STATE OF NEW MEXICO

NUTRIENT CRITERIA DEVELOPMENT PLAN

2007
REVISION 4

Prepared by

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EXECUTIVE SUMMARY

Plant nutrients are essential for proper functioning of ecosystems. However, excess nutrients can have negative impacts on aquatic ecosystems. Nutrient impaired waters can cause problems that range from annoyances to serious health concerns (Dodds and Welch 2000). The primary limiting nutrients in freshwaters are phosphorus and nitrogen, with total nitrogen (TN) and total phosphorus (TP) being the primary measured variables. The federal Clean Water Action Plan of 1998 requires that EPA and States develop and implement numeric criteria for nutrients. In January 2001, EPA placed a notice in the Federal Register that called for each State to submit a plan to EPA outlining a process for adopting nutrient criteria (EPA 2001a). The Nutrient Criteria Development Plan for the New Mexico Environment Department Surface Water Quality Bureau (SWQB) is outlined in this document. The nutrient threshold values will be used to identify nutrient impaired reaches, develop Total Maximum Daily Loads (TMDLs) and National Pollution (NPDES) permits, and monitor the effectiveness of nutrient management strategies.

SWQB will develop nutrient threshold values for different waterbody types and different classes within each type. Waterbodies are prioritized as follows: 1) streams, 2) rivers, 3) lakes and reservoirs, and 4) wetlands. Nutrient data will be compiled for New Mexico from EPA's Storage and Retrieval System (STORET), USGS, and SWQB and additional data will be gathered from Federal, State, Tribal, and local water quality agencies and universities. Data gaps will be identified and data will be collected to fill gaps as part of nutrient criteria development projects as well as regular water quality surveys. In addition to data on primary (TN, TP, chlorophyll *a*, total suspended solids (TSS), and turbidity) and secondary nutrient variables (Dissolved Oxygen (DO), pH, benthic macroinvertebrates, periphyton, and Ash Free Dry Mass (AFDM)), SWQB will gather data on classification parameters such as geology, elevation, watershed size, and designated aquatic life use.

Statistical analyses will be used to classify waterbodies and determine threshold values for select variables. Once threshold values are established, they will be tested and refined before proposing for adoption into the water quality standards (WQS) or inclusion in assessment protocols. Numeric TN and TP criteria will be adopted into the state water quality standards while threshold values for the other variables (DO, pH, and chlorophyll *a*) will incorporated into the weight-of-evidence approach used in the assessment protocol. The variables selected will differ with waterbody type and a suite of variables will be used to determine impairment. For example, periphyton chlorophyll *a* and TP will be used in streams while plankton chlorophyll *a* and Soluble Reactive Phosphate (SRP) may be used in reservoirs, a trophic index may be used for lakes that includes a number of variables, and a weight-of-evidence approach will be used to determine impairment for streams and rivers. The variables selected will be those that show the best relationship with indicators of impairment and will include at a minimum TN, TP, and chlorophyll *a*.

Three general approaches for criteria development are discussed in the EPA Guidance manual: (1) identification of reference sites for each waterbody class based on best professional judgment or percentile selections of data plotted as frequency distributions, (2) use of predictive relationships, and (3) application and/or modification of established nutrient/algal thresholds. SWQB will explore the use of the different approaches as needed for different waterbody types. This will produce criteria and translator values of greater scientific validity and account for waterbody classes with no available reference conditions or insufficient data to conduct robust statistical analysis. The Regional Technical Advisory Group (RTAG) will review the criteria, threshold values, and data analysis used in their development. Public review and comment,

including a public hearing, is part of the process for proposing changes to New Mexico WQS.Background

1.0 DEFINITION OF PROBLEM

Plant nutrients are essential for proper functioning of ecosystems. However, excess nutrients cause conditions unfavorable for the proper functioning of aquatic ecosystems. Unfortunately, the magnitude of nutrient concentration that constitutes “excess” is difficult to determine. Nutrient concentrations vary widely and interact with many biological and physical variables. Nutrient pollution results in a continuum of undesirable effects, from very minor to major impairments, depending on numerous factors. For example, nutrient concentrations that would not cause a problem in rapidly flowing waters in forested areas with a canopy over the waterbody can create major blooms in lower gradient waterbodies with no forest canopy. In this type of setting, prolonged sunlight and low flow velocity provide optimal conditions for photosynthesis and minimal dispersion of algae. Increases in suspended sediment concentrations can contribute to excessive nutrient concentrations, as suspended organic and inorganic particles also carry nutrients, particularly adsorbed phosphorus. Acceptable concentrations of nutrients may depend on the designated use of a waterbody. For example, higher nutrient concentrations, in some situations, may be desirable to manage a lake for a warm water fishery, but may preclude water quality suitable for recreational activities, such as swimming.

The primary limiting nutrients in freshwaters are phosphorus and nitrogen. Nitrogen (N) and Phosphorus (P) have different chemical properties and are therefore involved in different chemical processes. Phosphorus is a mineral nutrient introduced into biological components of the environment by breakdown of rock and soil minerals. Breakdown of mineral phosphorus produces inorganic phosphate ions (PO_4^{3-}) that can be absorbed by plants from soil or water. Phosphorus moves through the food web primarily as organic phosphorus (after it has been incorporated into plant or algal tissue) where it may be released as phosphate in urine or other waste by heterotrophic consumers and reabsorbed by plants or algae to start another cycle (Nebel and Wright 2000).

Phosphorus is found primarily in two forms in freshwater, organic and inorganic. The biologically available form of inorganic P in water is orthophosphate (PO_4^{-3}). Most P in surface water is bound organically, and much of the organic P fraction is in the particulate phase of living cells, primarily algae (Wetzel and Likens 1991). The remainder of the organic fraction is present as dissolved and colloidal organic P. Phosphorus readily sorbs to clay particles in the water column, reducing availability for uptake by algae, bacteria, and macrophytes. Exchange of P between sediments and overlying water involves net movement of P into sediments. Exchanges across the sediment interface are regulated by mechanisms associated with mineral-water equilibria, sorption processes, redox interactions, and activities of bacteria, fungi, algae, and invertebrates. Therefore, P in sediment is slow to recycle into the water column.

The primary reservoir of nitrogen is the atmosphere. Plants and animals cannot utilize nitrogen directly from the air, but require nitrogen in mineral form such as ammonium ions (NH_4^+) or nitrate ions (NO_3^-) for uptake. However, a number of bacteria and cyanobacteria (blue-green algae) can convert nitrogen gas to the ammonium form through a process called biological nitrogen fixation. Nitrogen gas dissolved in the water column may be converted to ammonia (a usable form of N) by nitrogen-fixing bacteria and algae when nitrate or ammonia are not readily available. However, receiving waters can lose N through denitrification – anaerobic transformation of nitrate or nitrite into gaseous N oxides which are released into the air – mediated by denitrifying bacteria (Atlas and Bartha 1993). Mineral forms of nitrogen can be taken up by plants and algae and incorporated into plant or algal tissue. Nitrogen follows the same pattern of food web incorporation as phosphorus, and is released in waste primarily as ammonium compounds. The ammonium compounds are usually converted to nitrates by nitrifying bacteria, making it available again for uptake, starting the cycle anew (Nebel and Wright 2000).

