Texas Commission on Environmental Quality

Nutrient Criteria Development Plan

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Executive Summary

The Environmental Protection Agency (EPA) has mandated that states develop nutrient criteria. The State of Texas has narrative nutrient criteria but no numerical criteria to address nutrients and eutrophication.

The TCEQ staff will develop and evaluate criteria 1) to maintain water quality in water bodies that are relatively unimpacted and 2) to address excessive nutrients and eutrophication where indicated. The TCEQ staff will also develop procedures to assess compliance with criteria and to apply criteria to wastewater permits and other regulatory actions. Preliminary criteria development will focus on major reservoirs; criteria for streams and rivers, estuaries, and wetlands will subsequently be evaluated in that order. This effort will be staged over several years, and the TCEQ staff will provide drafts of criteria and implementation procedures for EPA review throughout the process. As criteria are developed for each water body type, they will be included in subsequent surface water quality standards triennial revisions.

Purpose

This plan is intended to provide a framework for developing nutrient water quality standards for the state of Texas. The staff of the Texas Commission on Environmental Quality (TCEQ) in conjunction with the U.S. Geological Service (USGS) is evaluating options for nutrient criteria for consideration by the United States Environmental Protection Agency (EPA) and the public during the next triennial revision of the Texas Surface Water Quality Standards (Chapter 307 in Title 30 of the Texas Administrative Code). The plan outlines the work to be performed, status of data analyses, options for criteria development, and time frames for developing and considering nutrient criteria. The information in this plan is subject to change as more information is collected and evaluated and as the information is reviewed by the TCEQ, stakeholders, and the EPA.

Current Status of Nutrient Regulation in Texas

The State of Texas has no numerical criteria for nutrients but does currently consider nutrient controls by 1) applying narrative criteria to address permitted nutrient loadings at sites of concern, 2) developing watershed rules which require nutrient reductions in wastewater discharges in or near specified water bodies, and 3) employing the TCEQ's antidegradation policy to increases in discharge loads of nutrients. The TCEQ also screens phosphorus and nitrate nitrogen and chlorophyll *a* monitoring data as a preliminary indication of areas of possible concern in the Texas Water Quality Inventory under Section 305(b) of the federal Clean Water Act (CWA).

Scope of Criteria Development

TheTCEQ is exploring several complementary strategies to develop nutrient criteria. Strategies now being investigated include the following: 1) basing criteria on concentrations of nutrients; 2) basing criteria on direct indicators of eutrophication, such as chlorophyll *a*; 3) developing "translator" procedures that relate concentrations of nitrogen and phosphorus to direct indicators of eutrophication; 4) basing criteria on historical "ambient" averages with a statistical allowance for variability; and 5) developing criteria based on the effect of nutrients or indicators of eutrophication on uses. Work on use-based criteria for reservoirs is being conducted by the Texas Water Conservation Association and other members of the TCEQ nutrient criteria workgroup.

With respect to spatial scales for nutrient criteria, the TCEQ has evaluated the procedures for developing criteria as defined in EPA guidance using 1) EPA''s aggregate ecoregions and 2) smaller Level III ecoregions within Texas. The TCEQ has found that smaller scales and other ways to group reservoirs are needed to address spatial variability in nutrient concentrations and impacts. The TCEQ has evaluated criteria based on 1) data from individual water bodies; 2) grouping water bodies according to geological, chemical, physical, or hydrologic characteristics; and 3) grouping water bodies in smaller geographic regions or watersheds. The USGS performed this work on selected reservoirs with sufficient data for the analysis and found that the largest percentage of

variability between reservoirs was explained by reservoir size, watershed size, and ecoregion. This and related information will be used to group reservoirs for additional nutrient evaluations and criteria development.

For assessing water bodies and regulatory actions such as wastewater discharge permits, the TCEQ is also evaluating a "weight of evidence" approach to incorporate historical monitoring data for chlorophyll *a*, total phosphorus, and total nitrogen for individual water bodies. The evaluation of permitted discharges, for example, could be based on screening criteria developed from historical data for all of these variables, in addition to the criteria that might be explicitly listed in the water quality standards (e.g., for chlorophyll *a*). The use of additional screening criteria will be evaluated as options and included in the Procedures to Implement the Texas Surface Water Quality Standards.

Studies

Much of the development of nutrient criteria is based on evaluation of existing long-term data. In addition, the TCEQ is coordinating several studies that will provide new data where information is lacking. These studies include (1) an assessment of nutrients, dissolved oxygen, and attached vegetation in selected streams in East Texas, (2) a follow-up study to assess nutrients, dissolved oxygen, and attached vegetation in selected streams in Central Texas, and (3) an assessment of dissolved oxygen, nutrients, and chlorophyll *a* in the "transition zone" where streams and rivers enter shallow, backwater areas of reservoirs. Other nutrient-related studies are also being conducted by the Texas Parks and Wildlife Department, universities, regional river authorities, and water districts in Texas.

Workgroup

The TCEQ has formed a diverse Nutrient Criteria Development Workgroup in order to obtain ongoing stakeholder input from state and federal agencies, Texas river authorities, cities, industry, environmental groups, agriculture representatives, and other interested parties. Six work sessions have been conducted.

Schedule/History

This revised plan is provided to the EPA as a preliminary indication of the TCEQ staff's efforts in accordance with the EPA's notice in the Federal Register dated January 9, 2001: "Nutrient Criteria Development; Notice of Ecoregional Nutrient Criteria." The EPA stated that 1) "by the end of 2001, each State and authorized Tribe should complete a plan for developing and adopting nutrient criteria into State or Tribal water quality standards", and 2) "by the end of 2004, States and authorized Tribes should adopt nutrient criteria (either numeric criteria or as procedures to translate a narrative nutrient criteria into a quantified endpoint) for the water body type and ecoregions associated with the section 304(a) water quality criteria that EPA publishes by the end of 2001."

The TCEQ staff previously drafted a preliminary general work plan to further evaluate the EPA's nutrient criteria and investigate additional options which would lead to criteria development. The

initial draft work plan was sent to the EPA Region 6 on November 30, 2001, and a letter providing updated information to the work plan was submitted on December 21, 2002. In December 2004, the TCEQ sent the EPA a more detailed plan including information on the TCEQ scope of work for developing nutrients for reservoirs, rivers and streams, and estuaries; schedules; and descriptions of how proposed criteria were calculated. The current plan is an update of the December 2004 plan.

