Lake Worth: Polychlorinated Biphenyls in Fish Tissue

- **One TMDL Adopted August 2005**
  Approved by EPA October 2005

- **Two TMDLs Added by Addendum July 2014**
  Approved by EPA November 2014 (scroll to view or print this publication)

Prepared by the:
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Addendum One to One Total Maximum Daily Load for Polychlorinated Biphenyls (PCBs) in Fish Tissue in Lake Worth

One Total Maximum Daily Load for Polychlorinated Biphenyls (PCBs) in Fish Tissue in West Fork Trinity River Below Eagle Mountain Lake

For Segment 0808
Assessment Unit 0808_01

Introduction

The Texas Commission on Environmental Quality (TCEQ) adopted the total maximum daily load (TMDL) *One Total Maximum Daily Load for Polychlorinated Biphenyls (PCBs) in Fish Tissue in Lake Worth: Segment 0807* (TCEQ 2005) on 8/10/2005. The TMDL was approved by the United States Environmental Protection Agency (EPA) on 10/13/2005. This document represents an addendum to the original TMDL document.

This addendum includes information specific to one additional segment located within the watershed of the approved TMDL project for PCBs in fish tissue in Lake Worth. This addendum presents the new information associated with the additional segment.

Refer to the original, approved TMDL document for details related to the overall project watershed as well as the methods and assumptions used in developing this TMDL. This addendum focuses on the subwatershed of the additional segment. This subwatershed was addressed in the original TMDL. This addendum provides the details related to developing the TMDL allocation for the additional segment, which was not addressed individually in the original document. This segment is also covered by an implementation plan (I-Plan) that was approved by TCEQ on 8/23/2006 (TCEQ 2006).

Problem Definition

The TCEQ first identified the PCBs in fish tissue impairment to the segment and assessment unit (AU) included in this addendum in the 2012 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) (TCEQ 2012). The impairment listing was the result of the issuance of Fish and Shellfish Consumption Advisory No. ADV-45 by the Texas Department of State Health Services (DSHS) on 11/15/2010. The new advisory revised the consumption restriction on Lake Worth to cover only three fish species (blue catfish, smallmouth buffalo, and channel catfish), but also clarified the coverage area to specifically include the connected West Fork Trinity River below Eagle Mountain Lake (Segment 0808) (DSHS 2010a,b). See Figure 1 for a map of the watershed.

