

**WYOMING**  
**NUTRIENT CRITERIA DEVELOPMENT PLAN**

**Final**  
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*Wyoming Department of  
Environmental Quality*



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## 1.0 BACKGROUND

Eutrophication of the nation's surface water resources (lakes, reservoirs, rivers, streams and wetlands) due to excessive nutrients (nitrogen and phosphorus) is recognized as a significant water quality problem. The U.S. Environmental Protection Agency's (EPA's) national water quality summary reports to Congress consistently identify excessive nutrients as one of the top three leading causes of impairments of the nation's water (along with siltation and pathogens). Nutrient inputs support primary producers that are essential for supporting healthy, diverse and productive ecosystems. However, excessive nutrient inputs can result in abundant growth of periphyton, macrophytes and/or phytoplankton leading to oxygen depletion, potentially toxic algal blooms, imbalances in biological community composition, human health concerns and a general decline in aquatic resources.

In 1998 EPA published the *National Strategy for the Development of Regional Nutrient Criteria* (USEPA 1998) under section 304(a) of the Clean Water Act (66 *Federal Register* [FR] 1671). That document describes the national approach for developing nutrient criteria and working with states in the adoption of nutrient criteria. Following this approach, EPA produced technical guidance documents for nutrient criteria development for rivers and streams, lakes, and estuaries (USEPA 2000a, 2000b, 2001a). Draft guidance for wetland criteria has recently been released (USEPA 2007). In addition, EPA proposed criteria for Nutrient Ecoregions for Rivers and Streams and for Lakes and Reservoirs in a series of Water Quality Criteria Recommendations documents (USEPA 2000c, 2000d, 2000e, 2001b, 2001c, 2001d, 2001e, 2001f). These proposed criteria, based on nutrient ecoregions, were intended to serve as a springboard for states to develop more refined nutrient criteria, stating that "States and Tribes need to identify with greater precision the nutrient levels that protect aquatic life and recreational uses..." (USEPA 2000a, 2000b). EPA expected states to adopt or revise the proposed nutrient ecoregion criteria into state water quality standards (WQS) by 2004 while recognizing that the time needed to develop standards and the available resources differed significantly among states.

This nutrient criteria plan was developed in response to EPA's request for states to adopt nutrient criteria into state WQS. In a 2001 memorandum from the director of EPA's Office of Science and Technology, EPA provided guidance to states on the development of nutrient criteria plans and described the role of these plans in the adoption of nutrient criteria. EPA further restated its goal "...to work with states to establish the necessary quantitative endpoints to reduce excessive nutrient inputs to the nation's waters..." and to prevent further water quality impairments due to excessive nutrients.

The objective of this document is to outline Wyoming's plan to gather data on its streams and lakes and develop criteria that will best protect the designated uses of Wyoming's water resources from nutrient impacts. During this process, Wyoming will continue to collect and analyze data, seek public and stake holder input, and propose nutrient criteria that ensure that Wyoming surface water standards are protective for all classes of waters.

## 2.0 CURRENT STATUS OF WYOMING NUTRIENT CRITERIA

### 2.1 Current Status of Nutrient Regulation in Wyoming

Wyoming has no numeric criteria for total nitrogen (TN) and total phosphorus (TP). Two nutrient compounds are regulated by Wyoming Surface Water Quality Standards (WQS): ammonia ( $\text{NH}_3$ ) and nitrate+nitrite (WDEQ 2007b). Ammonia is potentially toxic to aquatic life under specific pH and temperature conditions. The numeric ammonia criteria are applied to all Class 1 and 2 waters, and a narrative criterion is applied to Class 3 waters in the state. Elevated nitrate levels might impact human health; therefore, a nitrate criterion is applied to all drinking waters. The values of these criteria designed to protect against toxic effects are well above those generally considered a threat for eutrophication. In addition to these nutrient compounds, Wyoming's Surface WQS also include turbidity and dissolved oxygen (DO) criteria. Turbidity is a recommended parameter for nutrient criteria development, and DO is considered an important surrogate for nutrient effects (USEPA 2000a).

### 2.2 EPA Recommended Nutrient Criteria for Wyoming Nutrient Ecoregions

There are seven Level III ecoregions in Wyoming (Figure 1): Snake River Plain (12), Middle Rockies (17), Wyoming Basin (18), Wasatch and Uinta Mountains (19), Southern Rockies (21), Western High Plains (41), and Northwestern Great Plains (43). USEPA (2002) provides descriptions of each Level III ecoregion.