In fiscal year 2005, the TCEQ staff produced draft proposals for nutrient criteria for selected major reservoirs in the state for review by the TCEQ management, stakeholders, and the EPA. Draft proposed criteria are intended to be available for consideration in the next surface water quality standards revisions for Texas. The next major standards revision is scheduled to be in progress through 2006 and 2007 and into 2008. The TCEQ has begun the next water quality standards revision even though major provisions of the previous triennial revision are still being reviewed by the EPA..

Reservoirs have been the TCEQ staff's initial priority, but efforts to develop nutrient criteria for streams and rivers are occurring simultaneously. In the near future, the TCEQ will be consolidating available data for estuaries and adding them to the data base of nutrient information. Investigations into what types of data are available for wetlands will follow.

A preliminary schedule of tentative target dates is presented in Appendix D. Major steps and time frames for revisions of the TCEQ's water quality standards are noted in Appendix E.

Methods to Develop Nutrient Criteria

Nutrient Data Base Development

There is substantial monitoring data available from the last 30 years for major water bodies in Texas. Historical monitoring data will be used to 1) develop criteria, 2) assess feasibility and effectiveness of the criteria, 3) evaluate impacts of wastewater discharges and other regulatory actions, and 4) determine if relationships between nutrients and response variables, such as chlorophyll *a*, exist. The USGS, through funding from the EPA, has supported the development of nutrient criteria in Texas. One of the USGS tasks was to create a nutrient data base from data downloaded from the TCEQ Texas Regulatory and Compliance System (TRACS) and from the USGS National Water Information System (NWIS). Data available extends back to the 1970's, and the available parameters include those listed in Appendix A. The baseline data base for reservoirs was created from these sources. The USGS data base contained final data sets for chlorophyll a, total phosphorus, and total nitrogen for least impacted reservoirs and those with land use in their water sheds that were less than 20% agriculture and urban. The USGS used this data as well as additional raw TRACS data for other constituents for statistical evaluations.

The USGS completed development of nutrient data bases for 1) reservoirs and 2) streams and rivers in October 2001. The TCEQ and the USGS periodically updated the data bases with newer data as it became available. Data used for developing criteria for reservoirs and for streams and rivers extends from January 1, 1970 to April 30, 2003. An end date was needed to allow for time for data analysis

instead of continuous data base updates. Thirty plus years of data was enough to determine if historical trends or patterns existed and was a large enough data set for statistical analysis for many reservoirs. Additional river and stream data may be retrieved from TRACS or replacement data base such as SWQMIS in the future to increase the size of the data set.

The TCEQ took the original data set and restructured it into an ACCESS relational data base format. The TCEQ combined all reservoir and river and stream data into this new relational data base format. As more information is collected on estuaries and wetlands, they can now be added into this single data base.

Additional parameters or data from other sources can also be added as needed. Data collected on individual water bodies not contained in the TRACS or NWIS data bases may also be considered in developing site-specific nutrient criteria.

Reservoirs

The TCEQ selected reservoirs as the first water body type to develop nutrient criteria because of their importance in sustaining cities, farms, ranches, and industry during times of drought and extreme flows; and because Texas has extensive long-term data on nutrients, water-column chlorophyll *a*, and other relevant parameters in the main pools of large reservoirs.

Phytoplankton are generally a key component of eutrophication in reservoirs, and the long-term availability of chlorophyll *a* data provides a relatively direct measure of phytoplankton abundance. If a reservoir is not aesthetically pleasing for recreation, it often times is a result of large populations of phytoplankton. The initial assumption was that chlorophyll *a* would be a good indicator of the amount of phytoplankton in the water column and therefore eutrophication or impairment.

The TCEQ collects data as do other state and federal agencies, river authorities, water districts, and academia. The body of literature on lakes, which are similar to reservoirs, is also extensive.

I. Applying EPA's Methodology to Texas Reservoirs

The USGS initially evaluated the potential for using EPA's methodology to develop nutrient criteria. Level III ecoregions in Texas were used as the basis for spatial aggregation rather than EPA's aggregate national ecoregions.

Historical data from the main pools of reservoirs in each Level III ecoregion were pooled, and criteria for total phosphorus, total nitrogen, and chlorophyll *a* were calculated as the 25th percentiles for each ecoregion in accordance with EPA guidance. The resulting criteria are listed in Appendix A. The resulting criteria for total phosphorus were lower than EPA's national criteria for large aggregate ecoregions in Level III ecoregions 25, 26, 27, and 32; and higher than EPA's criteria in Level III ecoregions 24, 31, 29, 30, 33, and 35.

Preliminary analyses indicate that criteria calculated by this method are frequently less than the average ambient concentrations of phosphorus, nitrogen, and chlorophyll *a*; even in relatively unimpacted reservoirs. Setting criteria at these levels would result in up to about 50 percent of relatively unimpacted reservoirs not meeting criteria.

II. Criteria Based on Historical Conditions in Individual Reservoirs

Criteria based on historical ambient data on individual reservoirs can be appropriate for those reservoirs that are in good trophic condition. The purpose for nutrient criteria for such reservoirs (termed "least impacted") is to maintain and protect existing conditions. This approach reduces some of the high variability that is inherent in calculations based on aggregated reservoirs. Initial factors used to select "least impacted" reservoirs include the following: 1) availability of historical data, 2) limited urban and agricultural land use in the watershed, 3) absence of major discharges in the nearby watershed, 4) no trend of increasing eutrophication, and 5) judgment of experts with firsthand knowledge of a reservoir's watershed and water quality characteristics.

A. Data selection

For continued analysis and investigations, the TCEQ/USGS selected 110 reservoirs that had sufficient data to support criteria calculations. These reservoirs were the same as those listed and assessed for trophic state in the 2002 TCEQ Texas Water Quality Inventory [305(b) report]. The main pool stations for each reservoir were selected to perform the calculations and only surface values of a constituent were used. Data from main pool areas was selected because it is readily available. Data from coves, small arms, and transition zones is sparse for many reservoirs, highly variable, and are often representative of relatively small areas of a reservoir. Data was restricted to surface samples because of a lack of uniformly available data from deeper samples. Criteria for total phosphorus, total nitrogen, and chlorophyll *a* were included in this evaluation.

B. Identifying least impacted reservoirs

For preliminary analyses, reservoirs are considered to be least impacted if they have the following characteristics:

1. A total of less than 10% of the land use in the surrounding watershed is a combination of urban land use (such as, high intensity residential, low intensity residential, urban / recreational grasses, and commercial, industrial, transportation land uses) or agricultural land use (such as orchards / vineyards, row crops, small grains, and fallow land). The applicable watershed is truncated to exclude the watershed of upstream reservoirs. The TCEQ Source Water Assessment and Protection (SWAP) data base was used to determine land use for approximately 3/4 of the 110 reservoirs. For reservoirs not included in the SWAP data base, the USGS acquired land use

data from the Nation Land Cover Data set in order to further categorize the remaining reservoirs.