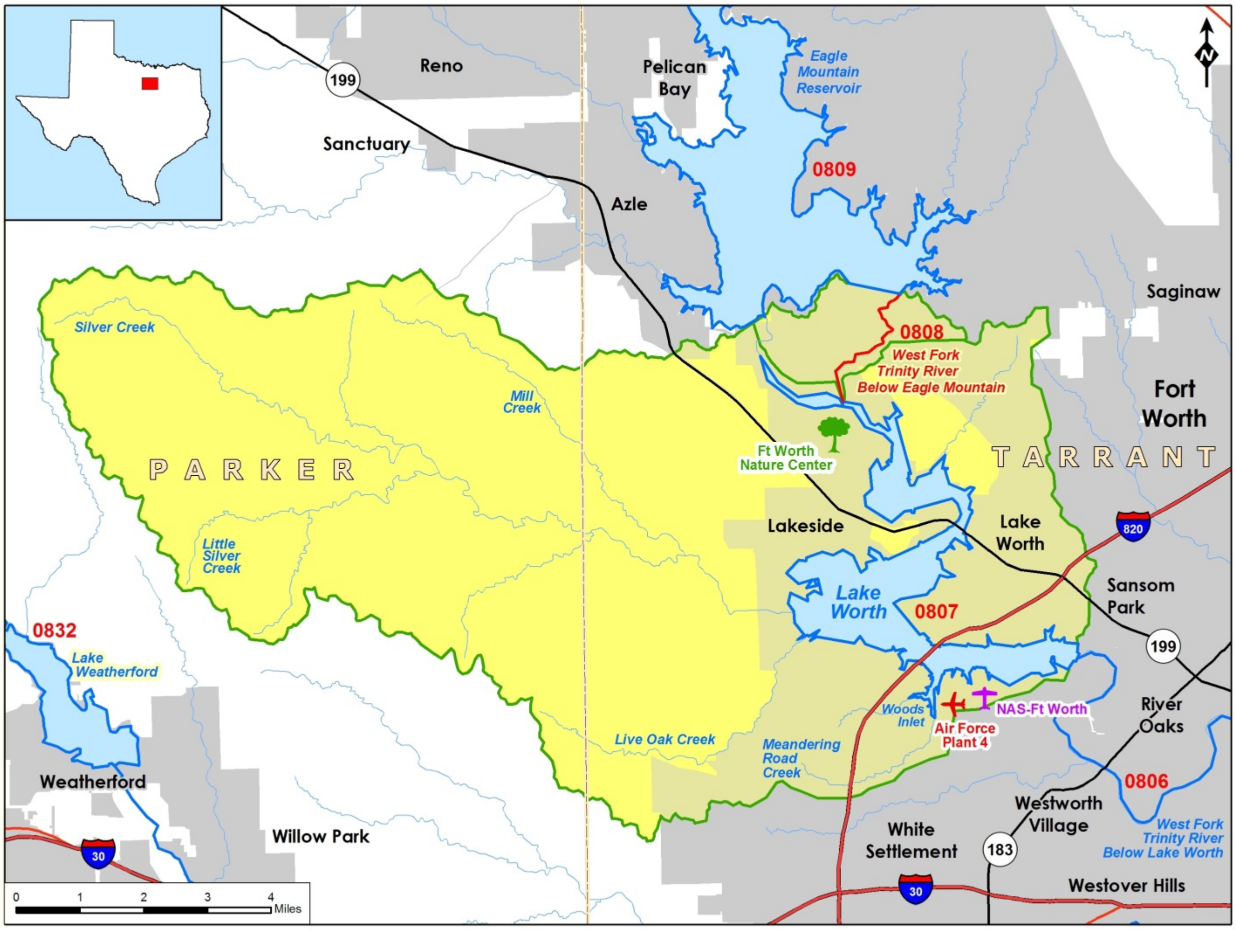

Figure 1. Lake Worth watershed

Designated Uses and Water Quality Standards

Segments 0807 and 0808 are classified water quality segments as defined in the Texas Surface Water Quality Standards (TSWQS) in Title 30 Texas Administrative Code (TAC) Chapter 307. Chapter 307.10 (Appendix A) establishes designated uses for these segments as primary contact recreation, high aquatic life, and public drinking water supply. In addition, TSWQS presume all classified segments to have sustainable fisheries (30 TAC 307.6(d)(5)(A), which are defined as ". . . sufficient fish production or fishing activity to create significant long-term human consumption of fish" (30 TAC 307.3(a)(67)). The fish consumption use of a water body is not supported when a consumption advisory or ban has been issued by the DSHS.

Watershed Overview

West Fork Trinity River below Eagle Mountain Lake (Segment 0808) is a 2.5-mile segment extending from the dam on Eagle Mountain Lake (Segment 0809) downstream to the upper end of Lake Worth (Segment 0807) (see Figure 1). Both lakes are impoundments of the West Fork Trinity River (see Ulery *et al.* 1993). Lake Worth was constructed in 1914 and impounds a 94-square mile watershed below the Eagle Mountain Lake dam.

The watershed for Segment 0808 is approximately three square miles (see Figure 2). Most of the flow in Segment 0808 is generated by releases from Eagle Mountain Lake. Much of Segment 0808 and the upstream end of Lake Worth are bordered by the 3621-acre Fort Worth Nature Center and Refuge, which consists largely of forest, prairie, and wetlands (Fort Worth 2011; see also <www.fwnaturecenter.org>). There are also some scattered residential properties near the Eagle Mountain Lake dam. Segment 0808 constitutes a single assessment unit, the smallest geographic area of use support reported in the Texas Integrated Report.