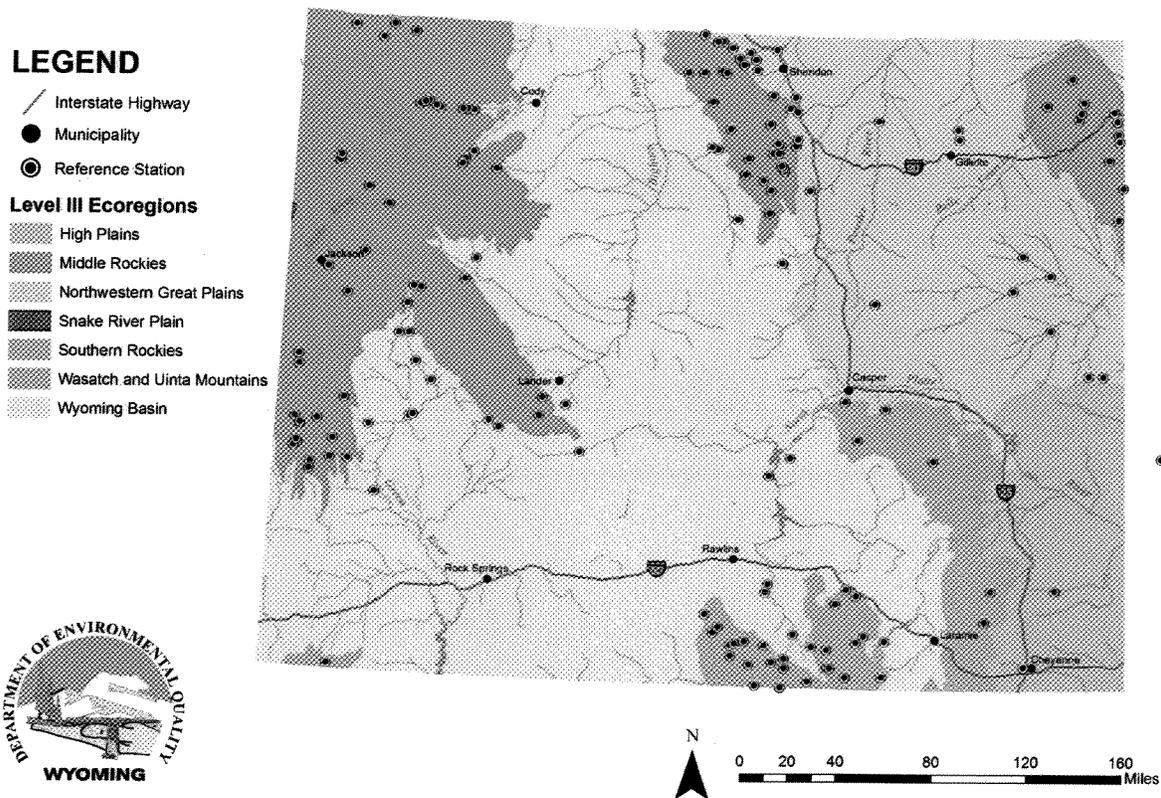


Figure 1. Level III ecoregions and Wyoming Department of Environmental Quality (WYDEQ) reference stations across Wyoming.

Using landscape-level geographic features, including climate, topography, regional geology and soils, biogeography, and broad land use patterns, EPA aggregated Wyoming's seven Level III ecoregions into the following four nutrient ecoregions: Nutrient Ecoregion II—Western Forested Mountains (Middle Rockies, Southern Rockies, and Wasatch and Uinta Mountains); Nutrient Ecoregion III—Xeric West (Wyoming Basin and Snake River Plain); Nutrient Ecoregion IV—Great Plains Grass and Shrublands (Northwestern Great Plains); and Nutrient Ecoregion V—South Central Cultivated Great Plains (Western High Plains) (Omernik 2000). Waters within the same nutrient ecoregion are assumed to have similar background nutrient concentrations. EPA recommended nutrient criteria for lakes and reservoirs (Table 1) as well as streams and rivers (Table 2) in these nutrient ecoregions (USEPA 2000c, 2000d, 2000e, 2001b, 2001c, 2001d, 2001e, 2001f). Wyoming intends to use a combination of information gathered through the nutrient ecoregion study as well as information gathered from their monitoring program to evaluate appropriate nutrient criteria.

**Table 1. EPA-proposed nutrient criteria for nutrient ecoregions (N.E.) in Wyoming: Lakes and Reservoirs**

<i>Parameter</i>	<i>N.E. II</i>	<i>N.E. III</i>	<i>N.E. IV</i>	<i>N.E. V</i>
TP ( $\mu\text{g/L}$ )	8.75	17.00	20.00	33.00
TN ( $\mu\text{g/L}$ )	100.00	400.00	440.00	560.00
Chlorophyll <i>a</i> ( $\mu\text{g/L}$ )	1.90	3.40	2.00	2.30
Secchi Depth (m)	4.50	2.70	2.00	1.30

Notes:  $\mu\text{g/L}$  = micrograms per liter; m = meters

**Table 2. EPA-proposed nutrient criteria for N.E. in Wyoming: Streams and Rivers**

<i>Parameter</i>	<i>N.E. II</i>	<i>N.E. III</i>	<i>N.E. IV</i>	<i>N.E. V</i>
TP ( $\mu\text{g/L}$ )	10.00	21.88	23.00	67.00
TN ( $\mu\text{g/L}$ )	120.00	380.00	560.00	880.00
Chlorophyll <i>a</i> ( $\mu\text{g/L}$ )	1.08	1.78	2.40	3.00
Turbidity (FTU/NTU)	1.30	2.34	4.21	7.83

