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**TISSUE SCREENING LEVEL GUIDELINES
FOR ISSUANCE OF PUBLIC HEALTH ADVISORIES
FOR SELECTED CONTAMINANTS**
and
Supporting Documentation

Louisiana Department of Environmental Quality
Louisiana Department of Health and Hospitals
Louisiana Department of Wildlife and Fisheries
Louisiana Department of Agriculture and Forestry

Tissue Screening Levels (TSL) are “screening values which are defined as concentrations of contaminants in fish or shellfish tissue that when exceeded may pose potential public health concern and that are used as thresholds against which levels of contamination in similar tissue collected from the ambient environment can be compared.””If the mean concentration of a contaminant in fish / shellfish tissue exceeds the TSL, then the waterbody, contaminant(s), and / or fish / shellfish species of potential concern are further evaluated. The screening process provides a rapid measure for identifying waterbodies, chemicals, and fish / shellfish species of potential concern.” It is important to note that the screening process does not replace or supersede the formal advisory process as set forth in Louisiana’s *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish*.

“The EPA-recommended risk-based methods for developing screening values are presented in the U.S. EPA’s “*Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories*” (EPA, 2000). Methods presented in the EPA guidance document were used in conjunction with the assumptions presented in Table 1” of *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish* “to develop Louisiana fish-tissue screening levels.”

“The protocol is designed to provide standardized guidelines regarding the development and issuance of fish and shellfish consumption advisories while allowing for the incorporation of site-specific data that are reliable and validated.” “The TSL will be revised as needed to ensure that the advisory process is based on the most current toxicity and exposure information available.”¹

¹Quoted text from “*Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish*”. LDEQ, LDHH, LDWF, and LDAF (2010).

SELECT TISSUE SCREENING LEVELS ¹

Contaminant	Noncarcinogenic Screening Level ² (ug/kg)	Carcinogenic Screening Level ³ (ug/kg)	FINAL SCREENING LEVEL (ug/kg)
Cadmium	2300	---	2300
Methylmercury	230	---	230
Polychlorinated biphenyls (PCB)	---	270	270
Total TEQ	---	3.6 (ppt)	3.6 ppt
Chlordane	1200	1600	1200
DDD	---	2300	2300
DDE	---	1600	1600
DDT	---	1600	1600
Dieldrin	130	34	34
Endosulfan	14,000	---	14,000
Endrin	700	---	700
Heptachlor	1200	120	120
Hexachlorobenzene	1900	340	340
Lindane	700	420	420
Mirex	470	300	300
Toxaphene	---	500	500

¹Both noncarcinogenic and carcinogenic risk-based screening levels are presented. The lower of the two values shall be used as the tissue screening level

²The noncarcinogenic screening levels are based on a target hazard quotient (THQ) of 1.0. If multiple noncarcinogens that affect the same target organ or have the same critical effect are present in the tissue, the noncarcinogenic screening levels may need to be adjusted downward to account for potential additive health effects.

³The carcinogenic screening levels are based on a target risk (TR) of 1E-04. If multiple carcinogens are present, the carcinogenic screening levels may need to be adjusted downward to prevent the total cancer risk from exceeding 1E-04.

A TSL may be calculated using an appropriate toxicity value and the equations and assumptions presented in this document. The TSLs presented here are based on default assumptions but TSLs can also be developed using site-specific exposure data if available, reliable and validated. Similarly, different TSLs may be used when toxicity factors are updated. Other toxicity factors such as ATSDR's chronic oral Minimal Risk Levels (MRLs), may be used to develop TSLs where appropriate to protect sensitive sub-populations. All TSLs are subject to the Agencies' approvals.

Adjust TSL for Additive Health Effects (if warranted)

If more than one COC is present in fish/shellfish tissue, the screening process should include the calculation of a total hazard index for each target organ/critical effect and/or a total cancer risk prior to screening a waterbody from further consideration in the advisory process.

Noncarcinogens.

If multiple noncarcinogenic COC are present in fish/shellfish tissue that have the same target organ or elicit the same critical effect, a total hazard index shall be calculated for each target organ/critical effect. The target organ/critical effect identified for this evaluation should be the target organ/critical effect on which the RfD is based. This information can be obtained from IRIS. The total hazard index for each target organ/critical effect can be calculated as follows:

$$\text{THI} = [(C_1/\text{TSL}_1) + (C_2/\text{TSL}_2) + \dots + (C_i/\text{TSL}_i)]$$

where:

THI = total hazard index for a target organ/critical effect

C_i = arithmetic mean concentration in tissue for the i^{th} contaminant;

TSL_i = tissue screening level for tissue for the i^{th} contaminant.

The THI should be less than or equal to one (1.0) for each target organ/critical effect. If the THI exceeds unity, then proceed to the development of an advisory (see Section 2.2 in the *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shelfish*).

Refer EPA's Integrated Risk Information System for the target organs and critical effects.

Carcinogens.

If multiple carcinogens are present calculate a total cancer risk as follows:

$$\text{TCR} = [(C_1/\text{TSL}_1) + (C_2/\text{TSL}_2) + \dots + (C_i/\text{TSL}_i)] \times 10^{-4}$$

where:

TCR = total cancer risk

C_i = arithmetic mean concentration in tissue for the i^{th} contaminant; and

TSL_i = tissue screening level for tissue the i^{th} contaminant.