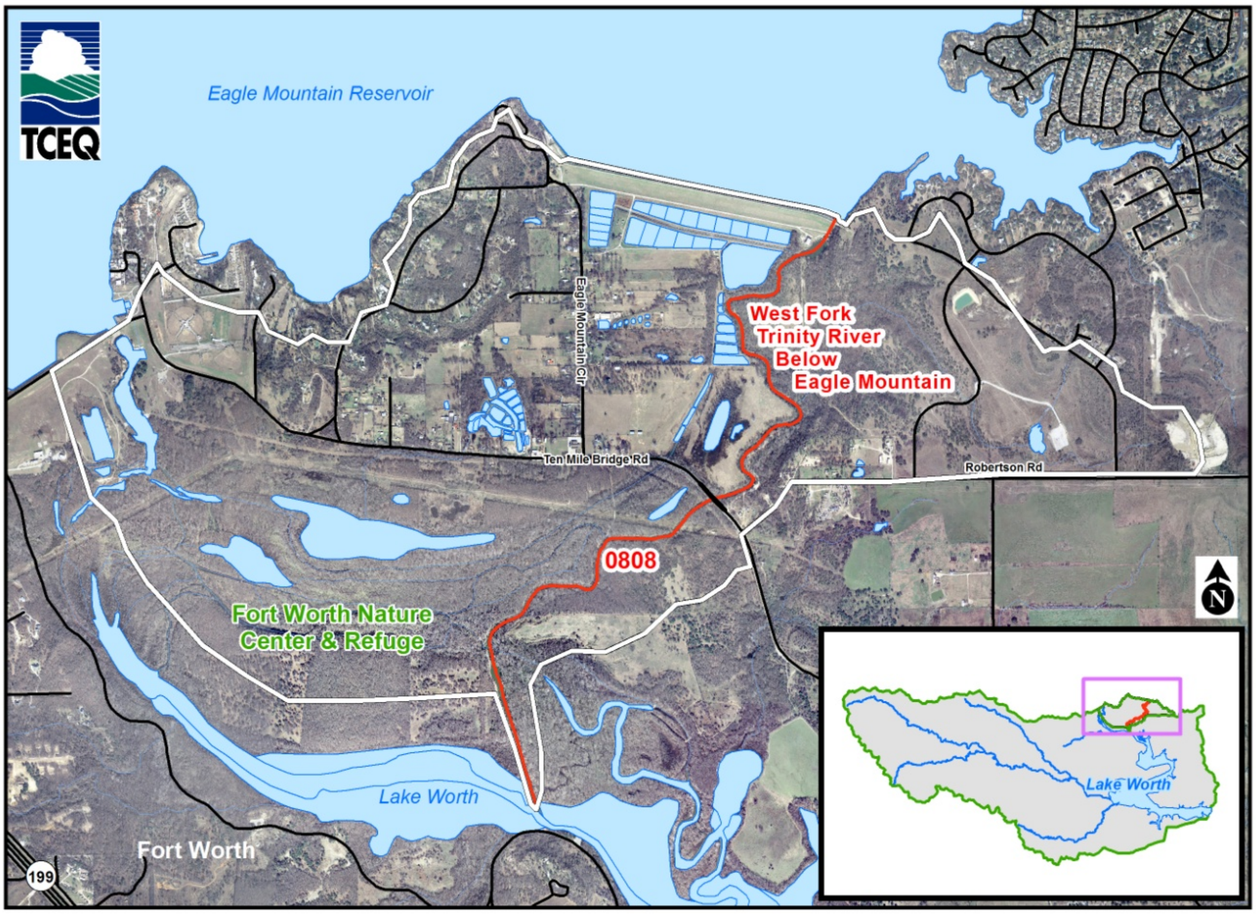

Figure 2. Segment 808 Watershed

Tissue Contamination and Risk Assessment

PCBs were manufactured and widely used in the United States prior to USEPA restriction (Erickson 2001). These restrictions did not require PCB-containing materials to be removed from service, and many are still in use (USEPA 1999). PCBs are common environmental contaminants (Smith *et al.* 1988; Kuehl *et al.* 1994), and are frequently found at elevated levels in the tissue of aquatic organisms (Eisler 1986; Evans *et al.* 1991). USEPA (1992) found PCB residues in fish tissue at 91 percent of 388 nationwide locations in 1986-87. PCBs have been detected in fish tissue and sediment in a number of water bodies in Texas (Dick 1982; Van Metre and Callender 1996), including the Dallas/Fort Worth area (Van Metre and Callender 1997). Because of their low solubility, PCBs are not acutely toxic to aquatic life, but instead cause sublethal and chronic effects (Eisler 1986; Khan 2003).

PCBs are a frequent cause of fish consumption advisories in the U.S. (USEPA 1999). Elevated concentrations are frequently found in game fish tissue (Kuehl *et al.* 1994). Fish consumption can be a primary route of human exposure to PCBs, with significantly elevated blood serum and milk contaminant levels found in those consuming contaminated fish (Asplund *et al.* 1994; USEPA 1999; Stewart *et al.* 1999).

PCBs can cause a variety of adverse health effects and are classified as probable human carcinogens (Safe 1994; Longnecker *et al.* 1997; ATSDR 2000; Longnecker 2001; Schantz *et al.* 2001). Cogliano (1998) reviewed available data and found a strong case that all PCB mixtures can cause cancer. Different mixtures have different potencies as a result of environmental processes that alter these mixtures through partitioning, chemical transformation, and preferential bioaccumulation.

The consumption advisory for Lake Worth was issued on the basis of an unacceptable carcinogenic risk of liver cancer and a noncarcinogenic risk of possible adverse liver effects due to fish tissue PCB concentrations. The health assessment (DSHS 2010a,b) evaluated risk to a 70-kg adult consuming an average of 30 grams of contaminated fish per day, and to a 15- to 35-kg child consuming an average of 15 grams of contaminated fish per day, both for an exposure period of 30 years.

Endpoint Identification

The assessment endpoint (USEPA 1994) and ultimate goal of this TMDL is the reduction of PCB concentrations in fish tissue to a level that constitutes an acceptable risk to consumers of fish from Lake Worth and Lower West Fork Trinity River below Eagle Mountain Reservoir, thereby allowing DSHS to remove the consumption advisory. Fish tissue PCB concentrations are the direct cause of the impairment in the segments. A numeric fish tissue target is consistent with how fish consumption advisories are issued, and is more closely tied to the protection of human health. It is also easier to quantify contaminants like PCBs in fish tissue than in water. In addition, a fish tissue target better integrates the spatial and temporal complexity associated with PCB contamination in aquatic systems (USEPA 2001).

Source Assessment

Segment 0808 was previously evaluated for potential PCB sources as part of the Lake Worth TMDL (TCEQ 2005). The small, undeveloped nature of the watershed and the lack of PCBs in upstream Lake Worth sediments indicated there were no significant PCB sources within the Segment 0808 watershed.

As part of the current evaluation, applicable databases were again reviewed for the presence of TCEQ-regulated facilities within the Segment 0808 watershed (see Table 1). Only four regulated sites, covered by the Texas Pollutant Discharge Elimination system (TPDES) general storm water permit for construction activities, were found to be within that watershed. Although Segment 0808 is listed as part of the TPDES Phase II municipal separate storm sewer system (MS4) permit for Tarrant County, the segment watershed is not within the urbanized area where Phase II permit coverage is required (see Census 2010 Urban Area Reference Maps at

< http://cfpub.epa.gov/npdes/stormwater/urbanmaps.cfm>).

Table 1. TCEQ-regulated facilities located within the watershed of Segment 0808.

Type of Facility	No. Facilities [a]
Individual TPDES Wastewater Discharges	0
TPDES Phase I MS4	0
TPDES Phase II MS4 (General Permit TXR040000)	0[b]
Industrial multi-sector general permit (MSGP) TXR050000	0
Construction activities >one acre (General Permit TXR150000)	4
Concrete production (General Permit TXR110000)	0
Aquaculture production (General Permit TXR130000)	0
Petroleum bulk stations and terminals (General Permit TXG340000)	0
Hydrostatic test water discharges (General Permit TXG670000)	0
Water contaminated by petroleum fuel or petroleum substances (General Permit TXG830000)	0
Concentrated animal feeding operations (General Permit TXG920000)	0
Livestock manure compost operations (General Permit WQG20000)	0
Permitted-active municipal solid waste landfills	0
Permitted-closed municipal solid waste landfills	0
Unauthorized-closed municipal solid waste landfills	0
Superfund sites	0
Industrial & hazardous waste registrations	0
Industrial & hazardous waste remediation	0
Used oil facilities	0
Emergency response	0
Brownfield site assessments	0
Underground Injection Control sites	0
Voluntary Cleanup Program sites	0

[a] Information retrieved 27 December 2013 from:
TCEQ Water Quality Permit Query at < http://www1.tceq.texas.gov/wqpaq/>;
TCEQ Water Quality General Permits & Registrations at < http://www2.tceq.texas.gov/wq_dpa/index.cfm>;
TCEQ Index to Superfund Sites by County at
<www.tceq.state.tx.us/remediation/superfund/sites/county/index.html>;
TCEQ Central Registry at <http://www12.tceq.state.tx.us/crpub/>; and
NCTCOG Closed and Abandoned Municipal Solid Waste Landfill Inventory at
<www.nctcog.org/envir/SEELT/disposal/facilities/index.asp>.

