Patrick Bayou

Deer Park, Texas

EPA Facility ID: TX000605329

Basin: Buffalo-San Jacinto

HUC: 12040104

Executive Summary

Patrick Bayou, which is within the lower portion of the San Jacinto River Basin, is a small bayou of the Houston Ship Channel. Industrial facilities and nearby urban/residential areas have discharged permitted industrial wastewater, effluent from a municipal wastewater treatment plant, and stormwater runoff into Patrick Bayou for several years. These discharges are suspected to be the primary sources of pesticides, PAHs, inorganic compounds (metals), and PCBs found in bayou sediments. Sediments in wetlands bordering the bayou are also contaminated. These contaminants are considered a threat to downstream NOAA trust resources, such as shrimp, blue crab, and black drum, which use the surface water and sediments of Patrick Bayou, the NOAA habitat of concern.

Site Background

Patrick Bayou, which is within the lower portion of the San Jacinto River Basin near Deer Park, Texas, is a small tidal tributary of the Houston Ship Channel (Figure 1) (Broach and Crocker 1996; USEPA 2001). The bayou is on the south side of the ship channel, approximately 3.7 km (2.3 mi) upstream of its confluence with the San Jacinto River; it is shallow and approximately 4.8 km (3 mi) in length (Broach and Crocker 1996). The upper portion of the bayou, which flows through an industrial area of Deer Park, is lined with concrete. The lower section of Patrick Bayou has earthen banks and a soft mud bottom. The east fork of the bayou has more riparian vegetation than the main bayou and is more stream-like in its contour (Broach and Crocker 1996).

Contaminants primarily migrate into Patrick Bayou through direct discharges to the surface waters. For several years, Patrick Bayou has received permitted industrial wastewater discharges, effluent from the City of Deer Park wastewater treatment plant, and stormwater runoff from adjacent industrial facilities and nearby urban/residential areas (Broach and Crocker 1996; USEPA 2001).

Current permits allow facilities to discharge up to 530 million L (140 million gal) of treated wastewater and/or cooling water per day from eight different outfalls (not including outfalls that carry only stormwater). Occidental Chemical, Shell Chemical and Refinery, and Lubrizol (Figure 2) have outfalls discharging directly into Patrick Bayou. Occidental Chemical and Shell Chemical and Refinery are both chemical-manufacturing facilities. Lubrizol is a lubricant-manufacturing facility. In addition, the Deer Park wastewater treatment plant and Praxair, an air separation plant, both indirectly discharge wastewater into the bayou via drainage ditches. Rohm and Haas, another chemical-manufacturing facility, has an outfall that discharges into the Houston Ship Channel several hundred meters downstream of Occidental Chemical's discharge ditch. The Rohm and Haas discharge is thought to have possible effects within the bayou because of tidal influences (Broach and Crocker 1996).

