Disclaimer:
This initial draft circular is being provided for consultation purposes with the Nutrient Work Group. This is a preliminary document for review and may undergo changes based upon Nutrient Work Group input or other considerations prior to proposal through formal rulemaking procedures.

The formal rulemaking process under Title 2, Chapter 4, Part 3, MCA, which includes a notice of proposed rulemaking, hearing, and formal comment period has not yet commenced. Prior to final rule adoption, the public will be afforded the opportunity to submit data, views, or arguments orally or in writing and DEQ must fully consider all public comments on the proposed rule.

Circular DEQ-15: Draft 3

Implementation of Narrative Nutrient Standards and Implementation of the Adaptive Management Program

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Acronyms

AMP	Adaptive Management Plan
ARM	Administrative Rules of Montana
ARP	Alternative Restoration Plan
DO	Dissolved Oxygen
DSS	Decision Support System
EPA	United States Environmental Protection Agency
HUC	Hydrological Unit Code
LA	Load Allocation
MCA	Montana Code Annotated
MPDES	Montana Pollutant Discharge Elimination System
TDG	Total Dissolved Gas
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USGS	United States Geological Survey
WLA	Waste Load Allocation

1.0 INTRODUCTION

In 2021 the 67th Montana Legislature adopted Senate Bill 358, which described a new process for implementing narrative standards for nutrients in permits. The Montana Legislature also directed the department to eliminate the numeric nutrient criteria that had been adopted for total phosphorus (TP) and total nitrogen (TN)in Circular DEQ-12A. The numeric criteria in Circular DEQ-12A applied to wadeable streams across Montana as well as portions of the Yellowstone River. Circular DEQ-12A criteria were not applicable to Montana's remaining large rivers, lakes, reservoirs, or other state surface waters, all of which remained subject to Montana's narrative nutrient standards.

The narrative nutrient standards at Administrative Rules of Montana (ARM) 17.30.637(1) — "State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will: (e) create conditions which produce undesirable aquatic life" — are the primary narrative standards the department uses to regulate the impacts of excess phosphorus and nitrogen in state waters. These narrative nutrient standards now apply to all state surface waters, including those previously covered under Circular DEQ-12A. This circular provides a method to interpret the narrative nutrient standards and provides additional requirements related to the implementation of an adaptive management program.

While the narrative nutrient standards remain unchanged, 75-5-321, MCA, now requires the department to adopt rules allowing for the use of an adaptive management program when implementing the narrative standards. The adaptive management program is an incremental, watershed-based approach for protecting and maintaining water quality affected by excess nutrients. An important element of the adaptive management program is that it allows different nutrients (phosphorus vs. nitrogen) and nutrient sources to be addressed separately and incrementally over time by incorporating flexible decision-making which can be adjusted as management actions and other factors become better understood in each watershed.

Implementation of narrative nutrient standards via the adaptive management program and other regulatory pathways is shown in **Figure 1-1**. The department will evaluate each point source with nutrients as a pollutant of concern for reasonable potential to cause or contribute to an exceedance of the narrative nutrient standards. For point sources with reasonable potential, adaptive management can be used by the department to prioritize phosphorus reduction, where appropriate. Reduction of phosphorus is the initial phase of adaptive management and will be implemented if appropriate (see decision point in upper middle of **Figure 1-1**). If phosphorus control is successful in protecting receiving water body beneficial uses and downstream uses, ongoing monitoring is required but additional nutrient controls are not. If phosphorus-focused control is not successful in protecting water quality and beneficial uses, then phosphorus *and* nitrogen controls are implemented. Nitrogen sources in watersheds are often dispersed among different sources and adaptive management at this stage allows permittees to examine the potential for effective reduction of nutrients in their watershed in an iterative manner (see circular component in lower right area of **Figure 1-1**). The entire process is adaptive in that it allows for an incremental approach (phosphorus focus first, then nitrogen) and incorporates flexible decision-making which can be adjusted as management actions and other factors become better understood in each watershed.