[b] Segment 0808 is included under the Tarrant County Phase II MS4 permit, although the segment watershed is not within the designated urban area for required permit coverage.

Linkage Between Sources and Receiving Waters

The time required for the reduction of tissue PCB concentrations to the measurement endpoint target is a function of PCB persistence and fate in the environment. PCBs are extremely hydrophobic, and their affinity for sorption to soil and sediment, along with their tendency to partition into the lipids of aquatic organisms, determine their transport, fate, and distribution (Smith *et al.* 1988). PCBs degrade slowly, and may be present in sediment and tissue for long periods of time (Oliver *et al.* 1989; USEPA 1999).

Hydrologic Connection Between Segments 0807 and 0808

Segment 0808 occupies a 2.5-mile channel extending from the dam on Eagle Mountain Lake downstream to the upper end of Lake Worth (see Figures 1 and 2). Segment 0808 was isolated between the two lakes when Eagle Mountain Lake was constructed in 1932. Most of the flow in Segment 0808 is generated by releases from Eagle Mountain Lake. Backup from Lake Worth maintains water in the channel at other times. There is no physical barrier to fish movement between Segment 0807 and Segment 0808. The Eagle Mountain Lake dam is a barrier to further upstream movement.

The distance via the most direct route on water from the Lake Worth dam to the point where Segment 0808 enters the lake is approximately 8.8 miles as measured on a USGS topographic map. The distance from the upstream end of Woods Inlet to Segment 0808 is approximately 7.3 miles. Many of the fish species sampled for tissue PCB concentrations in Lake Worth, including the three species covered by ADV-45, are known to move over areas large enough to cover the distance from any point in Lake Worth to Segment 0808.

Lucas and Baras (2001) described five main types of fish migration – feeding, refuge seeking, spawning, recolonization/exploratory, and diel vertical and horizontal migrations. Fish populations may contain both a sedentary and a mobile component (Hale *et al.* 1986), so at least some portion of a population of many species may be capable of moving a significant distance. Fish exposed to PCBs in one portion of a water body can subsequently move to another area or another hydrologically-connected water body (Zlokovitz and Secor 1999; Bayne *et al.* 2002; Morgan and Lohmann 2010).

Fish migration over long river distances and within reservoirs and into their upstream tributaries has been relatively well-documented. June (1977) noted white crappie, carp, and bigmouth buffalo spawning in reservoir tributary embayments; and white bass, freshwater drum, and channel catfish moving upstream into major reservoir tributary streams during spawning season. Matthews (1998) observed that long upstream migrations are commonly associated with spawning in many species. Decker and Erman (1992) observed that several fish species appeared to migrate into a stream from a downstream reservoir during the spawning season. Hladík and Kubečka (2003) found 26 fish species and more than ten percent of the reservoir fish biomass migrating through a reservoir/river transition zone, with upstream spawning runs being the most important migrations.

Ruhr (1957) found that large populations of several species in upstream tributaries - including smallmouth buffalo and freshwater drum - had originated in downstream impoundments. No decline in the proportion of reservoir fish was found with increasing distance upstream from the impoundment in streams with no additional barrier to migration. Wrenn (1968) found smallmouth buffalo in a Tennessee reservoir moved up to 56 miles, although most of the tagged specimens had moved less than seven miles. Wrenn (1968) also cited another Tennessee reservoir study (Martin *et al.* 1964) where tagged smallmouth buffalo moved an average of 11.2 miles. Thompson (1933) calculated that smallmouth buffalo can move approximately one mile per day and 2.8 miles per week.

Blue catfish movement can span several hundred miles upstream and downstream in rivers (Graham 1999). Timmons (1999) reported blue catfish in Kentucky Lake moving an average distance of 10.6 to 15.5 miles and a maximum distance of 49 miles. Grist (2002) observed blue catfish to migrate a minimum of 21.4 miles to the upper riverine portion of a North Carolina reservoir during the spring, and concluded that movement within the reservoir was extremely varied. Tripp *et al.* (2010) found blue catfish in the upper Mississippi River system capable of moving as far as 428 river miles. Garrett (2010) found that blue catfish migrated up Missouri River tributary streams during the pre-spawning and spawning period, with individual movements of 171 to 216 miles. The timing of these migrations was not synchronous among individuals, with spawning-related migrations occurring from mid March through early July, and overwintering migrations taking place from mid-October through the end of December. Sixty-six percent of blue catfish migrated to and from seasonal habitats.

Channel catfish have been observed to migrate from reservoirs to upstream tributaries or headwater rivers to spawn, and then return to the reservoir for summer through winter months (Duncan and Meyers 1978; Hubert 1999). River populations of channel catfish show greater movement in spring than in other seasons, and there are frequent reports of individuals traveling in excess of 60 miles and as far as 291 miles (Hale *et al.* 1986; Fago 1999; Hubert 1999; see Hassan-Williams and Bonner 2011). Winter movement in an Arkansas reservoir was determined to be stimulated by rainfall and reservoir inflow (Duncan and Meyers 1978). Graham and DeiSanti (1999) reported that both blue and channel catfish accumulate below the Truman Lake dam in Missouri, in a 10.6-mile reach between reservoirs – a situation somewhat similar to the location of Segment 0808. Matthews (1998) observed that large aggregations of fish are common downstream from large dams.

Timmons (1999) reported channel catfish in Kentucky Lake moving an average distance of 6.8 miles and a maximum distance of 36 miles. Duncan and Meyers (1978) found that tagged channel catfish traveled a maximum distance of 26.8 miles and a mean distance of 3.8 miles in an Arkansas reservoir. Shrader *et al.* (2003) found that some channel catfish moved more than 155 miles upstream from an Oregon reservoir before being blocked by an upstream dam. Forty-eight percent of fish recovered in the reservoir had been tagged in the river, and 21 percent recovered in the river had been tagged in the reservoir. In a study of the movement of fish from a mid-reservoir tributary with known PCB contamination (Bayne *et al.* 2002), substantial numbers of channel catfish appeared to have moved 9.3 to 15.5 miles from the site of contamination.

