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Surface Water Assessment Methodology

Nueces River near Crystal City

Surface Water Assessment Methodology

Methodology for Use Support and Identification of Water Quality Concerns

The TNRCC administers water quality management programs with the goal of protecting, maintaining, and restoring Texas water resources. The TSWQS (TNRCC Rules, Chapter 307), adopted by the TNRCC on March 19, 1997, recognize the regional and geologic diversity of the state by dividing major river basins, bays, and estuaries into defined segments (referred to as classified segments). Appropriate water uses (aquatic life, contact recreation, oyster waters, etc.) are designated for each of the classified segments. Numerical criteria (concentrations) established in the TSWQS provide a quantitative basis for evaluating use support and managing point and nonpoint source loadings in Texas surface waters. These criteria are used as maximum or minimum instream concentrations that may result from permitted discharges and nonpoint sources. The procedure for comparing instream water quality conditions to numerical criteria is specified in the TSWQS. For example, dissolved oxygen measurements monitored in a water body may be compared to numerical criteria to determine if the designated aquatic life use is supported.

Texas Drinking Water Standards (TDWS), adopted by the TNRCC on June 4, 1977 and revised on November 25, 1994, assure the safety of public water supplies. Numerical criteria established in the TDWS for finished water provide a quantitative basis for evaluating support of the public water supply use.

In most instances, this guidance describes how numerical criteria can be compared to instream conditions as specified in the TSWQS/TDWS. In many cases, however, sufficient monitoring data for exact comparisons to numerical criteria cannot be reasonably obtained. For example, dissolved oxygen criteria are based in part on 24-hour averages. These conditions are not met by most monitoring efforts, which are based on “instantaneous” measurements at monthly or quarterly intervals. Compliance with the TSWQS/TDWS is therefore sometimes estimated from instream monitoring data using screening levels, which establish compliance targets that can be directly compared with monitoring data. Screening levels are intended to provide the best comparisons that can be reasonably attained with available data and numerical criteria in the TSWQS/TDWS.

Some of the numerical criteria in the TSWQS, such as water temperature, pH, chloride, sulfate, and total dissolved solids, are not associated with

single specific uses. Instead, they were established in the TSWQS to ensure support of multiple uses, and as tools to identify and manage the influences of point and nonpoint sources of pollution (see definitions on page 4-9 of the TSWQS).

Instream levels of nutrients and chlorophyll *a,* toxic substances in sediment, and toxic substances in fish tissue are useful in identifying water quality concerns and evaluating the causes of non-support of the narrative standards. Numerical criteria for these constituents have not been established in the TSWQS. Screening levels for these parameters were statistically developed from long-term monitoring data for this guidance. More recent monitoring data are compared to the screening levels to identify parameters and areas of concern.

The TSWQS also contain narrative criteria (verbal descriptions) which apply to all waters of the state. Narrative criteria include general information such as existence of excessive aquatic plant growths, foaming of surface waters, taste and odor producing substances, eroding sediment, and toxic materials. Narrative criteria are evaluated using numeric criteria if they are available. Other information consisting of water quality studies, existence of fish kills or contaminant spills, photographic evidence, local knowledge, and best professional judgment is also used to identify narrative criteria concerns and evaluate support of narrative criteria and associated designated uses.

To conduct the assessment, the most recent five years of surface water quality monitoring and finished drinking water data are assembled, ordered by parameter, and evaluated by analysts. In most cases, individual values for each parameter are compared to either numerical water quality criteria or screening levels, and the percentage of all values in exceedance is computed. The percent exceedance is then compared to categorical ranges (supporting, 0-10 percent; partially supporting, 11-25 percent; and not supporting, greater than 25 percent) to determine the degree of use support or criteria support. For those parameters where only narrative criteria have been established in the TSWQS, similar categorical ranges are used to identify water bodies with no concerns, or concerns for impairment. In a few cases where numeric criteria are established as averages (chloride, sulfate, and total dissolved solids criteria, chronic criteria for toxic substances, public drinking water criteria, and human health criteria), individual values for each parameter are summed and an average is computed. The average is then directly compared to criteria in the TSWQS/ TDWS to determine the degree of use support or criteria support.

Waters Covered in Assessments

All stream, reservoir, estuary, and oceanic sites with sufficient water quality data to assess at least one assigned use are to be evaluated. This includes sites within classified segments, as specified in the TSWQS, and sites off classified segments (unclassified waters). The general criteria in the TSWQS pertaining to aquatic life use (dissolved oxygen, toxic substances in water, water and sediment toxicity tests, sediment effects, and biological assessments), contact recreation use, fish consumption use, and narrative criteria are applied to assessment of unclassified waters unless site-specific criteria derived from receiving water assessments are available. Site-specific criteria for classified segments (water temperature, pH, chloride, sulfate, and total dissolved solids) do not apply to unclassified water bodies.

Sources of Data

SWQM data resident in the TNRCC Regulatory Activities and Compliance System (TRACS) database, finished drinking water quality data in the TNRCC's Water Utilities Division databases, CRP databases, volunteer monitoring programs, and/or other quality assured data may be considered for evaluation. In addition to SWQM data collected by the TNRCC, the TRACS database contains quality assured data from other state and federal agencies, river authorities, cities, and other monitoring groups. These data are collected with methods consistent with the *Surface Water Quality Monitoring Procedures Manual* (TNRCC, 1999). SWQM data are collected at fixed stations during routine monitoring and from many other sites selected for special studies and intensive surveys.

Finished drinking water data resident in the organic substances database of the TNRCC's Water Utilities Division are considered in assessment of the public water supply use. Inorganic substances in finished drinking water are not utilized in public water supply use assessment, since data are not readily available for analysis and elevated levels tend to be associated with groundwater sources rather than surface water. These data are collected under quality assurance plans that ensure data are of known and appropriate quality for assessment. Individual measurements, especially exceedances of the water quality criteria and screening levels, are reviewed by water quality analysts to determine if samples are representative and accurate.

Period of Record

All quality assured SWQM and finished water data collected during the most recent five-year period may be considered for assessment. Most monitoring groups collect data at fixed sites at recurring monthly or quarterly frequencies. In some cases, particularly for toxicants, samples

may be collected annually at these sites. The assessment must use a sample set that is representative of existing conditions at each site. At a minimum, samples distributed over one complete year must be utilized, with some made during an index period (March 15 - September 15). In some instances where water quality has dramatically improved or declined recently due to identified permanent changes in pollutant loadings (for example, new treatment facility, implementation of best management practices, hydrologic changes), the more recent and representative data set may be used for the assessment.

Minimum Number of Samples

For all field measurements (dissolved oxygen, pH, and temperature) and water quality constituents (nutrients, fecal coliforms, chlorophyll *a*, dissolved solids, and ions) collected routinely in surface water, at least nine samples over the five-year period of record are required for assessment. Monitoring sites with fewer than nine measurements/samples for any of the referenced parameters are not considered for assessment. An exception can be made for streams or reaches of streams that are 25 miles or less in length and for reservoirs or estuarine waters, or portions of reservoirs or estuarine waters (5,120 acres or eight square miles or less, respectively), where water quality conditions are similar. For these water bodies or portions of water bodies, field measurements and water quality constituents collected at multiple sites may be aggregated to meet the nine sample minimum requirement. In some instances dissolved oxygen is sampled intensively at regular intervals over a continuous 24-hour period, and bacteria (fecal coliform and enterococci) are sampled intensively five or more times over a 30-day period. A minimum of five intensive dissolved oxygen and bacteria sampling events is required for assessment. For all toxicants in water, sediment, fish tissue, or water and sediment toxicity tests, at least five samples over the five-year period are required for assessment. Samples for toxicants and toxicity may also be aggregated as described above.

Water quality data are not disregarded when the number of samples is less than the minimum required for aquatic life and recreational use assessments. These samples (fewer than nine for field measurements, water chemistry, and bacteria; five for toxic substances and toxicity testing) are evaluated separately with application of the same rating criteria used when the number of samples exceeds the minimum. In cases where less than the minimum number of samples is available, and compelling evidence from two or more samples suggests impairment of aquatic life or recreational uses, water quality concerns will be identified (see “Aquatic Life Use” section for additional information).

In finished drinking water, an average calculated from at least four samples is required for comparison to the primary and secondary standards. These minimum sample numbers were chosen to allow confidence in the assessment while making the best use of the limited monitoring resources.

Flow Conditions

For freshwater streams, screening is conducted with field measurements and samples (including toxicants in water, sediment, and fish tissue, and toxicity tests) collected when stream flow conditions equal or exceed the seven-day, two-year low flow (7Q2). Screening may also include data collected during high-flow runoff periods. Individual parameter concentrations that exceeded criteria or screening levels and were collected when stream flow was less than 7Q2 are excluded. After the data are omitted, the percent exceedance or mean concentration is recalculated to determine use support or identify water quality concerns. Dissolved oxygen criteria (24-hour average 2mg/L; 1.5 mg/L minimum), acute toxicity, and acute water quality criteria, as well as other general provisions specified in the TSWQS apply to intermittent streams (dry for at least a week in most years) when they have water in them. One exception is acute toxicity in water, which applies at all flow conditions. Low flow (7Q2) criteria are calculated from historical USGS stream flow records and are available in Appendix B in the TSWQS. In places where low-flow criteria are not available, they may be approximated from a downstream gaged site, or from one located in a nearby watershed of similar size. Another exception applies to assessment of dissolved oxygen criteria at various flows for streams located in eastern or southern areas of the state (see "Aquatic Life Use, Dissolved Oxygen Criteria").

Values Below Limits of Detection

Many individual values in SWQM and finished drinking water databases are reported as less than a minimum detection limit (nondetects). There is no generalized way to determine the true value for an individual nondetect in the range between zero and the reported minimum detection limit. For assessments, 50 percent of a minimum detection limit is computed for these nondetects and used for special reporting purposes. This is done to include as many individual data points in the analysis as possible and to indicate the level of monitoring effort. In many areas of the state, much of the nutrient and toxicant data for individual parameters are reported as nondetects. These occurrences in themselves are particularly noteworthy, because they may indicate levels are below those for concern. Values computed from 50 percent of minimum detection limits that exceed criteria or screening levels are not counted as exceedances. However, the 50 percent value reported for these nondetects is used in developing

screening levels and in calculation of summary statistics (minimum, maximum, and mean).

An exception to the above guidance regarding nondetects is made when evaluating chronic toxicant and human health criteria for water. The criteria for these constituents are expressed as mean values. In these cases, the smaller of the following measurements is used in calculation of the mean: the 50 percent value reported for nondetects; or 50 percent of the chronic criterion/human health criterion.

Spatial Coverage

Water quality data are reviewed station by station within classified and unclassified waters to determine geographical extent of use and criteria support and water quality concerns. The geographic extent is estimated based on review of existing data, spatial distribution of monitoring sites having the required minimum number of samples, known sources of pollution, influence of tributaries and hydrological modifications, and best professional judgment of TNRCC and CRP assessment personnel. Streams are measured in miles, reservoirs are measured in acres, and estuaries and oceans are measured in square miles. For large water bodies that have only one monitoring site, the data from that one station are not used to generate a monitored assessment for the entire reach or area. A single monitoring site is considered to be representative of no more than 25 miles in freshwater and tidal streams. A single monitoring site in reservoirs, estuaries, and oceans is considered representative of 25 percent of the total reservoir acres and estuary or ocean square miles, but not more than 5,120 acres or eight square miles. Major hydrological features, such as the confluence of a major tributary or an instream dam, may also limit the spatial extent of an assessment based on one station. Where possible, the SWQM Station ID number will be reported for the assessment. The remaining area not covered by a single site will be reported as not assessed.

Assignment of Causes and Sources of Pollutants

Whenever possible, analysts link causes of pollution with their sources for the analysis. Causes are those pollutants and other stressors that contribute to actual nonsupport or partial support of designated uses in a water body (see Table 16). Stressors are factors or conditions (low dissolved oxygen, stream flow, siltation, habitat alterations, etc.) other than specific pollutants that cause nonsupport of uses. Activities, facilities, or conditions that contribute pollutants or stressors are sources that result in nonsupport of designated uses in a water body (see Table 17).

Nonpoint source pollution is diffuse runoff that originates from precipitation moving over and through the ground. As nonpoint source runoff

moves, natural pollutants and pollutants resulting from human activity are carried with it to water bodies. Nonpoint sources include agricultural and urban storm water runoff.

Point source pollution refers to any discernible, confined and discrete conveyance, such as any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, concentrated animal feeding operation, or vessel or floating craft, from which pollutants are discharged to water bodies. Point sources are regulated by state and federal water quality permits, which may include discharge limitations, monitoring, and reporting requirements. For purposes of the 2000 CWA 303(d) List, storm water runoff from cities (population greater than 100,000) with Phase 1 Storm Water Permits are considered point sources of pollution.