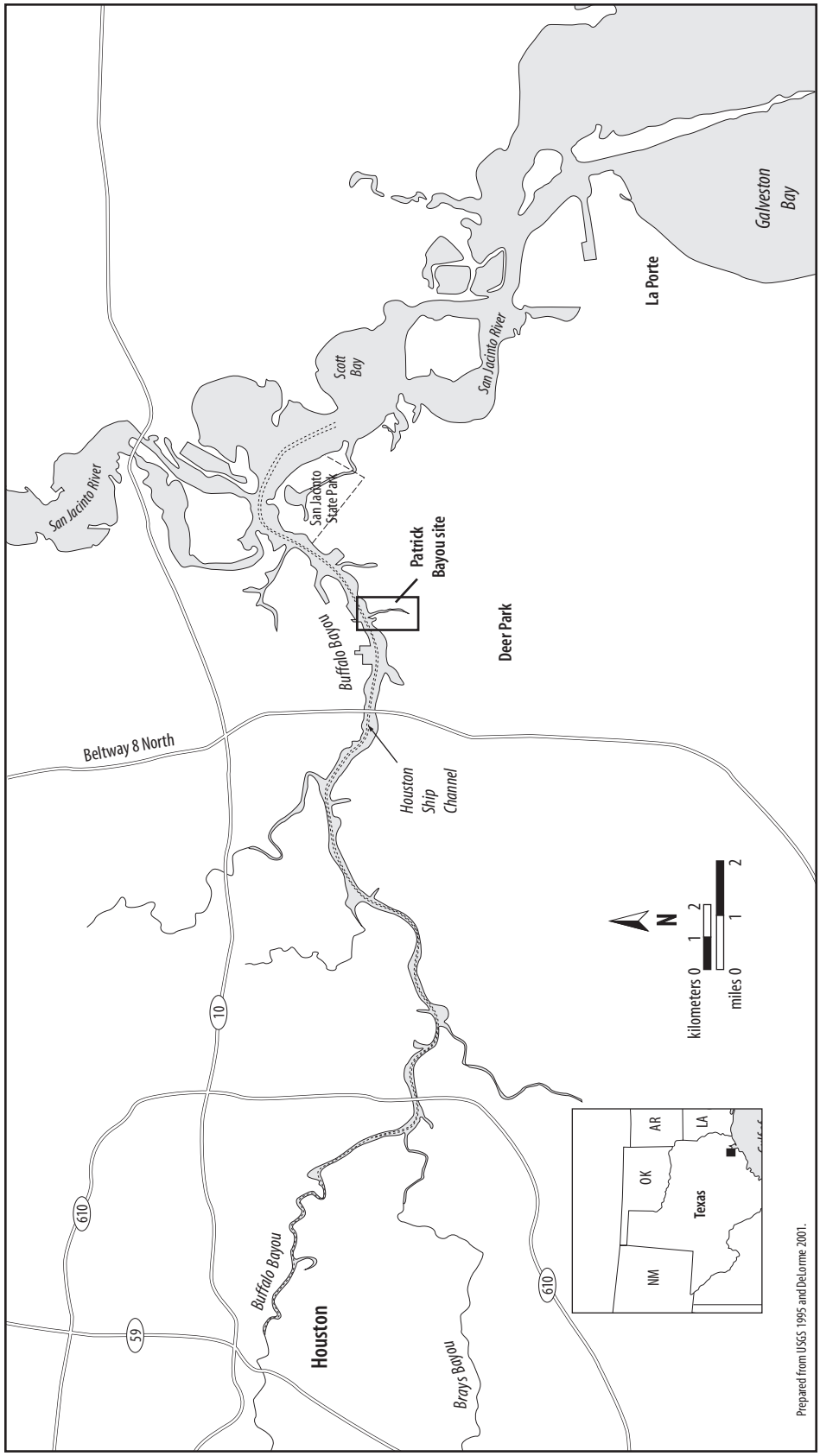

Figure 1. Location of Patrick Bayou site in Deer Park, Texas.