PCBs in Fish Tissue

PCBs are highly lipophilic (Matthews and Dedrick 1984), and rapidly accumulate in the tissues of aquatic organisms at levels considerably greater than that of both the water column and the sediments (Smith *et al.* 1988). PCB concentrations in aquatic organisms may be 2000 to more than a million times greater than that of the water column (USEPA 1999). Fish tissue PCB concentrations are influenced by a variety of factors (Swackhamer and Hites 1988), and can vary within the same water body (Stow *et al.* 1995; Lamon and Stow 1999) as well as among different fish species and size classes (Swackhamer and Hites 1988; Connor *et al.* 2005).

Comparison of tissue PCB concentration versus the distance from the PCB source area in the most recently collected fish samples in Segments 0807 and 0808 (October 2008; DSHS 2010a) (see Figure 3) found no predictive relationship ($R^2 = 0.009$) when all fish were included in the analysis. Examining the three species covered by the current consumption advisory (Figure 3) shows a weak relationship for smallmouth buffalo ($R^2 = 0.29$) and none for channel catfish ($R^2 = 0.07$). The sample size (N=4) for blue catfish was too small to make any determination. Smallmouth buffalo appear somewhat less mobile than the catfish species, and this is reflected in a slightly stronger correlation. However, the overall lack of any strong correlation between tissue PCB concentration and distance from the source area is further indication of the mobility of fish within Lake Worth and its tributaries (see Bayne *et al.* 2002).

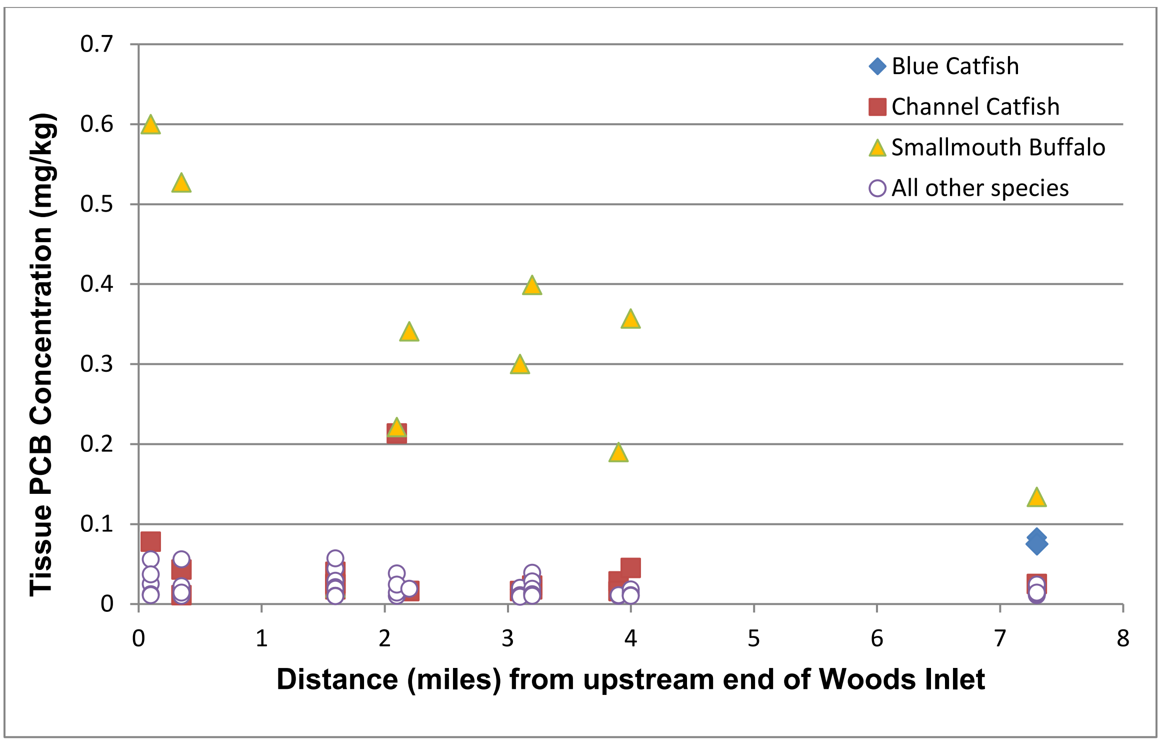

Figure 3. Fish tissue PCB concentrations (DSHS 2010a) versus distance from the PCB source area.

PCBs in Sediment

PCBs in sediment may be altered by environmental weathering, anaerobic reductive dechlorination, and aerobic microbial degradation. When weathering is the dominant process, sediments become enriched with higher-chlorinated congeners as the lower-chlorinated forms are preferentially solubilized and vaporized (Erickson 2001; Cacela *et al.* 2002). During anaerobic reductive dechlorination, microorganisms transform PCBs into lower-chlorinated forms by partially dechlorinating the more highly-chlorinated congeners (Erickson 2001; Magar *et al.* 2005). The result is an increase in lower-chlorinated congeners (Abramowicz *et al.* 1993), which are generally less toxic and more readily attacked by aerobic bacteria (Abramowicz 1995).

Except for one location immediately west of IH-820, total PCB concentrations in surface sediments in the lake upstream from the entrance to Woods Inlet were less than the detection limit (see Harwell *et al.* 2003). Dated core samples indicated that PCB concentrations in sediment were not detectable at any time in the upper-lake, indicating a lack of input from that portion of the lake watershed. Peak PCB concentrations in mid- and lower-lake core samples occurred in the 1960s, followed by an exponential decrease to the tops of the cores (Harwell *et al.* 2003). This trend is typical of sediment cores collected in other urban water bodies, reflecting times of peak PCB use and subsequent decline following USEPA restrictions (Van Metre and Callender 1997; Van Metre *et al.* 1997, 1998, 2003a,b; Ging *et al.* 1999; Van Metre and Mahler 1999; Imamoglu *et al.* 2002).

