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Guidance for Screening and Assessing Texas Surface and Finished Drinking Water Quality Data

(for State Fiscal Year 1999)

General Assessment Methodology

The Texas Natural Resource Conservation Commission (TNRCC) administers water quality management programs with the goal of protecting, maintaining, and restoring Texas water resources. The Texas Surface Water Quality Standards (TSWQS), 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 to 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 loadings in Texas surface waters. These criteria are used as maximum 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 (after treatment) 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[1] 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, fecal coliform criteria in the TSWQS are based on five measurements within 30-days and 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

[1]Instream - occurring in streams or rivers, reservoirs or lakes, and estuaries or gulfs.

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 4-5).

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 nonsupport 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 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, the same categorical ranges are used to identify water bodies with no concerns, potential 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.

Sources of Data

Surface water quality monitoring (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, Clean Rivers Program (CRP) databases, 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. 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.

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 salts) 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, *E. coli*, 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.

For freshwater streams, an initial screening is conducted with field measurements and samples (including toxicants in water, sediment, and fish tissue, and toxicity tests) collected at all flow conditions. If measured values are identified as contributing to partial support or nonsupport of a use or causing potential concerns or concerns, a secondary screening using the seven-day, two-year low flow (7Q2) is conducted. In the secondary screening, individual parameter values that exceeded criteria or screening levels and were collected when stream flow was less than 7Q2 are excluded and the values are re-calculated to determine use support or concerns. The lone 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 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.

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.

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.

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 and dissolved oxygen criteria are applied to assessment of unclassified waters unless site-specific criteria derived from receiving water assessments are available. Toxicant and other conventional criteria for unclassified waters are the same as those for the downstream classified segment. For unclassified freshwater streams that flow into tidally influenced water bodies, criteria from a nearby freshwater stream segment may be used for screening purposes.

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/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. 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 1). 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 2).

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. Nonpoint source pollution is largely unregulated by state and federal water quality management programs.

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 1998 Clean Water Act 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.

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*, fecal coliform, *E. coli*, enterococci, and toxicants in water 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.

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.

Table 1. 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
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
0900	Nutrients		
	0910 Phosphorus		
	0920 Nitrogen		
	0930 Other		

Table 2. 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 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

Table 2. List of Sources	
Code	**Source Category**
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
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

Table 2. List of Sources	
Code	**Source Category**
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
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

Table 2. List of Sources	
Code	**Source Category**
	9001 Unknown Point Source 9002 Unknown Nonpoint Source
9050	Sources Outside State Jurisdiction or Borders

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.

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[2] 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 umhos/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 aquatic life uses is based on assessment of dissolved oxygen criteria, toxic substances in water criteria, and ambient water and sediment toxicity tests. Each set of criteria is generally evaluated independently of each other, and nonsupport of aquatic life uses results if any are not attained.

[2] Specific conductance - the ability of water to pass on electical current

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[3] water bodies are presumed to have a high aquatic life use and corresponding dissolved oxygen criteria. The 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. Most of the dissolved oxygen data collected at fixed monitoring stations are instantaneous measurements, 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. Dissolved oxygen measurements made during the day are considered representative of the 24-hour mean. Support of assigned aquatic life uses for routinely collected instantaneous dissolved oxygen data is based on ranges for the percent of exceedances (see Table 3).

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. Dissolved oxygen measurements may also be made manually at 4-6 hour intervals over one 24-hour period, as long as one is made near sunrise (0500-0900 hours) to approximate the daily minimum. At least five 24-hour monitoring events within a five-year period are required to provide adequate data for assessment. All intensive 24-hour dissolved oxygen monitoring events must be spaced over an index period (March 15-September 15). 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 3).

Dissolved oxygen data collected by routine and intensive methods are 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.

[3]Perennial water bodies - those in which water flows continually during most years and which are dry less than two percent of the time.

