

Tables

Table 8-1**Counts of Fish and Shellfish Samples for the Baseline Human Health Risk Assessment**

Species	Tissue Type	Number of Samples
Target Fish Species		
White Perch	Skin-on Fillet	19
American Eel	Skin-off Fillet	32
Channel Catfish	Skin-off Fillet	11
Largemouth Bass	Skin-on Fillet	3
Alternate Fish Species		
White Catfish	Skin-off Fillet	19
Common Carp	Skin-on Fillet	12
White Sucker	Skin-on Fillet	5
Smallmouth Bass	Skin-on Fillet	3
Northern Pike	Skin-on Fillet	1
Shellfish		
Blue crab	Muscle and Hepatopancreas	41
Blue crab	Muscle	21
Blue crab	Hepatopancreas	7

Table 8-2**Land Use, Shoreline Type, Public Access, and Primary Types of Human Activities in the LPR**

Segment	Primary Land Uses	Shoreline Type¹	Public Access	Primary Types of Human Activities
RM 0-3	Industrial, marine, infrastructure (rail)	SP/B ~ 52.3% RR/S ~ 28.3% N/V ~ 19.4%	Limited access	Shoreline/dock work; occasional fishing
RM 3-6	Industrial, commercial, infrastructure (rail/ highway), urban, some green space	SP/B ~ 66.2% RR/S ~ 3.4% N/V ~ 30.5%	Limited access	Shoreline/dock work; passive recreation; occasional fishing; sculling/boating
RM 6-9	Urban, infrastructure (highway), parkland, commercial (retail), boat docks	SP/B ~ 52.3% RR/S ~ 3.0% N/V ~ 44.8%	Some access points along Riverbank Park shoreline; Kearny boat ramp; docks	Passive recreation; sculling/boating; fishing
RM 9-12	Urban, infrastructure (highway), parkland, boat docks, residential	SP/B ~ 41.8% RR/S ~ 0.0% N/V ~ 58.2%	Some access points along Passaic and Riverside County parks shoreline; Nutley boat ramp; docks	Passive recreation; sculling/boating; fishing
RM 12-15	Urban, infrastructure (highway), parkland, boat docks, residential	SP/B ~ 37.2% RR/S ~ 8.7% N/V ~ 54.1%	Some access points along park shoreline; bridge abutments; docks	Passive recreation; sculling/boating; fishing
RM 15-17.4	Commercial, parkland, residential	SP/B ~ 1.5% RR/S ~ 0.0% N/V ~ 98.5%	Access points along park shoreline; bridge abutments; dam	Passive recreation; sculling/boating (water depth limited); fishing

Notes:

1. Percent shoreline types taken from 2010 Habitat Survey (Windward 2014c).

N/V: natural/vegetated

RM: river mile

RR/S: riprap/stone

SP/B: sheetpile/bulkhead

Table 8-3

Summary of Receptor/Exposure Pathway Cancer Risks for LPRSA Baseline Human Health Risk Assessment: RME

Receptor Population	Age Group	Accessible Surface Sediment ^a								Sitewide Surface Water	RME Mixed Fish Diet ^b	Crab Muscle and Hepatopancreas
		Sitewide	RM 0-3	RM 3-6	RM 6-9	RM 6-9 East Bank	RM 9-12	RM 12-15	RM 15-17.4			
Recreational Angler	Young child	Pathways incomplete									1E-03	4E-04
	Adolescent	2E-05	6E-06	3E-06	4E-05	6E-05	1E-05	3E-06	1E-06	8E-06	2E-03	5E-04
	Adult	7E-06	3E-06	2E-06	2E-05	3E-05	6E-06	1E-06	5E-07	2E-06	3E-03	9E-04
	Young child/Adult ^c	7E-06	3E-06	2E-06	2E-05	3E-05	6E-06	1E-06	5E-07	2E-06	4E-03	1E-03
Swimmer	Young child	1E-05	5E-06	3E-06	3E-05	5E-05	9E-06	2E-06	1E-06	2E-05	Pathways incomplete	
	Adolescent	2E-05	6E-06	3E-06	4E-05	6E-05	1E-05	3E-06	1E-06	4E-05		
	Adult	7E-06	3E-06	2E-06	2E-05	3E-05	6E-06	1E-06	5E-07	1E-05		
	Young child/Adult ^c	2E-05	8E-06	4E-06	6E-05	8E-05	2E-05	4E-06	2E-06	3E-05		
Wader	Young child	1E-05	5E-06	3E-06	3E-05	5E-05	9E-06	2E-06	1E-06	3E-06		
	Adolescent	2E-05	6E-06	3E-06	4E-05	6E-05	1E-05	3E-06	1E-06	8E-06		
	Adult	7E-06	3E-06	2E-06	2E-05	3E-05	6E-06	1E-06	5E-07	2E-06		
	Young child/Adult ^c	2E-05	8E-06	4E-06	6E-05	8E-05	2E-05	4E-06	2E-06	5E-06		
Boater	Older child	4E-06	2E-06	9E-07	1E-05	2E-05	3E-06	8E-07	4E-07	3E-06		
	Teen	4E-07	2E-07	8E-08	1E-06	2E-06	3E-07	7E-08	2E-08	3E-06		
	Adult	3E-06	1E-06	7E-07	1E-05	2E-05	3E-06	7E-07	2E-07	3E-05		
Worker	Adult	2E-05	1E-05	5E-06	8E-05	1E-04	2E-05	5E-06	1E-06	Not quantified ^d		