An adaptive management plan (AMP) is a watershed-specific plan developed under the broader adaptive management program. Note that adaptive management is a complex, iterative process with the potential for feedbacks which may not all be presented in **Figure 1-1**.

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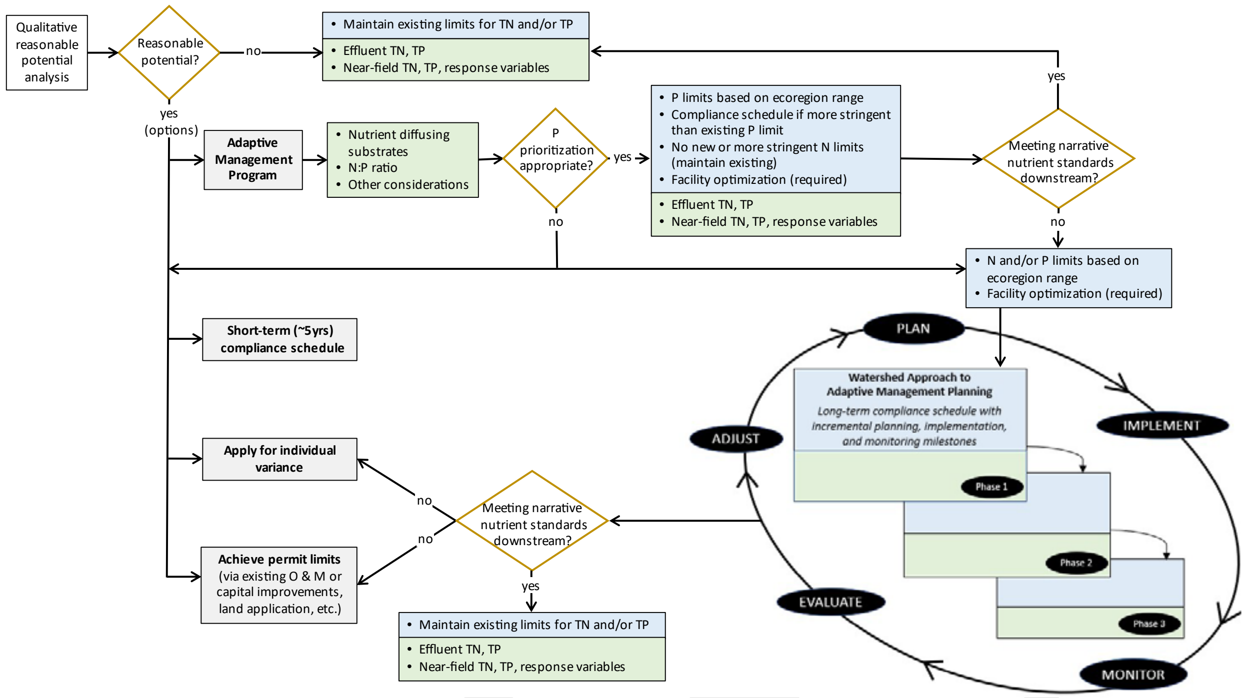

Figure 1-1. Flowchart Outlining Implementation of Narrative Nutrient Standards and Steps Leading to the Adaptive Management Program and Other MPDES Permit Compliance Options. In the colored boxes blue areas describe permit limits and conditions, green areas indicate monitoring requirements. Key decision points in the figure are diamond shaped.

As noted, **Figure 1-1** also addresses permittees who need or choose to select other regulatory tools instead of adaptive management to achieve the narrative nutrient standards. These additional tools include water quality standard variances and compliance schedules. These options have separate and distinct rules and regulations that are not included in this circular.

The department adopted this circular in conformance with the statutory requirements found in 75-5-321, MCA. This circular contains adaptive management implementation requirements for Montana's narrative nutrient standards found at ARM 17.30.637(1)(e) for point sources whose discharges contains total phosphorus and/or total nitrogen that has the reasonable potential to cause or contribute to an exceedance of the narrative nutrient standards. This circular is applicable only to the implementation of these narrative nutrient standards. The methods, implementation process, and department approach described in this circular are not applicable to any other department circular water quality standards including but not limited to nitrate + nitrite and ammonia.