Table 3. 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			All uses are fully supported if:	One or more uses are partially supported and remaining uses are fully supported if:	One or more uses are not supported if:
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.	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.	11-25 % of all means collected during each 24-hour sampling event are less than the 24-hour average criterion, 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.
	Toxicants	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, 11-25% exceed acute criterion.	For any individual parameter, Greater than 25% exceed acute criterion, and/or the mean exceeds the chronic criterion.
	Ambient Water and Sediment Toxicity	5	0-10% of samples have acute or chronic toxicity.	11-25% of samples have acute or chronic toxicity.	Greater than 25% of samples have acute or chronic toxicity

Table 3. Framework for Evaluating Use Support					
Use/Impact	**Parameter/Criteria or Screening Levels**	**Minimum Number of Samples**	**Fully Supporting**	**Partially Supporting**	**Not Supporting**
Contact Recreation	Routinely Collected Bacteria Samples (Fecal coliform 400 colonies/ 100 mL or *E. coli* 252 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 or *E. coli* 30-day geometric mean 126 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 or *E.coli* 252 colonies/ 100 mL). For Segment 2308 only (Fecal coliform 4,000 colonies/100 mL or *E.coli* 2,520 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.

Table 3. Framework for Evaluating Use Support					
Use/Impact	**Parameter/Criteria or Screening Levels**	**Minimum Number of Samples**	**Fully Supporting**	**Partially Supporting**	**Not Supporting**
	Intensively Collected Bacteria Samples (Fecal coliform 30-day geometric mean 200 colonies/100 mL or *E.coli* 30-day geometric mean 126 colonies/100 mL) For Segment 2308 only (Fecal coliform 30-day geometric mean 2,000 colonies/100 mL or *E.coli* 30-day geometric mean 1,260 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.
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 Closurers	-----	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.

Table 3. Framework for Evaluating Use Support					
Use/Impact	**Parameter/Criteria or Screening Levels**	**Minimum Number of Samples**	**Fully Supporting**	**Partially Supporting**	**Not Supporting**
	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.

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 4 and 5). 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.

Individual measurements of the 12 metals and 17 organic substances are compared against acute criteria established in the TSWQS (Tables 4 and 5). 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. 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 and 30 or more ambient samples are available, 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 of ionic silver.

The TNRCC developed a regression equation ($R^2 = 87$) 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 basin is used unless sufficient chloride values are available within the water body. The degree of aquatic life use support for toxicants in water is based on ranges for the percent of exceedances (see Table 3).

Table 4. 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 5. Criteria in Water for Specific Organic Substances 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	---	0.03	---	0.03
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

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 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 3).

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. The EPA Region 6 Laboratory conducts 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). In addition to this type of testing, the CRP also conducts short-term acute ambient water toxicity tests. Support of the aquatic life use using ambient toxicity data is based on the occurrence of toxicity in water and/or sediment (see Table 3).

Biological Monitoring

A more direct approach for assessment of the aquatic life use may be made by sampling biological communities and determining physical habitat quality. The TNRCC and Texas Parks and Wildlife Department are developing assessment methods for the use of indices of biological integrity for fish and benthic macroinvertebrate communities and for indices of habitat quality in Texas. When the methods are fully developed, they will be incorporated into the screening and assessment guidance.

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, and in some cases *Esherichia coli* (*E. coli*), are analyzed in water samples collected to determine support of the contact recreation use. Most of the fecal coliform and *E. coli* data are routinely monitored 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 and an *E.coli* density of 252 colonies/100 mL are established as screening levels, and support of the contact recreation use is based on specific ranges for the percent of exceedances (see Table 3). A fecal coliform criterion of 200 colonies/100 mL and an *E.coli* criterion of 126 colonies/100 mL (30-day geometric means) apply 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 means (see Table 3). 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/*E. coli* screening levels (for routinely collected data) and criteria (for intensively collected data) assigned to contact recreational waters (see Table 3). 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 or an *E.coli* criterion of 2,520 colonies/100 mL for routinely monitored data are 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 and *E.coli*, 1260 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/*E. coli* samples (see Table 3). The minimum number of samples needed to determine use support for noncontact recreation is the same as the minimum for determining contact recreation (see Table 3). 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.