Notes:  $\mu\text{g/L}$  = micrograms per liter; m = meters

### 2.3 Use Classification of Waters in Wyoming

Wyoming organizes its waters into four classes (WDEQ 2007a). These waters are classified according to existing and designated uses. Class 1 are those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution must be controlled through implementation of appropriate best management practices. These waters include all surface waters in the boundaries of national parks and congressionally designated wilderness areas, selected mainstem rivers, Fremont Lake and the wetlands adjacent to those waters. Class 2 are waters, other than those designated as Class 1, that are known to support fish and/or drinking water supplies or where those uses are attainable. Class 3 are waters, other than those designated as Class 1, that are intermittent, ephemeral or isolated waters and because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning, or certain perennial waters that lack the natural water quality to support fish. Waters not specifically designated as Class 1, 2, or 4, are designated Class 3 by default. Class 4 are waters, other than those designated as Class 1, where it has been determined that aquatic life uses are not attainable pursuant to the provisions of Section 33 of the Wyoming Surface WQS (WDEQ 2007a). Class 4 waters include waters that have an approved use attainability analysis (UAA) containing defensible reasons for not protecting aquatic life uses.

### 3.0 CONCEPTUAL APPROACH

EPA has recommended three possible approaches for establishing nutrient criteria (USEPA 2000a): (1) reference-based, (2) stressor-response, and (3) literature-derived values. The reference approach uses two principal methods. The first method is to derive criteria from ambient nutrient concentrations observed at a population of reference sites. EPA used this method to develop the recommended nutrient ecoregional criteria (Dodds et al. 1998; USEPA 2000a; Seip et al. 2000; Dodds and Oakes 2004; Rohm et al. 2002; Ice and Binkley 2003). Another option for determining reference-based criteria is to estimate reference conditions by empirical modeling. This can be performed either by extrapolation of land cover/nutrient concentration models for the condition of zero percent human land cover (Dodds and Oakes 2004), or construction of regression models on the basis of multiple natural predictors (Smith et al. 2003; Sheeder and Evans 2004). Either reference approach method requires appropriate classification to establish appropriate criteria for different waterbodies (Detenbeck et al. 2004; Snelder et al. 2004; Wickham et al. 2005).

Reference approaches using ambient nutrient concentrations within a waterbody class to establish criteria can lack a direct linkage to protection of designated uses (Dodds and Welch 2000; McMahon et al. 2003). If the criteria used to select reference sites do not incorporate a dimension of use condition and/or natural condition provisions are not written into narrative use descriptions, it is difficult to demonstrate clear evidence of use protection by simply choosing one percentile from a distribution of site values. Aquatic life use is one of the uses most commonly targeted for protection by nutrient criteria. Stressor-response approaches derive nutrient criteria on the basis of relationships between aquatic life measures and nutrient concentrations. Fortunately, biological assessment has been shown to be an efficient way to evaluate aquatic life use (Barbour et al. 2000; King and Richardson 2003), and the developed biological indicators provide a direct measure of aquatic life use condition. As a result, statistical analyses that directly relate eutrophication (stressor) to biological indicators or other valued aquatic life use attributes, can be used to develop ecologically meaningful nutrient criteria. Nutrient criteria that use stressor-response approaches have typically relied on algal biomass and algal community indicators (Welch et al. 1988; Stevenson 1997; Biggs 2000; Havens 2003). Stressor-response approaches may also provide direct links between nutrient concentrations and impacts to other designated uses. For instance, indicators derived from recreational user perception surveys could be related to nutrient concentrations, resulting in nutrient criteria protective of recreational use.

The literature-derived approach is based on developing criteria from existing literature for the same or similar regions. This approach recognizes that the impacts of nutrients on many systems have been well documented and that the literature provides another important source of guidance in developing protective nutrient criteria. This approach also includes the use of mechanistic models to develop nutrient criteria. In many regions, nutrient data are limited or not available, and interactions among multiple factors are difficult to incorporate into statistical models. In such a case, mechanistic modeling approaches can be applied to establish nutrient criteria (Somlyody 1997, 1998; Reckhow et al. 2005). The modeling approach has been principally used for site-specific criteria, because site-specific predictors are generally used.

## **4.0 WYOMING'S APPROACHES FOR DEVELOPING NUTRIENT CRITERIA**

Wyoming plans to apply a weight-of-evidence approach that incorporates a combination of all three of the conceptual approaches described in the previous section. In addition, Wyoming Department of Environmental Quality (WYDEQ) will use external review for evaluating the development of nutrient criteria.