1.1 Definitions

Adaptive Management Plan (AMP) means a watershed-specific plan developed under the adaptive management program to achieve the narrative nutrient standards and address nutrients in a specific watershed. An adaptive management plan includes a watershed monitoring plan and, if required, an implementation plan.

Adaptive Management Program means a watershed-scale program that protects water quality from the impacts of nutrient sources by: (a) prioritizing phosphorus reduction, as appropriate, while accounting for site specific conditions; (b) allowing for nutrient sources to be addressed incrementally over time by incorporating flexible decision-making which can be adjusted as management actions and other factors become better understood; (c) reasonably balancing all factors impacting a waterbody while considering the relative cost of treatment options, their feasibility, and their expected water quality improvement; (d) identifying specific nutrient reduction requirements, and (e) setting as its goal the protection and achievement of beneficial uses of the waterbody.

Far Field Sites means, for purposes of an adaptive management plan, instream sampling locations placed throughout the adaptive management plan watershed for the primary purpose of characterizing nutrient loads entering and exiting the watershed.

Large River means a perennial waterbody which has, during summer and fall baseflow (August 1 to October 31 each year), a wadeability index (product of river depth [in feet] and mean velocity [in ft/sec]) of 7.24 ft^2 /sec or greater, a depth of 3.15 ft or greater, or a baseflow annual discharge of 1,500 ft^3 /sec or greater. See also, **Table 2-1**.

Medium River means a perennial waterbody in which much of the wetted channel is unwadeable by a person during baseflow conditions.

Near Field Sites means, for purposes of an adaptive management plan, instream sampling locations near a point source discharge that (a) downstream of the point source represent segments of the stream directly under the influence of the point source's effluent and (b) upstream of the point source represent segments of the stream uninfluenced by the point source but having similar physical characteristic to the downstream location(s) in terms of gradient, flow, baseflow water depth, substrate, and stream shading.

Wadeable Stream means a perennial or intermittent stream in which most of the wetted channel is safely wadeable by a person during baseflow conditions.

2.0 Identify Waterbody Size

For purposes of developing an adaptive management plan (AMP), each point source receiving waterbody must be identified as a wadeable stream, medium river, or large river (see **Section 4.4** if discharging to or affecting a lake or reservoir). **Figure 2-1** is a guide to different sections of this document, depending on water body size; each section provides detail on the indicated subject.