Notes:

Cumulative cancer risks for surface water and sediment do not differ based on PCB toxicity approach, and only minimal differences are observed for tissue. Therefore, the results presented represent the results of the PCB-TEQ/non-DLC approach, which result in slightly higher risk estimates.

a. Accessible surface sediment is evaluated on both a sitewide basis and by three-mile river segments; incidental ingestion and dermal contact

b. RME Mixed Fish Diet is assumed to consist of equal fractions (20%) of American eel, white perch, channel catfish, largemouth bass, and common carp.

c. Potential cancer risks in this table represent exposures for a child and adult over a 26-year period (USEPA 2014).

d. Adult workers could include fire/rescue squads that may be exposed to the surface water, but their risks would be less than the risks quantified for an adult swimmer.

Shading indicates that the cumulative potential carcinogenic risk exceeds 10^{-4} .

DLC: dioxin-like congener

LPRSA: Lower Passaic River Study Area

PCB: polychlorinated biphenyl

RM: River Mile

RME: Reasonable Maximum Exposure

TEQ: Toxicity Equivalence Quotient

Table 8-4

Summary of Receptor/Exposure Pathway Cancer Risks for LPRSA Baseline Human Health Risk Assessment: CTE

Receptor Population	Age Group	Accessible Surface Sediment ^a								Sitewide Surface Water	RME Mixed Fish Diet ^b	Crab Muscle and Hepatopancreas
		Sitewide	RM 0-3	RM 3-6	RM 6-9	RM 6-9 East Bank	RM 9-12	RM 12-15	RM 15-17.4			
Recreational Angler	Young child	Pathways incomplete									5E-05	3E-05
	Adolescent	3E-06	1E-06	6E-07	8E-06	1E-05	2E-06	5E-07	2E-07	1E-06	5E-05	4E-05
	Adult	1E-06	6E-07	3E-07	4E-06	6E-06	1E-06	3E-07	9E-08	4E-07	8E-05	5E-05
	Young child/Adult ^c	1E-06	6E-07	3E-07	4E-06	6E-06	1E-06	3E-07	9E-08	4E-07	1E-04	8E-05
Swimmer	Young child	2E-06	7E-07	4E-07	5E-06	7E-06	1E-06	3E-07	1E-07	3E-06	Pathways incomplete	
	Adolescent	3E-06	1E-06	6E-07	8E-06	1E-05	2E-06	5E-07	2E-07	9E-06		
	Adult	1E-06	6E-07	3E-07	4E-06	6E-06	1E-06	3E-07	9E-08	3E-06		
	Young child/Adult ^c	3E-06	1E-06	7E-07	9E-06	1E-05	2E-06	6E-07	2E-07	6E-06		
Wader	Young child	2E-06	7E-07	4E-07	5E-06	7E-06	1E-06	3E-07	1E-07	5E-07		
	Adolescent	3E-06	1E-06	6E-07	8E-06	1E-05	2E-06	5E-07	2E-07	1E-06		
	Adult	1E-06	6E-07	3E-07	4E-06	6E-06	1E-06	3E-07	9E-08	4E-07		
	Young child/Adult ^c	3E-06	1E-06	7E-07	9E-06	1E-05	2E-06	6E-07	2E-07	8E-07		
Boater	Older child	7E-07	2E-07	1E-07	2E-06	2E-06	4E-07	1E-07	6E-08	6E-07		
	Teen	6E-08	3E-08	1E-08	2E-07	3E-07	5E-08	1E-08	3E-09	8E-07		
	Adult	4E-07	2E-07	9E-08	1E-06	2E-06	4E-07	9E-08	3E-08	4E-06		
Worker	Adult	2E-06	1E-06	5E-07	8E-06	1E-05	2E-06	5E-07	2E-07	Not quantified ^d		