### **4.1 Waterbody Prioritization**

Wyoming plans to develop nutrient criteria for different waterbody types in the following order:

1. Lakes and reservoirs
2. Streams and rivers
3. Wetlands

There are fewer lakes and reservoirs in the state than streams and rivers. In addition, there is substantially more scientific literature support for development of appropriate lake and reservoir nutrient criteria relative to streams and rivers. Therefore, nutrient criteria development for lakes and reservoirs will be the first priority and is anticipated to be more straightforward than developing criteria for streams.

### **4.2 Waterbody Classification**

Waterbody classification reduces the natural variability of nutrient parameters within a region by placing waterbodies into groups (classes) with similar watershed, ecological and/or other characteristics. This technique allows for nutrient criteria to be developed on a broader rather than site-specific scale. General waterbody types have been identified, including streams and rivers (wadeable and non-wadeable), lakes and reservoirs (natural and man-made), and wetlands. Waterbodies within these types will be further classified. Streams and rivers will be classified by Level III ecoregion and nutrient ecoregion during the nutrient criteria development process. Wyoming will also explore the possibility of further classifying streams and rivers using parameters such as geology, stream order, Level IV ecoregions, designated uses, and bioregional classifications used for developing statewide multimetric biological indices. For lake and reservoir classification, Wyoming will evaluate the use of variables such as ecoregions, designated uses, lake depth, watershed size, and geology.

Nutrient criteria development for lakes and reservoirs will focus first on Class 2AB lakes and reservoirs because these waters tend to be larger and have public access as well as established fisheries and recreational uses. WYDEQ will consider geographic region, lake size, accessibility, and designated uses when prioritizing lakes and reservoirs for nutrient criteria development. However, it should be noted that many lakes and reservoirs in Wyoming might not have the size, designated uses, or accessibility to warrant a high prioritization for nutrient criteria development.

Streams and rivers can be more difficult to understand than lakes. Existing data might not be sufficient for evaluating waterbody classes for nutrient criteria development in streams and rivers. WYDEQ is collecting more stream and river data, including algal species composition and biomass as well as more accurate nutrient parameters (with lower detection limits). These new data will

provide more precise measurements of nutrients as well as response data and allow better evaluation of waterbody classifications.

Waterbody classification and nutrient criteria development for wetlands will proceed as the wetlands program is adequately funded to produce sufficient data.

In addition to considering natural waterbody classification schemes, WYDEQ will explore statistical approaches to relate nutrient criteria to ecological attributes, designated uses, and management goals.

Appropriate reference conditions can often improve the nutrient criteria that protect designated uses. If reference stations reflect minimally disturbed conditions and represent full support of the waterbody's designated uses, nutrient concentrations can be derived that protect attainable uses. WYDEQ identified a number of stream reference stations in each of Wyoming's Level III ecoregions for the purpose of developing biological indices (Figure 1). The EPA Western Ecological Monitoring and Assessment Program (WEMAP) sampled several reference stations in Wyoming. These stations represent least-impacted ecological conditions which will be used as the foundation for defining benchmarks of designated uses for nutrient criteria development. Statistical analyses to examine the relationships between nutrients, algal species composition and biomass, chemical conditions [e.g., DO] and aquatic life uses (e.g., biological indices) will help to identify these appropriate benchmarks for waterbodies' designated aquatic life uses.

If it is deemed impractical for Wyoming to develop numeric nutrient criteria for each class and waterbody type, narrative nutrient criteria might be appropriate.

### **4.3 Variables for Nutrient Criteria Development**

EPA recommends that nutrient criteria be developed for four primary water quality variables including two causative variables (i.e., TP and TN) and two response variables (i.e., periphyton chlorophyll *a* and turbidity for streams and rivers, and phytoplankton chlorophyll *a* and Secchi depth for lakes and reservoirs). A number of secondary variables such as DO, pH, and benthic macroinvertebrates also may be considered, but principally for use in identifying appropriate criteria for the primary variables. Monitoring of these secondary variables helps to evaluate causes and effects of eutrophication in waterbodies and could be used to establish nutrient criteria and benchmarks for specific regions and waterbodies.

For many waterbodies, WYDEQ has monitoring data on the four primary water quality variables, plus a number of secondary variables including DO, pH, and conductivity. In addition, WYDEQ has conducted assessments using benthic macroinvertebrates and periphyton, at a large number of targeted sites. Beginning in 2007, periphyton chlorophyll *a* will be monitored at many river and stream sites. In lakes and reservoirs, phytoplankton chlorophyll *a* and Secchi depth are being monitored by WYDEQ and as part of the National Lakes Survey. The variables for wetland monitoring and potential nutrient criteria development will be addressed at a later date.

For lakes and reservoirs, WYDEQ will examine TN, TP, Secchi depth, and phytoplankton chlorophyll *a* as possible indicators. For streams and rivers, criteria could be developed for TN and TP and possibly periphyton chlorophyll *a* and/or periphyton metrics. Turbidity is not expected to

be a useful nutrient indicator for streams and rivers because turbidity varies with geology, soils, land uses, weather events, flow manipulations, and other factors unrelated to nutrient concentrations.