Table 16. List of Causes/Stressors

Code	Cause/Stressor	Code	Cause/Stressor
0000	Cause Unknown	1000	pH
0100	Unknown Toxicity	1100	Siltation
0200	Pesticides	1200	Organic Enrichment/Low Dissolved Oxygen
			1210 Low Dissolved Oxygen
0300	Priority Organics	1300	Salinity/TDS/Chloride/Sulfate
0400	Nonpriority Organics	1400	Thermal Modifications
0410	PCBs	1500	Flow Alterations
0420	Dioxins	1600	Habitat Alterations
0500	Metals	1700	Pathogens
	0510 Arsenic	1800	Radiation
	0520 Cadmium	1900	Oil and Grease
	0530 Copper	2000	Taste and Odor
	0540 Chromium	2100	Suspended Solids
	0550 Lead	2200	Noxious Aquatic Plants
	0560 Mercury	2400	Total Toxics
	0570 Selenium	2500	Turbidity
0600	Ammonia	2600	Exotic Species
0700	Chlorine	2800	Excessive Algal Growth
0800	Other Inorganics	2900	Inappropriate Littoral Vegetation

Table 16. List of Causes/Stressors (Continued)

Code	Cause/Stressor	Code	Cause/Stressor
0900	Nutrients		
	0910 Phosphorus		
	0920 Nitrogen		
	0930 Other		

Table 17. List of Sources

Code	Source Category
0100	Industrial Point Sources
	0110 Major Industrial Point Sources
	0120 Minor Industrial Point Sources
0200	Municipal Point Sources
	0210 Major Municipal Point Sources--dry and/or wet weather discharges
	0212 Major Municipal Point Sources--dry weather discharges
	0214 Major Municipal Point Sources--wet weather discharges
	0220 Minor Municipal Point Sources--dry and/or wet weather discharges
	0222 Minor Municipal Point Sources--dry weather discharges
	0224 Minor Municipal Point Sources--wet weather discharges
0400	Combined Sewer Overflow
0500	Collection System Failure
0900	Domestic Wastewater Lagoon
1000	Agriculture
	1050 Crop-Related Sources
	1100 Non-irrigated Crop Production
	1200 Irrigated Crop Production
	1300 Speciality Crop Production (e.g., horticulture, citrus, nuts, fruits)
	1350 Grazing-Related Sources

Table 17. List of Sources (continued)

Code	Source Category
1000 (continued)	1400 Pasture Grazing--riparian and/or upland
	1410 Pasture Grazing--riparian
	1420 Pasture Grazing--upland
	1500 Range Grazing--riparian and/or upland
	1510 Range Grazing--riparian
	1520 Range Grazing--upland
	1600 Intensive Animal Feeding Operations
	1620 Concentrated Animal Feeding Operations (CAFOs); permitted point sources
	1640 Confined Animal Feeding Operations Nonpoint Sources
	1700 Aquaculture
2000	Silviculture
	2100 Harvesting, Restoration, Residue Management
	2200 Forest Management (e.g., pumped drainage, fertilization, pesticide application)
	2300 Logging Road Construction/Maintenance
	2400 Silvicultural Point Sources
3000	Construction
	3100 Highway/Road/Bridge Construction
	3200 Land Development
4000	Urban Runoff/Storm Sewers
	4100 Non-industrial Permitted Sources
	4200 Industrial Permitted Sources
	4300 Other Urban Runoff
	4400 Illicit Connections/Illegal Hook-ups/Dry Weather Flows
	4500 Highway/Roadway/Bridge Runoff
	4600 Erosion and Sedimentation

Table 17. List of Sources (continued)

Code	Source Category
5000	Resources Extraction
	5100 Surface Mining
	5200 Subsurface Mining
	5300 Placer Mining
	5400 Dredge Mining
	5500 Petroleum Activities
	5700 Mill Tailings
	5800 Acid Mine Drainage
	5900 Abandoned Mining
	5950 Inactive Mining
6000	Land Disposal
	6100 Sludge
	6200 Wastewater
	6300 Landfills
	6400 Industrial Land Treatment
	6500 Onsite Wastewater Systems (septic tanks)
	6600 Hazardous Waste
	6700 Septage Disposal
7000	Hydromodification
	7100 Channelization
	7200 Dredging
	7300 Dam Construction
	7350 Upstream Impoundment
	7400 Flow Regulations/Modification
7550	Habitat Modification (other than hydromodification)
	7600 Removal of Riparian Vegetation
	7700 Bank or Shoreline Modification/Destabilization
	7800 Drainage/Filling or Wetlands

Table 17. List of Sources (continued)

Code	Source Category
7900	Marinas and Recreation Boating
	7910 In-water Releases 7920 On-land Releases
8050	Erosion from Derelict Land
8100	Atmospheric Deposition
8200	Waste Storage/Storage Tank Leaks (above ground)
8250	Leaking Underground Storage Tanks
8300	Highway Maintenance and Runoff
8400	Spills (accidental)
8500	Contaminated Sediments
8520	Debris and Bottom Deposits
8530	Internal Nutrient Cycling (primary lakes)
8540	Sediment Re-suspension
8600	Natural Sources
8700	Recreation and Tourism Activities
	8710 Releases From Boats 8750 Golf Courses
8900	Salt Storage Sites
8910	Groundwater Loadings
8920	Groundwater Withdrawal
8950	Other
9000	Unknown Source
	9001 Unknown Point Source 9002 Unknown Nonpoint Source
9050	Sources Outside State Jurisdiction or Borders

For each water body or portion of a water body where a designated use is partially supported or not supported, the cause(s) and source(s) are identified from available information (SWQM data, field observations, land use, CRP assessments, nonpoint source assessment reports, special studies, and intensive surveys).

Depth of Water Quality Measurements

Surface measurements (typically collected at a depth of one foot from the water surface) of water temperature, chloride, sulfate, total dissolved solids, nutrients, chlorophyll *a*, and fecal coliform are generally used in an assessment. Samples collected by the USGS that are composited over depth using equal-discharge-increment or equal-width-increment methods may also be utilized in an assessment. For dissolved oxygen and pH, measurements over the entire mixed surface layer are evaluated. For toxic substances in water, individual surface grab samples or surface-to-bottom composite samples are evaluated.

Determination of the Mixed Surface Layer

Monitoring personnel often make vertical field measurement profiles in deep freshwater streams that are mixed from the surface to the bottom. In these cases, all of the dissolved oxygen measurements made in the profile during each individual sampling event are averaged, and the mean compared to the criterion. Individual pH measurements made in the profile are compared to the minimum/maximum criteria. Only one exceedance is counted in cases where more than one pH measurement in the profile does not meet the minimum/maximum criteria. The mixed surface layer for tidally influenced water bodies is defined as the portion of the water column from the surface to the depth at which the specific conductance is 6,000 µmhos greater than the conductance at the surface. Dissolved oxygen and pH criteria apply to the entire mixed water column, or only to measurements made in the mixed surface layer if the water column is stratified.

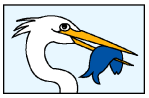
For reservoirs, the mixed surface layer is defined as the portion of the water column from the surface to the depth at which water temperature decreases by greater than 0.5°C. Dissolved oxygen and pH criteria apply to the entire mixed water column, or only to measurements made in the mixed surface layer if the water column is stratified. In rare instances rapid declines with depth in dissolved oxygen or pH may occur within the mixed surface layer defined by water temperature.

Determination of Tidal Influence

In most cases, the extent of tidal influence in freshwater streams that drain to tidal streams, estuaries, or the Gulf of Mexico is determined by making field measurements (specific conductance and salinity), collecting water samples (TDS and chloride), and observing level recorders sequentially upstream from their mouths over several complete tidal cycles. In the absence of monitored data, the tidal limit in a freshwater stream is approximated as the point where the five-foot contour line (five feet above mean sea level) on a USGS topographic map crosses the stream.

A water body is considered tidally influenced when there is observed tidal activity, TDS is greater than or equal to 2,000 mg/L, salinity is greater than or equal to 2 ppt, or specific conductance is greater than or equal to 3,077 µmhos/cm. Marine criteria developed in the TSWQS apply to all tidally influenced streams (classified and unclassified), estuaries, and the Gulf of Mexico.

Methodology for Screening and Assessing Use Support



Aquatic Life Use

Support of the aquatic life use is based on assessment of dissolved oxygen criteria, toxic substances in water criteria, ambient water and sediment toxicity tests, and biological screening levels for macrobenthos and fish, provided the minimum number of samples is available. Each set of criteria is generally evaluated independently of each other, and nonsupport of the aquatic life use results if any are not attained. The aquatic life use is identified as partially supported or not supported when water quality fails to attain rating criteria and at least the minimum number of samples is available for assessment. The aquatic life use is identified as a water quality concern when less than the minimum number of samples are available for assessment, and evidence is compelling (two or more samples exceed rating criteria and the exceedance rate is greater than 25%).

Dissolved Oxygen Criteria

An exceptional, high, intermediate, or limited aquatic life use is assigned to each classified water body in the TSWQS based on physical, chemical, and biological characteristics. Dissolved oxygen criteria (24-hour means) to protect these aquatic life uses for freshwater are 6.0, 5.0, 4.0, and 3.0 mg/L, respectively. The dissolved oxygen criteria are 1 mg/L lower for exceptional, high, and intermediate aquatic life uses in tidally influenced water bodies due to differences between oxygen solubility in fresh and salt water. There is no limited use for tidally influenced waters. Unclassified perennial water bodies are presumed to have a high aquatic life use and corresponding dissolved oxygen criteria. Unclassified streams with only perennial pools are assumed to have limited aquatic life uses (protected by a 3.0 mg/L criterion), and intermittent streams are assigned a dissolved oxygen criterion of 2.0 mg/L when water is flowing and exceeds the 7Q2. An exception to this general rule is where site-specific aquatic life use and associated dissolved oxygen criteria have been assigned to a perennial unclassified water body through a receiving water assessment (see Appendix D of the TSWQS). Another exception is for perennial streams located in the eastern and southern areas of the state where a strong dependent relationship exists among summertime dissolved oxygen concentration, stream flow, and channel bed slope. Due to this relationship, in some

instances, assessment of lower dissolved oxygen criteria than those assigned in the TSWQS for classified and unclassified streams may be possible (see Figure 1 and Table 3 in *Implementation of the TNRCC Standards via Permitting*, TNRCC, 1995a).

Most of the dissolved oxygen data collected at fixed monitoring stations are instantaneous measurements collected during daylight hours (0900 to 1400 hours), so direct comparison to the 24-hour criteria is not possible. Due to these data limitations, dissolved oxygen levels of 6.0, 5.0, 4.0, and 3.0 mg/L from the mixed surface layer are established in this guidance as single measurement minimum screening levels to evaluate support of respective exceptional, high, intermediate, and limited aquatic life uses. In the absence of 24-hour data, individual measurements are compared to the single measurement minimum screening levels. Support of the assigned aquatic life use at each site for routinely collected instantaneous dissolved oxygen data is based on ranges for the percent of exceedances when at least nine samples are available (see Table 18). An aquatic life concern is identified if less than nine samples are available and evidence is compelling (exceedance in at least two samples, and the exceedance rate is greater than 25%) (see Table 29).

Beginning in September 1997, the TNRCC and the CRP began intensive 24-hour monitoring of dissolved oxygen and other field measurements. This type of monitoring is targeted to water bodies where low instantaneous dissolved oxygen levels indicate partial or nonsupport of designated aquatic life uses. Preferred intensive monitoring is conducted with automated equipment that is preset to record and store field measurements hourly (or in some cases more frequently) over one 24-hour period. Four to eight dissolved oxygen measurements may also be made manually at even intervals over one 24-hour period at a site, as long as one is made near sunrise (0500-0900 hours) to approximate the daily minimum. For purposes of determining compliance with 24-hour criteria, samples collected near the surface will be considered representative of the mixed surface layer. At least five 24-hour monitoring events at each site within a five-year period are required to provide adequate data for assessment of the aquatic life use (Table 18). An aquatic life concern is identified if less than five samples are available and at least two exceed criteria (Table 29).

All intensive 24-hour dissolved oxygen monitoring events must be spaced over an index period (March 15-September 15). Twenty-four hour sampling events must be separated by approximately one month in time. Typically, two sites on a water body are monitored twice per year during the index period for two years (providing eight sets of 24-hour data). One of the two sites sampled will likely be a reference site. Support of assigned aquatic life uses is based on 24-hour dissolved oxygen average and minimum criteria for each monitoring event (see Table 18).

Dissolved oxygen data collected by routine and intensive methods are generally considered independently in assessments. In cases where assessments between routine and intensive data sets indicate different levels of use support, aquatic life use support is determined by the more intensively collected dissolved oxygen data. Where there are not enough 24-hour events (minimum of five) to independently determine support of the aquatic life use at a site, instantaneous and 24-hour dissolved oxygen measurements may be combined. The 24-hour dissolved oxygen average is calculated and treated as an instantaneous measurement for the day. The average is computed by summing all the measurements made during a 24-hour period and dividing by the number of measurements. Instantaneous measurements made manually within the 24-hour period after automated equipment is deployed are included in computation of the average for the day. However, instantaneous measurements made manually on the same day, prior to deployment of automated equipment, or after it is retrieved (used to verify the quality of remotely-sensed data) are excluded from the analysis.