Nitrogen and phosphorus are transported to receiving waterbodies from rain, overland runoff, groundwater, drainage networks, and industrial and residential waste effluents. Once nutrients have been transported into a waterbody, they can be taken up by algae, macrophytes, and micro-organisms either in the water column or in the benthos; sorbed to organic or inorganic particles in the water and sediment; or transformed and released as a gas from the waterbody (denitrification).

Excess nutrients in aquatic systems can have large impacts. Some effects of nutrient pollution are described below and clearly lead to degraded water quality and non-attainment of the Federal Clean Water Act goal "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" [CWA §101(a)] and the New Mexico Water Quality Act implied goal "to protect the public health, welfare, and to enhance the quality of water" (§§ 74-6-1 *et seq.*, NMSA 1978). Nutrient impaired waters can cause problems that range from annoyances to serious health concerns (Dodds and Welch 2000). Nuisance levels of algae and other aquatic vegetation (macrophytes) can develop rapidly in response to nutrient enrichment when other factors (e.g., light, temperature, substrate, etc.) are not limiting. The relationship between nuisance algal growth and nutrient enrichment in stream systems has been well documented in the literature (Welch 1992; Van Nieuwenhuyse and Jones 1996; Dodds et al. 1997; Chetelat et al. 1999). Documented impacts that can be attributed to nutrient impairment include:

- Taste and odor problems in drinking water supplies are usually caused by algal blooms and actinomycete (nitrogen fixing filamentous bacteria) occurrence and other bacterial blooms that frequently follow (Silvey and Watt 1971; Dorin 1981; Taylor et al. 1981). Blooms of certain cyanobacterial ("blue-green algae") species produce toxins that can affect animal and human health. Reports of livestock, waterfowl, and occasionally human poisonings after drinking from waterbodies with blue-green algal blooms are not uncommon (Darley 1982; Carmichael 1986, 1994).

- One of the most expensive problems caused by nutrient enrichment is increased treatment required for drinking water. Nutrient enriched waters commonly cause drinking water treatment plant filters to clog with algae or macrophytes (Welch 1992) and can contribute to corrosion of intake pipes (Nordin 1985). High algal biomass in drinking water sources requires greater volumes of water treatment chemicals, increased backflushing of filters, and additional settling times to attain acceptable drinking water quality (Nordin 1985).

- Human health problems can be attributed to nutrient enrichment. One serious human health problem associated with nutrient enrichment is formation of trihalomethanes (THMs). Trihalomethanes are carcinogenic compounds that are produced when certain organic compounds are chlorinated and bromated as part of the disinfection process in a drinking water treatment facility. Trihalomethanes and associated compounds can be formed from a variety of organic compounds including humic substances, algal metabolites, and algal decomposition products. Algal density and eutrophication level in raw water supplies have been correlated with production of THMs (Oliver and Schindler 1980; Hoehn et al. 1980).

- A study of nitrate in groundwater (the primary source of drinking water in the US) indicated that nitrate contamination generally increased with high nitrogen input, greater proportions of well-drained soils, and low woodland to cropland ratios (Nolan et al. 1997). New Mexico has an established a drinking water quality standard of 10 mg/L dissolved nitrate as N because nitrates in drinking water can cause potentially fatal low oxygen levels in the blood when ingested by infants. Nitrate concentrations as low as 4 mg/L in drinking water supplies from rural areas have also been linked to an increased risk of non-Hodgkin lymphoma (Ward et al. 1996). A more detailed discussion of human health concerns related to eutrophication can be found in Suess (1981).

- Adverse ecological effects associated with nutrient enrichment include large diurnal swings in dissolved oxygen (DO) and pH, reduction of habitat utilized by aquatic organisms by smothering or clogging, and occurrence of harmful algal blooms. High algal and macrophyte biomass may be associated with severe diurnal swings in DO and pH in some waterbodies (Welch 1992; Edmonson 1994; Correll 1998). High pH and low DO can have adverse effects on aquatic organisms and lead to fish kills in severe cases. Low DO can release toxic metals from sediments (Brick and Moore 1996), locally contaminating habitats of aquatic organisms. In addition, low DO can cause increased availability of toxic substances such as ammonia and hydrogen sulfide, reducing acceptable habitat for most aquatic organisms. In deeper lakes and reservoirs, nutrient pollution results in high chlorophyll levels, reduced light penetration, and conditions in which submerged aquatic vegetation, a critical habitat component, cannot grow. Thus, nutrient enrichment may alter composition and species diversity of aquatic communities (Nordin 1985; Welch 1992; Smith 1998; Carpenter et al. 1998; Smith et al. 1999).

- Harmful algal blooms (e.g., brown tides, toxic *Pfiesteria piscicida* outbreaks, and some types of red tides) are also associated with excess nutrients. Evidence suggests that nutrients may directly stimulate growth of the toxic form of *Pfiesteria*, although more research is required to demonstrate this conclusively (Burkholder et al. 1992; Glasgow et al. 1995). New Mexico has two types of toxic algae, *Lyngbya* sp. and *Prymnesium* sp. *Prymnesium* is known to occur in reservoirs on the lower Pecos River, while *Lyngbya* occurs in reservoirs on the lower Rio Grande. Nutrients are reported to play a significant role in *Prymnesium* blooms (Johansson and Graneli 1999a, 1999b; Johansson 2000; Graneli and Johansson 2001; Legrand et al 2001; Graneli and Johansson 2003a, 2003b; Skovgaard et al 2003). It seems likely that nutrients play a role in *Lyngbya* blooms as well, although this has yet to be documented.

2.0 OVERVIEW OF REQUIREMENT TO DEVELOP NUTRIENT CRITERIA

In a national report to congress, the Environmental Protection Agency (EPA) reported that nitrogen (N) and phosphorus (P) concentrations are among the leading causes of water quality impairment in the U.S. According to the report, 40% of rivers/streams and 51% of lakes/reservoirs have designated use impairments from excess nutrients, resulting in excessive algal growth (EPA 1996). The federal Clean Water Action Plan of March 1998 requires that

EPA and States develop and implement numeric criteria for nutrients. It states that "EPA will establish by the year 2000 numeric criteria for nutrients (i.e., nitrogen and phosphorus) that reflect the different types of water bodies (e.g., lakes, rivers, and estuaries) and different ecoregions of the country and will assist states and tribes in adopting numeric water quality standards based on these criteria" (EPA 1998a).