Where defensible nutrient criteria can be developed, numeric translators of narrative criteria may be established first, followed by actual numeric criteria. If defensible numeric criteria cannot be developed, either narrative criteria or numeric translators of narrative criteria may be used in lieu of numeric criteria.

#### **4.4 Wyoming's Approaches to Nutrient Criteria Development**

##### *Lake and reservoir criteria*

WYDEQ will use a weight-of-evidence approach for developing lake and reservoir nutrient criteria including the following:

- (1) Identifying percentile-derived nutrient criteria using reference and non-reference data plotted as frequency distributions. Setzler and Richards (2003) compiled nutrient data of lakes and reservoirs in EPA Region 8. Their results, as well as comparable analyses using updated data sets, will be used as an initial line of evidence for Wyoming's lake and reservoir nutrient criteria development.
- (2) Applying and/or modifying established nutrient thresholds (e.g., nutrient effect thresholds or algal limits from scientific literature) and stressor-response relationships for each specific use class. Empirical relationships have been developed for TP, Secchi depth and chlorophyll *a* (Vollenweider 1968; Carlson 1977; Carlson and Simpson 1996). These empirical models will be evaluated for possible development of nutrient criteria.
- (3) Criteria recommended from literature-based analyses will be compared with values generated from reference-based and stressor-response analyses. The conclusions from these analyses will assist in determining the appropriateness of numeric criteria for lakes and reservoirs.

##### *Stream and river criteria*

Although WYDEQ intends to use a weight-of-evidence approach on the basis of all three approaches recommended by EPA, a reference approach will be evaluated first. Statistical stressor-response relationships between nutrient concentrations, periphyton metrics, and support of aquatic life and other designated uses will also be evaluated. Using these approaches combined with literature review and expert consultations, nutrient criteria may be developed for different classes of streams and rivers.

#### **4.5 Downstream Uses and Approach for Cross-jurisdictional Waterbodies**

The purpose of developing nutrient criteria is to protect all classes of Wyoming surface waters. However, downstream uses must be considered when evaluating nutrient criteria to ensure that they do not result in adverse nutrient loadings to downstream waterbodies. For many downstream waterbodies, this will require evaluation of downstream and upstream WQS for surrounding states and tribes.

Once preliminary nutrient criteria are developed, WYDEQ may establish a stakeholder group comprising state, tribal, and federal agencies to evaluate and ensure that potential criteria do not threaten uses in adjacent states and tribal lands. WYDEQ is participating in the Regional Technical Advisory Group that includes representatives from EPA Region 8 office and Region 8 states. WYDEQ will also continue to attend regional and national nutrient criteria meetings, when possible, to learn about approaches used by other states and tribes, share Wyoming's nutrient criteria developments, and potentially incorporate findings and feedback where appropriate.

## 5.0 DATA CONSIDERATIONS

### 5.1 Inventory of Existing Data

WYDEQ will develop a database to store existing nutrient variables and other parameters to classify waterbodies. This database will include data on nutrients and other water quality parameters, as well as biological assemblages (i.e., algal, benthic macroinvertebrate, and fish biomass and composition). Reference stations will be identified.

The EPA legacy STORET and modernized STORET databases have nutrient data for Wyoming (Appendix 1). The U.S. Geological Survey (USGS) National Water Information System (NWIS) includes samples from Wyoming. Other sources of nutrient and biological data include the University of Wyoming (UW) and Utah State University (USU). Additional data exists from the U.S. Bureau of Reclamation (USBOR), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), U.S. Forest Service (USFS), U.S. National Park Service (USNPS), and/or the U.S. Bureau of Land Management (USBLM).

#### *Lakes and reservoirs*

A limited amount of nutrient data exists for lakes and reservoirs in Wyoming. The modernized STORET database contains information collected by the USBOR, USNPS, and USU. USGS, WYDEQ and EPA have also collected some nutrient-related data for lakes and reservoirs in Wyoming. However, these data were analyzed with higher detection limits, which could limit their usefulness. For example, a number of samples (approximately 300) with TP values were measured below 40 µg/L (recommended national nutrient ecoregion criteria for lakes within Wyoming range between 8 to 33 µg/L). Data in the USGS NWIS database were measured in the 1970s and 1980s, and most were reported at detection limits, which must be confirmed. Compared with phosphorus, nitrogen data may be more useful. Detection limits were 10 µg/L for nitrate+nitrite, 50 µg/L for ammonia, and 1 milligram per liter (mg/L) for total kjeldahl nitrogen (TKN).

In addition to the variables listed in Appendix 1, there are additional nutrient variables, such as total dissolved phosphorus and suspended nutrient concentrations, but these are less frequently available in the NWIS and STORET databases.

### *Streams and rivers*

Nutrient and biological parameters have been collected in a number of streams and rivers in Wyoming by various programs (Appendix II). WYDEQ has collected a large number of nutrient and biological samples statewide; however, the high reporting limits for nutrients limits the usefulness of the majority of the samples. The majority of USGS NWIS data were collected from 1946 to 2005. In addition, nutrient samples from three stations have been collected since the early 1900s by various USGS programs.