2. There are no major domestic point source discharges directly into the reservoir or within a two-hour water travel time of the reservoir. A major discharge is defined as one which is permitted to discharge more than 1 million gallons per day.

3. There is no apparent historic increase in the trophic condition of the reservoir. The USGS has reviewed the historical data to determine if any trends are apparent over time in the 110 candidate reservoirs. They have reviewed the data looking for trends in time using data collected 1) during all times of the year and 2) during warm months from May 1st thru September 30th.

The preliminary list of least impacted reservoirs was presented to the nutrient criteria advisory group, and their firsthand knowledge of these reservoirs was used to adjust the evolving list (Table 1 of Appendix C). The TCEQ's initial efforts to develop site-specific nutrient criteria have focused on the reservoirs in this list. Additional screening has been conducted to develop draft criteria for all 110 reservoirs, divided into groups with combined urban and agricultural land uses of 10-15%, 15-20%, and > 20%. (Tables 2, 3, and 4 of Appendix C). Criteria for these additional groups can be evaluated as options for the upcoming triennial standards revisions.

C. Calculation of Criteria

Preliminary criteria were calculated as the upper confidence interval of the mean, with the assumption that a sample size of 10 is used to assess a statistically significant departure from the mean. Confidence levels evaluated included 80th, 90th, 95th, and 99th percent (one-tailed). The calculation was done for chlorophyll *a*, with supplemental criteria calculated for total phosphorus and total nitrogen where sufficient data was available for the least impacted reservoirs.

III. Criteria Based on Reservoir Groupings

Criteria based on ambient conditions may not be appropriate for all reservoirs – such as reservoirs that have potentially elevated anthropogenic nutrient loadings in comparison to least impacted reservoirs. Other approaches are needed to develop criteria for these reservoirs. The TCEQ/USGS are reviewing historical ambient data to determine how reservoirs may be grouped so that reservoirs with sufficient data can be used as references for similar reservoirs that are 1) potentially impacted, or 2) have insufficient data to calculate nutrient criteria based on historical ambient data.

Reference criteria for each group of similar reservoirs would be calculated on pooled data for the least impacted reservoirs in the group. Calculation procedures would be similar to those described above for individual least impacted reservoirs.

The USGS is using multivariate analyses to assess similarities among reservoirs based on chemical, physical, and biological characteristics of the reservoirs. Previous and ongoing work on the classification of Texas reservoirs by other researchers (e.g., Dr. Al Groeger at Texas State University) will also be considered. Options being investigated for grouping reservoirs include the following:

1. Physical/hydrologic characteristics such as reservoir surface area, volume, shoreline complexity, mean depth, and detention time.

2. Chemical characteristics such as total dissolved solids, pH, alkalinity, inorganic turbidity.

3. Land use and vegetative characteristics of the surrounding watersheds.

4. Geographic proximity and connectivity - such as ecoregions and major watersheds.

IV. Criteria Based on Protecting Reservoir Uses

Additional ongoing development of reservoir nutrient criteria are based on protecting water quality related uses. Some Texas river authorities and other members of the Texas Water Conservation Association (TWCA) have formed a nutrient criteria committee to conduct use-based evaluations and to coordinate with the TCEQ on results and recommendations.

As part of their evaluations, TWCA has collected data to determine if there is a relationship between nutrients and uses; and to develop recommendations for establishing nutrient criteria to protect recreational uses. Water quality sampling and simultaneous user surveys were collected on nine Texas reservoirs during the warm months of 2003 and 2004. The goal of the study was to observe if chlorophyll *a* affected recreational use according to users' perceptions. The study also evaluated the extent to which the results can be applied to groups of reservoirs beyond the nine reservoirs sampled.

This study was similar to a variety of studies conducted elsewhere in the United States. These earlier studies provide supporting information, but the additional data collection effort was needed to better address reservoir conditions in Texas - particularly the relatively high levels of inorganic turbidity that occur in some Texas reservoirs. The results of this study and similar studies in other states can provide an additional option for approaches to establish nutrient criteria in Texas reservoirs.

Adverse eutrophic impacts on recreational uses, and in some cases on water supply uses, can depend in part on the magnitude and frequency of phytoplankton blooms in addition to

average conditions. The TCEQ will be investigating the historical ambient database to 1) determine if algal blooms can be detected, 2) note the frequency of algal "blooms" (if detected) above various target concentrations of chlorophyll *a*, and 3) characterize the relationship between measured "bloom" concentrations and long-term average concentrations of chlorophyll *a* during warm months

V. Setting Criteria

Based on historical data calculations, the TCEQ is preliminarily setting reservoir criteria based on historical "ambient" medians with a statistical allowance for variability for chlorophyll *a* for individual reservoirs. More chlorophyll *a* data exists for the selected 110 reservoirs than for total phosphorus and total nitrogen. A preliminary list of all 110 reservoirs will be reviewed for appropriateness. Some reservoirs will be removed from the list and other methods investigated for setting criteria. This is particularly relevant for reservoirs with high values of chlorophyll *a*. This list will be presented to the nutrient criteria workgroup, management, and the EPA. Subsequent modifications may occur.

The TCEQ is contemplating using the 99th confidence interval to set criteria. The statistical test assumes that the values fluctuate through time around the mean. The calculation does not take into account the probability of high chlorophyll *a* values as a result of reduced water volumes and drought or higher than normal temperatures that can increase algal growth. The 99th was selected to reduce the likelihood of listing a water body for nutrients or chlorophyll *a* under conditions that were considered an outlier in the development of the criteria. There are also concerns that chlorophyll *a* values from the fluorometric method, which the TCEQ changed to, will be higher than the spectrophotometric method values, on which the criteria was calculated.

The TCEQ will propose reservoir specific criteria or screening for individual reservoirs in the next triennial revision of the surface water quality standards. Screening and assessment will include the criteria for chlorophyll *a*, but may also include screening for total phosphorus and total nitrogen or a combination of the three.

Currently the TCEQ is only setting criteria for the main pool of reservoirs. Coves, the transition zone, and near shore portions of lakes will be investigated later. The lack of available data in these areas in all but a few reservoirs makes this a good topic for additional study.

VI. Relating Phosphorus and Nitrogen to Chlorophyll *a* Criteria ("Translators")

Criteria based on "response" variables such as chlorophyll *a* are a more direct measure of problem levels of aquatic vegetation. Response variables are directly applicable to monitoring data for the purpose of assessing compliance with criteria. Criteria for response measures need to be related to nutrient concentrations and loads in order to provide screening targets for wastewater permits and TMDLs.