Toxic Substances in Water Criteria

Support of the aquatic life use is also based on an evaluation of the prevalence and magnitude of toxic chemicals in water. The SWQM Database contains sufficient data for analysis of 12 metals and 132 organic substances (39 pesticides, 30 volatile organics, and 63 semivolatile organics). The TNRCC has developed water quality criteria in the TSWQS for the 12 metals, but for only 17 of the organic substances (see Tables 19 and 20). Support of the aquatic life use, based on toxic chemicals in water, includes an evaluation of those metals and organic substances for which criteria have been developed. Acute criteria apply to all waters of the state except in small zones of initial dilution near wastewater discharge points. Chronic criteria apply wherever there are aquatic life uses outside of mixing zones and stream flow is greater than the 7Q2.

Individual measurements of the 12 metals and 17 organic substances are compared against acute criteria established in the TSWQS (Tables 19 and 20). Selection of which set of criteria (freshwater or saltwater) to use in the comparison is based on the location of the station; for example, for a station located in tidally influenced water, the marine criteria are applicable. Five or more samples are required to evaluate support of the aquatic life use (Table 18). An aquatic life concern is identified if less than five samples are available and at least two exceed criteria (Table 29). For several toxic substance parameters where toxicity is defined as a function of pH or hardness, acute criteria are expressed as an equation based on this relationship. Appropriate pH and hardness values of long-term SWQM fixed station network data by segment are used to compute criteria (Refer to Table 6 in TNRCC publication RG-194, *Implementation of the TNRCC*

Standards via Permitting). Where segment-specific criteria are not available, those developed for the entire basin may be used (Refer to Table 2 in the TSWQS). In other instances where 30 or more ambient samples are available at a site, pH and hardness values are ranked from the lowest to the highest and the low 15th percentiles are used to compute criteria for the entire water body or for a specific site.

The TSWQS express the criterion for silver in the free ionic form. Silver data in the SWQM database are reported as the dissolved fraction. The percentage of dissolved silver that is present in the free ionic form is calculated and compared to the criterion. Silver data collected from a variety of water bodies throughout the United States indicate that a correlation exists between the dissolved chloride concentration and the percent free ionic silver.

The TNRCC developed a regression equation ($R^2 = 0.87$) that calculates the percentage of dissolved silver that is in the free ionic form. The following equation is used to determine what percentage of dissolved silver is in the free ionic form:

$$Y = \exp [\exp (1/(0.6559 + 0.0044 (Cl)))]$$

where,

Y = percent of dissolved silver in the free ionic form
Cl = dissolved chloride

The percentage obtained from the above equation is converted to a proportion and then multiplied by the dissolved fraction to obtain the free ionic silver concentration. For this equation, chloride values are obtained from the TNRCC's SWQM database. The 50th percentile value of the dissolved chloride concentration for each segment is used (Refer to the Percentiles and Ranges Section of the TNRCC Supplementary Information Manual). When the range of chloride values exceeds 140 mg/L (the upper extent of the TNRCC data range), the percentage of silver in the free ionic form will be 8.98 percent. Site specific criteria may be derived providing 30 or more ambient samples are available. Chloride values are ranked from the lowest to the highest and 50^{th} percentile is used to compute criteria for free ionic silver. The degree of aquatic life use support for toxicants in water is based on ranges for the percent of exceedances (see Table 18).

Support of the aquatic life use is also based on toxic substance chronic criteria. Selection of either freshwater or marine criteria for a given station is guided by the influence of tidal activity. Chronic criteria that are pH- or hardness-dependent are computed in the manner described above for acute criteria. For each parameter at each site, the mean of all values (five

Table 18. Framework for Evaluating Use Support

Use/Impact	Parameter/Criteria or Screening Levels	Minimum Number of Samples	Fully Supporting	Partially Supporting	Not Supporting
Overall Use Support	Evaluation of Designated and General Uses		All uses are fully supported.	One or more uses are partially supported and remaining uses are fully supported.	One or more uses are not supported.
Aquatic Life Support	Routinely Collected Instantaneous Dissolved Oxygen Measurements	9	0-10 % of all measurements (excluding those collected during intensive 24-hour monitoring events) are less than the instantaneous screening level.	At least 2 measurements, and 11-25 % of all measurements (excluding those collected during intensive 24-hour monitoring events) are less than the instantaneous screening level.	Greater than 25 % of all measurements (excluding those collected during intensive 24-hour monitoring events) are less than the instantaneous screening level.
	Intensively Collected 24-hour Dissolved Oxygen Measurements	5 sets	0-10 % of all means collected during each 24-hour sampling event are less than the 24-hour average criterion, and 0-10 % of the minimum values for each 24-hour sampling event are less than the minimum criterion.	At least 2 means, and 11-25 % of all means collected during each 24-hour sampling event are less than the 24-hour average criterion, and At least 2 minimum values, and 11-25 % of the minimum values for each 24-hour sampling event are less than the minimum criterion.	Greater than 25 % of all means collected during each 24-hour sampling event are less than the 24-hour average criterion, and Greater than 25 % of the minimum values for each 24-hour sampling event are less than the minimum criterion.
	Metals and Organic Sub-stances in Water	5	For any individual parameter, 0-10% exceed acute criterion, and/or the mean is less than or equal to the chronic criterion.	For any individual parameter, at least two measurements and 11-25% exceed acute criterion.	For any individual parameter, Greater than 25% exceed acute criterion, and/or the mean exceeds the chronic criterion.

Table 18. Framework for Evaluating Use Support (continued)

Use/Impact	Parameter/Criteria or Screening Levels	Minimum Number of Samples	Fully Supporting	Partially Supporting	Not Supporting
Aquatic Life Support (continued)	Ambient Water and Sediment Toxicity	5	0-10% of samples have acute or chronic toxicity.	At least 2 samples and 11-25% of samples have acute or chronic toxicity.	Greater than 25% of samples have acute or chronic toxicity
	Biological Assessment	2	See Table 9	See Table 9	See Table 9
Contact Recreation	Routinely Collected Bacteria Samples (Fecal coliform 400 colonies/ 100 mL)	9	0-25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.	Partial support is not assessed for the contact recreation use.	Greater than 25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.
Contact Recreation	Intensively Collected Bacteria Samples (Fecal coliform 30-day geometric mean 200 colonies/100 mL)	5 sets	0-25% of geometric means from intensive sampling events exceed one of the criterions.	Partial support is not assessed for the noncontact recreation use.	Greater than 25% of geometric means from intensive sampling events exceed one of the criterions.
Noncontact Recreation	Routinely Collected Bacteria Samples (Fecal coliform 400 colonies/100 mL) For Segment 2308 only (Fecal coliform 4,000 colonies/100 mL)	9	0-25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.	Partial support is not assessed for the contact recreation use.	Greater than 25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.
	Intensively Collected Bacteria Samples (Fecal coliform 30-day geometric mean 200 colonies/100 mL) For Segment 2308 only (Fecal coliform 30-day geometric mean 2,000 colonies/100 mL)	5 sets	0-25% of geometric means from intensive sampling events exceed one of the criteria.	Partial support is not assessed for the noncontact recreation use.	Greater than 25% of geometric means from intensive sampling events exceed one of the criteria.

Table 18. Framework for Evaluating Use Support (continued)

Use/Impact	Parameter/Criteria or Screening Levels	Minimum Number of Samples	Fully Supporting	Partially Supporting	Not Supporting
Public Water Supply	Finished Water Primary Drinking Water Standards	4	No violation of the MCL.	Partial support is not assessed.	Violation of the MCL.
Fish Consumption	Consumption Advisories/Aquatic Life Closures	-----	No fish/shellfish consumption advisories or aquatic life closures in effect.	Restricted-consumption advisory (limits on number or size of meals) in effect for general population or a subpopulation that could be at greater risk (e.g., pregnant women, children).	Aquatic life closure (no taking of aquatic life) in effect or fish/shellfish "no-consumption" advisory in effect for one or more species for the general population or subpopulation that could be at greater risk.
	Human Health Criteria for Water and Fish, Freshwater Fish Only and Saltwater Fish Only (toxic substances)	5	Mean is less than or equal to human health criteria.	Partial support is not assessed.	Mean exceeds human health criteria.
Oyster Waters	TDH Shellfish Maps	-----	Water quality data indicate good conditions and low densities of fecal coliform bacteria. Area approved for growing and harvesting shellfish.	Area conditionally approved for the growing and harvesting of shellfish based on predictable high densities of fecal coliform bacteria.	Area is restricted for the growing and harvesting of shellfish or prohibited due to water quality concerns based on high densities of fecal coliform bacteria or high risk of microbial contamination.

Table 19. Criteria for Specific Metals in Water for Protection of Aquatic Life
(All values listed or calculated in µg/L. Hardness concentrations are input as mg/L)

Parameter Code	Parameter	Freshwater Acute	Freshwater Chronic	Marine Acute	Marine Chronic
01106	Aluminum (d)	991	---	---	---
01000	Arsenic (d)	360	190	149	78
01025	Cadmium (d)	$e^{(1.128[\ln(\text{hardness})] - 1.6774}$	$e^{(0.7852[\ln(\text{hardness})] - 3.490}$	45.62	10.02
01030	Chromium (Tri)(d)	$e^{(0.8190)(\ln(\text{hardness})) + 3.688}$	$e^{(0.8190)(\ln(\text{hardness})) + 1.561}$	----	----
01040	Copper (d)	$e^{(0.9422[\ln(\text{hardness})] - 1.3844}$	$e^{(0.8545[\ln(\text{hardness})] - 1.386}$	16.27	4.37
00722	Cyanide (free)	45.78	10.69	5.6	5.6
01049	Lead (d)	$e^{(1.273 [\ln(\text{hardness})] - 1.460}$	$e^{(1.273 [\ln(\text{hardness})] - 4.705}$	140	5.6
71900	Mercury (t)	2.4	1.3	2.1	1.1
01065	Nickel (d)	$e^{(0.8460[\ln(\text{hardness})] + 3.3612}$	$e^{(0.8460[\ln(\text{hardness})] + 1.1645}$	119	13.2
01147	Selenium (t)	20	5	564	136
01075	Silver (d)(f)	0.92	----	2.3	----
01090	Zinc (d)	$e^{(0.8473[\ln(\text{hardness})] + 0.8604}$	$e^{(0.8473[\ln(\text{hardness})] + 0.7614}$	98	89

(d)-dissolved fraction; (t)-total metal; (f)-criteria corrected to free ionic form for individual samples.

Table 20. Criteria for Specific Organic Substances in Water for Protection of Aquatic Life
(All values listed or calculated in µg/L)

Parameter Code	Parameter	Freshwater Acute	Freshwater Chronic	Marine Acute	Marine Chronic
Pesticides					
39330	Aldrin	3.0	---	1.3	---
39350	Chlordane	2.4	0.0043	0.09	0.004
39370	DDT	1.1	0.0010	0.13	0.0010
39780	Dicofol (Kelthane)	59.3	19.8	----	----
39380	Dieldrin	2.5	0.0019	0.71	0.0019
39388	Endosulfan	0.22	0.056	0.034	0.0087
39390	Endrin	0.18	0.0023	0.037	0.0023
39782	gamma-Hexachlorocyclohexane	2.0	0.08	0.16	---
39410	Heptachlor	0.52	0.0038	0.053	0.0036
39530	Malathion	---	0.01	---	0.01
39480	Methoxychlor	---	0.03	---	0.03
39755	Mirex	---	0.001	---	0.001
39540	Parathion (ethyl)	0.065	0.013	---	---
39516	PCBs, total	2.0	0.014	10	0.03
39032	Pentachlorophenol	$e^{[1.005(pH) - 4.830]}$	$e^{[1.005(pH) - 5.290]}$	15.14	9.56
39400	Toxaphene	0.78	0.0002	0.21	0.0002
Semivolatile Organic Substances					
34461	Phenanthrene	30	30	7.7	4.6

sample minimum) collected during a five-year period is compared against the chronic criterion to determine aquatic life use support. If the mean exceeds the criterion, the use is not supported (see Table 18).

