ranch are above levels reported in clean non-contaminated sites. High selenium concentrations **were** not attributed to any particular area at the ranch. Residues of selenium in aquatic plants were in the low range of concentrations considered to cause adverse biological effects.

Recommendations

Interpretation **of** the available data indicates that additional investigations are needed to identify the forms of vanadium and strontium compounds present at the property and to assess the biological implications of these metals.

Elevated chromium levels in sediment at the moto-cross drainage **and** the Salt Pond need to be investigated. In particular, samples should be collected at the Salt Pond area to determine if it is the source of chromium on the White Ranch. In addition, samples should be collected at Hunter **Marsh** on Bitter Lake NWR.

The source(s) and nature of arsenic compounds in the Rio Hondo should be identified. Impacts of these compounds on aquatic organisms should be assessed.

The reported levels of selenium at the White Ranch and Bitter Lake suggest that additional studies are needed to determine impacts to Department **of** Interior Trust Resources. For further study of the potential impacts of identified trace elements, a Department of Interior Drainwater Study should be implemented for the Pecos River drainage.

Wastewater effluent being discharged into the Rio Hondo should be comprehensively analyzed for trace elements and priority pollutants.

Supplement I

Once the source and form of chromium along with the relative hazards to the ecology of the Refuge has been determined, the elimination of the **ponded** water area along the moto-cross drainage ditch should be considered. Filling in the ditch may be one consideration so that the ponding has been eliminated and chromium can diffuse evenly throughout the Refuge. Another consideration is the extension of the ditch so that it takes advantage of the mixing zone of the **Pecos** River which would eliminate concentration of chromium in the ditch area. The ditch area functions as an evaporation basin which concentrates chromium from the Salt Pond area which should be eliminated.

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