The TCEQ is developing several options to address total nitrogen and total phosphorus. Option one is to develop empirical relationships in the form of regression equations that relate nutrients to chlorophyll *a* using long term monitoring data. The TCEQ, in coordination with the USGS, investigated the correlation between nutrient concentrations and response variables such as chlorophyll *a* and secchi disc depth in Texas. Data for these evaluations is taken from the historical monitoring data for 110 Texas reservoirs. Correlations are poor when data from single reservoirs is independently evaluated. However, preliminary analysis indicates that the statistical relationship of nutrients to chlorophyll *a* improves when 1) the median concentrations of reservoirs are compared rather than individual sampling dates, 2) annual medians of reservoirs are grouped by ecoregions, and 3) a measure of inorganic turbidity (such as total suspended solids minus volatile suspended solids) is included as a variable in regression equations.

Option two is to develop screening criteria for total nitrogen and total phosphorus that are calculated from ambient historical data for individual reservoirs, using the same calculation procedures and statistical assumptions that have been previously described for chlorophyll *a* criteria. These screening criteria would constitute preliminary default targets that could be adjusted where additional information and studies are available.

Option three is to apply a more comprehensive site-specific evaluation of the nutrient - chlorophyll *a* relationship, using a combination of historical data, predictive water quality models, and additional site-specific information such as nutrient enrichment tests. These evaluations would be appropriate for TMDL studies or comparable watershed wasteload evaluations that address nutrient loadings from a variety of point and nonpoint sources.

VII. Implementing Criteria and Controlling Nutrient Impacts for Reservoirs

Procedures to assess standards compliance with monitoring data will be established in 1) Section 307.9 of the *Texas Surface Water Quality Standards*, and 2) *TCEQ Guidance for Screening and Assessing Texas Surface and Finished Drinking Water Quality Data*. Draft options to consider include 1) basing assessments on a mean or median concentration of chlorophyll *a* for at least one year, 2) using near-surface samples as a measure of chlorophyll *a* or nutrients, 3) averaging measurements of chlorophyll *a* taken at stations in the main pool of a reservoir, and 4) addressing total phosphorus and total nitrogen by comparing measured concentrations with secondary screening criteria developed from historical data, as described for chlorophyll *a.*

Procedures to assess and set loading limits on nitrogen and phosphorus from regulated sources, such as permitted wastewater discharges, will be established in the *TCEQ Procedures to Implement the Texas Surface Water Quality Standards*. Draft options to consider include 1) establishing screening concentrations for total nitrogen and total phosphorus that will attain chlorophyll *a* criteria, as described in VI above; 2) using steady-state, completely mixed nutrient models of the entire reservoir to compare loading impacts with screening concentrations for the main pool; 3) evaluating more localized effects with steady-state, completely mixed nutrient models or advective steady-state models, in order to

estimate the relative increase in nutrients; 4) establishing allowable localized increases in nutrients based on magnitude and geographic extent, size of wastewater discharge, sensitivity of receiving waters, trophic status and trends of receiving waters, localized impacts of existing discharges into the water body, and approximate extent of dispersion and circulation; 5) defining several levels of technology-based effluent limits for total phosphorus to address projected increases of nutrients that are above acceptable target levels; and 6) evaluating the TCEQ's watershed rule for wastewater discharges to selected reservoirs (Chapter 311 of Title 30 of the Texas Administrative Code) to see if additional reservoirs and wastewater permit conditions should be added.

VIII. Data Needs

Data for river/reservoir transition zones, small coves, and near shore concentrations of nutrients and chlorophyll *a* in reservoirs is limited. Texas reservoirs do have long term historical data for chlorophyll *a*, total phosphorus, and nitrate nitrogen in main pools. Total nitrogen data is available for many reservoirs but is more limited. TWCA's study on levels of chlorophyll *a* that constitute an aesthetic impairment has provided a starting point for evaluating use-based approaches, but additional use-based information is needed to assess fishing, recreation, and drinking water uses. There are a few special studies that have estimated the abundance of rooted macrophytes, and the Texas Parks and Wildlife Department estimates percent coverage of aquatic vegetation during reservoir fisheries surveys. In general, however, there is little data on the extent of attached vegetation in Texas reservoirs. Estimates of background loadings of nutrients are not available for most reservoirs, and experimental data is generally lacking to assess limiting nutrients.

IX. Additional Reservoir Studies

Substantial historical data from fixed station periodic monitoring exists for most Texas reservoirs. Selected studies of dissolved oxygen and nutrient dynamics in the river/reservoir transitional zones are ongoing. Preliminary studies by TWCA and others on use-based criteria have been completed. Special studies of water quality and nutrient conditions have been completed in the past for a variety of reservoirs; such as Lake Arlington, Lake Lavon, Lake Ray Hubbard, Lake Travis, Lake LBJ, Lake Dunlap, Canyon Lake, Lake Livingston, Lake Houston, Lake Bridgeport, Eagle Mountain Lake, Cedar Creek Reservoir, and Richland Chambers Reservoir.

X. Incorporating phosphorus and nitrogen into standards

The TCEQ is evaluating how total phosphorus and total nitrogen can be used in conjunction with chlorophyll *a* criteria. Several options are being considered. One option would be to set screening numbers for phosphorus and nitrogen to be used in standards assessment based on the historical data and variability calculations. Other options will be evaluated after final deliverables for statistical analyses on reservoirs is received from the USGS who is doing the analyses under contract.

XI. Implementing criteria

How a water body will be assessed to meet the nutrient criteria has not been determined. Options available include 1) limiting assessment to the main pool stations used to set the criteria, 2) setting screening levels for chlorophyll *a*, total phosphorus, and total nitrogen, 3) using set screening levels singly or in combination to determine an impairment.

XII. Data Gaps

Data for transition zones, small coves, and near shore concentrations of nutrients and chlorophyll *a* in reservoirs is limited or nonexistent. A study is underway on the transition zone in Texas reservoirs, but that information will not be available for some time.

Streams and Rivers

After initiating nutrient criteria development on reservoirs, the TCEQ and the USGS began working on developing criteria for rivers and streams. After reservoirs, rivers and streams are the largest data set available on TRACS. Rivers and streams impact downstream reservoirs, receive most of the nutrient load directly from wastewater discharges, and can be locally impacted by nutrients.

I. Applying EPA's Methodology to Texas Streams and Rivers

In a similar analysis as described above for reservoirs, the USGS evaluated the potential for using EPA's methodology to develop nutrient criteria. Level III ecoregions in Texas were used as the basis for spatial aggregation rather than EPA's aggregate national ecoregions.