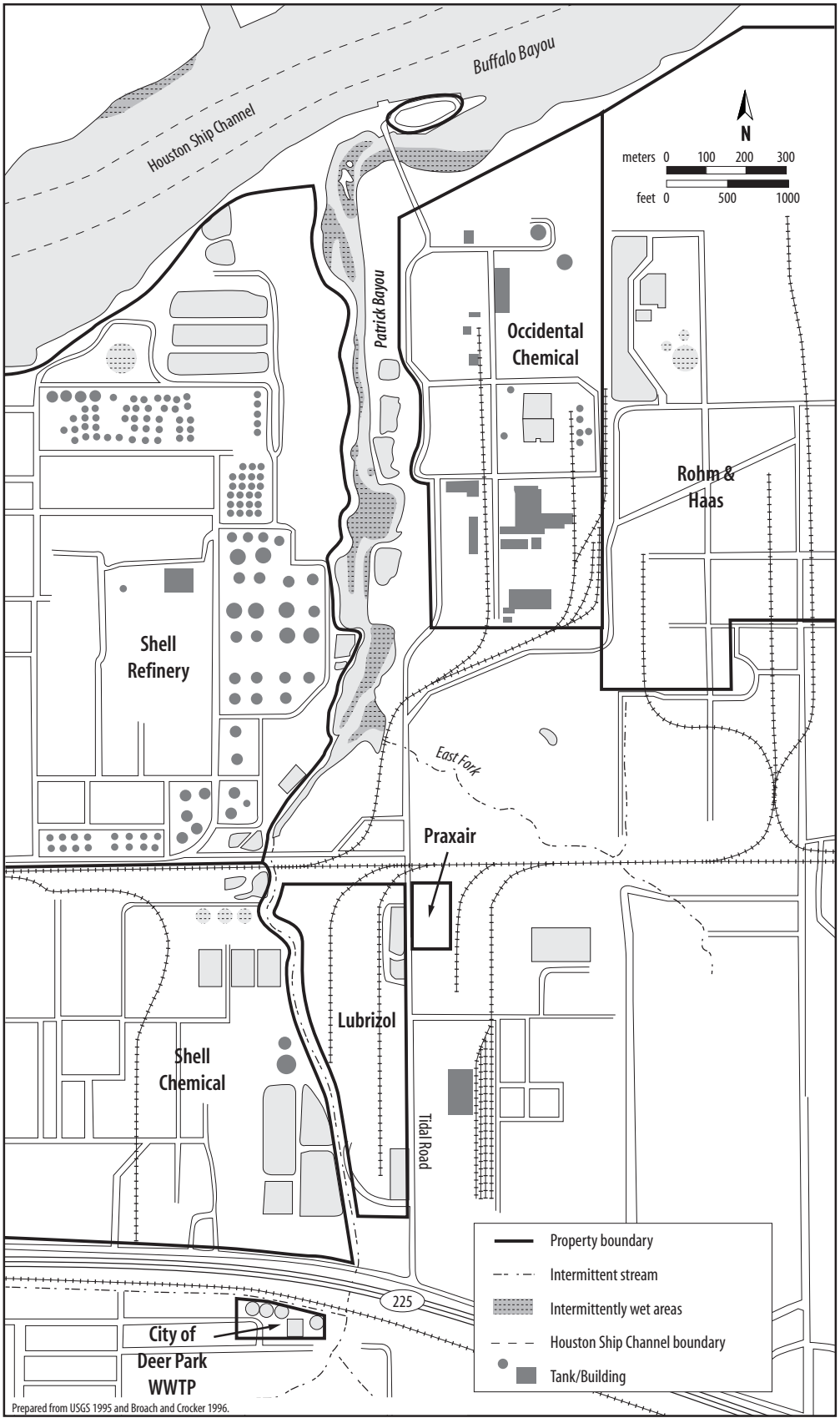

Figure 2. Detail of Patrick Bayou site.

In 1993, the Texas Natural Resource Conservation Commission (TNRCC) began monitoring a station near the mouth of Patrick Bayou after two unexplained fish kills occurred in 1990 (Broach and Crocker 1996). In 1993 to 1994, the City of Houston sponsored a large study to investigate toxic substances in the Houston Ship Channel and its tributaries. Results of that study showed Patrick Bayou to be the most contaminated of all the tributaries; bayou sediments were found to have high to moderate concentrations of pesticides, polynuclear aromatic hydrocarbons (PAHs), inorganic compounds (metals, including cadmium, chromium, mercury, nickel, and zinc), and polychlorinated biphenyls (PCBs) (Broach and Crocker 1996; USEPA 2001). A July 2000 site inspection showed elevated concentrations of mercury and PCBs in bayou sediments (USEPA 2001). Patrick Bayou was proposed for the National Priorities List on June 14, 2001.