Public Water Supply Use

In the TSWQS, 219 segments are designated for the public 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 6 and criteria for inorganic chemicals are shown in Table 7. 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 for water samples collected during a five-year period is computed. The means are compared to human health criteria shown in Table 8. Column A measures are used for freshwater bodies designated for public water supply. Column B measures are used for fresh waters

Table 6. 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 7. 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

which are not designated for public water supply, and ten times this level is used for unclassified perennial water bodies which are greater than third order streams. Column C measures 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.

The fish consumption use is also assessed by review of fish tissue data; human risk assessment information; consumption advisories, aquatic life closures, and fish/shellfish harvesting bans issued by the Texas Department of Health (TDH). Results of fish/shellfish tissue sampling by the TDH are available in their publication, *TDH Fish Sampling Data, 1970-1997*. 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 3).

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.

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 Texas Parks and Wildlife Department (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, 1997. Water bodies are classified as supporting, partially supporting, or not supporting according to the classification guidance provided in Table 3. Water bodies that are classified as prohibited for reasons other than water quality impairment are reported as not assessed. 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, run-off 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

Table 8. 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
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

Table 8. Human Health Criteria in Water				
Parameter Code	Parameter	Column A Water and Fish µg/L	Column B Freshwater Fish Only µg/L	Column C Saltwater Fish Only µg/L
------	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 8. 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
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.

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).

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.

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 maximum contaminant level (MCL) for primary drinking water standards. For water utility systems

with nine or fewer 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 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; or

(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 (Texas State Soil and Water Conservation Board, Texas Water Development Board, Texas Parks and Wildlife, Texas Department of Health, and federal agencies).

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. The EPA is developing procedures to generate criteria for selected toxicants in sediment; however, they have targeted only a few parameters, and the criteria have not been adopted. Criteria for toxicants in fish tissue have also not been developed. In the absence of established criteria, the TNRCC and the CRP 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, potential concerns, or concerns based on comparisons of water quality data to screening levels and application of rating criteria (Table 9). The geographical extent of concern within each water body follows the same basis as that for determining use support. Water bodies with concerns and potential concerns are candidates for further evaluation to determine if the narrative criteria in the TSWQS are violated.

Nutrients and Chlorophyll a *Screening Levels*

The screening levels listed for nutrients and chlorophyll *a* in Table 9 were statistically derived from long-term SWQM monitoring data (September 1, 1987-August 31, 1997). The 85th percentile values for each parameter in freshwater streams, tidal streams, reservoirs, and estuaries are shown in Table 9. 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 9.

Sediment Quality Screening Levels

Screening levels for toxicants in sediment were statistically derived by the TNRCC from long-term SWQM data (September 1987-August 1997). 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 10 and 11. Determination of the level of concern for each water body is determined by ranges for the percent of exceedances among sediment levels (see Table 9).

Fish Tissue Screening Levels

The screening levels for concentrations of toxicants in fish tissue were developed from human health criteria in the TSWQS. TDH screening levels were used for arsenic, cadmium, chromium, copper, and selenium. TDH screening levels for these metals 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 12 and 13). Screening levels developed by the TDH are used for the other five metals. Five years of data are screened using these levels. Support of the fish consumption use is based on specific ranges for the percent of exceedances among toxicants (see Table 9).

Table 9. Framework for Identifying Water Quality Concerns for Evaluating Pollution Impacts					
Category	**Parameter/Screening Levels**	**Minimum Number of Samples**	**No Concern**	**Potential Concern**	**Concern**
Nutrients Freshwater Streams	NH_3-N - 0.19 mg/L NO_2-N + NO_3-N - 3.54 mg/L OP - 0.93 mg/L TP - 1.20 mg/L Chl *a* - 16.1 µg/L	9	For any one parameter, 0-10% of values exceed the screening level.	For any one parameter, 11-25% of values exceed the screening level.	For any one parameter, more than 25%of values exceed the screening level.
Reservoirs	NH_3-N - 0.11 mg/L NO_2-N + NO_3-N - 0.43 mg/L OP - 0.09 mg/L TP - 0.18 mg/L Chl *a* - 22.7 µg/L	9			
Saltwater Tidal Streams	NH_3-N - 0.51 mg/L NO_2-N + NO_3-N - 2.51 mg/L OP - 1.05 mg/L TP - 1.47 mg/L Chl *a* - 24.0 µg/L	9	For any one parameter, 0-10% of values exceed the screening level.	For any one parameter, 11-25% 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 - 0.28 mg/L OP - 0.20 mg/L TP - 0.25 mg/L Chl *a* - 14.9 µg/L	9	For any one parameter, 0-10% of values exceed the screening level.	For any one parameter, 11-25% of values exceed the screening level.	For any one parameter, more than 25% of values exceed the screening level.