Notes:

Cumulative cancer risks for surface water and sediment do not differ based on PCB toxicity approach, and only minimal differences are observed for tissue. Therefore, the results presented represent the results of the PCB-TEQ/non-DLC approach, which result in slightly higher risk estimates.

a. Accessible surface sediment is evaluated on both a sitewide basis and by three-mile river segments; incidental ingestion and dermal contact

b. RME Mixed Fish Diet is assumed to consist of equal fractions (20%) of American eel, white perch, channel catfish, largemouth bass, and common carp.

c. Potential cancer risks in this table represent exposures for a child and adult over a 12-year period.

d. Adult workers could include fire/rescue squads that may be exposed to the surface water, but their risks would be less than the risks quantified for an adult swimmer.

Shading indicates that the cumulative potential carcinogenic risk exceeds 10^{-4} .

CTE: Central Tendency Exposure

DLC: dioxin-like congener

LPRSA: Lower Passaic River Study Area

PCB: polychlorinated biphenyl

RM: River Mile

TEQ: Toxicity Equivalence Quotient

Table 8-5

Summary of Receptor/Exposure Pathway Noncancer Hazards for LPRSA Baseline Human Health Risk Assessment: RME

Receptor Population	Age Group	Accessible Surface Sediment ^a								Sitewide Surface Water	RME Mixed Fish Diet ^b	Crab Muscle and Hepatopancreas
		Sitewide	RM 0-3	RM 3-6	RM 6-9	RM 6-9 East Bank	RM 9-12	RM 12-15	RM 15-17.4			
Recreational Angler	Young child	Pathways incomplete									193 ^e	50 ^e
	Adolescent	0.6	0.3	0.2	3 ^d	4 ^d	0.7	0.2	0.04	0.09	127 ^e	33 ^e
	Adult	0.2	0.1	0.05	0.8	1	0.2	0.06	0.02	0.03	123 ^e	32 ^e
Swimmer	Young child	0.9	0.5	0.2	4 ^d	5 ^d	1	0.2	0.05	0.3	Pathways incomplete	
	Adolescent	0.6	0.3	0.2	3 ^d	4 ^d	0.7	0.2	0.04	0.5		
	Adult	0.2	0.1	0.05	0.8	1	0.2	0.06	0.02	0.2		
Wader	Young child	0.9	0.5	0.2	4 ^d	5 ^d	1	0.2	0.05	0.05		
	Adolescent	0.6	0.3	0.2	3 ^d	4 ^d	0.7	0.2	0.04	0.09		
	Adult	0.2	0.1	0.05	0.8	1	0.2	0.06	0.02	0.03		
Boater	Older child	0.2	0.1	0.07	1	1	0.3	0.07	0.02	0.05		
	Teen	0.04	0.02	0.01	0.2	0.2	0.04	0.01	0.002	0.1		
	Adult	0.09	0.05	0.02	0.4	0.5	0.10	0.03	0.006	0.3		
Worker	Adult	0.5	0.3	0.2	2 ^d	3 ^d	0.6	0.2	0.04	Not quantified ^c		

Notes:

Cumulative noncancer hazards for surface water and sediment do not differ based on PCB toxicity approach, and only minimal differences are observed for tissue. Therefore, the results presented represent the results of the PCB-TEQ/non-DLC approach, which result in slightly higher risk estimates.

a. Accessible surface sediment is evaluated on both a sitewide basis and by three-mile river segments; incidental ingestion and dermal contact

b. RME Mixed Fish Diet is assumed to consist of equal fractions (20%) of American eel, white perch, channel catfish, largemouth bass, and common carp.

c. Adult workers could include fire/rescue squads that may be exposed to the surface water, but their risks would be less than the risks quantified for an adult swimmer.

d. Target organ HI above 1 includes developmental and reproductive effects (driven by TCDD-TEQ).

e. Target organ HIs above 1 include developmental and reproductive effects (TCDD-TEQ and dioxin-like PCBs); eye, nails, and immune effects (PCBs); and neurological effects (methyl mercury).