Ambient Water and Sediment Toxicity Tests

Aquatic life use support is also evaluated based on ambient water and sediment toxicity testing. The TNRCC, in cooperation with EPA Region 6 and the CRP, routinely collect water and sediment samples for ambient toxicity testing to assess potential toxicity in water bodies, and to evaluate the effectiveness of implemented toxicity control measures. Water bodies that have shown recurrent ambient water or sediment toxicity are candidates for more intensive special studies to confirm the occurrence of toxic conditions or nonsupport of aquatic life uses, and to determine the causes and sources of the toxicity. Laboratories conduct standard 7-day chronic toxicity tests on ambient water and sediment elutriates using *Ceriodaphnia dubia* (water flea) and *Pimephales promelas* (fathead minnow) in freshwater. For estuarine or saline waters and sediment a standard 9-day chronic toxicity test is conducted using *Cyprinodon variegatus* (Sheepshead minnow). Support of the aquatic life use using ambient toxicity data when five or more samples are available is based on the occurrence of toxicity in water and/or sediment (see Table 18). An aquatic life concern is identified when less than five samples are available and toxicity occurs in at least two (Table 29).

Biological Assessment

An exceptional, high, intermediate, or limited aquatic life use is assigned to each classified water body in the TSWQS based on physical, chemical, and biological characteristics. Biological characteristics which describe each aquatic life use category are assessed based on fish and/or benthic macroinvertebrate data. Determination of attainment of biological characteristics deemed appropriate for each aquatic life use category is based on use of multi-metric indices of biological integrity which integrate structural and functional attributes.

Fish Community Assessment. Fish community data are collected according to field methods specified in the TNRCC Receiving Water Assessment Procedures Manual. These data are used to evaluate the integrity of the fish community based on the Index of Biotic Integrity (IBI) (Table 21). The IBI cannot be used to assess fish community samples collected from reservoirs or tidal streams. Draft regionalized IBI metrics have been proposed by the Texas Parks and Wildlife Department. Ultimately, these regionalized IBIs are the preferred assessment tool. However, until the draft regionalized IBIs are finalized, data will be

Table 21. Statewide Index of Biotic Integrity: Scoring and Evaluation Criteria

Category	Metric	Scoring 5	3	1
Species richness and composition	1. Total number of fish species	*	*	*
	2. Number of darter species	≥3	1-2	0
	3. Number of sunfish species (excluding bass)	≥2	1	0
	4. Number of sucker species	≥2	1	0
	5. Number of intolerant species	≥3	1-2	0
	6. Percentage of individuals as tolerant	<5%	5-20%	>20%
Trophic composition	7. Percentage of individuals as omnivores	<20%	20-45%	>45%
	8. Percentage of individuals as insectivores	>80%	>40-80%	≤40%
	9. Percentage of individuals as piscivores	>5%	1-5%	<1%
Fish abundance and condition	10. Number of individuals in sample	>200	>50-200	≤50-0
	11. Percentage of individuals as hybrids	0%	>0-1%	>1%
	12. Percentage of individuals with disease or other anomaly	≤2%	>2-5%	>5%

*First-second order streams: ≥7(5), 4-6(3), ≤3(1)
Third-fourth order streams: ≥10(5), 5-9(3), ≤4(1)
Fifth-sixth order streams: ≥16(5), 8-15(3), ≤7(1)
Seventh-eighth order streams: ≥22(5), 11-21(3), ≤10(1)

Total Score for Aquatic Life Use Subcategories

58 - 60	**Exceptional**
48 - 52	**High**
40 - 44	**Intermediate**
< 34	**Limited**

evaluated using statewide criteria and the draft regionalized IBIs will be used as a supplemental assessment tool. For example, the regionalized IBI may be used to categorize samples for which the IBI score obtained using the statewide metric set falls in between categories.

Benthic Macroinvertebrate Community Assessment. Benthic macroinvertebrate data are collected according to field protocols specified in the TNRCC Receiving Water Assessment Procedures Manual. If benthic macroinvertebrates are collected according to quantitative protocols (Surber, quantitative snags), the integrity of the benthic macroinvertebrate community should be evaluated based on the Benthic Index of Biotic Integrity (Table 22). If benthic macroinvertebrates are collected according to Rapid Bioassessment (RBA) Protocols (5-minute kicknet, RBA snags) then the integrity of the benthic macroinvertebrate community should be evaluated based on the Metric Set for Evaluation of Benthic Macroinvertebrate Data Collected According to RBA Protocols (Table 23).

Aquatic Life Use Support Determination using Bioassessment Data. When available, the determination of fish and/or benthic macroinvertebrate integrity using the methods outlined above will be used in conjunction with physical and chemical data to provide an integrated assessment of support of Aquatic Life Use. Support for a given water body will be assessed according to the decision matrix specified in Table 24, and should be based on both fish and benthic macroinvertebrate samples. In certain instances, it may only be possible to collect either fish or benthic macroinvertebrates. Proper justification should be submitted detailing why only one type of community was sampled. After it has been determined that it is appropriate to use only fish or only benthic macroinvertebrates, rows in Table 24 that are marked with an asterisk may be used to interpret results. Determination of attainment for bioassessment data (column 1, Table 24) is based on the average of the total scores, derived as described in Table 21 for fish and in Table 22 or 23 for benthic macroinvertebrates, for each of two or more bioassessment events. If only two bioassessment events are considered then both should be conducted in the same year during the index period Mid-March to Mid-September with at least one of the two events occurring between August 1 and September 15. If more than two bioassessment events are considered, then the period of study should be two or more years with two events per year, all events should occur between Mid-March and Mid-September and at least one-half of the events should occur between August 1 and September 15. The average score should be compared to the aquatic life use point score ranges given in Table 21 for fish and in Table 22 or 23 for benthic macroinvertebrates, depending on what field protocols were followed.

Table 22. Metrics and Scoring Criteria for Surber Samples - Benthic Macroinvertebrates (Davis, 1997)

	METRIC	SCORING CRITERIA		
		5	3	1
CENTRAL BIOREGION **(Ecoregions: 23,24,27,29,30 31, and 32)**	1. Total Taxa	> 32	32 - 18	< 18
	2. Diptera Taxa	> 7	7 - 4	< 4
	3. Ephemeroptera Taxa	> 4	4 - 2	< 2
	4. Intolerant Taxa	> 8	8 - 4	< 4
	5. % EPT Taxa	> 30	30.0 - 17.4	< 17.4
	6. % Chironomidae	---a	< 22.3	≥ 22.3
	7. % Tolerant Taxa	---a	< 10.0	≥ 10.0
	8. % Grazers	> 14.9	14.9 - 8.7	< 8.7
	9. % Gatherers	> 15.2	15.2 - 8.8	< 8.8
	10. % Filterers	---a	> 11.9	≤ 11.9
	11. % Dominance (3 Taxa)	< 54.6	54.6 - 67.8	> 67.8
EAST BIOREGION **(Ecoregions: 33,34, and 35)**	1. Total Taxa	> 30	30 - 17	< 17
	2. Diptera Taxa	> 10	10 - 6	< 6
	3. Ephemeroptera Taxa	---b	> 3	≤ 3
	4. Intolerant Taxa	> 4	4 - 2	< 2
	5. % EPT Taxa	> 18.9	18.9 - 10.8	< 10.8
	6. % Chironomidae	---a	< 40.2	≥ 40.2
	7. % Tolerant Taxa	< 16.0	16.0 -24.3	> 24.3
	8. % Grazers	> 9.0	9.0 - 5.2	< 5.2
	9. % Gatherers	> 12.5	12.5 - 7.3	< 7.3
	10. % Filterers	---a	> 16.3	≤ 16.3
	11. % Dominance (3 Taxa)	< 57.7	57.7 - 71.6	> 71.6
NORTH BIOREGION **(Ecoregions 25 and 26)**	1. Total Taxa	> 33	33 - 19	< 19
	2. Diptera Taxa	> 14	14 - 8	< 8
	3. Ephemeroptera Taxa	---b	> 2	≤ 2
	4. Intolerant Taxa	> 3	3 - 2	< 2
	5. % EPT Taxa	> 14.4	14.4 - 8.2	< 8.2
	6. % Chironomidae	< 36.9	36.9 - 56.2	> 56.2
	7. % Tolerant Taxa	< 14.1	14.1 - 21.5	> 21.5
	8. % Grazers	---b	> 5.4	≤ 5.4
	9. % Gatherers	---a	> 14.9	≤ 14.9
	10. % Filterers	> 12.2	12.2 - 7.1	< 7.1
	11. % Dominance (3 Taxa)	< 68.1	68.1 - 84.5	> 84.5

a - discriminatory power was less-than-optimal for this bioregion, so metric was assigned only two scoring categories

b - median value for this bioregion was less than the metric selection criterion (< 5.5 for taxa richness metrics; < 12 for percentage metrics expected to decrease with disturbance), so metric was assigned only two categories

Aquatic Life Use Point Score Ranges: Exceptional >40; High 31-40; Intermediate 21-30; Limited <21

Table 23. Metrics and Scoring Criteria for Kick Samples, Rapid Bioassessment Protocol - Benthic Macroinvertebrates (Harrison, 1996)

	SCORING CRITERIA			
METRIC	**4**	**3**	**2**	**1**
Taxa Richness	> 21	15-21	8-14	< 8
EPT Taxa Abundance	> 9	7-9	4-6	< 4
Biotic Index (HBI)	< 3.77	3.77-4.52	4.53-5.27	>5.27
% Chironomidae	0.79-4.10	4.11-9.48	9.49-16.19	< 0.79 or >16.19
% Dominant taxon	< 22.15	22.15-31.01	31.02-39.88	> 39.88
% Dominant FFG	< 36.50	36.50-45.30	45.31-54.12	> 54.12
% Predators	4.73-15.20	15.21-25.67	25.68-36.14	< 4.73 or >36.14
Ratio of Intolerant:Tolerant taxa	> 4.79	3.21-4.79	1.63-3.20	< 1.63
% of total trichoptera as Hydropsychidae	< 25.50	25.51-50.50	50.51-75.50	> 75.50 or no trichoptera
# of non-insect taxa	> 5	4-5	2-3	< 2
% Collector-gatherers	8.00-19.23	19.24-30.46	30.47-41.68	< 8.00 or >41.68
% of total number as Elmidae	0.88-10.04	10.05-20.08	20.09-30.12	< 0.88 or >30.12

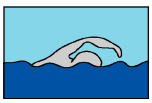
Aquatic Life Use Point Score Ranges:

Exceptional: > 36
High: 29 - 36
Intermediate: 22 - 28
Limited: < 22

Table 24. Decision Matrix for Integrated Assessments of Aquatic Life Use (ALU) Support Based on Bioassessment, Dissolved Oxygen, Toxics in Water and Toxicity in Water Testing Data

Aquatic Life Use Support Attainment					
Bioassessment Data	Dissolved Oxygen Data Meets Screening Criteria	Toxics in Water, Toxicity Testing All Meet Screening Criteria	Dissolved Oxygen Data Do Not Meet Screening Criteria	Toxics in Water, Toxicity Testing Do Not Meet Screening Criteria	Toxics in Water, Toxicity Testing Data Not Available
Benthic macroinvertebrate and fish bioassessments done and both attain designated ALU	Fully Supporting	Fully Supporting	Fully Supporting	Partially Supporting	Fully Supporting
Benthic macroinvertebrate and fish bioassessments done and one of the two does not attain designated ALU	Partially Supporting	Partially Supporting	Partially Supporting	Partially Supporting	Partially Supporting
Both benthic macroinvertebrate and fish bioassessment done and both indicate non attainment of designated ALU	Not Supporting	Not Supporting	Not Supporting	Not Supporting	Not Supporting
Only fish bioassessment done and indicates non attainment of designated ALU*	Not Supporting	Not Supporting	Not Supporting	Not Supporting	Not Supporting
Only benthic macroinvertebrate bioassessement done and indicates non attainment	Not Supporting	Not Supporting	Not Supporting	Not Supporting	Not Supporting
Only fish bioassessment done and indicates attainment of designated ALU*	Fully Supporting	Fully Supporting	Fully Supporting	Partially Supporting	Fully Supporting
Only benthic macroinvertebrate bioassessment done and indicates attainment of designated ALU*	Fully Supporting	Fully Supporting	Fully Supporting	Partially Supporting	Fully Supporting
Bioassessment data not available	Fully Supporting	Fully Supporting	Not Supporting	Not Supporting	Not Assessed

*Both fish and macroinvertebrate samples are required to make an aquatic life use (ALU) attainment determination for 305(b)/303(d) assessment purposes. In certain cases where it is only possible to collect one or the other, the ALU determination may be made based on only fish or benthic macroinvertebrates according to the framework presented in this table. Proper justification for why only one type of community was sampled is required.



Contact Recreation Use

Contact recreation is a use that is assigned to all water bodies except in special cases. Full support of the contact recreation use is not a guarantee that the water is completely safe of disease-causing organisms. Fecal coliform are analyzed to determine support of the contact recreation use. Most of the fecal coliform data are routinely collected at fixed stations at biannual, quarterly, or monthly frequencies. In water bodies where it is known or suspected that the contact recreation use may not be supported or where there is high recreation use, bacterial monitoring may be intensified (at least five samples collected within a thirty-day period). Intensive bacterial monitoring during at least five 30-day periods, when recreational use is high (March 15-September 15), is required to provide adequate data for assessment. All intensive bacteria monitoring events must occur within a five-year period. Typically, two sites on a water body are monitored intensively twice per year during the index period for two years (providing eight sets of intensively monitored bacteria data). One of the two sites sampled will likely be a reference site.