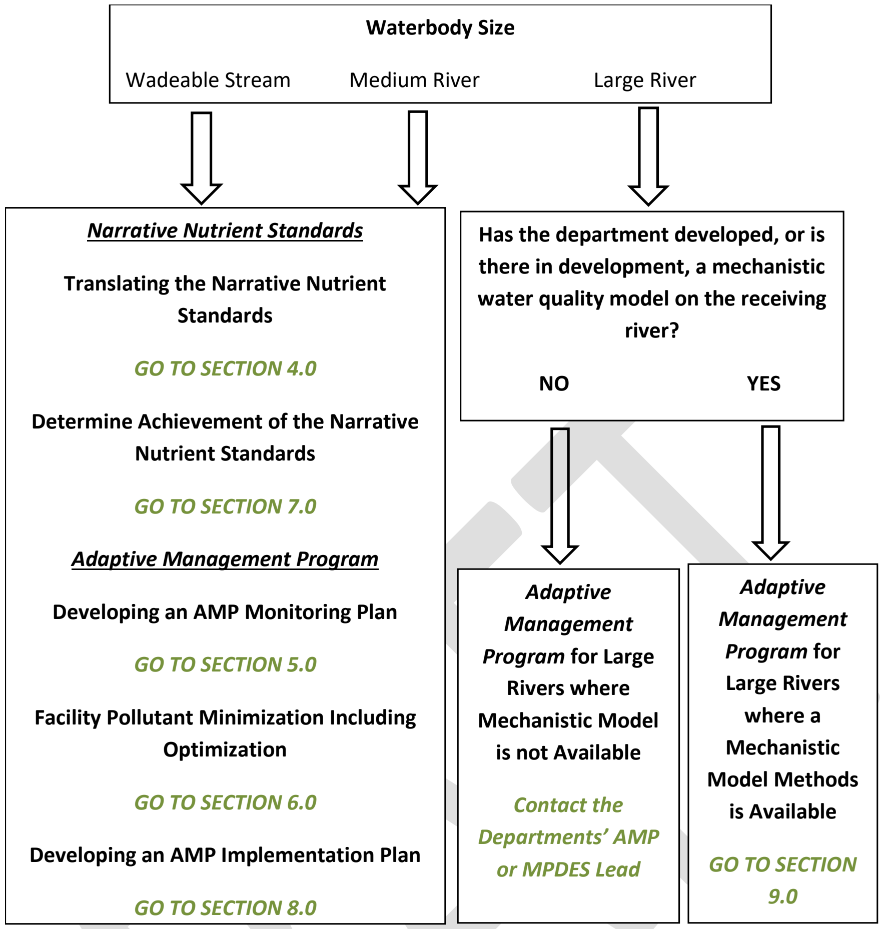

Figure 2-1. Guide to Sections in this Document Applicable to Different Topics as Appropriate for Different Sized Waterbodies

Permittees should refer to definitions in **Section 1.1**, the list of large rivers in **Table 2-1** below, and any other current department guidance when determining the size of their receiving water body.

Permittees on a large river should consult with the department as to the status of mechanistic modeling on the river segment they discharge to and then go to **Section 9.0**. Where models are developed or are being developed, modeling shall be used to examine the effects simulated point- and nonpoint-source pollution management activities will have on a waterbody's beneficial uses and water quality (**Section 9.0**). **Please note that permittees on medium rivers and wadeable streams are not precluded from developing and using a water quality model for their AMP.** However, developing water quality models is resource intensive, therefore this document provides simpler, more direct methods for developing and applying an AMP for medium rivers and wadeable streams. If an MPDES permittee or permittees on a wadeable stream or medium river chooses to develop a water quality model for their receiving waterbody, refer to **Section 9.0.**

For large rivers where a mechanistic model has not been developed and a model is not currently under development, the adaptive management program may follow a process similar to that for wadeable streams and medium rivers (phosphorus control first); however, the applicable water quality standards, response variables measured, and considerations about where to place monitoring sites may be different from smaller waterbodies. Permittees on large rivers where models are not developed nor are currently under development should consult with the department on developing an AMP and are advised to consider any current department guidance.

In circumstances where the receiving waterbody size or characteristics are not appropriately addressed by the sections in this circular, permittees must contact the department for guidance on developing an appropriate site-specific AMP.

Table 2-1. Large River Segments within the State of Montana

River Name	Segment Description
Big Horn River	Yellowtail Dam to mouth
Clark Fork River	Bitterroot River to state-line
Flathead River	Origin to mouth
Kootenai River	Libby Dam to state-line
Madison River	Ennis Lake to mouth
Missouri River	Origin to state-line
South Fork Flathead River	Hungry Horse Dam to mouth
Yellowstone River	State-line to state-line

3.0. Determining if Phosphorus Prioritization is Appropriate for the Point Source and the Waterbody

Section 75-5-321, MCA, requires the department to prioritize the minimization of phosphorus in a watershed where appropriate, accounting for site-specific conditions. NEW RULE I (2)(a) provides considerations the department must consider when evaluating if phosphorus prioritization is appropriate for a discharge facility. This section provides additional detail to support requirements in the rule.

3.1 Techniques for Identifying the Limiting Nutrient in a Waterbody

Nutrient diffusing substrates provide a mechanism to determine if phosphorus, nitrogen, or both control algae growth and primary productivity in a location of a stream or river. Nutrient diffusing substrates may be deployed in flowing waterbodies for the purpose of determining the limiting nutrient(s). The ratio of TN to TP (i.e., the Redfield Ratio) of ambient water samples from the waterbody may also be used to inform this analysis, but water TN:TP ratios should be used in conjunction with (not as an alternative to) nutrient diffusing substrates.