 Total Hazard Index presented. Shading indicates that one or more target organ-specific hazard indices exceed 1.

DLC: dioxin-like congener

HI: Hazard Index

LPRSA: Lower Passaic River Study Area

PCB: polychlorinated biphenyl

RM: River Mile

RME: Reasonable Maximum Exposure

TCDD: tetrachlorodibenzo-p-dioxin

TEQ: Toxicity Equivalence Quotient

Table 8-6

Summary of Receptor/Exposure Pathway Noncancer Hazards for LPRSA Baseline Human Health Risk Assessment: CTE

Receptor Population	Age Group	Accessible Surface Sediment ^a								Sitewide Surface Water	RME Mixed Fish Diet ^b	Crab Muscle and Hepatopancreas
		Sitewide	RM 0-3	RM 3-6	RM 6-9	RM 6-9 East Bank	RM 9-12	RM 12-15	RM 15-17.4			
Recreational Angler	Young child	Pathways incomplete									15 ^e	8 ^d
	Adolescent	0.2	0.1	0.06	0.9	1	0.2	0.07	0.02	0.03	9 ^e	4 ^d
	Adult	0.08	0.05	0.02	0.3	0.5	0.09	0.03	0.007	0.01	8 ^e	4 ^d
Swimmer	Young child	0.3	0.2	0.07	1	2 ^d	0.3	0.08	0.02	0.1	Pathways incomplete	
	Adolescent	0.2	0.1	0.06	0.9	1	0.2	0.07	0.02	0.3		
	Adult	0.08	0.05	0.02	0.3	0.5	0.09	0.03	0.007	0.08		
Wader	Young child	0.3	0.2	0.07	1	2 ^d	0.3	0.08	0.02	0.02		
	Adolescent	0.2	0.1	0.06	0.9	1	0.2	0.07	0.02	0.03		
	Adult	0.08	0.05	0.02	0.3	0.5	0.09	0.03	0.007	0.01		
Boater	Older child	0.09	0.05	0.03	0.4	0.5	0.1	0.03	0.007	0.02		
	Teen	0.01	0.007	0.00	0.05	0.07	0.01	0.004	0.0008	0.07		
	Adult	0.03	0.02	0.007	0.1	0.2	0.03	0.008	0.002	0.1		
Worker	Adult	0.2	0.1	0.1	0.8	1	0.2	0.06	0.02	Not quantified ^c		

Notes:

Cumulative noncancer hazards for surface water and sediment do not differ based on PCB toxicity approach, and only minimal differences are observed for tissue. Therefore, the results presented represent the results of the PCB-TEQ/non-DLC approach, which result in slightly higher risk estimates.

a. Accessible surface sediment is evaluated on both a sitewide basis and by three-mile river segments; incidental ingestion and dermal contact

b. RME Mixed Fish Diet is assumed to consist of equal fractions (20%) of American eel, white perch, channel catfish, largemouth bass, and common carp.

c. Adult workers could include fire/rescue squads that may be exposed to the surface water, but their risks would be less than the risks quantified for an adult swimmer.

d. Target organ HI above 1 includes developmental and reproductive effects (driven by TCDD-TEQ).

e. Target organ HIs above 1 include developmental and reproductive effects (TCDD-TEQ and dioxin-like PCBs); eye, nails, and immune effects (PCBs); and neurological effects (methyl mercury).

Total Hazard Index presented. Shading indicates that one or more target organ-specific hazard indices exceed 1.