In June 1998, in response to the call for regional nutrient criteria, EPA released the National Strategy for the Development of Regional Nutrient Criteria (EPA 1998b). In July 2000, EPA released the Nutrient Criteria Technical Guidance Manual to provide scientifically defensible technical guidance to assist States and Tribes in developing regionally-based numeric nutrient, algal, and macrophyte criteria for rivers and streams (EPA 2000). Since then, EPA has published Water Quality Criteria Recommendations documents proposing nutrient criteria for 13 of the 14 nutrient ecoregions for rivers and streams and 12 of the 14 ecoregions for lakes and reservoirs.

In January 2001, EPA placed a notice in the Federal Register that called for each State to submit a plan to EPA outlining a process for adopting nutrient criteria (EPA 2001a). A November 2001 memo from Geoffrey Grubbs, Director of EPA's Office of Science and Technology, provided more detail regarding the purpose and content of the Nutrient Criteria Development Plan, the flexibility available, and expectations on timeframes for plan development and criteria adoption (EPA 2001b). In 2002, New Mexico submitted a letter to EPA that stated the need for developing improved assessment methodologies to assist in implementing the State's 29-year old narrative nutrient criteria.

New Mexico's Integrated Clean Water Act §303(d)/§305(b) List of Impaired Waters and Report to Congress notes nutrient pollution as a cause of impairment to surface waters (NMWQCC 2004). Nutrient pollution can be described as excess amounts of nitrogen and phosphorus or the associated high algal biomass. Excess amounts of nitrogen and phosphorus can cause undesirable aquatic life and result in a dominance of nuisance species of algae, periphyton, and/or phytoplankton. Algae are either the direct (excessive and/or unsightly algal mats, toxic algal blooms, or surface plankton scums) or indirect (fluctuating DO and pH, and high turbidity) cause of most problems related to excessive nutrient enrichment. Nutrient impairment occurs when algal and macrophyte growths interfere with designated uses such as contact recreation, domestic water supply, or high quality coldwater aquatic life.

According to New Mexico's Integrated 2004-2006 CWA §303(d)/ §305(b) Report (NMWQCC 2004), 5.8% of all stream miles with known impairments, or 151.5 miles, are currently listed as impaired for excessive nutrients. However, these numbers likely do not reflect the true extent of nutrient impairment, as it has been difficult to assess for the attainment of the narrative standard without numeric translators.

With recognition of the pervasiveness and severity of nutrient-related problems, the need to accurately monitor and assess nutrient impairment and develop effective TMDLs for impaired waters is clear. Quantitative translators or criteria are necessary to accurately assess waters of the state. This document provides a draft plan for developing these threshold values for various waterbody types. This plan will be reviewed by interested parties and edited until mutually agreed upon by SWQB and EPA.

3.0 NEW MEXICO'S NUTRIENT CRITERIA WORK TO DATE

The State of New Mexico currently has a narrative nutrient criterion which states that, "Plant nutrients from other than natural causes shall not be present in concentrations that will produce undesirable aquatic life or result in a dominance of nuisance species in surface waters of the state" (Subsection E of 20.6.4.13 NMAC). New Mexico's narrative nutrient criteria can be challenging to assess as the relationships between nutrient levels and impairment of designated uses are not defined, and distinguishing nutrients from "other than natural causes" is difficult. Therefore, in 2002 SWQB developed a nutrient assessment protocol to assist in meeting these challenges. It was developed for streams as they represent the majority of assessed surface waters. While this protocol was successfully applied and used to develop 100% non-point source TMDLs, it lacked impairment thresholds and quantitative endpoints necessary to develop TMDLs with both point and non-point sources. It addressed both causal and response variables but did not result in quantifiable measures.

To address these deficiencies, SWQB with the assistance of EPA and the U.S. Geological Survey (USGS) refined the protocol in 2004. Mike Schaub and the EPA Region 6 RTAG provided comments on the protocol and Evan Hornig of the USGS conducted data analysis. Analysis of existing data and a literature review was conducted to develop impairment threshold values for each of the variables used in the assessment protocol. TN and TP threshold values were calculated for each Level III Ecoregion in New Mexico. Threshold values for the other variables were determined from the literature review and are applied statewide, as there were insufficient data to calculate values for the different regions. The threshold values are used to translate the narrative nutrient criterion to quantified endpoints (SWQB/NMED. 2006).

The SWQB's 2004 nutrient assessment protocol uses a weight-of-evidence approach and both cause (TN and TP) and response variables (DO, pH, periphyton chlorophyll *a*, and benthic macroinvertebrate metrics) to determine impairment. Of the four primary variables suggested by EPA in the Nutrient Criteria Technical Guidance Manual, only turbidity, or transparency, is not addressed. In streams within New Mexico, minimal primary production occurs in the water column and turbidity is influenced primarily by suspended sediment. SWQB has adopted a weight-of-evidence approach to conduct a more robust assessment and to account for diverse lotic systems and dynamic nutrient cycling. It is important to incorporate response variables into the assessment as ambient water column nutrient concentrations alone, "…cannot indicate supply because large biomass of primary producers may have a very high nutrient demand and render inorganic nutrient concentrations low or below detection" (Dodds and Welch 2000). In addition, nutrient concentrations in the water column are very dynamic and their relationships with impairment of designated uses are poorly defined.

In 2004 SWQB began collecting data to refine the threshold values in the 2004 nutrient assessment protocol and modify of established nutrient/algal thresholds. Chlorophyll a, periphyton community composition and other nutrient variables were collected from best available sites in streams from each of the level II ecoregions. A number of classification parameters where determined including geology, elevation, watershed size, and designated aquatic life use. These data were combined with data from STORET, and the national nutrient dataset used to re-calculate the threshold values. The chlorophyll a from best available sites in each ecoregion were used to calculate the ecoregion threshold values (the 95th percentile). The Total Phosphorus, Total Kjeldahl Nitrogen, and Nitrate plus Nitrite data were combined with historic data, divided by ecoregion and aquatic life use, and the threshold values (50th percentile) for each of these classed was calculated. These refined threshold values were incorporated into the 2007 nutrient assessment protocol. The periphyton community composition data is being analyzed for the development of a nutrient enrichment index which will beincorporated into the assessment protocol on completion. A copy of the SWQB's 2007 nutrient assessment protocol is attached (Appendix A).

NEW MEXICO'S NUTRIENT CRITERIA DEVELOPMENT PLAN

The following nutrient criteria development plan follows an outline provided by EPA to capture key elements and for consistency between States and Tribes (EPA 2001b). The recommended categories are included to address key elements established by EPA for inclusion into a State Nutrient Criteria Development Plan. The Nutrient Criteria Development Plan will be revised based on recommendations of the RTAG, public input, and results of data analysis. It will be reviewed and updated annually. The plan presents an approach for developing nutrient criteria in New Mexico. Criteria and threshold values will be developed to support the various uses or classes in the different waterbody types. There are four major stages to this process:

1) Collect and analyze data to develop classification systems for various water body types.