Targeted sampling of sediment cores, surface sediment (Figure 4), and storm-generated suspended sediment in Woods Inlet and its tributaries; and in suspended sediment discharges from Air Force Plant No. 4 (AFP4) storm water outfalls; traced the primary PCB source to the Meandering Road Creek watershed, and subsequently isolated several outfalls in the AFP4 storm sewer system (Besse *et al.* 2005; Schultz *et al.* 2005; Braun *et al.* 2008). Remediation of PCBs and other contaminants at AFP4 continues to be addressed through the U.S. Air Force (USAF) Installation Restoration Program and the TCEQ Defense and State Memorandum of Agreement Program. These efforts are discussed later in this report.

Sediment was monitored at two Meandering Road Creek locations and one Lake Worth location during most of the five-year ROD review period. The average concentration of Aroclor 1254 in 28 sediment samples collected between 2002 and 2006 was 0.057 mg/kg, which is less than the 0.1 mg/kg remediation goal specified in the ROD. Values were less than the detection limit in 17 of the 28 samples, and greater than the remediation goal in five of the 28 samples (Earth Tech 2008). In addition, Braun *et al.* (2008) noted that surface bed sediment PCB concentrations at 16 of 20 box core sample sites in Meandering Road Creek and Woods Inlet were less than the concentrations measured three years earlier by Besse *et al.* (2005).

Segment 0808 was previously evaluated for potential PCB sources as part of the Lake Worth TMDL (TCEQ 2005). The small, undeveloped nature of the watershed and the lack of PCBs in upstream Lake Worth sediments indicated there were no significant PCB sources within the Segment 0808 watershed.

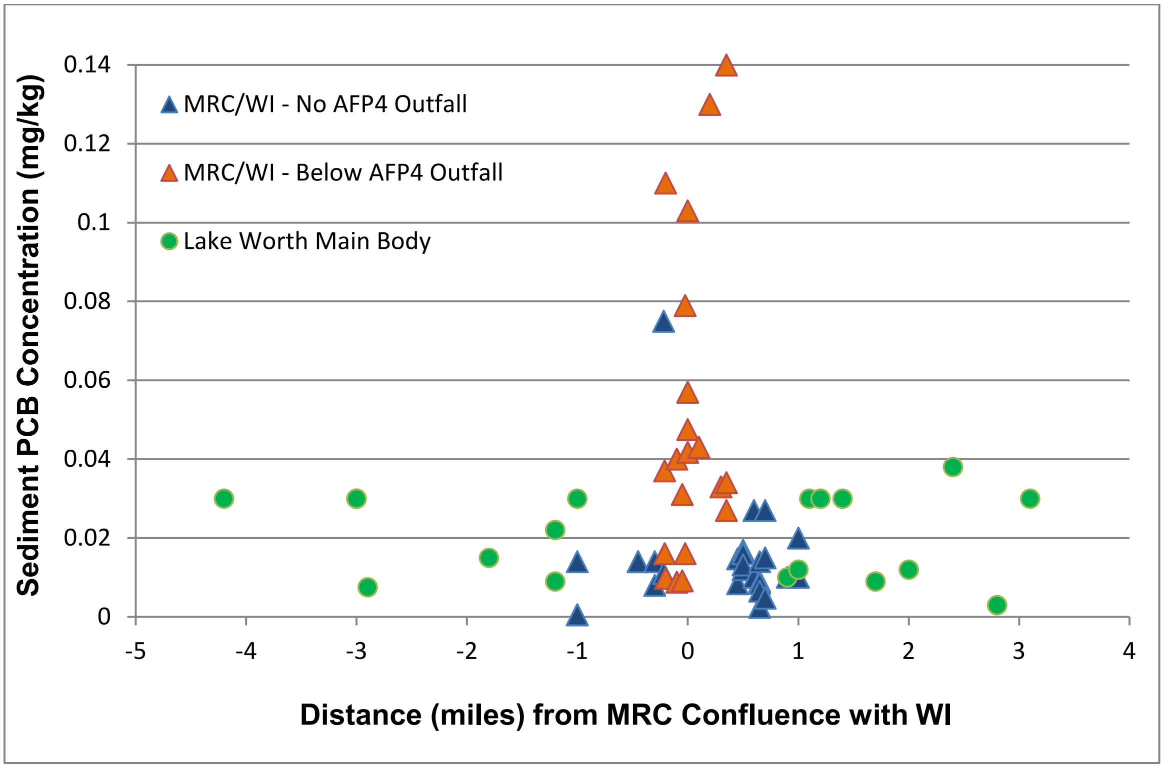

Figure 4. Surface sediment PCB concentrations in Woods Inlet (WI), Meandering Road Creek (MRC), and the main body of Lake Worth.

Concentrations are graphed against the distance between the sampling location and the confluence of MRC and WI adjacent to AFP4. Negative distances represent sample sites in MRC upstream from the MRC/WI confluence and in the main body of Lake Worth upstream from the mouth of WI. Positive distanc es are downstream from the MRC/WI confluence. Lake samples with results less than the detection limit are graphed as one-half of the limit. Sources: Harwell et al. (2003), Besse et al. (2005), and Braun et al. (2008).

Seasonality

Although there may be seasonal fluctuations in contaminant uptake and elimination, critical conditions such as low flow and seasonal variability in loading are not major influences on the long-term process of reducing PCBs in Lake Worth fish tissue. In addition, site remediation activities at AFP4 are expected to permanently mitigate major PCB sources, while any best management practices undertaken will likely be in place throughout the year to control any remaining sources.