The variables collected and their data quality (e.g., detection limits) vary among programs. Data in legacy STORET were collected from 1990 to 1997 compared to modernized STORET containing data collected between 1976 and 2004. Many data from the legacy STORET are similar to samples within the modernized STORET data set but have small differences in the record (e.g., sampling date). STORET data were collected by seven agencies, including USBOR, EPA National Aquatic Resource Survey, EPA WEMAP, Montana Department of Environmental Quality (MDEQ), USNPS, Utah Department of Environmental Quality (UDEQ), and WYDEQ. USU sampled 35 reference sites for water chemistry (including TP and nitrate+nitrite) and 18 reference sites and 53 non-reference sites in Wyoming for nutrient and biological data (periphyton and benthic macroinvertebrates). UW obtained continuous nutrient measurements (with low detection limits) at a limited number of Wyoming streams from 1999 to 2007. The total number of samples from USU and UW is unknown.

### **5.2 Identifying Data Gaps and Collecting New Data**

Although the number of existing samples in the databases is large, it is recognized that a number of data quality issues and the spatial and temporal distribution of data will likely reduce the number of samples that can be used in the final analysis. Some of the issues that need to be addressed include repeat samples collected at the same station, samples collected at different times along the streamflow hydrograph, and the use of different analytical methods and detection limits for nutrient variables. The ability to conduct stressor-response analyses is dependent on having an adequate number of sites with concurrent data for both nutrients and response variables.

Ecoregion and waterbody classes are an important tool for developing nutrient criteria. Some areas of Wyoming have relatively little data compared to others (Figure 1). Both EPA WEMAP and WYDEQ have spatially distributed reference sites in each of the seven Level III ecoregions in Wyoming. WYDEQ will compile the existing data into a spatially referenced database so that gaps can be identified and mitigated with ongoing and additional nutrient sampling.

### **5.3 Data Quality Objectives**

Data will continue to be collected as part of the nutrient criteria development process and regular water quality surveys. As data sets are reviewed for nutrient criteria development, data gaps will be identified for consideration in future sampling activities. WYDEQ's monitoring program will continue to focus on reference and non-reference sites for various classes and waterbody types. A suite of nutrient, biological, and physical variables will be measured concurrently.

Periphyton biomass and species composition can be important response variables linking both nutrient criteria and designated uses. In 2007 Wyoming began collecting periphyton and

chlorophyll *a* in streams and rivers. Historically, WYDEQ did not collect TN but now includes this parameter in its routine sample analysis. WYDEQ has improved its detection limit for TP from 100 µg/L to 10 µg/L. The detection limit for nitrate/nitrite was also improved to 30 µg/L from 100 µg/L. These changes will improve the quality of data for nutrient criteria development.

Samples will be collected and processed in accordance with methods documented in an approved Quality Assurance Project Plan (QAPP) and associated Standard Operating Procedures (SOP). The quality assurance and quality control (QA/QC) procedures in the QAPP will include the collection and analysis of replicate water samples, adherence to calibration methods, and taxonomic verification of a subset of periphyton and benthic macroinvertebrate samples. More detailed data quality objectives (DQOs) will be developed as needed for nutrient criteria development projects.

## **6.0 SCHEDULE OF NUTRIENT CRITERIA DEVELOPMENT**

### **6.1 Schedule and Milestones for Lakes and Reservoirs**

2008-2010

- Inventory of existing lake and reservoir data
- Data compilation into integrated database
- Literature review for lake and reservoir nutrient criteria

2011

- Analysis of existing lake and reservoir data
- Design and implementation of additional data collection for lakes and reservoirs

2012

- Additional lake and reservoir sampling

2013

- Develop proposed lake and reservoir nutrient criteria

2015

- Stakeholder Review of Lake and Reservoir Nutrient Criteria

### **6.2 Schedule and Milestones for Streams and Rivers**

2008-2010

- Inventory of existing data
- Data compilation into an integrated database
- Ongoing sampling of streams and rivers

2011

- Continue sampling of streams and rivers
- Analysis of existing data
- Design and implementation of supplemental data collection

2012

- Continue sampling of streams and rivers
- Evaluation of other stream and river classes (large rivers)
- Design and implementation, if needed, of sampling program for other stream and river classes

2012–2013

- Continue sampling of streams and rivers

2014

- Develop proposed nutrient criteria for wadeable streams and rivers

2015

- Stakeholder review of nutrient criteria for wadeable streams and rivers
- Continued sampling as needed

## **7.0 OTHER CONSIDERATIONS**

### **7.1 Administrative Procedures and Processes (Appendix 3)**

Adopting criteria into the Wyoming Surface WQS requires formal rule making, which is an involved process (see Appendix 3). Numerous public meetings and hearings before the Water and Waste Advisory Board and the Environmental Quality Council (EQC) typically require more than two years before a proposed rule is finalized. After the EQC adopts the rule, it is sent to the attorney general (AG) for a letter of compliance. The AG submits the rule and letter of compliance to the governor. If he or she approves the rule, the governor signs it, and the rule package is sent to the secretary of state for certification. The rule is then formally submitted to EPA Region 8 for approval or disapproval.