For routinely monitored bacteria data (including individual samples collected during intensive monitoring events), a fecal coliform density of 400 colonies/100 mL is established as a screening level, and support of the contact recreation use is based on specific ranges for the percent of exceedances and a nine sample minimum (see Table 18). A contact recreation concern is identified when less than nine samples are available and evidence is compelling (exceedance in at least two samples and rate is greater than 25%) (Table 29). A fecal coliform criterion of 200 colonies/100 mL (30-day geometric mean) applies to intensive monitoring events. Support of the contact recreation use for intensively monitored bacteria data is based on specific ranges of the percent exceedances of geometric mean (see Table 18). In cases where assessments between routine and intensively monitored data indicate different levels of use support, contact recreation use support is determined by the more intensively collected data.

Noncontact Recreation Use

A noncontact recreation use is assigned to water bodies where ship and barge traffic makes contact recreation unsafe (Segments 1005, 1701, 2437, 2438, 2484, and 2494). The noncontact recreation use for these water bodies is protected by the same fecal coliform screening level (for routinely collected data) and criteria (for intensively collected data) assigned to contact recreational waters (see Table 18). Fecal coliform densities are elevated and recurrent in Segment 2308 of the Rio Grande near El Paso, and they are caused by pollution that cannot be reasonably controlled. A fecal coliform screening level of 4,000 colonies/100 mL for

routinely monitored data is assigned to protect the noncontact recreation use in this segment. For intensively monitored data, 30-day geometric mean criteria are established in the TSWQS to protect the noncontact recreation use (fecal coliform, 2,000 colonies/100 mL) in Segment 2308. Support of the noncontact recreation use is based on specific ranges for the percent of exceedances among fecal coliform samples, provided at least nine samples are available (see Table 18). A noncontact recreation concern is identified when less than nine samples are available and evidence is compelling (exceedance in at least two samples and a rate greater than 25%) (Table 29). Some water bodies (for example, Segments 1006 and 1007 of the Houston Ship Channel) are not assigned either contact or noncontact recreation uses due to local statutes which preclude recreational uses for safety reasons. There is, however, an enterococci criterion to provide protection against incidental use.

Public Water Supply Use

In the TSWQS, 219 segments are designated for the public water supply use. That use for these water bodies is protected by the TDWS. The primary drinking water criteria for organic chemicals are shown in Table 25 and criteria for inorganic chemicals are shown in Table 26. The criteria apply to finished (after treatment) drinking water that is sampled at the point of entry to distribution systems. Public water supply use support is based on exceedance of maximum contaminant levels (MCLs) for primary drinking water standards. An annual mean of samples (minimum of four) is computed and compared to the primary standards.

Fish Consumption Use

Support of the fish consumption use is determined by two assessment methods. The first is by the designation of the human health criteria in the TSWQS. For each toxicant parameter at each site, the mean of all values (five sample minimum) for water samples collected during a five-year period is computed. The means are compared to human health criteria shown in Table 27. Column A criteria are used for freshwater bodies designated for public water supply. Column B criteria are used for fresh waters which are not designated for public water supply, and ten times this level is used for unclassified perennial water bodies which are less than third order streams. Column C criteria are used for classified and unclassified marine water bodies. Selection of either freshwater (column B) or saltwater (column C) criteria for a given station is guided by the influence of tidal activity.

Table 25. Maximum Contaminant Levels for Organic Chemicals in Public Drinking Water Supplies

Contaminant	mg/L	Contaminant	mg/L
Alachlor	0.002	Ethylbenzene	0.7
Aldicarb	0.003	Ethylene dibromide (EDB)	0.00005
Aldicarb sulfone	0.002	Glyphosate	0.7
Alicarb sulfoxide	0.004	Heptachlor	0.0004
Atrazine	0.003	Heptachlor epoxide	0.0002
Benzene	0.005	Hexachlorobenzene	0.001
Benzo(a)pyrene	0.0002	Hexachlorocyclopentadiene	0.05
Carbofuran	0.04	Lindane	0.0002
Carbon tetrachloride	0.005	Methoxychlor	0.04
Chlordane	0.002	Monochlorobenzene	0.1
2,4-D	0.07	Oxamyl (vydate)	0.2
Dalapon	0.2	Pentachlorophenol	0.001
Dibromochloropropane (DBCP)	0.0002	Picloram	0.5
Di(2-ethylhexyl) adipate	0.4	Polychlorinated biphenyls (PCB)	0.0005
Di(2-ethylhexyl) pthalate	0.006	Simazine	0.004
o-Dichlorobenzene	0.6	Styrene	0.1
p-Dichlorobenzene	0.075	2,3,7,8-TCDD (Dioxin)	0.00000003
1,2-Dichloroethane	0.005	Tetrachloroethylene	0.005
1,1-Dichloroethylene	0.007	Toluene	1.0
cis-1,2-Dichloroethylene	0.07	Toxaphene	0.003
trans-1,2-Dichloroethylene	0.1	2,4,5-TP (Silvex)	0.05
Dichloromethane	0.005	1,2,4-Trichlorobenzene	0.07
1,2-Dichloropropane	0.005	1,1,1-Trichloroethane	0.2
Dinoseb	0.007	1,1,2-Trichloroethane	0.005
Diquat	0.02	Trichloroethylene	0.005
Endothall	0.1	Vinyl chloride	0.002
Endrin	0.002	Xylenes (total)	10.0

Table 26. Maximum Contaminant Levels for Inorganic Chemicals in Public Drinking Water Supplies

Contaminant[1]	mg/L	Applicable System[2]
Antimony	0.006	CN
Arsenic	0.05	CN
Asbestos	7 million fibers/liter (longer than 10 μm)	CN
Barium	2.0	CN
Beryllium	0.004	CN
Cadmium	0.005	CN
Chromium	0.1	CN
Cyanide	0.2 (as free cyanide)	CN
Fluoride	4.0	C
Mercury	0.002	CN
Nickel	0.1	CN
Nitrate	10.0 (as nitrogen)	CNT
Nitrite	1.0 (as nitrogen)	CNT
Nitrate + Nitrite (total)	10.0 (as nitrogen)	CNT
Selenium	0.05	CN
Thallium	0.002	CN

[1] Dissolved fraction analyzed for metals
[2] C = Community; N = Non-transient, non-community; T = Transient, non-community

The fish consumption use is also assessed by review of TDH published fish tissue data; human risk assessment information; consumption advisories, aquatic life closures, and fish/shellfish harvesting bans issued by the TDH. Results of fish/shellfish tissue sampling by the TDH are available in their latest publication, *TDH Fish Sampling Data, 1970-1997* (TDH, 1998). The TDH data are periodically updated to reflect recent sampling. The fish consumption use is supported in water bodies where the TDH has collected tissue data and a subsequent risk assessment indicates no appreciable risk of deleterious effects due to consumption over a lifetime. The use is partially supported when a restricted-consumption advisory has been issued for the general population, or a subpopulation that could be at greater risk (children or women of child-bearing age). The fish consumption use is not supported when a no-consumption advisory has been issued for the general population, or for a subpopulation that could be at greater risk, or an aquatic life closure has

been issued that prohibits the taking of aquatic life from the affected water body (see Table 18).

Water bodies are not assessed for the fish consumption use when toxicant in water data are insufficient (minimum of five samples) for comparison to human health criteria, or when the TDH does not have a minimum of five fish/shellfish tissue samples for toxic contaminants within the last ten years.

Table 27. Human Health Criteria in Water

Parameter Code	Parameter	Column A	Column B	Column C
		Water and Fish µg/L	Freshwater Fish Only µg/L	Saltwater Fish Only µg/L
39330	Aldrin	0.0312	0.0327	0.0218
39337	Alpha hexachlorocyclohexane	0.645	0.997	0.665
34030	Benzene	5[1]	312	208
39120	Benzidine[2]	0.0011	0.0035	0.0023
34526	Benzo(a)anthracene	0.0011	0.0035	0.0023
34247	Benzo(a)pyrene	0.0261	0.0265	----
39338	Beta hexachlorocyclohexane	2.26	3.49	2.33
34268	Bis(chloromethyl)ether	0.0207	1.59	1.06
32102	Carbon tetrachloride	5[1]	182	121
39350	Chlordane[3]	0.0210	0.0213	0.0213
34301	Chlorobenzene	1,305	4,947	3,298
32106	Chloroform	----	12,130	8,087
34320	Chrysene	0.0261	0.0265	----
79778	Cresols	4,049	46,667	31,111
39360	4',4'-DDD	0.297	0.299	0.199
39365	4',4'-DDE	0.0544	0.0545	0.0363
39370	4',4'-DDT	0.0527	0.0528	0.0352
------	Danitol	0.709	0.721	0.481
34306	Chlorodibromomethane	100[1]	15,354	10,236
77651	1,2,-Dibromoethane	0.0518	1.15	0.769
39380	Dieldrin[2]	0.0012	0.0012	0.0008

Table 27. Human Health Criteria in Water (continued)

Parameter Code	Parameter	Column A	Column B	Column C
		Water and Fish µg/L	Freshwater Fish Only µg/L	Saltwater Fish Only µg/L
34531	1,2-Dichloroethane	5[1]	1,794	1,196
34501	1,1-Dichloroethylene	7[1]	87.4	58.3
39780	Dicofol	0.215	0.217	0.144
------	Dioxins/Furans (TCDD Equivalents)[2] Equivalency Compound Factors 2,3,7,8 TCDD 1.0 1,2,3,7,8 PeCDD 0.5 2,3,7,8 HxCDD's 0.1 2,3,7,8 TCDF 0.1 1,2,3,7,8 PeCDF 0.05 2,3,4,7,8 PeCDF 0.5 2,3,7,8 HxCDF's 0.1	0.0000010	0.0000010	0.0000007
39782	Gamma hexachlorocyclohexane (Lindane)	0.2[1]	16.0	10.7
39410	Heptachlor[2]	0.0177	0.0181	0.0120
39420	Heptachlor epoxide	0.2[1]	7.39	4.92
39700	Hexachlorobenzene	0.0129	0.0129	0.0086
34391	Hexachlorobutadiene	9.34	11.2	7.48
34396	Hexachloroethane	84.4	94.1	62.7
88813	Hexachlorophene	0.0531	0.0532	0.0355
01049	Lead (d)	5	25	3.85
71900	Mercury[4]	0.0122	0.0122	0.0250
81595	Methyl ethyl ketone	4,411	886,667	591,111
39755	Mirex	0.0171	0.0189	0.0126
34447	Nitrobenzene	41.8	721	481
73611	*N*-Nitrosodiethylamine	0.0382	7.68	5.12
73609	*N*-Nitroso-di-*n*-Butylamine	1.84	13.5	8.98
39516	PCBs (Polychlorinated Biphenyls)[5]	0.0013	0.0013	0.0009
77793	Pentachlorobenzene	1.09	1.11	0.739
39032	Pentachlorphenol	129	136	90.5

Table 27. Human Health Criteria in Water (continued)

Parameter Code	Parameter	Column A	Column B	Column C
		Water and Fish µg/L	Freshwater Fish Only µg/L	Saltwater Fish Only µg/L
77045	Pyridine	88.1	13,333	8,889
77734	1,2,4,5-Tetrachlorobenzene	1.43	1.52	1.01
34475	Tetrachloroethylene	5[1]	1832	1221
39400	Toxaphene[2]	0.0440	0.0445	0.0297
77687	2,4,5-Trichlorophenol	2,767	4,021	2,681
39175	Vinyl Chloride	2[1]	94.5	63.0

[1] Based on Maximum Contaminant Levels (MCLs) specified in 30 TAC §290 (relating to Water Hygiene).
[2] Calculations based on measured bioconcentration factors with no lipid correction factor applied.
[3] Calculations based on USEPA action levels in fish tissue.
[4] Compliance will be determined using the analytical method for cyanide amenable to chlorination or weak-acid dissociable cyanide.
[5] Calculated as the sum of seven PCB congeners: 1016, 1221, 1232, 1242, 1254, 1248, and 1260.
(d) Indicates the criteria are for the dissolved fraction in water. All other criteria are for total recoverable concentrations.

Oyster Waters Use

The TDH has authority to administer the National Shellfish Sanitation Program for the state. This authority allows the TDH to classify shellfish growing areas and issue certificates for the interstate shipment of shellfish. The TPWD has the responsibility for enforcement of laws concerning harvesting of shellfish. The TDH annually publishes maps that depict the classification of shellfish growing areas in Texas estuaries. These maps do not provide the current status of shellfish growing areas. Status (open or closed) of shellfish growing areas is subject to change by the TDH at any time. These changes may be due to high rainfall and runoff, flooding, hurricanes and other extreme weather conditions, major spills, red tides, or the failure or inefficient operation of wastewater treatment facilities. Assessment of the oyster waters use is made using the TDH Seafood Safety Division *Classification of Shellfish Harvesting Area Maps*, dated November 1, 1999 or more recent updates. Water bodies are classified as supporting, partially supporting, or not supporting according to the classification guidance provided in Table 18. The TDH classifies shellfish growing areas into one of four categories.