Historical data from rivers in each Level III ecoregions were pooled, and criteria for total phosphorus, total nitrogen, and chlorophyll *a* were calculated as the 25th percentiles for each ecoregion in accordance with EPA guidance.

II. Criteria Based on Historical Conditions in Individual Streams and Rivers

As with reservoirs, criteria based on historical ambient data on individual rivers might be appropriate for those rivers that have relatively small potential for anthropogenic nutrient loadings. The purpose of nutrient criteria for least-impacted rivers would be to maintain and protect existing conditions. Potential factors to select least-impacted rivers include the following: 1) availability of historical data, 2) limited urban and agricultural land use in the watershed, 3) absence of major discharges in the watershed, 4) no trend of increasing eutrophication, and 5) judgment of experts with firsthand knowledge of a water body's watershed and water quality characteristics.

Under this approach, preliminary criteria would be calculated as the upper confidence interval of the mean taking variability into account. Confidence levels to be considered

include 80th, 90th, 95th, and 99th percent (one-tailed). Other methods to establish criteria based on historical data can also be considered, as well as other states' approaches.

Criteria can be evaluated for chlorophyll *a*, total phosphorus, and total nitrogen. Preliminary analyses suggest that chlorophyll *a* in water is a useful indicator of eutrophication response in many larger, slower moving Texas rivers. Whether this response is similar in smaller wadeable streams in Texas is under investigation (see study described in VI below). Insufficient data currently exists to define the correlation between nutrients, aquatic vegetation, and use support.

Whether criteria will be set using chlorophyll *a*, nitrogen, or phosphorus is yet to be determined. The USGS is conducting statistical analyses to develop ambient-based criteria with preliminary data, with a target date of September 2007.

III. Criteria Based on Grouping Streams and Rivers

As with reservoirs, the use of reference groupings for establishing criteria might be useful where ambient conditions in a stream or river are inappropriate to use as baseline criteria. The TCEQ will review historical ambient data to determine how rivers and streams may be grouped so that those with sufficient data can be used as references for similar rivers and streams that are 1) potentially impacted, or 2) have insufficient data to calculate nutrient criteria based on historical ambient data. Calculation procedures would be similar to those described above for individual least impacted reservoirs.

Examples of characteristics to consider for grouping rivers and streams include river basins, ecoregions, average depth, wadeable versus nonwadeable, average and dry-weather flows, flow regime, extent of spring-fed flow, occurrence of tidal influence, water chemistry, land use, substrate type (e.g., gravel, incised sand/clay bottom, sand, bedrock), extent of tree canopy, and percent of flow from wastewater discharges.

IV. Relating Growth of Aquatic Plants in Rivers to Phosphorus and Nitrogen

For larger rivers, where phytoplankton are an important component of eutrophication, the statistical relationship between nutrient concentrations and water-column chlorophyll *a* will be evaluated. The evaluation will begin with the historical data that exists on phosphorus, nitrogen, and chlorophyll *a*. Measures of inorganic turbidity (such as total suspended solids minus volatile suspended solids) will also be included and are expected to be an important variable in regression equations.

In small streams, and in rivers where rooted macrophytes are the primary form of eutrophication, data on vegetation density that could help define the nutrient/vegetation relationship are available only from limited special-purpose studies. Available studies, such as an extensive survey of nutrient impacts and macrophytes on the Colorado River downstream of Austin, indicate that the relationship of vegetation and nutrients can be difficult to quantify.

A recent study in East Texas on 10 small streams, and a similar study underway on Central Texas streams (described below), will provide the starting point to evaluate relationships between nutrients and attached vegetation in small streams.

V. Data Needs for Rivers and Streams

Data showing the effect of nutrients on attached algae or rooted macrophytes in streams in Texas is limited. Not only is there limited data on concentrations of chlorophyll *a* and nutrients in attached vegetation, there is also sparse data on the extent of the attached vegetation, either algae or rooted macrophytes.

Additional information on attached vegetation, chlorophyll *a*, and nutrients will allow the TCEQ to use the substantial data available on chlorophyll *a* and nutrients in the water column for comparisons.

In smaller streams and rivers, (and in some shallow, larger rivers dominated by macrophytes), chlorophyll *a* in water does not appear to be as useful an indicator of nutrient enrichment as chlorophyll *a* in attached algae. More study is needed to determine if chlorophyll *a* in attached algae is more important than water column chlorophyll *a* in Texas streams.

Because of the lack of data, the TCEQ and other entities are planning projects to collect nutrient, attached vegetation, and chlorophyll *a* data. Some of these projects will span two or three years with the results not due for delivery until 2008.

VI. Ongoing Studies

Preliminary sampling for nutrients, water column chlorophyll *a*, and attached vegetation was conducted on small east Texas streams in coordination with the USGS, and results are under evaluation. Current sampling is underway in additional streams in central Texas, and the target date for completing this second study is June 2007. Other state and regional agencies are initiating similar work on Texas streams in other parts of the state.

To address this data gap, the USGS, under contract with the TCEQ/EPA, collected data on nutrient concentrations and the extent of attached vegetation in 10 wadeable streams in East Texas. Sampling included dissolved oxygen measurements over 24 hours, habitat surveys, collection of fish and benthic organisms, biomass estimates of attached algae, and nutrients and conventional parameters in water. Similar sampling occurred in 2005 and 2006 in central Texas streams. The additional stream data will be incorporated into the nutrient data base for evaluation of nutrient criteria.

The goal of the study is to provide data that can be used to develop preliminary options for nutrient criteria that are analogous to those options under consideration for reservoirs. In addition, the effectiveness of sampling procedures will be evaluated to determine if estimates

of the extent of attached vegetation can be incorporated in routine, periodic statewide monitoring efforts.

VII. Controlling Nutrient Impacts for Streams and Rivers

Data showing the effect of nutrients on streams in Texas is limited. Though some chlorophyll *a* water column data exists, little or no data exists for attached algae. In Texas, attached algae in small streams can be a large sink or source of nutrients.

The TCEQ currently evaluates nutrient additions to streams from wastewater discharges on a case-by-case basis under the narrative criterion. Effluent limits for phosphorus have been required for a variety of discharges to streams and rivers that are considered sensitive to nutrient enrichment. Procedures to indicate nutrient concerns based on monitoring data are established in the *TCEQ Guidance for Screening and Assessing Texas Surface and Finished Drinking Water Quality Data*.