2) Determine impairment thresholds for select variables for each class of waterbody with guidance by the RTAG.

3) Apply the threshold values and analyze data to test and refine threshold values.

4) Once the TN and TP threshold values have been thoroughly tested, propose for adoption into the New Mexico WQS through the following steps. (Threshold values for other indicators will be incorporated into the weight-of-evidence approach used in the assessment protocol.)

    a) Solicit public comment on draft TN and TP criteria for a minimum of 30-days. Amend draft criteria as appropriate based on public comment.

    b) Hold informal public meetings to discuss the proposed criteria as amended. Amend as appropriate based on the meetings.

    c) Commence formal process to petition the New Mexico Water Quality Control Commission (NMWQCC) to amend the WQS at 20.6.4 NMAC following procedures set forth in the New Mexico Water Quality Act, NMWQCC rules or rulemaking guidelines, and the NM Water Quality Management Plan (NMWQCC 2002).

The NMWQCC is responsible for adoption of WQS for the State, including nutrient criteria. In its role of providing technical support, the SWQB is responsible for developing nutrient criteria that are scientifically defensible and specific to the unique conditions in New Mexico. To meet these responsibilities, SWQB will continue to use the weight-of-evidence approach (i.e. more than a single variable) in proposing nutrient criteria and developing threshold values and nutrient assessment protocols.

4.0 CONCEPTUAL APPROACH

EPA offers three approaches to development of nutrient criteria:

1) Develop nutrient criteria that fully reflect localized conditions and protect specific designated uses using EPA's Technical Guidance Manuals (EPA 2000), or

2) Adopt EPA's 304(a) Nutrient Criteria Recommendations (EPA 2001a), or

3) Develop a unique, scientifically defensible method utilizing:
    a) Empirical approaches
    b) Loading models
    c) Cause and effect based studies or relationships
    d) Other analytical tools

SWQB will use a combination of approaches 1 and 3. This allows the State to use EPA guidance as well as other scientifically defensible methods for development of nutrient criteria and is most consistent with the intent of the New Mexico Water Quality Act. Criteria will be established based on regional conditions, the designated uses, and identified biological impacts. In following EPA's Technical Guidance Manual (EPA 2000), SWQB will follow the nine steps involved in criteria development. A brief discussion of each of the steps is given below:

4.1 Identify water quality needs and goals

SWQB needs to develop nutrient criteria and threshold values that reflect regional conditions, protect designated uses, and provide accurate assessments. The criteria and threshold values will be used to identify nutrient-impaired reaches, develop TMDLs and NPDES permits, and monitor the effectiveness of nutrient management strategies. This step will be revisited throughout the criteria development process to assure defined needs and goals are being addressed.

4.2 Classify waterbodies first by type and then by trophic status

The intent of classification is to identify groups of systems that have comparable characteristics (i.e., biological, ecological, physical, and chemical features). Classifying reduces the variability of measured parameters within classes and maximizes variability among classes. Classification will allow criteria and threshold values to be identified on a broader rather than site-specific scale.

SWQB has and will continue to evaluate different methods of classifying waterbodies. General waterbody types have been identified including streams (wadeable), rivers (generally non-wadeable), lakes (natural), reservoirs (man-made), and wetlands. The waterbodies within these groups will be further classified. For streams, SWQB initially classified sites by Level III ecoregion , then further divided these classes by designated use (dividing waters within each ecoregion into warm, intermediate [i.e., segments with both cold and warm water designated uses], and coldwater aquatic life uses). In the future, the utility of other parameters such as geology, stream order, and Level IV ecoregions will be explored in classifying groups in each waterbody type. Classification of lakes and reservoirs will be undertaken next using such variables as ecoregions, watershed size, aquatic life use, and geology. Wetland classification will also take place if the wetlands program is adequately funded to produce sufficient data.

SWQB contractors will use multivariate techniques to explore different classification systems for the various waterbodies. Once the waterbodies are classified, the gradient and relationships of the variables in each class will be examined. The distribution of select variables will be used to classify systems by trophic status.

4.3 Select variables for monitoring nutrients.

Variables, in the context of this document, are measurable attributes that can be used to evaluate the condition and degree of eutrophication in a water body. EPA recommends that four primary water quality variables be addressed: TN, TP, chlorophyll *a* as an estimate of algal biomass, and turbidity. A number of secondary variables such as DO, pH, and benthic macroinvertebrates are also recommended. Measurements of these variables provide a means to evaluate nutrient enrichment and can form the basis for establishing regional and waterbody-specific nutrient criteria and threshold values.

SWQB will monitor the four primary water quality variables on all waterbodies plus a number of secondary variables including DO concentration, DO percent saturation, and pH. In addition, SWQB will conduct biomonitoring of benthic macroinvertebrate, periphyton, phytoplankton, and fish community composition at select sites. Biomonitoring and analysis will be in accordance with the methods documented in the EPA Rapid Bioassessment Protocol For Use in Wadeable Streams: Periphyton, Benthic Macroinvertebrates, and Fish (RBP) (Barbour et al1999), Stream Periphyton Monitoring Manual (Biggs and Kilroy 2000), and/or the NMED Standard Operating Procedures (SOP) (SWQB/NMED 2005). In rivers and streams, periphyton community composition, and chlorophyll *a* will be monitored. Water column chlorophyll *a* concentration, phytoplankton community composition, and secchi depth will be monitored in lakes and reservoirs. Water column chlorophyll *a* concentration and phytoplankton community composition will also be monitored on select rivers. The variables for monitoring and potential criteria development for wetlands are yet to be determined.

For streams, criteria will be developed for TN and TP. If analysis demonstrates that they are useful indicators of trophic status, threshold values will also be developed for periphyton chlorophyll *a*, DO saturation, DO fluctuation, and/or periphyton and benthic macroinvertebrate metrics and Stream Condition Indices (SCI).

For rivers, criteria will be developed for TN and TP. If analysis demonstrates that they are useful indicators of trophic status, threshold values will also be developed for periphyton chlorophyll *a*, DO saturation, DO fluctuation, phytoplankton chlorophyll *a*, periphyton and/or benthic macroinvertebrate metrics and Stream Condition Indices (SCI).

For lakes and reservoirs, criteria or threshold values will be developed for TN, TP, secchi depth, and phytoplankton chlorophyll *a*. For assessment, all of these variables may be combined in a trophic status index for which threshold values will be determined. If analysis demonstrates that they are useful indicators of trophic status, threshold values will also be developed for orthophosphate, DO saturation, DO fluctuation, and/or phytoplankton community composition.

The TN, TP, DO saturation and chlorophyll a threshold values and DO and pH criteria currently in the New Mexico WQS and the associated assessment protocols will be used in the weight-of-evidence approach to assessing streams and rivers. For example, a reach may be listed as impaired for nutrients if the DO criterion is exceeded AND two other nutrient-related variables also exceed the respective threshold values. Non-support is determined if three out of five of the indicators exceed threshold values. See New Mexico's Nutrient Assessment Protocol for additional details (SWQB/NMED 2007).