Approved Area

An approved area is a shellfish growing area approved by the TDH for growing and harvesting shellfish for direct marketing. The approved area

is not subject to contamination from human and/or animal fecal matter in amounts that may present an actual or potential hazard to public health. The approved area is not contaminated with pathogenic organisms, poisonous substances, or marine biotoxins. The classification of an approved area is determined by a sanitary survey conducted by the TDH. An approved area meets criteria except under extreme conditions.

Conditionally Approved Area

A conditionally approved area is determined by the TDH to meet approved criteria for a predictable period. Events causing the degraded water quality must be predictable and definable (river stage, wastewater treatment plant effluents, runoff conditions). A conditionally approved shellfish growing area is closed when the area does not meet the approved criteria.

Restricted Area

Restricted areas are shellfish growing areas with threatened poor water quality classified by the TDH from which shellfish may be harvested only if permitted and subjected to a suitable and effective cleansing process. The harvested shellfish must be cleaned by depuration (moved to processing plants for cleansing in clean water) or by relaying (moved to estuarine waters in a clean area). Areas classified as restricted for reasons other than water quality impairment are reported as not assessed.

Prohibited Area

A prohibited area is where there is no current sanitary survey, or where the sanitary survey or other monitoring program data indicate that fecal material, pathogenic microorganisms, poisonous or deleterious substances, marine toxins, or radionuclides may reach the area in excessive concentrations. The taking of shellfish for any human food purposes from such areas is prohibited. Shellfish from a prohibited area may not be taken for cleaning by depuration or relaying. Areas that are classified as prohibited for reasons other than water quality impairment are reported as not assessed.

Threatened Water Bodies

As outlined in 40 CFR section 130.2(j) and in EPA guidance, states are required to identify water-quality limited segments "where it is known that water quality does not meet applicable water quality standards, and/or is *not expected to meet* applicable water quality standards." Those water bodies *not expected to meet* applicable water quality standards are considered "threatened." As a result, water bodies that are supporting their designated uses and have no exceedances of criteria may be categorized as threatened. A water body is considered threatened if:

(1) Information provided by TNRCC's Water Utilities Division indicates detections in treated water of organic chemicals that are above 50 percent of the MCL for primary drinking water standards. For water utility systems with nine or fewer finished drinking water samples, two or more must exceed 50 percent of the MCL for the associated water body to be considered threatened; for systems with more than nine finished drinking water samples, 11 percent or more of the samples must exceed 50 percent of the MCL. For a water body to be classified as threatened, individual organic substances may actually exceed the MCL (that is, values are not restricted to the range between 50 percent of the MCL and the MCL). A water body is considered nonsupportive of the water supply use when the annual average (minimum of four samples) for organic substances exceeds the MCL (see Methodology for Screening and Assessing Use Support). These chemicals must also represent possible source water contaminants from a surface water source.

(2) Human health (toxicants in water) criteria for consumption of fish are exceeded and available fish/shellfish tissue data have been evaluated by the TDH, through a risk assessment, indicating fish/shellfish are safe for consumption.

(3) Other reliable, available data and information indicate an apparent declining water quality trend (that is, water quality conditions have deteriorated, compared to earlier assessments, but the waters still support uses). The information must demonstrate that in the next two to four years, uses or criteria will not be supported unless additional pollution controls are implemented. Threatened water bodies, in this context, are those where specific pollutants are identified and documented as probable contributors to nonsupport of uses and/or criteria in the future.

For future 305(b) assessments, the TNRCC and the CRP will continue to identify additional sources of available data and information that could be used to determine whether a water body's uses are threatened. Links to other TNRCC program areas (for example, source water protection) will be strengthened, and greater use will be made of data and information from other agencies (TSSWCB, TWDB, TPWD, TDH, and federal agencies).

Methodology for Screening and Assessing General Uses

Water quality criteria for several constituents are established in the TSWQS to safeguard general water quality, rather than for protection of a specific use. Water temperature, pH, chloride, sulfate, TDS, and enterococci bacteria are the parameters in this grouping. Enterococci criteria are assigned only to two Houston Ship Channel segments. Specific criteria for each of the other parameters are assigned to each classified segment in the TSWQS based on physical, chemical, and biological characteristics. Data from a five-year period are compared to specific segment criteria in order to determine compliance. Only surface water temperature values are evaluated. Values of pH are evaluated over the mixed surface layer. The degree of water temperature and pH criteria support is based on specific ranges for the percent of exceedances (see Table 28). Water temperature, pH, chloride, sulfate, and TDS criteria developed for classified segments do not apply to unclassified water bodies.

Chloride, sulfate, and TDS criteria in the TSWQS represent annual averages of all values that were collected when streamflow equaled or exceeded the seven-day, two-year low-flow value established for each segment. Due to infrequent monitoring and absence of stream flow information at many sites, all of the chloride, sulfate, and total dissolved solids values measured during the five-year period are averaged for all sites within the water body and compared to the criterion for each parameter. For cases where total dissolved solids were not measured, a value is calculated by multiplying specific conductance measured at the surface by a factor of 0.65. The chloride, sulfate, and total dissolved solids criteria are not supported if the average value exceeds the criteria (Table 28).

An enterococci bacterial screening level (500 colonies/100 mL) is established for two Houston Ship Channel Segments (1006 and 1007) to provide indication of contamination rather than protection of a recreational use. Due to heavy ship and barge traffic on the Houston Ship Channel, local statutes have been enacted to discourage any kind of water-based recreation. The degree of enterococci criteria support is based on specific ranges for the percent of exceedances (see Table 28).

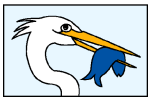
Table 28. Framework for Evaluating General Use Support

Parameter	Units/Criteria	Minimum Number of Samples	Fully Supporting	Partially Supporting	Not Supporting
Water temperature	°C, segment-specific	9	0-10% exceed criterion	At least 2 measurements and 11-25% exceed criterion	Greater than 25% exceed criterion
pH	Standard units, segment-specific	9	0-10% do not meet criteria	At least 2 measurements and 11-25% do not meet criteria	Greater than 25% do not meet criteria
Chloride	mg/L, segment-specific	9	Segment average less than or equal to criterion	Partial support is not assessed	Segment average exceeds criterion
Sulfate	mg/L, segment-specific	9	Segment average less than or equal to criterion	Partial support is not assessed	Segment average exceeds criterion
Total dissolved solids	mg/L, segment-specific	9	Segment average less than or equal to criterion	Partial support is not assessed	Segment average exceeds criterion
Enterococci bacteria	500 colonies/100 mL	9	0-10% exceed criterion	Partial support is not assessed	Greater than 25% exceed criterion

Methodology for Screening and Assessing Water Quality Concerns

Water quality criteria for nutrients and chlorophyll *a* in water have not been developed for Texas by the TNRCC. Sediment criteria have been developed by the EPA for only a few parameters, and the criteria have not been adopted. Criteria for some toxicants in fish tissue were developed from human health criteria in the TSWQS. In the absence of established criteria, the TNRCC, the CRP, and the NOAA developed screening levels for these three water quality indicator groups in order to identify areas where elevated levels may constitute cause for concern. The screening levels do not represent adopted state criteria and should not be considered as such. Waters are classified as having no concerns or concerns based on comparisons of water quality data to screening levels and application of rating criteria (Table 29). The geographical extent of concern within each water body follows the same basis as that for determining use support. Water bodies with concerns are candidates for targeted monitoring in subsequent years and further evaluation to determine if the narrative criteria in the TSWQS are violated.

Water quality concerns are also identified for water and sediment parameters where insufficient sample numbers prevented assessment of designated aquatic life and recreational uses. In order for a water quality concern to be identified, compelling evidence must be shown (exceedance of at least two samples or greater than 25% exceedance) by the sample data. Water bodies with identified concerns are targeted for increased monitoring.



Aquatic Life Concerns

Support of the aquatic life use is determined by dissolved oxygen, toxic substances in water, water and sediment toxicity tests, sediment effects, and biological screening levels when at least minimum samples numbers are available for assessment (see "Aquatic Life Use Support" and Table 18). When the number of samples available for assessment are less than the prescribed minima, the data are not disregarded, but are used to identify aquatic life concerns provided there is compelling evidence (exceedance of screening levels by two or more samples and the rate of exceedance is greater than 25%). Aquatic life concerns are identified based on instantaneous and 24-hour dissolved oxygen data, toxic substance acute criteria and ambient water and sediment toxicity tests (Table 29).

Table 29. Framework for Identifying Water Quality Concerns

Category	Parameter/Screening Levels	Minimum Number of Samples	No Concern	Concern
Aquatic Life	Routinely Collected Instantaneous Dissolved Oxygen Measurements	< 9	0-25 % of all measurements (excluding those collected during intensive 24-hour monitoring events) are less than the instantaneous screening level.	Two or more samples and greater than 25 % of all measurements (excluding those collected during intensive 24-hour monitoring events) are less than the instantaneous screening level.
	Intensively Collected 24-hour Dissolved Oxygen Measurements	< 5 sets	0-25 % of all means collected during each 24-hour sampling event are less than the 24-hour average criterion, and 0-25 % of the minimum values for each 24-hour sampling event are less than the minimum criterion.	Two or more collected during each 24-hour sampling event are less than the 24-hour average criterion, and Two or more minimum values for each 24-hour sampling event are less than the minimum criterion.
	Metals and Organic Substances in Water	< 5	For any individual parameter, 0-25% exceed acute criterion	For any individual parameter, two or more exceed acute criterion
	Ambient Water and Sediment Toxicity	< 5	0-25% of samples have acute or chronic toxicity.	Two or more samples have chronic toxicity

Table 29. Framework for Identifying Water Quality Concerns (continued)

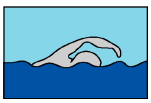
Category	Parameter/Screening Levels	Minimum Number of Samples	No Concern	Concern
Contact Recreation	Routinely Collected Bacteria Samples (Fecal coliform 400 colonies/ 100 mL)	< 9	0-25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.	Two or more and greater than 25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.
Contact Recreation	Intensively Collected Bacteria Samples (Fecal coliform 30-day geometric mean 200 colonies/100 mL)	< 5 sets	0-25% of geometric means from intensive sampling events exceed one of the criterions.	Two or more geometric means from intensive sampling events exceed one of the criterions.
Noncontact Recreation	Routinely Collected Bacteria Samples (Fecal coliform 400 colonies/100 mL). For Segment 2308 only (Fecal coliform 4,000 colonies/100 mL)	< 9	0-25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.	Two or more and greater than 25% of all samples collected (including those collected during intensive monitoring events) exceed one of the screening levels.
Noncontact Recreation, continued	Intensively Collected Bacteria Samples (Fecal coliform 30-day geometric mean 200 colonies/100 mL) For Segment 2308 only (Fecal coliform 30-day geometric mean 2,000 colonies/100 mL)	< 5 sets	0-25% of geometric means from intensive sampling events exceed one of the criteria.	Two or more geometric means from intensive sampling events exceed one of the criteria.

Table 29. Framework for Identifying Water Quality Concerns (continued)

Category	Parameter/Screening Levels	Minimum Number of Samples	No Concern	Concern
Nutrients				
Freshwater Streams	NH_3-N - 0.16 mg/L NO_2-N + NO_3-N - 3.50 mg/L OP - 0.90 mg/L TP - 1.10 mg/L Chl *a* - 13.7 µg/L	9	For any one parameter, 0-25% of values exceed the screening level.	For any one parameter, more than 25%of values exceed the screening level.
Reservoirs	NH_3-N - 0.12 mg/L NO_2-N + NO_3-N - 0.34 mg/L OP - 0.10 mg/L TP - 0.24 mg/L Chl *a* - 22.3 µg/L	9	For any one parameter, 0-25% of values exceed the screening level.	For any one parameter, more than 25%of values exceed the screening level.
Saltwater Tidal Streams	NH_3-N - 0.44 mg/L NO_2-N + NO_3-N - 2.34 mg/L OP - 0.90 mg/L TP - 1.11 mg/L Chl *a* - 23.0 µg/L	9	For any one parameter, 0-25% of values exceed the screening level.	For any one parameter, more than 25% of values exceed the screening level.
Estuaries	NH_3-N - 0.12 mg/L NO_2-N + NO_3-N - 0.26 mg/L OP - 0.18 mg/L TP - 0.23 mg/L Chl *a* - 14.6 µg/L	9	For any one parameter, 0-25% of values exceed the screening level.	For any one parameter, more than 25% of values exceed the screening level.