Table 9. Framework for Identifying Water Quality Concerns for Evaluating Pollution Impacts					
Category	**Parameter/Screening Levels**	**Minimum Number of Samples**	**No Concern**	**Potential Concern**	**Concern**
Toxicants in Sediment	12 Metals and 131 Organic Substances (85th Percentiles; see Tables 10 and 11)	5	For any one parameter, 0-10% of values exceed the screening level.	For any one parameter, 11-25% 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 (85th Percentiles; see Tables 12 and 13)	5	For any one parameter, 0-10% of values exceed the screening level.	For any one parameter, 11-25% 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.	Partial support is not assessed.	Mean exceeds criteria.
	Surface Water Secondary Drinking Water Standards	9	Mean less than or equal to criteria.	Partial support is not assessed.	Mean exceeds criteria.
	Increased Costs for Demineralization	-----	Demineralization is not used to treat surface water.	Partial support is not assessed.	Demineralization used to treat surface water.

Table 10. Screening Levels for Metals in Sediment (All values in mg/kg dry weight)					
Parameter Code	**Parameter**	**Type of Water Body**			
		Freshwater Stream	**Tidal Stream**	**Reservoir**	**Estuary**
01003	Arsenic	6.6	6.6	35.4	7.6
01008	Barium	186.0	251.0	293.0	380.0
01028	Cadmium	1.06	0.95	2.00	0.83
01029	Chromium	19.6	45.0	38.0	30.3
01043	Copper	17.0	33.3	25.0	23.0
01052	Lead	40.0	85.9	62.2	28.0
01053	Manganese	560.0	488.0	1380.0	662.0
71921	Mercury	0.12	0.28	0.19	0.34
01068	Nickel	14.6	20.3	27.2	19.0
01148	Selenium	1.4	1.5	2.0	2.21
01078	Silver	1.5	1.6	1.6	1.5
01093	Zinc	81.3	182.0	144.0	105.0

Table 11. Screening Levels for Organic Substances in Sediment (All values in µg/kg dry weight)					
Parameter Code	Parameter	Type of Water Body			
		Freshwater Stream	Tidal Stream	Reservoir	Estuary
Pesticides					
39731	2,4-D	36.0	40.0	51.0	64.0
39741	2,4,5-T	8.0	8.7	12.6	14.5
39761	2,4,5-TP (silvex)	6.5	8.05	19.0	12.0
39333	Aldrin	4.92	11.3	7.85	2.15
39076	*alpha*-Hexachlorocyclohexane	5.72	12.19	18.15	2.5
46290	*beta*-Hexachlorocyclohexane	8.35	50.0	30.0	9.52
46292	*delta*-Hexachlorocyclohexane	8.35	4.5	30.0	9.52
39783	*gamma*-Hexachlorocyclohexane (lindane)	4.92	12.19	11.7	1.4
39351	Chlordane, total	29.2	12.3.0	46.8	14.98
81404	Chloropyrifos (dursban)	92.5	87.15	172.5	80.0
39363	DDD, total	10.0	22.6	22.0	8.5
39368	DDE, total	12.95	21.35	21.0	4.15
39373	DDT, total	11.0	24.38	15.65	7.5
82400	Demeton	95.7	102.05	301.0	----
39571	Diazinon	37.2	60.5	100.0	7.0
79799	Dicofol (kelthane)	25.0	41.5	----	25.0
39383	Dieldrin	5.74	11.3	6.5	2.8
39389	Endosulfan	10.7	65.0	25.68	10.0
34354	Endosulfan sulfate	7.65	41.0	19.95	12.5
39393	Endrin	8.11	21.09	14.7	3.31
39581	Guthion	60.1	96.0	172.5	84.7
39413	Heptachlor	4.65	10.68	10.0	2.15
39423	Heptachlor epoxide	6.0	16.4	18.15	2.35
39701	Hexachlorobenzene	383.45	165.0	11.67	1.2
39531	Malathion	27.55	57.6	50.5	8.5