Although turbidity and TSS will continue to be collected at each site, these parameters will not be used in the first cut of indicators of stream eutrophication. Water quality data from New Mexico indicate that turbidity may not be a useful nutrient indicator in streams of this region because few rivers in New Mexico have the depth and velocity conducive to large phytoplankton blooms. However, both streams and rivers in the arid southwest can have large sediment loads that greatly influence turbidity. Further analysis will be done to examine the relationships between turbidity, TSS, nutrient concentrations and chlorophyll *a* concentration.

4.4 Design a sampling program for monitoring nutrients and algal biomass.

New monitoring programs should be designed to identify statistically significant differences in nutrient and algal conditions while maximizing available management resources. For streams, initial monitoring efforts will focus on targeting reference reaches that can be used to classify streams and identifying threshold values for nutrients, algal biomass, and secondary variables. With CWA §104(b)(3) funding, SWQB has selected 10 reference sites on streams in each of 5 ecoregions and monitored a suite of nutrient variables at these sites. A subset of these sites will continue to be monitored to examine seasonal and annual variability and trends. These data will be supplemented by monitoring additional test and reference sites over time to generate a data set sufficient to conduct robust statistical analyses. Other waterbody types such as rivers, lakes, and reservoirs will also continue to be monitored to develop data sets for analysis. SWQB has a wetlands program and has begun to monitor these systems.

4.5 Collect data and build database.

Nutrient data from STORET, USGS, and SWQB data sources has been compiled for New Mexico. Data from additional sources such as current and historical quality controlled water quality monitoring data from various Federal, State, Tribal, local water quality agencies, and university studies will be incorporated into the final dataset before analysis. Very little data on stream periphyton chlorophyll *a* concentration are available. SWQB has an in-house relational Water Quality Database that is used to store and manipulate existing and newly gathered monitoring data. SWQB will use Ecological Data Application System (EDAS) for biomonitoring data and classification parameters. EDAS is a relational database that has been developed for EPA by TetraTech for storing and analyzing biological information. EDAS has already been populated with SWQB's benthic macroinvertebrate data.

The survey of 50 stream reference sites in 2004 contributed significantly to the dataset. Additional data from rivers, lakes and reservoirs will be collected between 2005 and 2008. This will add reference sites to the dataset of nutrient variables as well as data from a range of condition. It will also provide concurrently collected cause and response variables including a substantial dataset of periphyton chlorophyll *a* concentrations and diatom community composition from different water body types. This data will also be used to develop a benthic macroinvertebrate stream condition index (B-SCI) and diatom nutrient index.

4.6 Analyze data.

Statistical analyses will be used to interpret monitoring data for criteria and threshold value development. Nutrient criteria development relates in situ nutrient concentrations, algal biomass, and changes in ecological condition (e.g., nuisance algal biomass, notable shifts in community composition, and deoxygenation). Threshold values will also be determined by analyzing the distribution of all of the data in a class of water bodies or that of the reference sites. In addition, the relative magnitude of an enrichment problem may be determined by examining total nutrient concentration and chlorophyll *a* frequency distributions for stream classes. In addition, data will be analyzed to define the relationships between variables and, where possible, identify cause and effect relationships and impairment thresholds. One example of this process would be to identify the chlorophyll *a* concentration above which exceedences of the DO criterion occur in a given waterbody class. Historic and recently collected data will be analyzed to examine statistical relationships among response variables and indicators of aquatic life such as a B-SCI.

4.7 Develop criteria based on reference conditions and data analyses.

Three general approaches for criteria setting are discussed in the EPA Guidance manual: (1) identification of reference sites for each waterbody class based on best professional judgment (BPJ) or percentile selections of data plotted as frequency distributions, (2) use of predictive relationships (e.g., trophic state classifications, models, biocriteria), and (3) application and/or modification of established nutrient/algal thresholds (e.g., nutrient concentration thresholds or algal limits from published literature). The 2007 Stream Nutrient Assessment Protocol uses TN, TP, and Chlorophyll a thresholds based on percentile selections and thresholds for other variables based on established thresholds. For lakes, both percentile selections and trophic state classifications will be tested. For reservoirs, distributions will be examined but predictive relationships will probably be necessary to develop thresholds. SWQB will explore the use of the different approaches as needed for different waterbody types. This will produce criteria and threshold values of greater scientific validity and account for waterbody classes with no available reference conditions, such as mainstem reservoirs. Selected criteria, threshold values, and the data analysis used in their development will be reviewed by the RTAG.

4.8 Implement nutrient control strategies.

Nutrient criteria and threshold values will be used in assessing waters and protecting water quality. Identifying waters with nutrient impairment is important and nutrient criteria are critical in determining limits in NPDES permits for point source discharges. The permit limits for TN, TP, and other trace nutrients emitted from wastewater treatment plants, factories, food processors, and other dischargers can be appropriately adjusted and enforced in accordance with the criteria. TMDLs can be established on the basis of nutrient criteria to address non-point sources of nutrient loading. Resource managers can use nutrient criteria to help define source load allocations for a watershed. Once sources have been identified, resource managers can implement best management practices and other activities necessary to maintain or improve the system.

4.9 Monitor effectiveness of nutrient control strategies and reassess validity of criteria

Nutrient criteria and threshold values can be applied to evaluate the relative success of management activities. Measurements of nutrient enrichment variables in the receiving waters preceding, during, and following specific management activities, when compared to criteria or threshold values, provide an objective and direct assessment of the success of the management project. Establishment of nutrient criteria will add two causal (TN and TP) and a number of response parameters (chlorophyll *a*, DO, pH) to the measurement process required for New Mexico's Integrated CWA §303(d)/ §305(b) Report. These measurements can be used to document change and monitor the progress of nutrient reduction activities. Development and refinement of nutrient criteria and threshold values is an iterative process and adoption of or changes to the criteria will occur during rulemakings to amend New Mexico's WQS (20.6.4 NMAC).

5.0 RELATION TO STATE USE CLASSIFICATIONS

The Clean Water Act requires that States establish "designated uses" for each water body (e.g., Coldwater Aquatic Life, Warmwater Aquatic Life, Primary Contact) and develop criteria necessary to support those uses. Just as nutrient criteria and threshold values will differ among ecoregions, different criteria may also be needed to support a particular use designation. New Mexico's preferred approach is to put nutrient criteria in the same framework as other water quality criteria by having different criteria for each use where appropriate and possible to define. New Mexico's WQS currently includes fifteen designated uses: High Quality Coldwater Aquatic Life, Coldwater Aquatic Life, Marginal Coldwater Aquatic Life, Warmwater Aquatic Life, Marginal Warmwater Aquatic Life, Limited Aquatic Life, Wildlife Habitat, Primary Contact, Secondary Contact, Livestock Watering, Irrigation/Irrigation Storage, Fish Culture, Domestic Water Supply, Municipal Water Supply, and Industrial Water Supply. While it may be difficult to determine how nutrient impairment fits with particular designated uses, data analysis should help to define relationships between the variables and use impairment. For instance, what level of algal growth causes unpleasant tastes and odors and associated increase in expense of treating drinking water supplies? Is excessive algal growth adversely affecting the biological community? Are excess nutrients causing harmful algal blooms that are limiting fishing or swimming opportunities? Is excessive algal growth aesthetically displeasing? Answers to some of these questions are subjective and difficult to apply in terms of a water quality criterion.