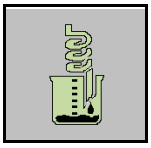
Table 29. Framework for Identifying Water Quality Concerns (continued)

Category	Parameter/Screening Levels	Minimum Number of Samples	No Concern	Concern
Toxicants in Sediment	12 Metals and 131 Organic Substances (85th Percentiles, PELs, and TELs); see Tables 15 and 16	5	For any one parameter, 0-25% of values exceed the screening level.	For any one parameter, more than 25% of values exceed the screening level.
Toxicants in Fish Tissue	7 Metals and 31 Organic Substances; see Tables 17 and 18	5	For any one parameter, 0-25% of values exceed the screening level.	For any one parameter, more than 25% of values exceed the screening level.
Public Water Supply	Finished Water Secondary Drinking Water Standards	4	Mean less than or equal to criteria.	Mean exceeds criteria.
	Surface Water Secondary Drinking Water Standards	9	Mean less than or equal to criteria.	Mean exceeds criteria.
	Increased Costs for Demineralization	-----	Demineralization is not used to treat surface water.	Demineralization used to treat surface water.
Narrative Criteria	Nutrients, sediment contaminants, fish tissue contaminants, other narrative criteria	-----	Information available indicates attainment of screening levels and narrative criteria.	Information available indicates a concern; however, it is insufficient to determine impairment of uses or criteria.



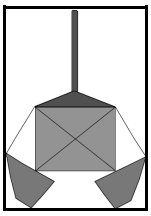
Contact and Noncontact Recreation Concerns

Support of contact and noncontact recreation uses is determined by instantaneous and intensively collected fecal coliform data when at least minimum sample numbers are available for assessment (see "Contact and Noncontact Recreation Support" and Table 18). When the minimum number of samples available for assessment is less than the prescribed minima, the data are not disregarded, but are used to identify contact and noncontact recreation concerns provided there is compelling evidence (exceedance of screening levels by at least two samples and the rate of exceedance is greater than 25%) (Table 29).



Nutrients and Chlorophyll a Screening Levels

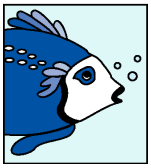
The screening levels listed for nutrients and chlorophyll *a* in Table 29 were statistically derived from long-term SWQM monitoring data (September 1988 - August 1998). The 85th percentile values for each parameter in freshwater streams, tidal streams, reservoirs, and estuaries are shown in Table 29. Determination of the level of concern for each water body is determined by ranges for the percent of exceedances among nutrient and chlorophyll *a* measurements shown in Table 29.



Sediment Quality Screening Levels

Criteria have not been adopted for the wide array of contaminants in sediment. The EPA has developed procedures to generate criteria for selected toxicants in sediment; however, they have targeted only a few parameters, and criteria have not been adopted. Sediment screening levels developed by the TNRCC (85th percentiles) from long-term SWQM data and by NOAA are used to evaluate sediment concerns. Probable effects levels (PELs) developed by NOAA are used to identify compounds which are likely elevated to toxic concentrations. Freshwater and marine PELs are based on benthic macroinvertebrate community metrics and toxicity tests. The PEL, as the geometric mean of the 50th percentile of impacted, toxic samples and the 85th percentile of non-impacted samples, is the level above which adverse biological effects are frequently expected. The threshold effects levels (TELs) developed by NOAA are based on benthic community metrics and toxicity tests results. The TEL is calculated as the geometric mean of the 15th percentile concentration of the toxic effects data set and the median of the no-effects data set. The TEL, therefore, represents the concentration below which adverse biological effects are rarely expected to occur. In order to compute sediment 85th percentiles, the SWQM Database was first screened for specific metals and organic substances with at least 25 observations statewide within four types of water bodies: freshwater streams, reservoirs, tidally influenced streams, and estuaries. This screen resulted in the selection of 12 specific metals and 131 specific organic substances (38 pesticides, 30 volatile organics,

and 63 semivolatile organics). The 85th percentile values for each parameter in the four different water body types are shown in Tables 30 and 31. The sediment 85th percentiles are based on the ten-year period (September 1988 - August 1998) and are revised annually. At least five sediment samples at each site are required for assessment of sediment concerns based on 85th percentile, TEL, and PEL screening levels. Determination of the level of concern for each water body is determined by ranges for the percent of exceedances among sediment TELs and 85th percentiles (see Table 29).



Fish Tissue Screening Levels

The screening levels for concentrations of toxicants in fish tissue were developed from human health criteria in the TSWQS, except for the metals arsenic, cadmium, chromium, copper, and selenium . Screening levels for these metals are based on TDH screening levels which are slightly lower than the levels used to issue consumption advisories.

The human health criteria in the standards are expressed as allowable concentrations of toxicants in surface waters. This allowable concentration in water is determined by calculating an allowable concentration in fish tissue and then dividing by the bioaccumulation factor for that particular toxicant. The formulas for deriving human health criteria were developed by the EPA. The following procedures and assumptions were used to calculate allowable fish tissue concentrations.

For noncarcinogens: $RTC = \frac{RfD \times WT}{FC}$

For carcinogens: $RTC = \frac{(RL)/(q1^*) \times WT}{FC}$

Definitions:

RTC = Reference tissue concentration (as mg of toxicant/kg of fish tissue), which is the allowable concentration of the toxicant in edible fish tissue.

RfD = Reference dose (as mg of toxicant/kg human body weight/day), which is the allowable exposure of the toxicant (through ingestion of fish) on a daily basis. Reference doses were obtained from the USEPA Integrated Risk Information System (IRIS), which is an updated computer database for assessing human health effects of toxicants.

WT = Weight of an average human adult (70 kg).
FC = Average amount of fish consumed per person (as kg of fish per day). This amount was 0.010 kg/day for fresh waters, and 0.015 kg/day for marine waters.
RL = Risk level for carcinogens (= 1/100,000). This is the potential risk of cancer for each person exposed at the allowable dose over a 70-year period.

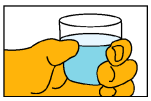
q1* = Cancer potency slope factor (as the reciprocal of mg/kg/day). This factor is the relationship (slope) of cancer risk and dose, and it is indicative of a chemical's potential to cause cancer in humans. Values for q1* are extrapolated from data on cancer rates in laboratory animals that are exposed at very high dose rates. The q1* values were obtained from the EPA IRIS database.

Additional procedures and assumptions:

(1) The ratio of average body weights was used to convert data on laboratory test animals to human scale. When the weight of test animals was not specified, the average weights were considered to be 0.35 kg for rats, 0.03 kg for mice, and 70 kg for humans.

(2) If the concentration of a substance in fish tissue used for these calculations was greater than the applicable U.S. Food and Drug Administration Action Level for edible fish and shellfish tissue, then the acceptable concentration in fish tissue was lowered to the Action Level for calculation of criteria.

Using this approach, screening levels were developed for two metals and 31 organic substances (See Tables 32 and 33). Screening levels developed by the TDH are used for the other five metals. Five years of data are screened using these levels. Identification of fish tissue concerns is based on specific ranges for the percent of exceedances among toxicants (see Table 29).



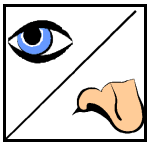
Public Water Supply Concerns

All finished water samples (minimum of four) collected over the most recent five-year period are used to compute a mean to compare to the secondary standards in the TDWS. Secondary MCLs that are evaluated are limited to chloride (300 mg/L), sulfate (300 mg/L), and total dissolved solids (1,000 mg/L) (see Table 29). These criteria were developed to

ensure that water supply utilities can treat and deliver water that is free of objectionable tastes and odor for reasonable costs to consumers.

Public water supply concerns are also evaluated in surface water bodies that are designated for the public water supply use in the TSWQS by comparing chloride, sulfate, and total dissolved solids concentrations in surface water to the secondary drinking water criteria. Samples (minimum of nine) from all sites within a water body are averaged for the comparisons (see Table 29).

Implementation of advanced treatment may be required for water supplies with elevated chloride, sulfate, and total dissolved solids concentrations. Public water supply systems that experience increased costs for demineralization treatment are identified as concerns for dissolved solids in the surface water body (see Table 29).



Narrative Concerns

In addition to numeric criteria and screening levels, designated uses are also protected by narrative criteria. Narrative criteria include:

(1) Concentrations of taste and odor producing substances;
(2) Floating debris and suspended solids;
(3) Settleable solids (eroding sediment);
(4) Surface waters should be maintained in an aesthetically attractive condition;
(5) Waste discharges that cause substantial and persistent changes from ambient conditions or turbidity or color;
(6) Foaming of a persistent nature;
(6) Oil, grease, or related residue that produce a visible film of oil or globules of grease on the water surface;
(7) Surface waters should not be toxic to man from ingestion of water, consumption of aquatic organisms, or contact with the skin, or to terrestrial or aquatic life; and
(8) Nutrients from permitted discharges or other controllable sources should not cause excessive growth of aquatic vegetation that impairs an existing, attainable, or designated use.

The analysis and identification of narrative concerns is inherently less objective and consistent than that for numeric screening levels. Therefore, narrative standards are assessed using narrative criteria for which related numeric data exist (for example, excessive aquatic plant growths associated with instream nutrient concentrations) (Table 29). All water bodies with nutrient, contaminated sediment, contaminated fish tissue, and public water supply concerns identified by screening numeric criteria are auto-

matically evaluated to determine if they also fail to support narrative criteria.

Additional information is solicited from CRP partners, TNRCC central and regional office staffs, and other basin stakeholders to document conditions that may contribute to narrative criteria concerns. The information about narrative concerns is used to strengthen or validate water quality concerns identified using numeric screening techniques. Such information may consist of water quality studies, occurrence of fish kills or contaminant spills, photographic evidence, local knowledge, and best professional judgment.

Table 30. Screening Levels for Metals in Sediment
(All values in mg/kg dry weight)

Parameter Code	Parameter	Threshold Effect Level (TEL)		Probable Effect Level (PEL)		85th Percentile by Water Body Type			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
01003	Arsenic	5.9	7.24	17.0	41.6	6.32	7.78	37.3	6.9
01008	Barium	--	--	--	--	181.0	230.0	297.0	381.0
01028	Cadmium	0.596	0.676	3.53	4.21	1.00	0.75	2.00	0.95
01029	Chromium	37.3	52.3	90.0	160.4	18.9	30.0	40.0	31.0
01043	Copper	35.7	18.7	197.0	108.2	15.9	33.3	24.4	19.0
01052	Lead	35.0	30.24	91.3	112.18	31.6	107.0	58.7	24.39
01053	Manganese	--	--	--	--	557.0	477.0	1400.0	662.0
71921	Mercury	0.174	0.13	0.486	0.696	0.11	0.288	0.198	0.304
01068	Nickel	18.0	15.9	35.9	42.8	14.2	20.5	29.9	18.4
01148	Selenium	--	--	--	--	1.42	1.24	2.8	2.19
01078	Silver	--	0.73	--	1.77	1.0	1.5	1.6	0.92
01093	Zinc	123.1	124.0	315.0	271.0	75.9	180.0	156.0	97.0

Table 31. Screening Levels for Organic Substances in Sediment
(All values in µg/kg dry weight)

Parameter Code	Parameter	Threshold Effect Level (TEL)		Probable Effect Level (PEL)		85th Percentile by Water Body Type			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
Pesticides									
39731	2,4-D					37.5	60.0	95.0	75.0
39741	2,4,5-T					8.0	11.5	24.0	15.0
39761	2,4,5-TP (silvex)					6.5	10.5	28.0	14.55
39333	Aldrin					5.72	16.4	13.5	5.0
39076	*alpha*-Hexachlorocyclohexane					6.53	17.5	23.45	5.0
46290	*beta*-Hexachlorocyclohexane					7.8	47.0	30.0	9.52
46292	*delta*-Hexachlorocyclohexane					7.8	50.0	30.0	9.52
39783	*gamma*-Hexachlorocyclohexane (lindane)	0.94	0.32	1.38	0.99	5.74	15.0	13.6	2.5
39351	Chlordane, total	4.5	2.26	8.9	4.79	30.6	200.0	80.0	24.0
81404	Chloropyrifos (dursban)					45.75	87.15	172.5	80.0
39363	DDD, total					11.5	34.95	26.68	12.5
39368	DDE, total					14.15	25.0	23.0	5.0
39373	DDT, total	6.98	3.89	4450.0	51.7	12.0	28.65	19.95	10.0
82400	Demeton					100.0	102.05	301.0	----
39571	Diazinon					40.45	72.0	105.0	48.0
79799	Dicofol (kelthane)					25.0	31.0	----	25.0

Table 31. Screening Levels for Organic Substances in Sediment (continued)