Table 11. Screening Levels for Organic Substances in Sediment (All values in µg/kg dry weight)					
Parameter Code	Parameter	Type of Water Body			
		Freshwater Stream	Tidal Stream	Reservoir	Estuary
39481	Methoxychlor	12.0	24.38	26.68	12.5
79800	Mirex	2.5	25.0	----	3.85
39541	Parathion	27.55	56.95	56.67	7.0
39514	PCB-1016	41.7	1000.0	179.5	100.0
39491	PCB-1221	45.0	1000.0	179.5	100.0
39495	PCB-1232	41.7	1000.0	179.5	100.0
39499	PCB-1242	40.6	1000.0	179.5	100.0
39503	PCB-1248	40.6	1000.0	179.5	115.0
39507	PCB-1254	40.6	1000.0	179.5	100.0
39511	PCB-1260	43.85	1000.0	174.0	115.0
39519	PCB, total	56.7	105.5	31.0	30.0
39118	Pentachlorobenzene	444.75	950.0	-----	0.95
39403	Toxaphene	81.0	243.75	125.0	80.5
Volatile Organic Substances					
34218	Acrylonitrile	1150.0	1650.0	2,650.0	1900.0
34237	Benzene	250.0	315.0	500.0	390.0
34290	Bromoform	250.0	390.0	390.0	550.0
88802	Bromomethane	480.0	800.0	1300.0	950.0
34299	Carbon tetrachloride	250.0	315.0	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	800.0	1300.0	950.0
34579	2-Chloroethyl vinyl ether	1900.0	3000.0	5750.0	3900.0
34318	Chloroform	300.0	315.0	500.0	390.0
88835	Chloromethane	480.0	800.0	1300.0	950.0
34330	Dichlorobromomethane	250.0	315.0	500.0	390.0

Table 11. Screening Levels for Organic Substances in Sediment (All values in µg/kg dry weight)					
Parameter Code	Parameter	Type of Water Body			
		Freshwater Stream	Tidal Stream	Reservoir	Estuary
88805	1,2-Dibromomethane	225.0	435.0	----	395.0
34499	1,1-Dichloroethane	250.0	315.0	500.0	390.0
34534	1,2-Dichloroethane	250.0	315.0	500.0	390.0
34504	1,1-Dichloroethylene	250.0	335.0	500.0	390.0
34549	1,2-trans-Dichloroethylene	250.0	335.0	550.0	390.0
34544	1,2-Dichloropropane	250.0	315.0	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	390.0	550.0	390.0
34426	Methylene chloride	351.7	390.0	550.0	395.0
34478	Tetrachloroethylene	250.0	450.0	550.0	390.0
34519	1,1,2,2-tetrachloroethane	250.0	390.0	550.0	390.0
34483	Toluene	312.5	390.0	550.0	390.0
34509	1,1,1-trichloroethane	250.0	315.0	500.0	390.0
34514	1,1,2-trichloroethane	250.0	315.0	500.0	390.0
34487	Trichloroethylene	250.0	435.0	550.0	390.0
45510	Xylenes, total	690.0	1050.0	1600.0	1150.0
34495	Vinyl chloride	550.0	800.0	1300.0	950.0
Semivolatile Organic Substances					
34208	Acenaphthene	716.5	1709.0	2400.0	1021.5
34203	Acenaphthylene	716.5	1709.0	2400.0	1021.5
34223	Anthracene	800.0	1920.0	2400.0	1030.0
39121	Benzidine	1050.0	6650.0	3150.0	1423.5
34529	Benzo(a)anthracene	776.5	1800.0	2400.0	1100.0
34250	Benzo(a)pyrene	767.0	1800.0	2400.0	1100.0
34233	Benzo(b)fluoranthene	776.5	1848.7	2400.0	1100.0