CTE: Central Tendency Exposure

DLC: dioxin-like congener

HI: Hazard Index

LPRSA: Lower Passaic River Study Area

PCB: polychlorinated biphenyl

RM: River Mile

TCDD: tetrachlorodibenzo-p-dioxin

TEQ: Toxicity Equivalence Quotient

Table 8-7

Identification of Potential Chemicals of Concern Based on RME Scenario

Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and ≤10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and ≤10 ⁻⁵	Chemicals with Target Organ Effect HI>1	Chemicals with Target Organ Effect HI>0.1 and ≤1
RME Mixed Fish Diet				
TCDD-TEQ PCBs	Dieldrin Heptachlor Epoxide	4,4'-DDD 4,4'-DDE cis-Chlordane Gamma-Chlordane Hexachlorobenzene	TCDD-TEQ PCBs Methyl mercury	Mercury, inorganic 4,4'-DDE Dieldrin Heptachlor Epoxide trans-Nonachlor
Crab Muscle and Hepatopancreas				
TCDD-TEQ PCB-TEQ	PCBs (total) PCBs (non-DLC) Dieldrin	Arsenic, inorganic 4,4'-DDE Heptachlor Epoxide	TCDD-TEQ PCBs	None
Accessible Surface Sediment River Mile 6-9^a				
None	TCDD-TEQ	None	TCDD-TEQ ^b	None
Accessible Surface Sediment River Mile 6-9 East Bank				
None	TCDD-TEQ	None	TCDD-TEQ ^b	TCDD-TEQ ^c
Sitewide Surface Water				
None	None	None	None	None

Notes:

The potential COC selection for PCBs was based on the higher of the risks/hazards estimated for total PCBs and PCB-TEQ.

a. No potential COCs were identified for other RM segments.

b. TCDD-TEQ HI for RM 6-9 and RM 6-9 East Bank accessible surface sediment exceeds 1 for the following receptors: angler (adolescent), swimmer and wader (young child and adolescent), and worker (adult).

c. TCDD-TEQ HI for RM 6-9 East Bank accessible surface sediment is equal to 1 for the following receptors: angler (adult), swimmer and wader (adult), and boater (older child).