The TCEQ staff intend to evaluate the narrative criterion for nutrients during the upcoming revisions of the surface water quality standards, in order to ensure that the criterion facilitates implementation of interim control procedures for nutrient loads.

Additional procedures to assess and set loading limits on nitrogen and phosphorus from regulated sources can be considered for streams and rivers during the upcoming revisions of the *TCEQ Procedures to Implement the Texas Surface Water Quality Standards*. Draft options to consider include 1) using steady-state, advective models (such as QUAL-TX) to estimate the relative increase and distance of downstream impacts; 2) establishing allowable localized increases in nutrients based on magnitude and geographic extent, size of wastewater discharge, sensitivity of receiving waters, trophic status and trends of receiving waters, and localized impacts of existing discharges into the water body; and 3) defining several levels of technology-based effluent limits for total phosphorus to address projected increases of nutrients that are above acceptable target levels; and 4) evaluating the TCEQ's rules that establish phosphorus limits for wastewater discharges to selected watersheds (Chapters 311 and 213 of Title 30 of the Texas Administrative Code) to see if additional streams and wastewater permit conditions should be added.

Estuaries

Nutrient criteria development for estuaries follows reservoirs and rivers in sequence, because of 1) the high complexity and variability of the estuarine environment; 2) the historical emphasis on increasing freshwater inflows and nutrients to estuarine systems to boost fishery production; 3) the larger watershed scale and diverse nutrient contributions to tidal rivers and estuaries; and 4) less information and available analyses to relate nutrient concentrations and load to eutrophication conditions in estuaries.

Excessive nutrients are a potential concern in Texas estuaries. Those concerns include 1) localized sources of loading which can cause eutrophication, 2) development of harmful algal blooms along the Texas coast, 3) increased turbidity due to excessive phytoplankton blooms that reduce light penetration and lower the productivity of seagrasses, and 4) zones of hypoxia in the Gulf of Mexico caused by large sources of nutrient loading.

I. Approaches to Investigate Nutrient Criteria for Estuaries

The TCEQ is initiating evaluation of nutrient criteria for estuaries with the same process that has been previously described for reservoirs and rivers. The TCEQ intends to 1) establish a nutrient database of historical ambient data, as has been accomplished for reservoirs and rivers; 2) evaluate EPA's approach and national criteria; 3) consider preliminary criteria based on historical ambient nutrient and chlorophyll *a* concentrations; 4) analyze available data to try to elucidate the relationship between nutrients and phytoplankton occurrence, 5) consider the results of previous and ongoing evaluations of the effects of freshwater inflows and associated nutrients to Texas estuaries; and 6) consider the role of nutrients in excessive blooms of phytoplankton.

As one option, preliminary evaluations of criteria can be considered using ambient historical monitoring data for phosphorus, nitrogen, and chlorophyll *a*, with statistical allowance for variability – as previously described for reservoirs. Historically based criteria for these parameters might be evaluated as multiple screening criteria, as discussed in more detail for reservoirs. Groupings of reference estuaries in Texas can also be evaluated, but the small number of estuary systems will limit this approach. The transition zone between advective rivers and open estuaries will need additional assessment. Some of the approaches that are now under study for the transition zones where streams and rivers enter reservoirs might be applicable. Separate kinds of evaluations and approaches for criteria might be needed for tidal rivers, shallow transitional estuaries, and open bays.

More extensive analyses of individual estuary systems is anticipated to be needed to evaluate a sufficient range of criteria options. Subsequent updates of the nutrient development plan can consider more detailed approaches towards nutrient criteria for estuaries. There have been a variety of studies of Texas estuaries to evaluate the effect of freshwater inflows on estuarine productivity, and these studies will be relevant in considering nutrient criteria.

II. Data and Information Needs for Estuaries

Data needs and questions to address for criteria development include the following: 1) assessing the level of nutrients and phytoplankton productivity in large tidal rivers where they enter Texas estuaries; 2) defining historical ambient conditions and gradients of nutrients and chlorophyll *a* in highly variable estuarine systems; 3) defining appropriate levels of nutrients to maintain desirable estuarine fishery production while precluding excessive eutrophication; 4) assessing the effects of nutrients and phytoplankton on turbidity and seagrass propagation; and 5) assessing the role of nutrients in blooms of harmful algae.

III. Addressing Nutrient Loads to Estuaries

The TCEQ staff intend to evaluate the narrative criterion for nutrients during the upcoming revisions of the surface water quality standards in order to ensure that the criterion facilitates implementation of interim control procedures for nutrient loads.

Procedures to indicate nutrient concerns based on monitoring data are established in the *TCEQ Guidance for Screening and Assessing Texas Surface and Finished Drinking Water Quality Data*.

The TCEQ currently evaluates nutrient additions from wastewater discharges on a case-by-case basis under the narrative criterion, and recently effluent limits for nitrogen have been considered for discharges to locally sensitive estuarine areas

The TCEQ intends to coordinate with the Gulf of Mexico Program and the Gulf of Mexico Alliance projects that address nutrient loadings to the Gulf of Mexico.

The transition of freshwater streams and rivers to tidal characteristics will have to be investigated. The extent that these areas change over time and the impact that they have on nutrients, water chemistry, and biological communities poses problems similar to those in reservoir transition zones. The TCEQ is currently involved in a transition zone study. It is hoped that this study will provide insights into how nutrient criteria may be developed for coastal waters.

Whether criteria will be set using chlorophyll *a*, nitrogen, or phosphorus or other constituent is yet to be determined. No data analysis is currently underway. The TCEQ is committed to reviewing all available data and running statistical analyses to determine the best method to use to protect the state's estuaries from eutrophication.

Before criteria development can commence, additional questions and issues will need to be resolved. The TCEQ will need to define what portion of tidal waters will be considered estuaries, tidal rivers, or bays. The TCEQ will need to define data gaps.

Wetlands

Texas is estimated to have 6,471,000 acres of inland wetlands and 1,648,000 acres of coastal wetlands. Wetlands in Texas can be adversely impacted by excessive nutrient loadings, mainly from nonpoint sources. There are only a few cases where permitted wastewater discharges flow directly into wetlands areas.

I. Approaches to Investigate Nutrient Criteria for Wetlands

The Nutrient Criteria Technical Guidance Manual for Wetlands is one in a series of EPA documents that support the National Nutrient Strategy to develop water body-specific nutrient criteria. Nutrient Criteria Technical Guidance Manuals have been developed for the water bodies discussed above. The wetlands guidance document will provide background information for the development of nutrient criteria for wetlands. Once EPA provides the document, the TCEQ will evaluate the national approach for it's applicability to Texas wetlands. After that review of the national guidance is complete, this nutrient criteria development plan will be updated to reflect Texas' approach for development of wetland nutrient criteria.