Table 11. Screening Levels for Organic Substances in Sediment (All values in µg/kg dry weight)					
Parameter Code	Parameter	Type of Water Body			
		Freshwater Stream	Tidal Stream	Reservoir	Estuary
34524	Benzo(ghi)perylene	767.0	1800.0	2400.0	1050.0
34245	Benzo(k)fluoranthene	776.5	1800.0	2400.0	1100.0
34639	4-Bromophenyl phenyl ether	776.5	1800.0	2400.0	1021.5
88811	Cresols, total	1592.7	2215.0	4185.0	1650.0
34281	Bis(2-chloroethoxy)methane	776.5	1709.0	2400.0	1021.5
34276	Bis(2-chloroethyl)ether	776.5	1709.0	2400.0	1021.5
34286	Bis(2-chloroisopropyl)ether	776.5	1709.0	2400.0	1021.5
34584	2-Chloronaphthalene	947.1	1970.5	2709.5	950.0
34589	2-Chlorophenol	1050.0	1950.0	2400.0	1470.0
34644	4-Chlorophenyl phenyl ether	767.0	1800.0	2400.0	1021.5
34323	Chrysene	776.5	1920.0	2400.0	1100.0
34559	Dibenz(a,h)anthracene	767.0	1800.0	2400.0	1021.5
34295	n-Butyl benzyl phthalate	792.0	1800.0	2400.0	1021.5
39112	Di-n-butyl phthalate	936.5	2580.0	2400.0	1050.0
34599	Di-n-octyl phthalate	850.0	1800.0	2400.0	1050.0
34539	1,2-Dichlorobenzene	683.0	1399.5	2400.0	1021.5
34569	1,3-Dichlorobenzene	670.0	1399.5	2400.0	1021.5
34574	1,4-Dichlorobenzene	730.0	1399.5	2400.0	950.0
34634	3,3'-Dichlorobenzidine	1150.0	2750.0	4782.5	1423.5
34604	2,4-Dichlorophenol	1250.0	1950.0	3850.0	1750.0
34339	Diethyl phthalate	761.0	1800.0	2400.0	1050.0
34609	2,4-Dimethylphenol	1150.0	2050.0	3850.0	1563.0
34344	Dimethyl phthalate	800.0	1709.0	3850.0	1021.0
34660	4,6-Dinitro-o-cresol	1960.0	4050.0	3850.0	3000.0
34619	2,4-Dinitrophenol	2250.0	6650.0	6250.0	3000.0
34614	2,4-Dinitrotoluene	800.0	1800.0	3850.0	1021.5
34629	2,6-Dinitrotoluene	776.5	1709.0	2400.0	1021.5
34349	1,2-Diphenylhydrazine	750.0	1300.0	1950.0	950.0

Table 11. Screening Levels for Organic Substances in Sediment (All values in µg/kg dry weight)					
Parameter Code	Parameter	Type of Water Body			
		Freshwater Stream	Tidal Stream	Reservoir	Estuary
39102	Bis(2-Ethylhexyl)phthalate	900.0	2300.0	2400.0	1100.0
34379	Fluoranthene	800.0	2300.0	2400.0	400.0
34384	Fluorene	767.0	1800.0	2400.0	1021.5
39705	Hexachlorobutadiene	800.0	1800.0	3850.0	1100.0
34389	Hexachlorocyclopentadiene	1321.7	2300.0	3900.0	1423.5
34399	Hexachloroethane	800.0	1709.0	2400.0	1050.0
73120	Hexachlorophene	490.0	4055.0	----	885.0
34406	Indeno(1,2,3-cd)pyrene	767.0	1800.0	2400.0	1050.0
34411	Isophorone	776.5	1709.0	2400.0	1021.5
34455	3-Methyl-4-chlorophenol	1450.0	2580.0	----	1750.0
34445	Naphthalene	700.0	1399.5	2400.0	1021.5
34450	Nitrobenzene	776.5	1709.0	2400.0	1021.5
34594	2-Nitrophenol	1169.5	2050.0	3850.0	1563.9
34649	4-Nitrophenol	2250.0	6650.0	4170.0	3000.0
88817	N-Nitrosodiethylamine	600.0	1920.0	----	900.0
34441	N-Nitrosodimethylamine	862.5	1709.0	2400.0	1021.5
73159	N-Nitrosodi-n-butylamine	750.0	1920.0	----	900.0
34431	N-Nitrosodi-n-propylamine	776.5	1709.0	2400.0	1021.5
34436	N-Nitrosodiphenylamine	767.0	1399.5	2400.0	1050.0
39061	Pentachlorophenol	1550.0	2600.0	2000.0	2860.0
34464	Phenanthrene	800.0	1920.0	2400.0	1050.0
34695	Phenol	1050.0	1950.0	2400.0	1500.0
34472	Pyrene	776.5	2300.0	2400.0	1200.0
88823	Pyridine	750.0	1920.0	4450.0	1100.0
88826	1,2,4,5-tetrachlorobenzene	670.0	1920.0	----	900.0
34554	1,2,4-trichlorobenzene	625.0	1399.5	2725.7	1050.0
78401	2,4,5-trichlorophenol	1200.0	2050.0	2725.7	1563.9