COC: chemical of concern

HI: Hazard Index

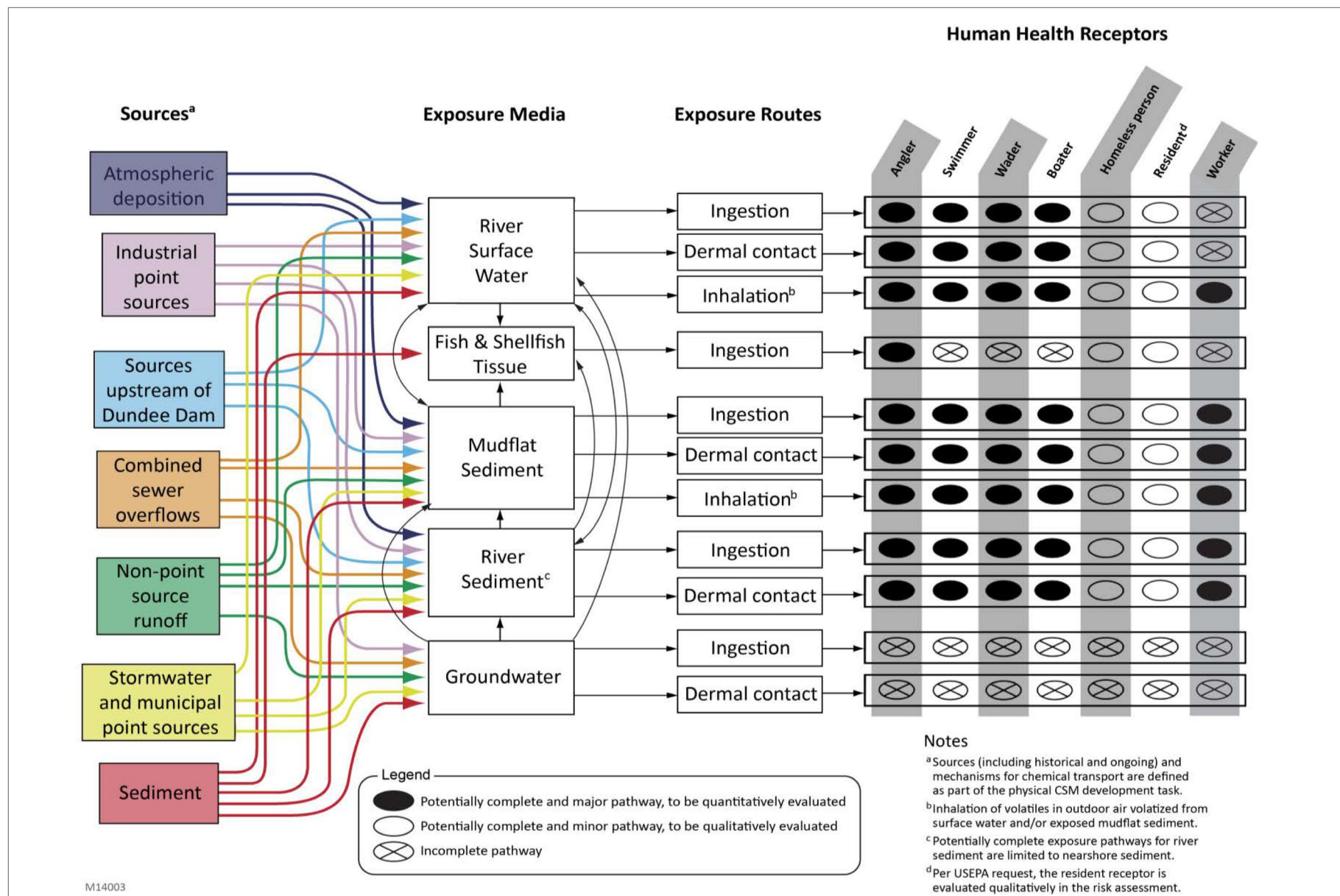
PCB: polychlorinated biphenyl

RME: Reasonable Maximum Exposure