SWQB will explore different approaches to applying nutrient criteria and relating the criteria and threshold values to designated uses. Some steps necessary in relating nutrient criteria to uses include the following:

- Determine regional reference conditions for nutrients and/or algae that reflect attainment of uses or unimpaired conditions for each waterbody class.
- Establish a model for determining "expected conditions" in relation to nutrients and algae where regional reference conditions cannot be determined.
- Where possible, identify the variable level that causes an impairment of a designated use.

5.1 General Applicability to All Uses

The initial approach is to define appropriate reference conditions that represent a level of nutrient variables at which there are no known impairments of the designated use due to nutrient over-enrichment. If reference conditions accurately reflect minimally disturbed conditions, then all attainable uses should be protected if the variables are equal to or better than reference conditions. In the event that it is deemed impractical for New Mexico to determine nutrient criteria and threshold values for each designated use in each class and waterbody type, nutrient criteria or appropriate numeric translator will be generally applied to all uses, as is the current practice of implementing existing narrative nutrient criteria. Thresholds for some variables will be applied at the ecoregion level or based on other classifications.

5.2 Applicability Tailored to Specific Categories

Nutrient criteria and threshold values will eventually be developed for all waterbodies, including specific categories of streams, rivers, lakes, wetlands, and reservoirs. These specific categories will be defined utilizing such factors as designated use and ecoregion. SWQB will consider the designated use of waters when grouping and prioritizing waters for criteria development.

Special attention will be given to interstate waters due to the necessity for cooperation between state, tribal, and federal agencies. SWQB will work with other parties interested in developing criteria for systems that cross state and tribal boundaries. SWQB is currently a participant in the Animas River Nutrient Workgroup that includes representatives from Colorado, New Mexico, and Colorado municipalities and the Southern Ute Tribe. This workgroup is coordinating efforts to monitor and assess the Animas River with regards to trophic status, including the development of threshold values for TN, TP, and periphyton chlorophyll *a* concentration. A similar workgroup with representatives from New Mexico, Texas, Arizona, and Colorado will be formed for nutrient criteria development. A web site will be created to post criteria development plans, draft assessment protocols and criteria and updates of progress, in order to create a form for regional information and discussion. SWQB will contact tribal and state representative of waters crossing jurisdictional boundaries and work with them in developing nutrient criteria to minimize the variation in criteria for a given waterbody. While SWQB will work with other state and tribal agencies in developing criteria, the criteria will only apply to waterbodies under New Mexico's jurisdiction. SWQB will also attend regional and national nutrient criteria meetings to learn about approaches used by other states and tribes, present our work, and incorporate findings and feedback.

Nutrient criteria and threshold values may be related to use classifications by defining quantitative relationships among nutrient variables and parameters that are more directly related to or descriptive of the particular designated uses. For example, regression or change point analysis could help determine a threshold level for phosphorus and an index of biological integrity value. Another possibility would be to use an algal species composition model that could help determine chlorophyll *a* levels that result in a significant shift in the food web supporting a game fishery. As a final example, data from drinking water utilities could help determine turbidity levels that require increased chlorination and resulting in levels of disinfection by-products that increase treatment expenses above a specified threshold. SWQB will survey water treatment facilities to gather information on this issue.

5.3 Development of Refined Use Classifications

Data collected specifically for the development of nutrient and bio criteria, as well as data collected during rotational intensive monitoring studies, are used to further refine use designations, standards segments, and assessment units.

6.0 RELATION TO PHYSICAL CLASSIFICATION

For the purpose of developing nutrient criteria, EPA (2000) suggests classifying aquatic systems to identify waterbodies (e.g., rivers, streams, lakes, wetlands) that have comparable characteristics (i.e., similar biological, ecological, physical, and/or chemical features) so that data can be compared or extrapolated within and among types. The term "classification" as used here refers to the process of grouping or categorizing water bodies based on physical characteristics, and should not be confused with regulatory use classification. Nutrient criteria will be developed for the following water body types:

- Streams
- Rivers
- Lakes
- Reservoirs
- Wetlands

These waterbodies will be classified into groups with similar features. A meaningful organization of waterbodies depends on identification of variables showing similarity within groups. Classification systems that incorporate these factors will be used in developing a spatial framework for nutrient indicators. Variables that have been identified using the River Invertebrate Prediction and Classification System (RIVPACS) may be used. An outcome of this predictive model is to determine the environmental factors most strongly associated with biological variation among sites. Some factors that are anticipated to be included in the classification system for waterbodies in New Mexico include: designated uses, land use/watershed characteristics, geology, stream order, reservoir size/shape, stream gradient (slope), width/depth ratio, entrenchment ratio, sinuosity, channel materials, etc. Data related to these parameters will need to be collected and organized as we develop waterbody classifications.

6.1 Lake Type

Classification for lakes and reservoirs will be based on physical characteristics such as lake vs. reservoir, geologic origins, surface area, mean depth, watershed size, reservoir management, residence time, stratification and mixing, as well as ecoregion. Trophic status and designated uses will be critical issues for lake and reservoir classification and criteria development.

6.2 Stream Order/Watershed Size

The utility of stream order and watershed size as a classification parameter will be explored. Within a specific ecoregion, stream order may be an important classification parameter depending on results of a more detailed analysis. Stream order may be also used to distinguish rivers from streams. In working on the development of biocriteria, SWQB found that watershed size significantly influences results. However, conclusions may differ for nutrients and stream order. SWQB is currently in the process of determining the stream order of all of our stream and river monitoring stations.

6.3 Ecoregion Sub-scales

Different areas of the state typically have different nutrient levels depending on waterbody type, native soil types, groundwater hydrology, and land use patterns (agriculture, forest, urban, etc.). Therefore, different criteria will be necessary in different areas, based on local or regional conditions. SWQB has tentatively established three aquatic life uses for streams, which will be superimposed on five Level III Ecoregions (Omernik 1987) for a possible total of fifteen classes. These ecoregions are based on geology, geography, plant and animal communities, soil types, elevation, watershed size, and other descriptors. The use of Level IV Ecoregions will be explored as those delineations are finalized and become available. There are approximately fifty draft Level IV Ecoregions proposed for New Mexico. The distribution of the variables for each region will be examined and those regions that do not show significant differences will be aggregated to limit the number of criteria developed.