Diffusing substrates may be deployed upstream and downstream of a facility in the same locations where other instream data are collected (more on these locations in **Section 5.0**). Results from nutrient diffusing substrates deployed downstream of a point source should be considered together with the status of phosphorus and nitrogen treatment and effluent concentrations from the facility. Downstream of a discharge, a receiving waterbody (via diffusing substrate data) could show nitrogen limitation but, rather than reducing nitrogen concentrations in the effluent, it might be effective (from a cost and engineering perspective) to first lower facility effluent phosphorus concentrations and—as a result—move the waterbody towards P limitation and reduction of nuisance algae growth, etc. Permittees are advised to consider any current department guidance on this subject.

In areas of the state where nitrogen is the primary limiting nutrient (e.g., in the Absaroka-Gallatin Volcanic Mountains level IV ecoregion in **Table 4-2**, where natural background phosphorus is already at saturating concentrations), nitrogen control will likely be required in addition to phosphorus control. Some MPDES permits regulate activities where total nitrogen is present in the effluent, however total phosphorus is absent. For these circumstances, the department shall limit total nitrogen rather than total phosphorus, when necessary.

4.0 WADEABLE STREAMS AND MEDIUM RIVERS: TRANSLATION OF THE NARRATIVE NUTRIENT STANDARDS

The narrative nutrient standards at ARM 17.30.637(1)(e) are translated into actionable measures in order to implement the standards into MPDES permits and other department programs. **Table 4-1** shows the instream nutrient causal and instream response variable parameters, applicable to different beneficial uses and regions of the state, that must be measured in order to translate the narrative nutrient standards. **Section 5.0** provides details on collecting these data and **Section 7.0** presents details on interpreting these data as applicable to MPDES permittees under the adaptive management program. Department programs (e.g., MPDES Permitting, Monitoring and Assessment, Total Maximum Daily Load (TMDL)) must use these parameters to translate the narrative nutrient standards but may have program-specific data compilation and analysis methods appropriate for their purposes and documented in their respective work units.

Several response variable and thresholds are under development and will be updated when completed (projected completion: Spring 2023).

Table 4-1. Components of the Narrative Nutrient Standards Translator. An "X" indicates the parameter applies and is required to be measured at monitoring sites in an AMP monitoring plan and for department programs translating the narrative nutrient standards.

			Response Variable (threshold)			
Ecoregional Zone	**Associated Benefical Use**	**Nutrient Causal Variables (*see* nutrient concentration ranges, by ecoregion)**	**DO Delta**	**Benthic Chl*a* ; AFDW**	**% filamentous algae bottom cover**	**Macroinvertebrates**
Western and transitional ecoregions	Recreation	**X**		**X** (150 mg Chla/m^2; 35 g AFDM/m^2)	**X** (30% cover)	
Western and transitional ecoregions	Aquatic Life	**X**	**X** (TBD)			**X** (metrics, thresholds TBD)
Western and transitional ecoregions, high gradient streams (>1% slope)	Aquatic Life	**X**				**X** (metrics, thresholds TBD)
Eastern ecoregions	Aquatic Life	**X**	**X** (5.3 mg DO/L)			**X** (metrics, thresholds TBD)

4.1 Translation of the Narrative Nutrient Standards Varies by Geographic Zone

Table 4-1 indicates that ecoregional zones (i.e., ecologically similar geographic areas) are used to segregate the applicable nutrient concentration and response variable data used to translate the narrative nutrient standards. Ecoregional zones are made up of ecoregions or parts of ecoregions (ecoregions are discussed next). For purposes of this circular, two broad ecoregional zones are identified (**Figure 4-1**)[1].