TCDD: tetrachlorodibenzo-p-dioxin

TEQ: Toxicity Equivalence Quotient

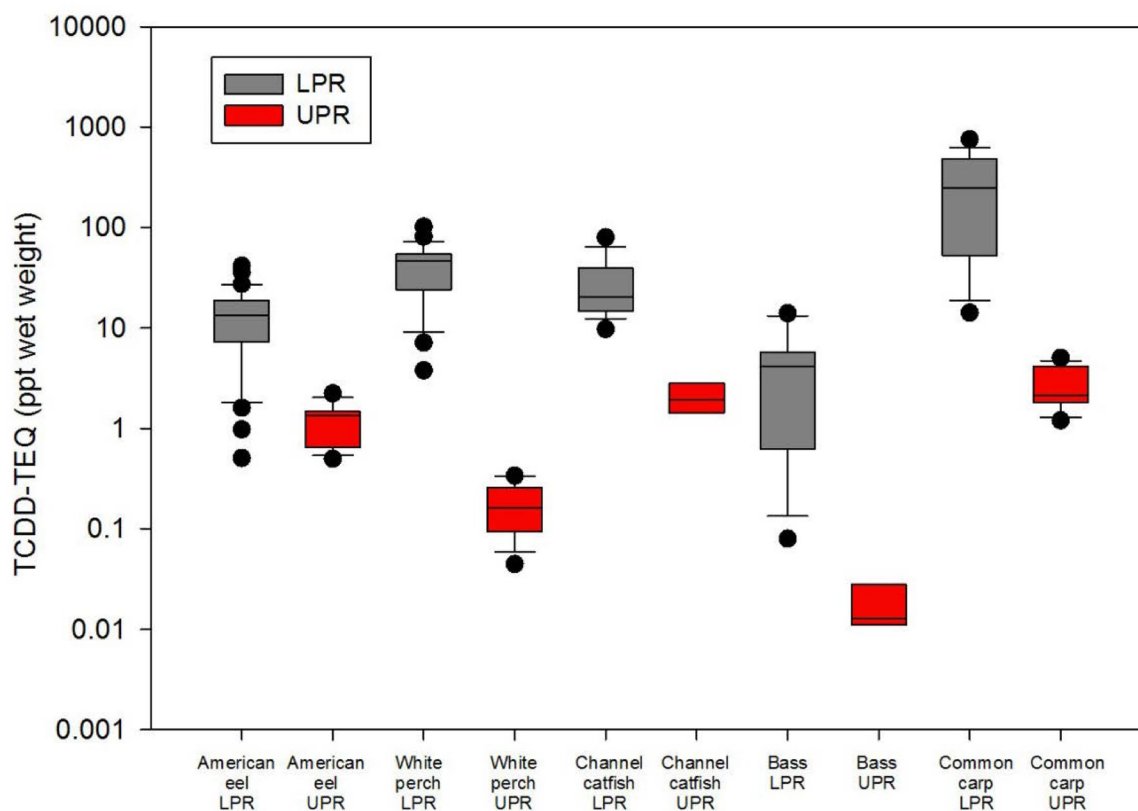
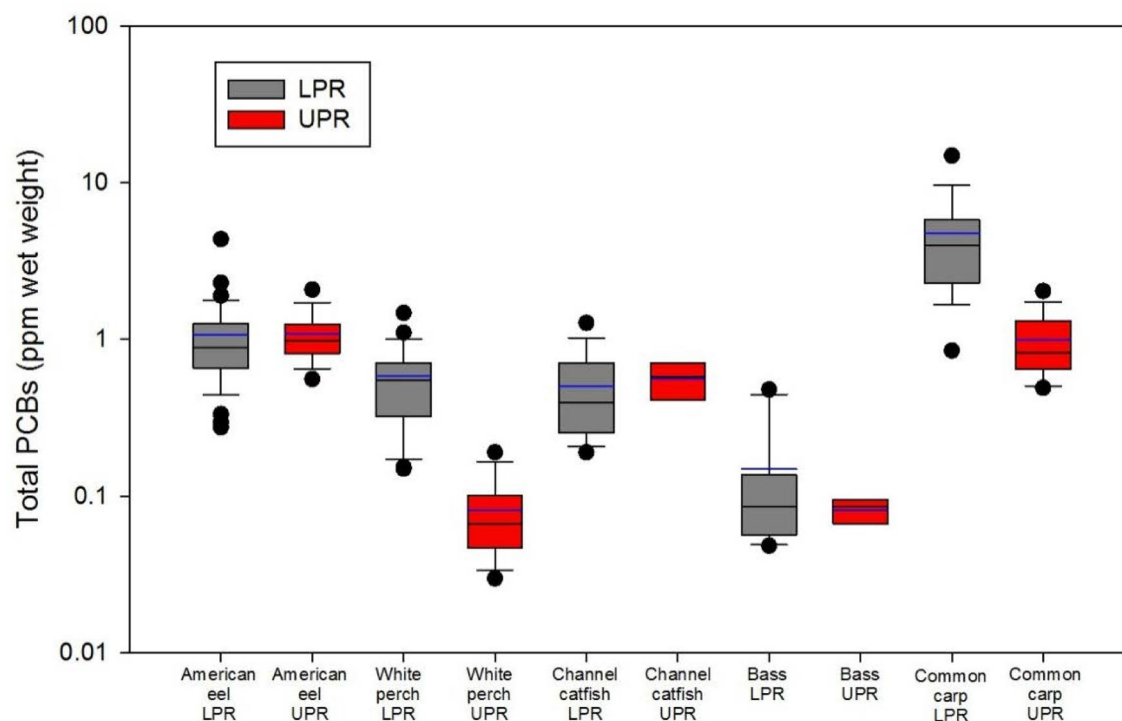
Figures