Criteria and threshold values will be developed for and applied at the ecoregion sub-scale level for most waterbodies, depending on what is determined to be the most appropriate classification. New Mexico has six Level III Ecoregions, and each category of waterbody (e.g., stream, river, lake, etc.) will be addressed within the specific ecoregion or other appropriate classification. For example, there may be criteria for coldwater aquatic life streams in the Southern Rockies Ecoregion and a separate set of criteria for coldwater aquatic life streams in the Arizona/New Mexico Mountains or transitional aquatic life streams in the Southern Rockies. These TN and TP criteria will be incorporated into the standards on a segment specific basis in order to capture the sub-ecoregion classification of waterbodies.

Segment-specific consideration will also be required for effluent dominated waterbodies, highly engineered waterbodies, or waterbodies that cross ecoregional boundaries (Tetra Tech 2002). Additionally, segment-specific criteria and threshold values may be needed in waterbodies with unique ecological conditions (e.g., the naturally acidic Sulphur Creek on the Valles Caldera National Preserve) and naturally interrupted, intermittent, or ephemeral reaches.

6.4 Seasonality

Quantitative nutrient-related criteria, such as chlorophyll *a* and biomass, will experience seasonal variations. Regular water quality surveys monitor sites 8 times per year for TN and TP. A subset of sites will be monitored for these and other variables seasonally and over multiple years to examine inter- and intra-year variability. Seasonal and annual variations will be examined. However, monitoring will focus primarily on a critical low flow index period from August to November to coincide with biomonitoring and to use conservative sampling techniques by sampling during critical conditions.

7.0 PRIORITIZATION OF WATERS

Prioritization of waterbodies and sites is necessary given limited resources allotted to meet the water quality objectives of the SWQB and EPA. SWQB will prioritize waters for the development of nutrient criteria and threshold values according to the waterbody type as follows: 1) streams, 2) rivers, 3) lakes and reservoirs, and 4) wetlands. Streams were selected as the highest priority as they represent the majority of the waters assessed in New Mexico. Once the threshold values for this class of waterbodies are in the refinement phase, SWQB will begin development of threshold values for lakes and reservoirs. A large body of data exists for reservoirs and they are a highly valued resource, so they have been selected as the second priority. SWQB has a fairly large dataset of concurrently collected TN, TP, Soluble Reactive Phosphate, chlorophyll *a* and secchi depth, which will be supplemented with data from other entities. There may be gaps in the lakes data set that need to be filled before thresholds can be determined for all the variables. After lakes and reservoirs have been addressed, analysis for development of protocols for rivers will take place. The data set for rivers has more gaps, so this waterbody type will be addressed third. SWQB is currently developing monitoring methods for rivers and in doing so compiling a dataset that can be used to supplement existing data and develop threshold values for nutrient assessment of rivers. SWQB recently began a wetlands program, so the process of collecting wetlands data has not yet begun. Therefore, nutrient criteria development for wetland was given the lowest priority.

Monitoring of the various waterbody types will be ongoing to develop datasets for use in classification, and threshold development and refinement. Additionally, monitoring will serve the multiple purposes of filling in data gaps for nutrient variables and benthic macroinvertebrates as well as providing additional information on reference and/or expected conditions. The following activities describe data collection, waterbody classification, and threshold development:

1) Assimilate and analyze existing data from state, tribal, federal, and academic sources.
2) Collect data on nutrient variables during the scheduled basin survey rotation according to the Draft 10-year Water Quality Monitoring Strategy (SWQB 2004). This allows the Bureau to maximize resources by tying nutrient criteria monitoring to monitoring efforts based on the scheduled basin survey rotation. These surveys usually monitor a range of impairment conditions.
3) Perform targeted sampling for assessment units known to have a nutrient impairment (according to the Integrated CWA §303(d)/§305(b) Report) and at reference sites.
4) Develop a classification system for each waterbody type.
5) Define reference or expected conditions for each class, through examination of reference conditions or modeling.
6) Identify threshold values for select variables in each class.
7) Test and refine the threshold values.

8.0 INVENTORY OF EXISTING DATA

The first step in development of nutrient criteria for waterbodies in New Mexico is to populate a database with existing nutrient variables and the parameters needed to classify waterbodies. This includes data on nutrients and other water quality parameters, algal community, benthic macroinvertebrate community, and physical site characteristics.

8.1 EPA National Nutrient Database

The National Nutrient Database stores and analyzes nutrient water quality data and serves as an information resource for states, tribes, and others in establishing scientifically defensible numeric nutrient criteria and threshold values. It contains ambient data from Legacy STORET data system, the USGS's National Stream Quality Accounting Network (NASQAN) data and National Water Quality Assessment (NAWQA) data, and other relevant sources such as universities and states/tribes. SWQB will start data analysis for nutrient criteria development with the EPA National Nutrient Database.

8.2 Additional Data Sources

Starting in 2001, SWQB began working with Evan Hornig (then with USGS) to supplement the nutrient dataset used by EPA to develop the ecoregional nutrient criteria recommendations (EPA 2001a) and to compile associated data needed to classify streams. New Mexico will verify data in the EPA National Nutrient Database and supplement it with data from:

- USGS
- USBOR
- USFWS
- State Universities
- Neighboring States
- SWQB in-house database
- USFS
- USBLM
- NM State Parks
- Tribes

Information related to biological parameters will be entered into EDAS. Data entry into EDAS has already been initiated for SWQB’s macroinvertebrate data. The database will include data on physical characteristics, nutrients response variables, and aquatic communities.

8.3 Identification of Data Distribution and Gaps

The collected data will be inventoried and data gaps identified. Spatial and temporal distribution will be considered. Some regions of the state have relatively little data due to the scarcity of water. The critical gaps are lack of periphyton assemblage, biomass, and periphyton chlorophyll *a* data within New Mexico. Three years of periphyton and associated nutrient data is considered essential to delineate the minimum annual variability for these hydrologic systems. Data will be needed to establish reference conditions for these variables and examine variability across ecoregion and waterbody class.

8.4 Identification of Database Management Needs

SWQB has an in-house water quality database for all ambient chemical and physical data collected by SWQB. Once this data has gone through the Quality Assurance process, it is uploaded to STORET. The SWQB plans to develop additional reports and tools in the database to assist with nutrient criteria development. Additional data on classification parameters will need to be collected and added to the data set (e.g. stream order, lake volumes, land use, and geology coverages). EDAS will need to be added to in order to house these additional parameters.

8.5 Representativeness of Data

Representativeness of the data will be evaluated. Representativeness is believed to be fairly extensive but, unfortunately, incomplete (i.e., not all parameters have been collected at the same time from the same site and many parameters have not been collected at all at most of the sites). The on going monitoring of reference sites and test throughout the state will increase the representativeness of the dataset. There may be some bias toward more impacted areas, as that is where sampling was typically directed during past rotational basin surveys. Normalization using means or medians to collapse data and provide representative sample numbers may be necessary.