### **7.2 Stakeholder Input and Public Participation**

Public participation is a regular part of the process for development of nutrient criteria to be included in Wyoming's Surface WQS (see Appendix 3). The public will be encouraged to participate at various stages of standards development through mailings, newspaper notices, and by posting drafts of any changes to the standards on the WYDEQ Web site.

### **7.3 Regional Technical Assistance Group (RTAG) Coordination**

The WYDEQ has participated in and will continue to participate in Regional Technical Assistance Group (RTAG) meetings. Communications and coordination with EPA Region 8 staff and other participants in the RTAG group have been ongoing and will likely continue in the future.

### **7.4 Scientific Review**

Scientific peer review will be conducted for all subsequent nutrient criteria development, as stated in the analytical approaches above. Wyoming will likely obtain assistance from EPA Region 8 and possibly arrange for a review of criteria from national nutrient experts.

### **7.5 Other Issues**

The availability of resources for monitoring, lab analysis, and data analysis will affect nutrient criteria development in Wyoming. WYDEQ will continue to seek support from EPA to fund some of the monitoring and data analysis. WYDEQ will use EPA labs as needed to analyze chlorophyll *a* and biomass samples.

Adopting nutrient criteria into Wyoming's Surface WQS may occur once implementation issues (such as permit limits) are addressed and supported by the various stakeholders.

## 7.6 Anticipated Costs and Staffing Requirements

The cost estimate shown here is approximate and will be affected by a variety of factors. Especially approximate were the costs for additional data collection, since it remains to be seen how much additional data will be required. The tasks were organized from the timeline and separated by waterbody type. With the exception of additional data collection, which will require a team of staff scientists, most of the work here would take approximately 2,000 hours to complete over the approximately 5–8 year time frame. This is essentially a one-fifth to one-quarter time position averaged over the entire time frame, realizing that some years would require more time than others.

**Table 3. Cost estimate**

<b>Task</b>	<b>Lakes and reservoirs</b>	<b>Streams and rivers</b>	<b>Large rivers</b>
Inventory data	\$12,000	\$12,000	\$12,000
Data compilation	\$50,000	\$50,000	\$25,000
Design of additional data collection	\$20,000	\$20,000	
Literature review	\$30,000		
Additional sampling	\$45,000–55,000/year	Already being collected as part of monitoring program	\$45,000–55,000/year
Analysis of historical data	\$50,000	\$50,000	\$50,000
Analysis of existing data	\$50,000	\$50,000	\$50,000
Evaluation of other stream classes			\$16,000
Develop proposed criteria	\$20,000	\$12,000	\$12,000
Public review/comment	\$10,000	\$10,000	\$10,000
<b>Total</b>	\$242,000 (not including additional sampling)	\$204,000	\$175,000 (not including additional sampling)

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## Appendices

### Appendix 1. Data available for lake and reservoir nutrient criteria development in Wyoming.

Nutrient related variables in lakes and reservoirs and total number of samples collected in Wyoming that are housed in the STORET, USGS NWIS, and WYDEQ databases. Data in the NWIS database were collected from 1964 to 2003. Data in the STORET database were collected between 1981 and 2004.

**Table A-1. Available lake and reservoir data**

Characteristic name	Legacy STORET		Modernized STORET		USGS NWIS		WYDEQ	
	Number of sites	Number of samples	Number of sites	Number of samples	Number of sites	Number of samples	Number of lakes/reservoirs (actual sites)	Number of samples
Fecal coliform			9	15	1	1		
Nitrogen as ammonia	7	114	11	99	35	182	15 (85)	229
Nitrogen as TKN	4	14	11	22	27	123		
Nitrogen as Nitrite+Nitrate			25	139	66	363	15 (85)	229
Nitrogen as TN					22	118		
Phosphorus as TP	11	119	42	391	36	145		
Phosphorus as orthophosphate			8	15	22	155	15 (85)	229
Phytoplankton biomass	6	41	17	17	21	177	15 (79)	157
Turbidity	3	14	12	96				
pH			142	634			15 (85)	229
DO	10	47	88	531			15 (85)	164

**Appendix 2. Data available for stream nutrient criteria development in Wyoming.**

Nutrient and biological parameters have been collected by various programs in a number of Wyoming streams and rivers. Data in the USGS NWIS database were collected from 1905 to 2005. Data in the modernized STORET database were collected between 1976 and 2004. Data in the legacy STORET database were collected from 1990 to 1997. USU collected water chemistry data from 2000 to 2003. UW also had more recent data, especially nitrogen data, since 1999 in a number of Yellowstone sites. The total number of samples is unknown from USU and UW. The detection limits for nutrients vary according to sampling date, sampling methods, different projects and different agencies.