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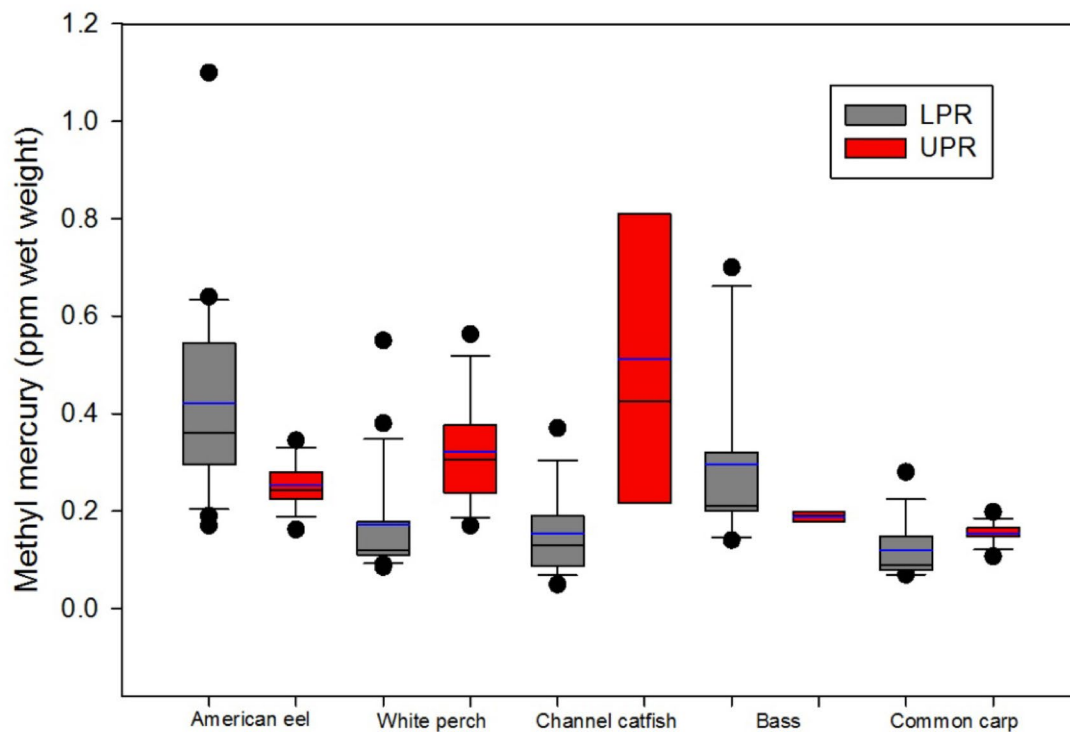
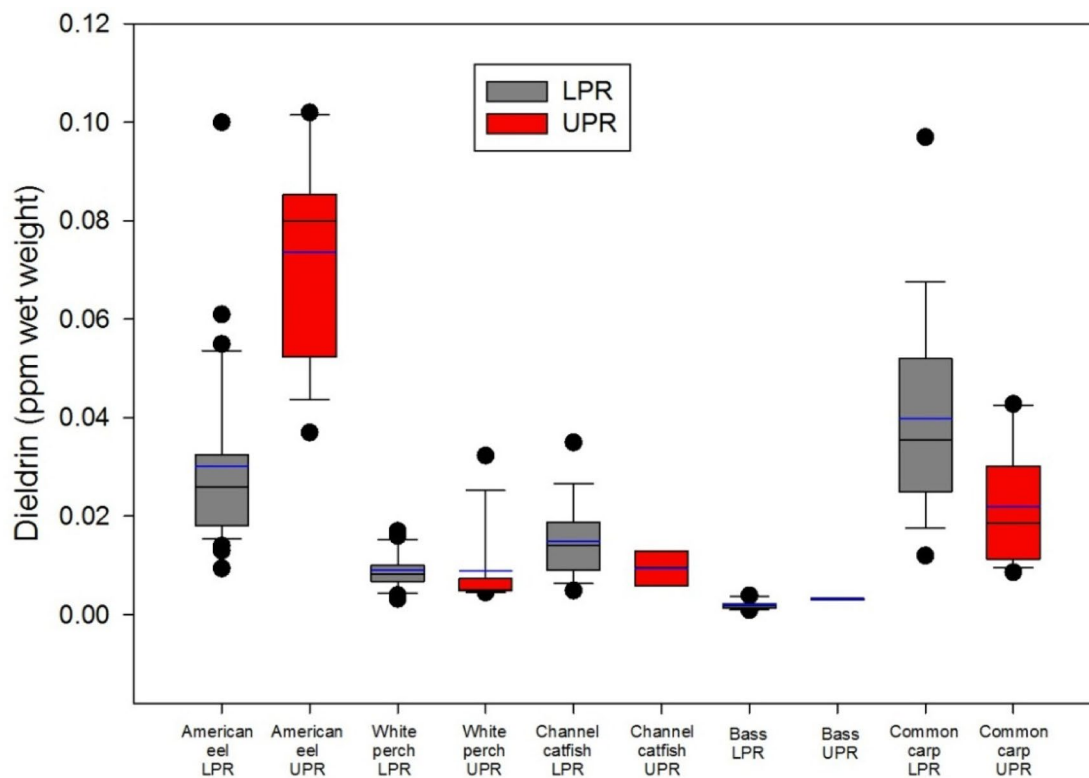
Figure 8-1
General Human Health Conceptual Site Model for the LPRSA

Remedial Investigation Report
Lower Passaic River Study Area Remedial Investigation/Feasibility Study



LPR – Study Area: Lower Passaic River (final 17.4 miles of the River) (data from Windward [in prep]-a)
 UPR – Reference Area: Upper Passaic River (above Dundee Dam) (data from Windward [in prep]-.)

Figure 8-2
Box Plots of PCBs and TCDD-TEQ in LPRSA and UPR Fish (Fillet)



LPR – Study Area: Lower Passaic River (final 17.4 miles of the River) (data from Windward [in prep]-a)
 UPR – Reference Area: Upper Passaic River (above Dundee Dam) (data from Windward [in prep]-_)

Figure 8-3
Box Plots Dieldrin and Methyl Mercury in LPRSA and Background Fish Tissue (Fillet)