9.0 REQUIREMENTS FOR NEW DATA COLLECTION

Additional data will be collected in order to classify sites and develop variable thresholds based on inventory of existing data and identification of data gaps.

9.1 Physical, Chemical, and Biological Measurement Variables

Rivers/Streams: Physicochemical parameters, TP, TN, chlorophyll *a*, AFDM, periphyton and benthic macroinvertebrates will be concurrently monitored. Whenever possible this will include a multiple-day deployment of multi-parameter meters set to take hourly reading to examine diurnal fluctuations in DO and pH. Classification variables such as ecoregion, stream order, geology, and aquatic life use will also be determined.

Lakes, Wetlands, and Reservoirs: Soluble Reactive Phosphate is thought by some to be more critical than TP because TP is tied to sediment and not biologically available. However, knowledge about rates of uptake processes is often needed to make SRP data meaningful. TP is used in Carlson Trophic Index. SRP, TP, TN, chlorophyll *a*, AFDM, periphyton and/or phytoplankton, secchi depths, and depth profiles of physicochemical parameters will be concurrently monitored. Classification variables such as ecoregion, reservoir size, and elevation will also be determined.

9.2 Sampling and Analysis Plan

Nutrient data has been compiled for New Mexico from STORET, USGS, and SWQB. Additional data will be gathered from Federal, State, Tribal, and local water quality agencies as well as university studies. Data gaps will be identified. The survey of fifty reference sites in 2004 will contribute significantly to the dataset. The nutrient criteria development projects will include monitoring of a subset of sites on both a seasonal and yearly basis to examine inter- and intra-year variability. Data will continue to be collected to fill gaps as part of the nutrient criteria development projects as well as regular water quality surveys. Specific sampling plans will be developed for nutrient criteria development projects being conducted with CWA §104(b)(3) funding.

Statistical analyses will be used to interpret monitoring data for criteria and threshold value development. Nutrient criteria development should relate nutrient concentrations, algal biomass, and changes in ecological condition (e.g., nuisance algal biomass, notable shifts in community composition, and deoxygenation). Threshold values can also be determined by analyzing the distribution of all of the data in a class of water bodies or that of the reference sites.

Three general approaches for criteria setting are discussed in the EPA Guidance manual: (1) identification of reference sites for each waterbody class based on BPJ or percentile selections of data plotted as frequency distributions, (2) use of predictive relationships (e.g., trophic state classifications, models, biocriteria), and (3) application and/or modification of established nutrient/algal thresholds (e.g., nutrient concentration thresholds or algal limits from published literature). SWQB will explore the use of the different approaches as needed for different waterbody types. This will produce criteria and threshold values of greater scientific validity and account for waterbody classes with no available reference conditions, such as mainstem reservoirs. Selected criteria and the data analysis used to identify criteria will be reviewed by the RTAG.

9.3 Data Quality Objectives

Data will continue to be collected as part of the nutrient criteria development projects as well as regular water quality surveys. Sampling will focus on reference and test sites in the various classes and waterbody types. A suite of primary and secondary variables as well as habitat variables will be measured concurrently. A subset of sites will be monitored seasonally and over multiple years to examine inter- and intra-year variability. However, monitoring will focus primarily on a critical low flow index period from August to November.

Samples will be collected and processed in accordance with methods documented in our EPA approved Quality Assurance Project Plan (QAPP) and associated Standard Operating Procedures (SOP). The QA/QC procedures in the QAPP include the collection and analysis of 10% of water samples, adherence to calibration methods, and taxonomic verification of a subset of periphyton and benthic macroinvertebrate samples. Also included is a thorough QA review of all site and analytical data, including flagging of all parameter that are outside of the control limits. More detailed data quality objectives (DQOs) will be developed for nutrient criteria development projects being conducted with CWA §104(b)(3) funding.

10.0 OTHER CONSIDERATIONS

10.1 Administrative Procedures and Process

The NMWQCC must approve proposed criteria before they can be incorporated into *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC). A public review and comment period and a public hearing are required. Upon completion of the public review process, if substantive changes are not required, the NMWQCC can approve the final proposal, accepting the final rule for state purposes. This whole process typically takes six to twelve months. After the revised WQS are published through the state records office, they are sent to EPA Regions 6 for review and approval. This process can take more than 24 months depending on the extent of proposed changes and Section 7 consultation with USFWS.

10.2 Stakeholder Input and Public Participation

An opportunity for public review is required as part of our process for development of criteria to be included in New Mexico WQS. As noted above, public participation is required. In addition, it is possible that we will hold public information meetings before formal hearings to get additional input.

10.3 RTAG Coordination

The SWQB has and will continue to participate in RTAG meetings. Draft threshold values and monitoring and assessment protocols will be sent out for RTAG review and comment.

10.4 Scientific Review

Scientific peer review will be conducted for all subsequent nutrient criteria development. New Mexico is fortunate to have a scientific community actively involved in various aspects of nutrient ecology. The SWQB plans to make significant use of that expertise.

10.5 Other Issues

The most critical item to consider is availability of resources for monitoring, lab analysis, and data analysis. Only a small portion of this plan may be implemented without continued 104(b)(3) funding or additional funds from EPA.

SCHEDULE

This schedule provides a general timeline for the activities outlined in this document. The plan and schedule will be reviewed and adjusted annually with input from EPA. If there is a need to deviate from the plan, EPA will be notified.

Dec 2007	Complete monitoring of 2007 lake and reservoir sites and add to existing dataset
	Complete monitoring of 2007 river data and add to existing dataset
	Test and refine wadeable stream threshold values
	Review and update Nutrient Criteria Development Plan
July 2008	Complete compilation and review of lake and reservoir nutrient indicator dataset
	Compile river nutrient indicator dataset
	Test and refine stream diatom index
Dec 2008	Initial data analysis and draft lake and reservoir classification system
	Add 2008 data to river dataset and complete compilation and review
	Review and update Nutrient Criteria Development Plan
	Add diatom index to stream nutrient assessment protocol
July 2009	Draft lake and reservoir threshold values
	Analyze river nutrient indicator dataset
	Compile wetlands data and identify data gaps
Dec 2009	Test lake and reservoir threshold values
	Draft river classifications and threshold values
	Begin to fill data gaps and draft wetlands classification
	Review and update Nutrient Criteria Development Plan
July 2010	Test and refine lake and reservoir threshold values
	Test river threshold values
	Complete wetlands dataset and initial data analysis
Dec 2010	Draft lake and reservoir assessment protocol
	Draft river threshold values
	Draft wetland classification and draft threshold values
	Review and update Nutrient Criteria Development Plan

Streams	**Lakes/Reservoirs**	**Rivers**	**Wetlands**	**Other**

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