Margin of Safety

A margin of safety (MOS) is required in a TMDL to account for any uncertainty about the pollutant load and its association with water quality. The MOS may be an explicit component that leaves a portion of the potential assimilative capacity of a water body unallocated, or an implicit component established using conservative analytical assumptions. This TMDL uses an implicit MOS based on:

a) conservative assumptions used in the development of the fish tissue endpoint concentration;

b) the use of conservative model assumptions and a conservative water quality end-point to develop the TMDL load allocations; and

c) the difficulty in accurately quantifying on-going instream PCB reductions.

USEPA (2000) guidance on the assessment of contaminant data for use in fish advisories contains an extensive discussion of the assumptions and uncertainties present in the calculation of fish consumption limits and fish tissue target concentrations. Conservative assumptions and calculations are used throughout the guidance to provide a MOS for these various uncertainties. Strict criteria exist concerning the types of studies used and the data required to support these assumptions and calculations. Numeric adjustments are made for the extrapolation of study results from animals or humans to the general population, and to provide a conservative upper bound on cancer risk values and a conservative oral RfD for noncarcinogens. Adjustments are designed to provide a safe margin between observed toxicity and potential toxicity in a sensitive human (see USEPA 2005 and <www.epa.gov/iris/subst/0294.htm> for additional details).

Pollutant Load Allocation

Investigations associated with remedial activities at AFP4 have determined that any remaining PCB release to the lake is small and confined to Woods Inlet and the downstream end of Meandering Road Creek adjacent to AFP4. TCEQ has not established a sediment concentration standard for PCBs; however, sediment core samples collected in Lake Worth and Woods Inlet found an exponential decrease in PCB concentrations in the more recently-deposited sediment compared with the deeper deposits from the 1960s when PCB production and use were at a peak (Harwell *et al.* 2003; Besse *et al.* 2005). Burial beneath recently-deposited sediment in the lake has likely removed remaining PCBs from availability to fish or for downstream transport.

Fish tissue sampling in Lake Worth has been conducted five times between April/May 1999 and October 2008. Tissue PCBs were quantified either as Aroclor equivalents or as individual congeners (see footnotes in Table 2). Differences in the calculation of total PCBs can introduce data comparability issues (de Solla *et al.* 2010). Aroclor analysis may yield significant error because it assumes that the distribution of PCB congeners in environmental samples and parent Aroclor compounds is similar. Aroclor analysis is also less sensitive (*i.e.* method detection limits are much greater) than congener analysis, and thus the latter allows actual quantitation of PCBs at levels of environmental significance in a greater range of samples (see Connor *et al.* 2005).

All available fish tissue data are shown in Figure 5 and Table 2 in order to illustrate the general shifts in total PCB concentrations through time; however, caution should be used in making too direct a comparison due to the use of different analytical methods. DSHS recently switched from analyzing Aroclor mixtures to the measurement of PCB congeners in fish tissue, and congeners were analyzed for the most recent tissue samples in Segments 0807 and 0808 (see DSHS 2010a). DSHS risk characterizations are independent of one another, and fish tissue PCB data based on Aroclors used for earlier assessments were not used as part of the data for the most recent evaluation.

Available data indicate a general decline in fish tissue PCB concentrations in Lake Worth (see Figure 5 and Table 2). This decline has allowed a reduction in the number of species covered by a DSHS consumption advisory, from all fish in the initial advisory to only three species (blue catfish, channel catfish, and smallmouth buffalo) in the current advisory.