NOAA Trust Resources

The NOAA trust habitat of concern is Patrick Bayou, including its surface water and bottom sediments. NOAA trust resources that use Patrick Bayou are listed in Table 1. The area is typical of oligohaline estuarine environment with brackish water species present (Seiler 2003). The results of fish sampling in Buffalo Bayou and in Scott and Galveston Bays were used to predict the species likely to be found in Patrick Bayou (Broach 2001; Robinson 2001). Brown shrimp and white shrimp likely use Patrick Bayou as both nursery and adult habitat, while blue crab likely use it only as nursery habitat. Black drum, sheepshead minnow, and Southern flounder likely use Patrick Bayou as both nursery and adult habitat (Broach 2001; Robinson 2001).

Table 1. NOAA trust resources present in Buffalo Bayou, Scott and Galveston Bay downstream of the Patrick Bayou site (EVS 1989; Broach 2001; Robinson 2001).

Species		**Habitat Use**				**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Migratory Route	Comm.	Rec.
MARINE/ESTUARINE FISH							
Atlantic croaker	*Micropogonias undulatus*	◆	◆	◆		◆	◆
Atlantic menhaden	*Brevoortia*	◆	◆	◆	◆		
Black drum*	*Pogonias cromis*	◆	◆	◆	◆	◆	◆
Gulf kingfish	*Menticirrhus littoralis*			◆		◆	◆
Red drum	*Sciaenops ocellatus*	◆	◆	◆	◆	◆	
Sand seatrout	*Cynoscion arenarius*	◆	◆	◆		◆	
Sea catfish	*Arius felis*	◆	◆	◆		◆	◆
Sheepshead minnow*	*Cyprinodon variegatus*	◆	◆	◆		◆	◆
Southern flounder*	*Paralichthys lethostigma*	◆	◆	◆	◆	◆	◆
INVERTEBRATES							
Blue crab*	*Callinectes sapidus*	◆	◆	◆	◆	◆	◆
Brackish water clam	*Rangia cuneata*	◆	◆	◆			
Brown shrimp*	*Farfante penaeus aztecus*	◆	◆	◆	◆	◆	◆
Eastern oyster	*Crassostrea virginica*	◆	◆	◆		◆	◆
White shrimp*	*Litopenaeus setiferus*	◆	◆	◆	◆	◆	◆

* Fisheries information for these species is only valid for Scott Bay and Galveston Bay.

There is recreational fishing of blue crab and catfish in the Houston Ship Channel just downstream of Patrick Bayou (Broach and Crocker 1996). Lower Galveston Bay supports several important commercial fisheries including species listed in Table 1. The Texas Department Health has issued a consumption advisory for the Houston Ship Channel, all contiguous waters, and the Upper Galveston Bay area. The advisory includes blue crab and catfish and recommends consumption of no more than one meal per month for the general public and no consumption for children and women of childbearing age. This advisory has been issued because of elevated concentrations of dioxins in blue crabs and all species of catfish (TDH 2001; TNRCC 2001; USEPA 2001).

Site-Related Contamination

Contaminants of concern have been detected in both the sediment and surface water of Patrick Bayou. The TNRCC collected sediment and surface water samples from 11 stations, ten inside the bayou and one just upstream of the mouth of the bayou. No groundwater or soil samples were collected for the TNRCC study (Broach and Crocker 1996). The maximum concentrations of contaminants of concern and associated screening guidelines are listed in Table 2. Guidelines for a marine ecosystem were used in screening the analytical results because the bayou is tidally influenced and contains brackish water throughout much of its length.