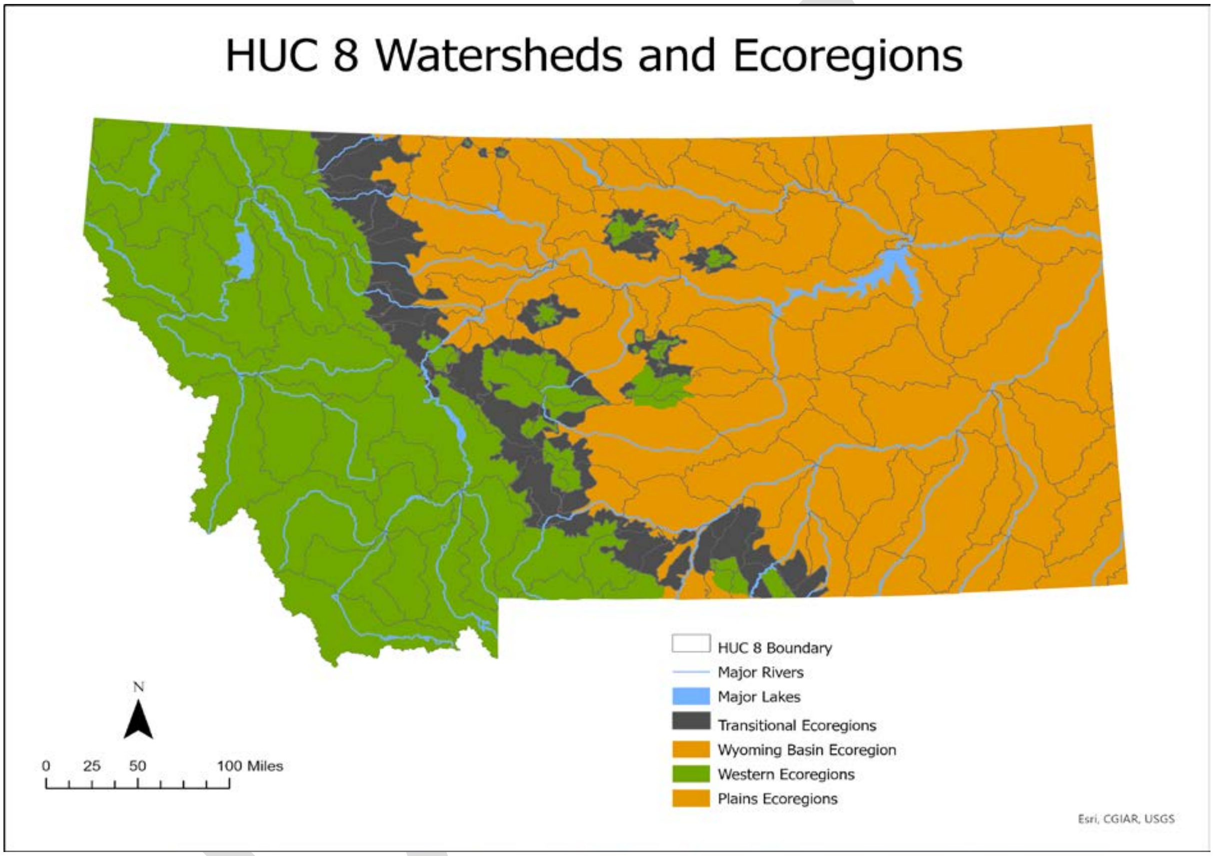

Figure 4-1. Ecoregional Zones in Montana, along with 8-digit Hydrologic Unit Codes (HUC) Boundaries. For purposes of this circular, the green and dark gray areas comprise a western ecoregional zone, the dark orange area an eastern ecoregional zone.

In **Figure 4-1,** the western and transitional ecoregions (green and dark gray areas) comprise a single western ecoregional zone, while an eastern ecoregional zone (in orange) comprises the second.

Wadeable streams and medium rivers in each zone typically display the following general characteristics:

Western Ecoregional Zone streams are those that are usually perennial and generally clear during summer/fall base flow, have moderate gradient, are mostly gravel- to cobble-bottomed, comprise a pool-riffle-run series longitudinally, have limited macrophyte populations, and generally support a salmonid fish population. This zone has a high degree of geographic overlap with Montana's A-1 and B-1 waterbody classifications (see ARM 17.30.607 through 613).