II. Data Needs for Wetlands

Available data on wetlands water quality in TCEQ data bases is very limited. Basic sampling for nutrient concentrations, water column chlorophyll *a*, attached vegetation, and 24-hour dissolved oxygen is needed to describe water quality for a variety of wetlands types in Texas. Baseline data would provide a means to 1) assess wetlands nutrient and vegetative characteristics under relatively unimpacted conditions; 2) define problem levels of enrichment and aquatic vegetation; 3) establish the relationship between nutrients and growth of wetlands vegetation; 4) provide appropriate ambient concentrations on which to base criteria where the goal is to preserve existing conditions; and 5) assess the point at which enrichment impairs wetlands functions and values

There have been several recent projects for wetlands construction or wetlands enhancement that have data collection that could be useful for assessing nutrient impacts. One example has been studies funded by the City of Corpus Christi to assess the effects of an experimental wastewater diversion to a coastal wetland. Future investigation will provide more information on the types of data that would be useful in developing nutrient criteria for wetlands since all resources are currently concentrated on reservoirs and streams and rivers.

Using EPA 106 funding, the TCEQ is coordinating with the U.S. Corps of Engineers to develop a hydrogeomorphic (HGM) assessment of wetlands functions that will be consistent with approaches used in other areas of the U.S.

Boundary Waters

Texas shares boundary waters with New Mexico, Oklahoma, Arkansas, Louisiana, and Mexico. The TCEQ recognizes that any eventual criteria for shared boundary waters need to be developed in close coordination with adjacent states, EPA, and the International Boundary and Water Commission (for reaches and reservoirs on the Rio Grande). The Regional Technical and Assistance Group for nutrient development will be utilized as a preliminary point of coordination for any criteria developed for boundary waters. The TCEQ also anticipates that separate interstate workgroups may be needed to establish nutrient criteria for shared waters.

As the TCEQ moves into developing criteria for reservoirs and rivers that border Texas and other states and Mexico, they will be contacting these entities to collaborate on nutrient criteria development. The TCEQ is currently participating in the EPA Region VI effort to consolidate and assess nutrient data on the Red River in order to establish a framework for coordinated development of nutrient criteria for this shared boundary water.

Appendix A: Nutrient Database Constituents

Table 1: Nutrient Data Base Constituents	
Parameter	**Notes**
Nitrogen	ammonia, nitrate, nitrite, total N, total Kjeldahl N, nitrite + nitrate, organic N
Phosphorus	orthophosphorus, total phosphorus
Solids	filterable and nonfilterable total suspended solids, volatile suspended solids, tds
Dissolved oxygen	membrane, daytime grabs plus 24-hour means for last 3 years
Chlorophyll *a*	spectrophotometric
Pheophytin *a*	spectrophotometric
Alkalinity	bicarbonate, total, filtered, carbonate
Hardness	as dissolved CaCO3
Stream flow	instantaneous cubic feet per second
Conductivity	
Turbidity	Hach Turbidimeter, lab ntu's
Temperature	
Secchi depth	

Table 2: Base Line Nutrient Data Base Constituents for Reservoirs	
Parameter	**Notes**
Nitrogen	total nitrogen
Phosphorus	orthophosphorus, total phosphorus
Solids	filterable and nonfilterable total suspended solids, volatile suspended solids
Chlorophyll *a*	spectrophotometric
Turbidity	Hach Turbidimeter, lab ntu's
Secchi depth	

Appendix B: Examples of Reservoir Criteria for Level III Ecoregions Using EPA's Methodology for Reservoirs

Ecoregion Name	Ecoregion No.	TP mg/L	TN mg/L	Chlorophyll *a* µg/L
Chihuahuan Deserts	24	0.021	0.951	1.250
Western High Plains	25	0.020	3.120	2.621
Southwestern Tablelands	26	0.012	0.399	1.256
Central Great Plains	27	0.026	0.456	1.408
Southern Texas Plains	31	0.050	0.054	4.130
Central Oklahoma/Texas Plains	29	0.040	0.430	1.688
Edwards Plateau	30	0.016	0.995	7.515
Texas Blackland Prairies	32	0.034	0.728	3.690
East Central Texas Plains	33	0.060	0.858	9.165
South Central Plains	35	0.040	1.195	4.371
Western Gulf Coastal Plain	34	0.147	0.566	2.646

Appendix C: Least Impacted Reservoirs

Table 1: Reservoirs with 0-10% Urban plus Agriculture Land Use in the Watershed

Reservoir	% Land Use as Urban plus Agriculture
Amistad Reservoir	0.9
B. A. Steinhagen Reservoir	3.6
Caddo Lake	6.1
Canyon Lake	11.1
Choke Canyon Reservoir	10.8
Diversion Lake	3.3
Farmers Creek (Nocona Lake)	8.6
Houston County Lake	4.2
Hubbard Creek Reservoir	6.5
Inks Lake	3.8
Lake Amon G. Carter	5.3
Lake Bob Sandlin	2.8
Lake Bridgeport	4.2
Lake Buchanan	9.2
Lake Cisco	5.8
Lake Corpus Christi	6
Lake Cypress Springs	3.2
Lake Georgetown	3.3
Lake Jacksonville	11
Lake Limestone	5
Lake Marble Falls	6.6

Reservoir	% Land Use as Urban plus Agriculture
Lake Murvaul	1.8
Lake Palo Pinto	3.9
Lake Travis	5.9
Lake Tyler	8.1
Medina Lake	4.9
O.C. Fisher Reservoir	4.8
Red Bluff Reservoir	0.02
Stillhouse Hollow Lake	4.4

Table 2: Reservoirs with 10-15% Urban plus Agriculture Land Use in the Watershed

Reservoir	% Land Use as Urban plus Agriculture
Buffalo Springs Lake	13
Cedar Creek Reservoir	12
Cox Lake	12
Lake Arrowhead	12
Lake Brownwood	11
Lake Crook	14
Lake Kickapoo	13
Lake Lyndon B. Johnson	11
Lake Ray Roberts	13
Lake Sweetwater	14
Lake Texana	15
Lake Theo	14
Lake Weatherford	14
Leon Reservoir	14
Palo Duro Reservoir	10
Pat Cleburne Reservoir	14
Twin Buttes Reservoir	13

Table 3: Reservoirs with 15-20% Urban plus Agriculture Land Use in the Watershed

Reservoir	% Land Use as Urban plus Agriculture
E.V. Spence Reservoir	17
Eagle Mountain Reservoir	18
Lake Austin	16
Lake Coleman	20
Lake Granbury	17
Lake Kemp	19
Lake Livingston	17
Lake Mackenzie	17
Lake Worth	19
Millers Creek Reservoir	17
Oak Creek Reservoir	17
Pat Mayse Reservoir	16