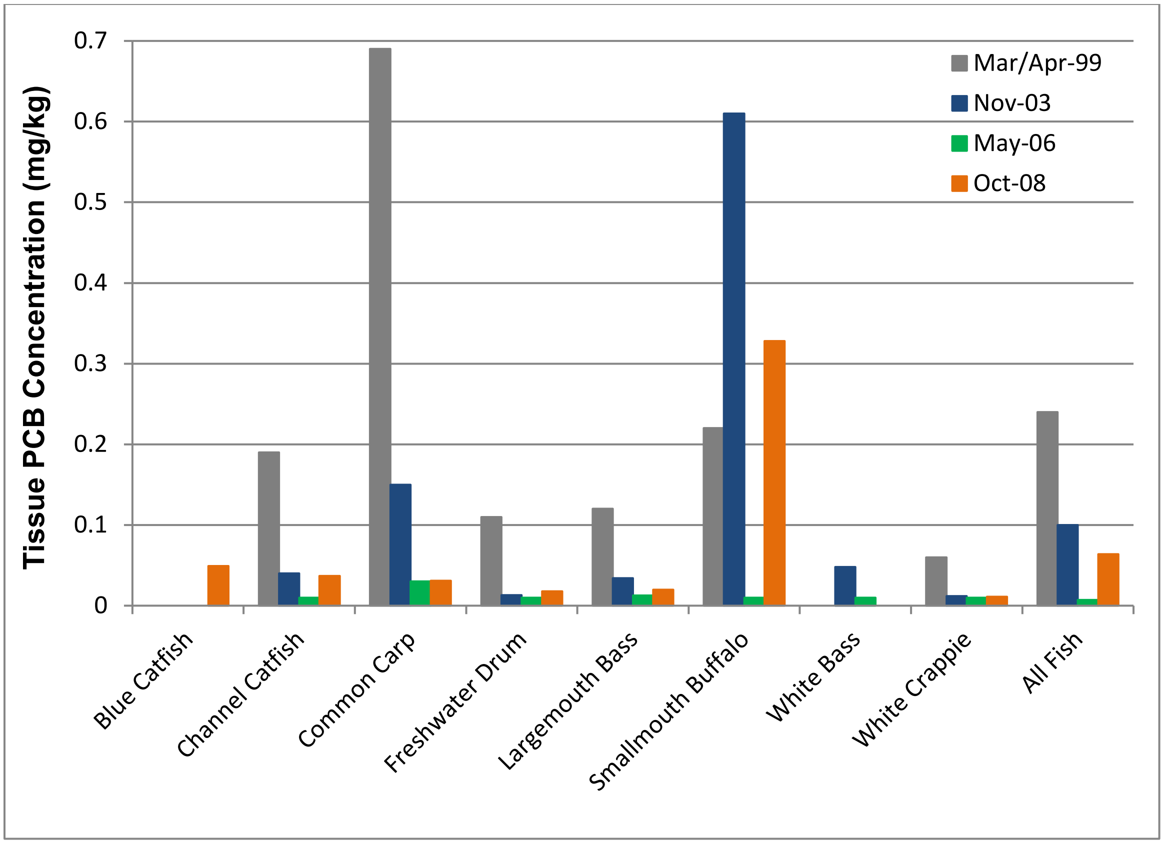

Figure 5. Changes in mean total PCB concentrations in fish tissue in Lake Worth, 1999-2008. Source and types of data are those shown in Table 2 footnotes. May 2000 results are not included since only one species was collected. Segment 0808 data are included as part of the Oct-08 dataset (DSHS 2010a).

Table 2 includes the October 2008 tissue concentrations both for all sample sites used by DSHS (2010a), and for the sample site in Segment 0808. The mean PCB concentration in Segment 0808 fish was similar to or less than that of the entire October 2008 sample in six of eight species, including channel catfish and smallmouth buffalo. The two blue catfish collected in Segment 0808 constitute half of the entire October 2008 sample, and the mean concentration in those two fish exceeds that of all four specimens. The sample size for the Segment 0808 site is relatively small (1-3 fish per species and a total of ten fish), and some caution should be used in comparing these concentrations to the entire sample set.

The goal of the Lake Worth TMDL is removal of the fish consumption advisory and restoration of the fish consumption use. Sediment and fish tissue sampling results indicate substantial progress toward this goal. Because of the hydrologic connection between Segments 0807 and 0808 and the lack of any PCB sources in the Segment 0808 watershed, the pollution controls implemented for Lake Worth are expected to restore the fish consumption use to both segments.

Table 2. Mean total PCB concentrations (∑PCB) in Lake Worth and Segment 0808 fish tissue samples, 1999-2008. Highlighted species are those covered by the current fish consumption advisory. Mean ∑PCB concentrations are in mg/kg. N = fish sample size.

	Mar/Apr 1999[a]		May 2000[b]		Nov 2003[c]		May 2006[d]		Oct 2008[e]		Oct 2008[e] Seg 0808[f]	
Fish Species	**N**	**Mean ∑PCB**	**N**	**Mean ∑PCB**	**N**	**Mean ∑PCB**	**N**	**Mean ∑PCB**	**N**	**Mean ∑PCB**	**N**	**Mean ∑PCB**
Blue Catfish	0	-	0	-	0	-	0	-	4	0.049	2	0.079
Channel Catfish	10	0.19	0	-	10	0.040	6	<0.01	18	0.037	1	0.025
Smallmouth Buffalo	5	0.22	0	-	5	0.61	3	<0.01	10	0.328	1	0.134
Common Carp	10	0.69	0	-	5	0.15	3	0.027	9	0.031	1	0.021
Freshwater Drum	10	0.11	0	-	5	0.013	5	<0.01	10	0.018	1	0.024
Largemouth Bass	10	0.12	14	0.077	10	0.034	6	0.008	19	0.020	3	0.012
White Crappie	10	0.06	0	-	8	0.012	5	<0.01	10	0.011	1	0.014
White Bass	0	-	0	-	5	0.048	6	<0.01	0	-	0	-
All Fish	55	0.23	14	0.077	48	0.10	34	0.012	80	0.064	10	0.041

[a] Moring (2002) – Sum of Aroclor 1254 + Aroclor 1260; Values less than the detection limit were treated as one-half of the detection limit.
[b] Unpublished data provided in May 2006 by Clarence Reed, Fort Worth Department of Environmental Management – Aroclor 1260.
[c] Giggleman and Lewis (2004) – Analysis of 96 congeners; Authors treated values less than the detection limit as being just below the detection limit (*e.g.* <0.0005 mg/kg treated as 0.0004 mg/kg) as a conservative approach.
[d] FWDEM (2006) – Sum of Aroclor 1016 + Aroclor 1260; Mean of <0.01 mg/kg indicates all samples were less than the detection limit; Other means were recalculated using one-half of the detection limit for values less than the detection limit.
[e] Table 4e in DSHS (2010a) – Analysis of 43 congeners that are relatively abundant in the environment, likely to occur in aquatic life, and most likely to show assessable toxicity based on structure-activity relationships; Values less than the detection limit treated as one-half of the detection limit.
[f] Data from Site 10 at West Fork Trinity River in DSHS (2010a). This site is in Segment 0808.

Public Participation

There are numerous resources available to the public regarding TMDL impairments in Lake Worth and West Fork Trinity River below Eagle Mountain Lake. TCEQ maintains a project overview at

<http://www.tceq.texas.gov/assets/public/waterquality/tmdl/63lakeworthpcbs/63-lakeworthpo.pdf>

summarizing TMDL and I-Plan activities. DSHS maintains information related to the consumption advisory on their web page at

< http://www.dshs.state.tx.us/seafood/survey.shtm#advisory>.

USAF addresses the PCB and consumption advisory issues during regular public meetings on AFB4.

Implementation and Reasonable Assurance

The segment covered by this addendum is within the existing Lake Worth TMDL project watershed. This watershed is within the area covered by the I-Plan developed for the Lake Worth TMDL. Please refer to the original TMDL document for additional information regarding implementation and reasonable assurance.

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