Eastern Ecoregional Zone streams are those that are low-gradient and which may become intermittent during summer/fall baseflow, often have deep pools even when intermittent, commonly have a mud bottom, may be quite turbid, are often very sinuous, frequently have substantial macrophyte populations including near-bank emergent macrophytes, often have filamentous algae but sometimes only phytoplankton algae (i.e., a green color to the stream water), and generally support warm-water fish species (e.g., green sunfish, black bullheads, silvery minnows, etc.). This zone has a high degree of geographic overlap with Montana's B-2, B-3, and C-3 waterbody classifications (see ARM 17.30.607 through 613).

Ecoregions are geographic areas representing relatively uniform aquatic ecological environments[2] including ambient stream nutrient concentrations, macroinvertebrate populations, and diatom algae populations. Ecoregions must be based on the 2002 version (version 2) of the U.S. Environmental Protection Agency map which is found at: https://www.epa.gov/eco-research/ecoregion-download-files-state-region-8#pane-24. Ecoregions are hierarchical; level III ecoregions cover large geographic areas which transcend Montana's state borders and comprise multiple level IV (small-scale) ecoregions (**Figure 4-2**).

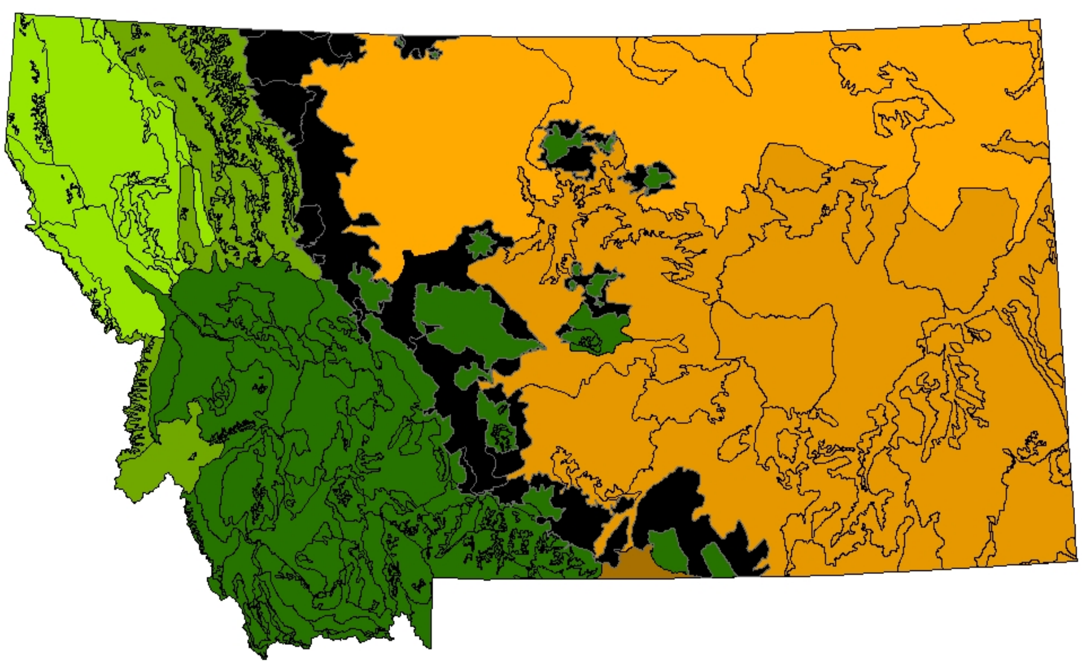

Figure 4-2. Ecoregions in Montana. Coarse-scale level IIIs are shown as green- or orange-colored areas, while small-scale level IVs are outlines within those. The black area represents transitional areas along the Rocky Mountain Front and is comprised of a series of level IV ecoregions.