Table 11. Screening Levels for Organic Substances in Sediment (All values in µg/kg dry weight)					
		Type of Water Body			
Parameter Code	Parameter	Freshwater Stream	Tidal Stream	Reservoir	Estuary
34624	2,4,6-trichlorophenol	1150.0	2050.0	2400.0	1500.0

Table 12. 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

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 9). 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 9).

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 9).

Table 13. 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
Semivolatile Organic Substances			
34241	Benzidine	0.0003	0.0002
34530	Benzo(a)anthracene	0.3150	----
34251	Benzo(a)pyrene	0.3150	----
Parameter Code	**Parameter**	**Freshwater**	**Saltwater**
88812	Cresols, total	886.667	591.111

Table 13. Screening Levels for Organic Substances in Tissue (All Values in mg/kg Wet Weight)			
Parameter Code	**Parameter**	**Freshwater**	**Saltwater**
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

Methodology for Screening and Assessing Water Temperature, pH, Chloride, Sulfate, Total Dissolved Solids, and Enterococci Criteria

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, total dissolved solids, 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. Water temperature and pH are field measurements that are made at each site. 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 14).

Chloride, sulfate, and total dissolved solids criteria in the TSWQS represent annual averages of all values that were collected when streamflow 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 14).

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 14).

Table 14. Framework for Evaluating Water Temperature, pH, Chloride, Sulfate, Total Dissolved Solids and Enteroccoci Criteria					
Parameter	**Units/Criteria**	**Minimum Number of Samples**	**Fully Supporting**	**Partially Supporting**	**Not Supporting**
Water temperature	°C, segment-specific	9	0-10% exceed criterion	11-25% exceed criterion	Greater than 25% exceed criterion
pH	Standard units, segment-specific	9	0-10% do not meet criteria	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
Enteroccoci bacteria	500 colonies/100 mL	9	0-10% exceed criterion	11-25% exceed criterion	Greater than 25% exceed criterion

Methodology for Screening and Assessing Narrative Criteria

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;

(7) Oil, grease, or related residue that produce a visible film of oil or globules of grease on the water surface;

(8) 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

(9) 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 determination of narrative criteria support is inherently less objective and consistent than that for numeric criteria. Therefore, narrative standards are assessed using narrative criteria for which associated numeric data exist (for example, excessive aquatic plant growths associated with instream nutrient concentrations). All water bodies with nutrient, contaminated sediment, contaminated fish tissue, and public water supply concerns identified by screening numeric criteria are automatically 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 nonsupport of narrative criteria. The information about nonsupport of narrative criteria is used to strengthen or validate water quality concerns identified using numeric screening techniques. Such information may consist of water quality studies, existence of fish kills or contaminant spills, photographic evidence, local knowledge, and best professional judgment. Ambient water and sediment toxicity tests are used to determine support of the narrative criterion that surface waters shall not be toxic to aquatic life (see also aquatic life use in Table 3). These tests are also used in determining support of designated aquatic life uses.