The TCR should be less than or equal to 1×10^{-4} . If the total cancer risk exceeds 1×10^{-4} , then proceed to the development of an advisory (Section 2.2 of the above mentioned Protocol)

Supporting Documentation for the Calculation of the Tissue Screening Levels

$$\text{Noncarcinogenic TSL} = \frac{THQ \times BW \times AT \times 365 \text{ days / yr}}{EF \times ED \times (RfD_o \times IRF)}$$

Where:

Parameter	Definition (units)	Input value
TSL	Tissue screening level (mg/kg)	***
THQ	Target hazard quotient	1
BW	Body weight (kg)	70
AT	Averaging time (years)	30
EF	Exposure frequency (days/year)	365
ED	Exposure duration (years)	30
RfD	Reference dose (mg/kg-day)	Chemical-specific
IRF	Fish ingestion rate (g/day)	30

$$\text{Carcinogenic TSL} = \frac{TR \times BW \times AT \times 365 \text{ days / yr}}{EF \times ED \times (CSF \times IRF)}$$

Parameter	Definition (units)	Input value
TSL	Tissue screening level (mg/kg)	***
TR	Target cancer risk	1E-04
BW	Body weight (kg)	70
AT	Averaging time (years)	70
EF	Exposure frequency (days/year)	365
ED	Exposure duration (years)	30
CSF	Cancer slope factor (risk per mg/kg-day)	Chemical-specific
IRF	Fish ingestion rate (g/day)	30

To convert from mg/kg (ppm) to ug/kg (ppb), multiply by 1000.

To convert from mg/kg (ppm) to ng/kg (ppt), multiply by 1,000,000.

Select Toxicity Factors: Reference Doses and Cancer Slope Factors ^a

Contaminant	Reference Dose (mg/kg-day)	Cancer Slope Factor [(mg/kg-day) ⁻¹]
Arsenic	3E-04	1.5E+00
Cadmium	1E-03	---
Methylmercury	1E-04	---
Polychlorinated biphenyls (PCB)	---	2E+00
Aroclor 1254	2E-05	2E+00
Aroclor 1016	7E-05	7E-02
Aroclors 1221, 1232, 1242, 1248, 1260	---	2.0E+00
Chlordane	5E-04	3.5E-01
DDD	---	2.4E-01
DDE	---	3.4E-01
DDT	---	3.4E-01
Dieldrin	5.5E-05	1.6E+01
Endosulfan	6E-03	---
Endrin	3E-04	---
Heptachlor	5E-04	4.5E+00
Hexachlorobenzene	8E-04	1.6E+00
Lindane	3E-04	1.3E+00 ^b
Mirex	2E-04	1.8E+00 ^b
Toxaphene	---	1.1E+00
Total TEQ ^c	--	1.56E+05

^aThe toxicity values presented here are reference doses and cancer slope factors from EPA's Integrated Risk Information System (IRIS), except where noted. Other toxicity values such as ATSDR's chronic oral Minimal Risk Levels (MRLs), may be applied as appropriate to protect sensitive sub-populations (e.g., use of cadmium and endosulfan MRLs). All toxicity factors are subject to the Agencies' approvals and can be revised when current values are updated. ^bObtained from EPA's Health Effects Assessment Summary Tables (HEAST).

^cIncludes dioxin, furan, and PCB congeners with 2,3,7,8-TCDD-like activity.

Dioxin, Furan, and PCB Congener Toxicity Equivalent Factors (TEF)

Congener	TEF
Chlorinated dibenzo-p-dioxins	
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0003
Chlorinated dibenzofurans	
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.03
2,3,4,7,8-PeCDF	0.3
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0003
Non-ortho substituted PCBs	
PCB 77	0.0001
PCB 81	0.0003
PCB 126	0.1
PCB 169	0.03
Mono-ortho substituted PCBs	
PCB 105	0.00003
PCB 114	0.00003
PCB 118	0.00003
PCB 123	0.00003
PCB 156	0.00003
PCB 157	0.00003
PCB 167	0.00003
PCB 189	0.00003
Reference: Van den Berg <i>et al.</i> , 2006. The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. <i>Tox. Sci. Advance</i> Access, 7 July.	

Calculation of the Total TEQ for Dioxins, Furans, and/or PCB Congeners

Polychlorinated dibenzodioxins (PCDD), dibenzofurans (PCDF), and polychlorinated biphenyls (PCB) shall be evaluated using the total TEQ approach. The TEF values presented above in combination with the site-specific tissue data shall be used to calculate a total toxic equivalent concentration (TEQ) in each species of concern as follows:

$$\text{Total TEQ} = \sum_{n1} [\text{PCDD}_i \times \text{TEF}_i] + \sum_{n2} [\text{PCDF}_i \times \text{TEF}_i] + \sum_{n3} [\text{PCB}_i \times \text{TEF}_i].$$

where:

Parameter	Definition
Total TEQ	Total Toxic Equivalent Concentration
PCDD	Concentration of PCDD congener in tissue
PCDF	Concentration of PCDF congener in tissue
PCB	Concentration of PCB congener in tissue
TEF	Congener-specific toxic equivalent factor

The total TEQ for each species shall be compared to the TSL for Total TEQ.