**Table A-2. Available streams and river data**

Characteristic name	Legacy STORET			Modernized STORET			USGS NWIS			USU			UW		WYDEQ	
	Number of sites	Number of samples	Number of sites	Number of sites	Number of samples	Number of sites	Number of samples	Number of sites	STAR program sites	WEMAP program sites	Number of sites	Number of sites	Number of sites (reference sites)	Number of sites (reference sites)	Number of samples (reference sites)	
DO	360	1,243	575	1,299					*	*			900 (175)	1,319 (386)		
Fecal coliform			85	628					*	*						
pH			1,562	2,976					*	*			904 (175)	1,332 (1,332)		
Turbidity	307	467	622	1,415					*	*			893 (175)	1,318 (387)		
Nitrogen as ammonia	48	612	135	499		733	4,928		*	*	11		55 (7)	55 (7)		
Nitrogen as TKN	62	1,393	18	330		903	9,287		*	*						
Nitrogen as TN	6	103	5	165		297	3,983		*	*	11					
Nitrogen as Nitrite	49	682				180	3,229		*	*						
Nitrogen as Nitrate			146	587		484	18,300		*	*						
Nitrogen as Nitrite+Nitrate	128	626	174	329		803	12,093		35 (35)	71 (18)	11		890 (175)	1,304 (388)		
Phosphorus as TP	134	1,777	237	986		717	16,821		35 (35)	71 (18)			890 (175)	1,304 (387)		
Phosphorus as orthophosphate	6	77	50	483		828	4,977		*	*						
Phytoplankton, total, cells per milliliter						219	1,125									
Periphyton Biomass as Dry Mass or Ash Free Dry Mass			*	*		64	210		35 (35)	71 (18)						
Chlorophyll a, periphyton			*	*		47	170		35 (35)	71 (18)			133 (42)	136 (45)		
Chlorophyll a, phytoplankton						64	241						133 (42)	136 (45)		
Periphyton, species																
Fish			77	81												
Benthic Macroinvertebrates			380	478					35 (18)	71 (18)			1003 (215)	1,344 (403)		
Invertebrates, benthic, wet weight						87	129									

\* The numbers of samples are uncertain because they were not present in databases; however, the parameters were collected by these programs.

### **Appendix 3. WYDEQ Rules Promulgation**

Procedures for promulgating rules as proposed by WYDEQ require following both the Agency's procedures and steps set forth in the Administrative Procedures Act. The process for promulgating a rule includes making the proposed rule available for public comment before advancing through the Water and Waste Advisory Board (WWAB), the Environmental Quality Council (EQC) and being signed by the governor. Following is a summary of the process that would be followed upon proposing promulgation of a Nutrient Criteria Rule.

All rules begin by preparing the draft rule and a statement of principal reasons (SOPR) for review and comment by the program administrator and director and may also go to the Division assistant attorney for additional consultation.

After the director approves of the draft rule and the SOPR, public outreach is mandatory for all water quality rules. This is done by preparing an outreach document through various outlets including posting on the WYDEQ website and providing a 30-day notice for solicitation of comments in a newspaper with statewide distribution. A public meeting is held after the completion of the 30-day comment period to receive any additional comments. Any revisions to the rule package must first be approved by the division administrator with any input given by the division's assistant attorney before going to the WWAB for evaluation.

Notice of the WWAB meeting schedule is mailed to each interested party, posted on the Agency Web site, and placed in a public newspaper with state wide distribution at least 30 days before the meeting. At the meeting, the WWAB hears WYDEQ's recommendation, takes public comment, and determines whether the recommended rule and SOPR should be advanced to the EQC or revised and brought back for additional consideration. If the WWAB requires additional consideration by the WYDEQ, the WWAB comments are incorporated, a new meeting is scheduled, and additional public notice is given.

When the WWAB is satisfied with the proposed rule or has made any countering recommendations, the administrator/director will prepare a memo to proceed with formal rule adoption. The proposed rule is then sent to the governor for consideration and any additional changes. After the governor's comments are incorporated into the rule, the director recommends adoption of the proposed rule to the chairman of the EQC.

The EQC will hold a public hearing on the proposed rule after at least 45 days public notice to hear a discussion on the rule and to take public comments. At the end of the hearing, the EQC may choose to keep the record open for additional comments or chose to close the record and set a regular meeting to consider adopting, rejecting, or modifying the rule and SOPR.

Upon adoption and signature of the rule and SOPR by the EQC, a final rule package is completed for review by the Legislative Services Office (LSO) and the governor. If the rule package is approved by the governor after consideration is given by the LSO, the rule package is then sent to the secretary of state's office to be filed. During this process, the governor can choose to approve the rule as submitted or veto the rule, or portions of the rule, within 75 days from the time the

director signs the certification page. The rule becomes effective after the governor signs the certification page and it is stamped by the secretary of state's office.

The entire process generally takes at least 2 years and often more than 3 years for controversial rule makings.

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