Parameter Code	Parameter	TEL		PEL		Type of Water Body			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
39383	Dieldrin	2.85	0.715	6.67	4.3	6.1	14.3	11.0	4.5
39389	Endosulfan					10.7	65.0	27.2	10.0
34354	Endosulfan sulfate					7.65	41.0	19.95	12.5
39393	Endrin	2.67	–	62.4	--	9.85	24.38	18.15	5.0
39581	Guthion					62.5	96.0	172.5	84.7
39413	Heptachlor					5.72	12.19	12.75	5.0
39423	Heptachlor epoxide	0.6	–	2.74	–	6.8	27.8	23.45	5.0
39701	Hexachlorobenzene					434.1	395.85	150	119.5
39531	Malathion					40.45	72.0	96.6	25.0
39481	Methoxychlor					12.5	59.0	32.95	15.0
79800	Mirex					2.5	25.0	----	3.85
39541	Parathion					40.4	71.3	83.9	25.0
39514	PCB-1016					41.7	1000.0	179.5	115.0
39491	PCB-1221					43.85	1000.0	179.5	115.0
39495	PCB-1232					41.7	1000.0	179.5	115.0
39499	PCB-1242					35.25	1000.0	179.5	115.0
39503	PCB-1248					40.6	1000.0	179.5	120.0
39507	PCB-1254					40.6	1000.0	179.5	115.0
39511	PCB-1260					41.7	1000.0	174.0	115.0
39519	PCB, total	34.1	21.55	277.0	188.79	61.5	107.0	82.0	95.15

Table 31. Screening Levels for Organic Substances in Sediment (continued)

Parameter Code	Parameter	TEL		PEL		Type of Water Body			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
39118	Pentachlorobenzene					452.0	950.0	-----	1.2
39403	Toxaphene					98.5	451.0	179.0	100.0
Volatile Organic Substances									
34218	Acrylonitrile					1150.0	1650.0	2650.0	1950.0
34237	Benzene					250.0	312.5	500.0	390.0
34290	Bromoform					250.0	315.0	550.0	390.0
88802	Bromomethane					480.0	750.0	1300.0	980.0
34299	Carbon tetrachloride					250.0	312.5	500.0	390.0
34304	Chlorobenzene					250.0	390.0	550.0	390.0
34309	Chlorodibromomethane					250.0	315.0	500.0	390.0
34314	Chloroethane					550.0	750.0	1300.0	980.0
34579	2-Chloroethyl vinyl ether					1900.0	3000.0	5750.0	3900.0
34318	Chloroform					300.0	312.5	500.0	390.0
88835	Chloromethane					480.0	750.0	1300.0	950.0
34330	Dichlorobromomethane					250.0	312.5	500.0	390.0
88805	1,2-Dibromomethane					220.0	435.0	----	400.0
34499	1,1-Dichloroethane					250.0	312.5	500.0	390.0
34534	1,2-Dichloroethane					250.0	312.5	500.0	390.0
34504	1,1-Dichloroethylene					245.0	335.0	500.0	390.0
34549	1,2-trans-Dichloroethylene					250.0	335.0	550.0	395.0

Table 31. Screening Levels for Organic Substances in Sediment (continued)

Parameter Code	Parameter	TEL		PEL		Type of Water Body			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
34544	1,2-Dichloropropane					250.0	312.5	500.0	390.0
34702	cis-1,3-Dichloropropylene					250.0	315.0	500.0	390.0
34697	trans-1,3-Dichloropropylene					250.0	315.0	500.0	390.0
34374	Ethylbenzene					250.0	340.0	550.0	390.0
34426	Methylene chloride					350.0	340.0	550.0	400.0
34478	Tetrachloroethylene					250.0	435.0	550.0	390.0
34519	1,1,2,2-tetrachloroethane					250.0	390.0	550.0	390.0
34483	Toluene					312.5	360.0	550.0	390.0
34509	1,1,1-trichloroethane					250.0	312.5	500.0	390.0
34514	1,1,2-trichloroethane					250.0	315.0	500.0	390.0
34487	Trichloroethylene					250.0	390.0	550.0	390.0
45510	Xylenes, total					650.0	950.0	1600.0	1150.0
34495	Vinyl chloride					550.0	750.0	1300.0	980.0

Table 31. Screening Levels for Organic Substances in Sediment (continued)

Parameter Code	Parameter	TEL		PEL		Type of Water Body			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
Semivolatile Organic Substances									
34208	Acenaphthene	–	6.71	–	88.9	767.0	1399.5	2400.0	1050.0
34203	Acenaphthylene	–	5.87	–	127.87	767.0	1399.5	2400.0	1050.0
34223	Anthracene	–	46.85	–	245.0	776.45	1800.0	2400.0	1050.0
39121	Benzidine					1050.0	6650.0	3150.0	1430.0
34529	Benzo(a)anthracene	31.7	74.83	385.0	692.53	776.45	1709.0	2400.0	1110.0
34250	Benzo(a)pyrene	31.9	88.81	782.0	763.22	750.0	1709.0	2400.0	1200.0
34233	Benzo(b)fluoranthene					776.45	1800.0	2400.0	1050.0
34524	Benzo(ghi)perylene					750.0	1709.0	2400.0	1100.0
34245	Benzo(k)fluoranthene					767.0	1709.0	2400.0	1200.0
34639	4-Bromophenyl phenyl ether					767.0	1709.0	2400.0	1050.0
88811	Cresols, total					1648.2	2297.0	4185.75	1700.0
34281	Bis(2-chloroethoxy)methane					776.45	1399.5	2400.0	1050.0
34276	Bis(2-chloroethyl)ether					776.45	1399.5	2400.0	1050.0
34286	Bis(2-chloroisopropyl)ether					767.0	1399.5	2400.0	1050.0
34584	2-Chloronaphthalene					950.0	1970.0	2790.0	1050.0
34589	2-Chlorophenol					1050.0	1950.0	2400.0	1500.0
34644	4-Chlorophenyl phenyl ether					767.0	1709.0	2400.0	1050.0
34323	Chrysene	57.1	107.77	862.0	845.98	776.45	1800.0	2400.0	1200.0
34559	Dibenz(a,h)anthracene	–	6.22	–	134.61	750.0	1709.0	2400.0	1050.0

Table 31. Screening Levels for Organic Substances in Sediment (continued)

Parameter Code	Parameter	TEL		PEL		Type of Water Body			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
34295	n-Butyl benzyl phthalate					792.0	1709.0	2400.0	1050.0
39112	Di-n-butyl phthalate					900.0	2430.0	2400.0	1100.0
34599	Di-n-octyl phthalate					800.0	1709.0	2400.0	1100.0
34539	1,2-Dichlorobenzene					683.0	1375.0	2400.0	1050.0
34569	1,3-Dichlorobenzene					670.0	1375.0	2400.0	1050.0
34574	1,4-Dichlorobenzene					715.0	1375.0	2400.0	1021.45
34634	3,3'-Dichlorobenzidine					1100.0	2750.0	4782.5	1563.9
34604	2,4-Dichlorophenol					1207.0	1950.0	3850.0	1750.0
34339	Diethyl phthalate					767.0	1800.0	2400.0	1100.0
34609	2,4-Dimethylphenol					1150.0	1950.0	3850.0	1732.15
34344	Dimethyl phthalate					800.0	1399.5	3850.0	1100.0
34660	4,6-Dinitro-o-cresol					1950.0	3850.0	3850.0	3000.0
34619	2,4-Dinitrophenol					2250.0	6550.0	6250.0	3450.0
34614	2,4-Dinitrotoluene					800.0	1709.0	3850.0	1100.0
34629	2,6-Dinitrotoluene					767.0	1399.5	2400.0	1050.0
34349	1,2-Diphenylhydrazine					750.0	1300.0	1950.0	950.0
39102	Bis(2-Ethylhexyl)phthalate					900.0	1920.0	2400.0	1200.0
34379	Fluoranthene	111.0	112.82	2355.0	1493.54	776.45	2176.9	2400.0	1200.0
34384	Fluorene	–	21.7	–	144.35	750.0	1709.0	2400.0	1050.0
39705	Hexachlorobutadiene					776.45	1550.0	3850.0	1257.4

Table 31. Screening Levels for Organic Substances in Sediment (continued)

Parameter Code	Parameter	TEL		PEL		Type of Water Body			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
34389	Hexachlorocyclopentadiene					1321.65	1920.0	3900.65	1563.9
34399	Hexachloroethane					776.45	1399.5	2400.0	1100.0
73120	Hexachlorophene					490.0	4055.0	----	885.0
34406	Indeno(1,2,3-cd)pyrene					750.0	1709.0	2400.0	1100.0
34411	Isophorone					776.45	1399.5	2400.0	1050.0
34455	3-Methyl-4-chlorophenol					1400.0	2450.0	----	1750.0
34445	Naphthalene	–	34.57	–	390.64	700.0	1375.0	2400.0	1050.0
34450	Nitrobenzene					767.0	1399.5	2400.0	1050.0
34594	2-Nitrophenol					1150.0	1950.0	3850.0	1732.15
34649	4-Nitrophenol					2250.0	6550.0	4170.0	3000.0
88817	N-Nitrosodiethylamine					600.0	1920.0	----	900.0
34441	N-Nitrosodimethylamine					850.0	1709.0	2400.0	1050.0
73159	N-Nitrosodi-n-butylamine					700.0	1920.0	----	900.0
34431	N-Nitrosodi-n-propylamine					767.0	1399.5	2400.0	1050.0
34436	N-Nitrosodiphenylamine					767.0	1399.5	2400.0	1100.0
39061	Pentachlorophenol					1600.0	3100.0	2440.0	3000.0
34464	Phenanthrene	41.9	86.68	515.0	543.53	776.0	1800.0	2400.0	1100.0
34695	Phenol					1050.0	1950.0	2400.0	1563.0
34472	Pyrene	53.0	152.66	875.0	1397.6	776.45	2100.0	2400.0	1257.4
88823	Pyridine					750.0	1800.0	4450.0	1100.0

Table 31. Screening Levels for Organic Substances in Sediment (continued)

Parameter Code	Parameter	TEL		PEL		Type of Water Body			
		Freshwater	Marine	Freshwater	Marine	Freshwater Stream	Tidal Stream	Reservoir	Estuary
88826	1,2,4,5-tetrachlorobenzene					670.0	1920.0	----	950.0
34554	1,2,4-trichlorobenzene					625.0	1375.0	2725.65	1100.0
78401	2,4,5-trichlorophenol					1200.0	2050.0	2725.65	1650.0
34624	2,4,6-trichlorophenol					1100.0	2050.0	2400.0	1563.9
Other Sediment Parameters									
00557 00561	Oil and grease					445.5	1210.0	1030.0	274.2

Table 32. Screening Levels for Metals in Tissue
(All values listed as mg/kg Wet Weight)

Parameter Code	Parameter	Freshwater	Saltwater
01004	Arsenic *	3.0	3.0
71940	Cadmium *	0.5	0.5
71939	Chromium *	100.0	100.0
71937	Copper *	40.0	40.0
71936	Lead	1.25	8.333
71930	Mercury	1.0	1.0
01149	Selenium *	2.0	2.0

* Texas Department of Health screening level

Table 33. Screening Levels for Organic Substances in Tissue
(All Values in mg/kg Wet Weight)

Parameter Code	Parameter	Freshwater	Saltwater
	Pesticides		
34680	Aldrin	0.1360	0.0904
39074	*alpha*-Hexachlorocyclohexane	0.3660	0.2440
34258	*beta*-Hexachlorocyclohexane	1.2810	0.8540
39075	*gamma*-Hexachlorocyclohexane (lindane)	5.8520	3.9010
34682	Chlordane	0.3000	0.3000
81897	DDD	9.6060	6.4040
81896	DDE	5.4500	3.6340
39376	DDT	5.2770	3.5180
85684	Dicofol (Kelthane)	5.239	3.493
39406	Dieldrin	0.0570	0.0379
34687	Heptachlor	0.2020	0.1350
34686	Heptachlor epoxide	0.2530	0.1690
34688	Hexachlorobenzene	0.6090	0.4060
81645	Mirex	0.0355	0.0236
39515	PCBs	0.1340	0.0891
85679	Pentachlorobenzene	14.1870	9.4580
34691	Toxaphene	0.8270	0.5520

Table 33. Screening Levels for Organic Substances in Tissue (continued)

Parameter Code	Parameter	Freshwater	Saltwater
Semivolatile Organic Substances			
34241	Benzidine	0.0003	0.0002
34530	Benzo(a)anthracene	0.3150	----
34251	Benzo(a)pyrene	0.3150	----
88812	Cresols, total	886.667	591.111
34324	Chrysene	0.3150	----
34395	Hexachlorobutadiene	11.140	7.427
34400	Hexachloroethane	164.6670	109.7780
88815	Hexachlorophene	5.3200	3.5470
34451	Nitrobenzene	8.8670	5.9110
88818	N-Nitrosodiethylamine	0.0077	0.0051
88821	N-Nitrosodi-n-butylamine	0.4270	0.2850
39060	Pentachlorophenol	532.0000	354.6670
88824	Pyridine	17.7330	11.8220
88827	1,2,4,5-Tetrachlorobenzene	5.3200	3.5470