Contaminants of concern detected in sediment samples from Patrick Bayou are inorganic compounds (metals), PAHs, and PCBs. Maximum concentrations of eight metals exceeded the effects range-low (ERL) marine sediment screening guidelines. Maximum concentrations of arsenic, chromium, copper, nickel, and zinc exceeded ERLs by factors of slightly less than two. Maximum concentrations of lead and selenium were approximately six to seven times the ERLs, and the maximum concentration of mercury exceeded the ERL by more than an order of magnitude. Cadmium and silver were also detected, but at maximum concentrations below the ERLs. Elevated concentrations of arsenic centered near the upper/middle portion of the bayou, with the maximum concentration detected at a station in the east fork of Patrick Bayou. Maximum concentrations of chromium and zinc occurred in samples from the middle section of the bayou. Lead concentrations exceeded the ERL screening guideline at several stations along the bayou. The maximum concentration of mercury was found near the mouth, or northern section, of Patrick Bayou. Maximum concentrations of copper, nickel, and selenium were detected in sediments collected from the middle to northern section of the bayou; the maximum concentration of selenium was detected near the center of the bayou.

Several PAHs were detected in bayou sediments at concentrations exceeding ERL screening guidelines; all the maximum concentrations occurred in samples from the bayou's north and south ends. Maximum concentrations of PAHs exceeded the ERLs by one to two orders of magnitude.

PCB (Aroclor 1248) was detected at five stations; all results exceeded the ERL screening guideline by at least an order of magnitude. The maximum concentration of Aroclor 1248, which exceeded the ERL by two orders of magnitude, occurred in a sample from the south end of the bayou.

Surface water samples collected from Patrick Bayou were analyzed only for metals. Maximum concentrations of copper and mercury exceeded the ambient water quality criteria (AWQC) screening guidelines by factors of approximately seven and eight, respectively. The maximum concentration of nickel was slightly more than twice the AWQC. Arsenic, lead, and zinc were also detected, but at maximum concentrations that did not exceed the AWQC. Cadmium, chromium, selenium, and silver were not detected.

Table 2. Maximum concentrations of primary contaminants of concern detected in samples collected from Patrick Bayou (Broach and Crocker 1996).

	Water (µg/L)		Sediment (mg/kg)	
Contaminant	Surface Water	AWQC[a]	Sediment	ERL[b]
INORGANIC COMPOUNDS				
Arsenic	30	36	13	8.2
Cadmium	ND	9.3	0.33	1.2
Chromium[h]	ND	50	129	81
Copper	22	3.1	60	34
Lead	5.1	8.1	269	46.7
Mercury	0.79	0.094[c]	8.3	0.15
Nickel	18	8.2	42	20.9
Selenium	ND	71	6.8	1.0[f]
Silver	ND	0.95[d]	0.9	1
Zinc	43	81	290	150
PAHs				
Acenaphthene	N/A	710[e]	6.86	0.016
Acenaphthylene	N/A	300[e,d,g]	7.89	0.044
Anthracene	N/A	300[e,d,g]	3.41	0.0853
Benz(a)anthracene	N/A	300[e,d,g]	14.2	0.261
Chrysene	N/A	300[e,d,g]	17.1	0.384
Fluoranthene	N/A	16[e]	44.1	0.6
Fluorene	N/A	NA	4.1	0.019
2-Methylnaphthalene	N/A	300[e,d,g]	2.65	0.07
Naphthalene	N/A	2350[e,d]	7.93	0.16
Phenanthrene	N/A	NA	53.6	0.24
Pyrene	N/A	300[e,d,g]	33.5	0.665
PCBs				
Aroclor 1248	N/A	0.03	4.15	0.0227

a: Ambient water quality criteria for the protection of aquatic organisms (USEPA 1993, 1999). Marine chronic criteria presented.

b: Effects range-low represents the 10th percentile for the dataset in which effects were observed or predicted in studies compiled by Long et al (1998).

c: Derived from inorganics but applied to total.

d: Chronic criterion not available; acute criterion presented.

e: Lowest observable effect level (LOEL).

f: Marine apparent effects threshold (AET) for amphipod bioassay. The AET represents the concentration above which adverse biological impacts would be expected.

g: Value for chemical class.

h: Screening guidelines represent concentrations for $Cr.^{+6}$

NA: Screening guidelines not available.

N/A: Not analyzed for.

ND: Not detected.

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