Table 4: Reservoirs with greater than 20% Urban plus Agriculture Land Use

Reservoir	% Land Use as Urban plus Agriculture
Aquilla Reservoir	27
Brady Creek Reservoir	23
Fin Feather Lake	82
Granger Lake	28
Greenbelt Reservoir	36
Joe Pool Lake	25
Lake Arlington	59
Lake Coleman	20
Lake Colorado	29
Lake Fort Phantom Hill	27
Lake Graham	23
Lake J.B. Thomas	42
Lake Nasworthy	31
Lake Ray Hubbard	23
Lake Stamford	27
Lake Tanglewood	64
Lake Texoma	36
Lake Waxahachie	24
Lake Whitney	40
Lake Wichita	23
Lewisville Lake	23
Navarro Mills Reservoir	32
Proctor Lake	21
Town Lake	67
White Rock Lake	73

Appendix D: Draft Schedule for Developing Nutrient Criteria

Nutrient Criteria Development Plan

Task	Date	Done
Send initial nutrient criteria development plan to EPA	11/30/01	✔
Send revised draft Plan to EPA	1/31/05	✔
Send revised draft Plan to EPA	12/1/06	
Draft plan mutually agreed upon by the TCEQ and EPA		
Revise draft plan as needed	Ongoing	

Criteria Development

Reservoirs

Task	Date	Done
Complete initial reservoir data base (USGS)	10/31/01	✔
Advisory workgroup meeting 1	5/08/02	✔
Advisory workgroup meeting 2	2/24/03	✔
Advisory workgroup meeting 3	1/29/04	✔
Advisory workgroup meeting 4	3/15/05	✔
Advisory workgroup meeting 5	7/12/05	✔
Advisory workgroup meeting 6	9/26/05	✔
Establish final nutrient data base: 110 reservoirs; Jan 1970 - Apr 2003	12/19/03	✔
Incorporate additional parameters into data base	Ongoing	
Incorporate additional supporting information on individual reservoirs	Ongoing	
Review scientific literature that links levels of algae and vegetation with impacts on water quality uses	12/31/03	✔
Develop draft list of least-impacted reservoirs	4/1/04	✔
Evaluate trends over time of nutrients and chlorophyll *a*	4/21/04	✔
Calculate preliminary draft criteria for selected least impacted	8/1/04	✔

Task	Date	Done
reservoirs, based on confidence intervals for the means of chl *a*, TN, TP (80, 90, 95, and 99th confidence levels)		
Design and populate ACCESS relational data base with reservoir data.	7/31/06	✔
Conduct analyses to relate levels of nutrients to chlorophyll *a*	Ongoing	
Present current status of draft criteria to workgroup	3/1/2007	
Evaluate results of use-based criteria studies	Ongoing	
Send EPA preliminary staff draft of reservoir criteria	8/31/05	✔
Propose numerical nutrient criteria, implementation procedures to be used in permitting, and updates on assessment procedures during next triennial standards revision	[2008]	

Rivers and Streams

Task	Date	Done
Compile initial nutrient database for rivers and streams	10/31/01	✔
Search peer reviewed literature for articles on nutrients and their impact on rivers and streams.	4/30/06	✔
Stream data added to nutrient data base	7/31/06	✔
Finish data collection on dissolved oxygen, biota, nutrients, and attached algae for 33 East Texas streams	8/31/06	✔
Update workgroup on status of stream studies	3/1/07	
Incorporate additional information on individual streams and rivers	Ongoing	
Conduct preliminary evaluation of criteria for selected rivers based on historical average conditions using EPA methodology	8/31/05	✔
Finish data collection on dissolved oxygen, biota, nutrients, and attached algae for Central Texas streams	7/31/07	
Evaluate stream data on East and Central Texas streams, and apply results to consideration of nutrient criteria for streams. Deliverables from USGS due 7-31-07 for Central Texas streams.	9/30/07	
Expand/revise nutrient development plan and schedule for rivers and		

Task	Date	Done
streams as needed	Ongoing	
During next triennial standards revision, consider expanded narrative criterion and new implementation procedures to address nutrient impacts in rivers and streams	2008	
Propose numerical nutrient criteria, implementation procedures to be used in permitting, and update assessment procedures during triennial standards revisions	2011	

Estuaries

Task	Date	Done
Add TRACS data for estuaries into nutrient database	12/31/06	
Update workgroup on status of estuary database with notice on the web page	3/1/07	
Search peer reviewed literature for articles on nutrients and their impact on estuaries	Ongoing	
Incorporate additional information on individual estuaries	Ongoing	
Conduct preliminary evaluation of criteria for selected estuaries based on historical average conditions	1/31/08	
Expand/revise nutrient development plan and schedule for estuaries as needed	Ongoing	
During next triennial standards revision, consider expanded narrative criterion and new implementation procedures to address nutrient impacts in estuaries	2008	
Consider proposals for numerical nutrient criteria for estuaries during triennial standards revision	[2011]	

Wetlands

Task	Date	Done
Review EPA guidance for wetland nutrient criteria	TBD	
Search for available data on Texas wetlands	Ongoing	
Update workgroup on status of wetlands database	TBD	

Review available data for data gaps	TBD	
Formulate needs and ways to fill data gaps and if necessary contracts	TBD	
Conduct preliminary evaluation of criteria for selected wetlands based on available data	TBD	
Expand/revise nutrient development plan and schedule for wetlands as needed	Ongoing	
During next triennial standards revision, consider expanded narrative criterion and new implementation procedures to address nutrient impacts in wetlands	2008	
Consider proposals for numerical nutrient criteria for wetlands during triennial standards revisions	TBD	

Appendix E: Time line for Revising the Texas Water Quality Standards (Title 30, Chapter 307, Texas Administrative Code)

Days	TASKS
0	TCEQ initiates rulemaking
30	Request for preliminary public comments
100	TCEQ convenes stakeholders workgroup
190	Preliminary draft of revisions for informal review
260	Revised draft revisions, preamble, and fiscal note
290	Draft revisions publicly approved by TCEQ Commissioners
330	Notice of hearing in Texas Register and mailout
380	Public hearing
470	Draft of final revisions and responses to comments
530	Standards revisions adopted as state rule at TCEQ Agenda.
550	Standards revisions effective as state administrative rule
610	Adopted standards published in Texas Register
640	TCEQ sends adopted revisions to EPA for review and approval