4.2 Nutrients: The Causal Variable

Table 4-1 shows that nutrients—the causal variables that must be measured as part of the narrative nutrient standards translation—are applicable as ranges, by ecoregion. The department carried out, compiled, and reviewed scientific literature and its own studies[3,4,5,6] which demonstrate that total phosphorus (TP) and total nitrogen (TN) concentrations protective of aquatic life and recreation beneficial uses vary across the state (ecoregion by ecoregion). The ranges of TP and TN concentrations that protect these beneficial uses are provided in **Table 4-2** and organized by ecoregion. Similarly, the department uses stream hydrograph and biological patterns to identify appropriate index periods applicable to wadeable streams and medium rivers for each ecoregion[3,4]. Montana streams and rivers are generally most vulnerable to excess nutrient impacts during the summer and early fall baseflow months, therefore values derived from the ranges in **Table 4-2** shall be applied seasonally, at a minimum, per the applicable time periods in **Table 4-2.** To identify the ecoregion applicable to a point source, start at the smallest geographic scale (column three from the left) and determine if the point source discharge is located in one of the listed level IV ecoregions. If it is not, then the nutrient ranges applicable to the larger-scale level III ecoregion (column two) applies.

Table 4-2. TP and TN Concentration Ranges for Specific Ecoregions that Protect Aquatic Life and Recreation Beneficial Uses. Also shown are the time periods when values derived from the ranges should be applied, at a minimum.

			Maximum Recommended Range		Applicable Time Period	
Ecoregional Zone	**Ecoregion (Level III)**	**Ecoregion (Level IV)**	**Total Phosphorus (µg/L)**	**Total Nitrogen (µg/L)**	**Start of Growing Season**	**End of Growing Season**
Western	Northern Rockies (15)	all	20 - 40	210 - 1,210	July 1	Sept. 30
Western	Canadian Rockies (41)	all	23 - 62	325 - 821	July 1	Sept. 30
Western	Idaho Batholith (16)	all	20 - 62	210 - 718	July 1	Sept. 30
Western	Middle Rockies (17)	all except 17i	20 - 40	210 - 1,210	July 1	Sept. 30
Western	Middle Rockies (17)	Absaroka-Gallatin Volcanic Mountains (17i)	61 - 105[b]	Use values from the lower end of the range for the Middle Rockies (17)	July 1	Sept. 30
Western (transitional)	Northwestern Glaciated Plains (42)	Sweetgrass Upland (42l), Milk River Pothole Upland (42n), Rocky Mountain Front Foothill Potholes (42q), and Foothill Grassland (42r)	23 - 80[c]	445 - 775	July 1	Sept. 30
Western (transitional)	Northwestern Great Plains (43)	Non-calcareous Foothill Grassland (43s), Shields-Smith Valleys (43t), Limy Foothill Grassland (43u), Pryor-Bighorn Foothills (43v), and Unglaciated Montana High Plains (43o)[a]	20 - 41[d]	439 - 1,125	July 1	Sept. 30
Eastern	Northwestern Glaciated Plains (42)	all except those listed above for 42	70 - 150	540 - 1,830	June 16	Sept. 30
Eastern	Northwestern Great Plains (43) and Wyoming Basin (18)	all except for those listed above for 43, and 43c below	70 - 150	540 - 1,830	July 1	Sept. 30
Eastern	Northwestern Great Plains (43)	River Breaks (43c)	None recommended	None recommended	None recommended	None recommended

[a]For the Unglaciated High Plains ecoregion (43o), the range applies only to the polygon located just south of Great Falls, MT.
[b]Based on the 25th and 75th percentiles of the natural background concentrations in this level IV ecoregion.
[c]Lower end based on streams' origins in the Canadian Rockies; upper end based on 75th percentile of natural background for these ecoregions.
[d]Lower end based on similarity to Middle Rockies, upper end based on Elk Creek reference site.

4.3 Response Variables

The response variables in **Table 4-1** (e.g., DO delta, benthic algae density, macroinvertebrates) were selected because they are known to be responsive to eutrophication (excess nutrient concentrations), area readily measured, and have been linked by the department to the specified beneficial uses indicated[5].

4.4 MPDES Discharges that May Affect a Lake, Reservoir, or a Downstream waterbody

Loading of nutrients to lakes and reservoirs occurs year-round and, in northern temperate regions like Montana, spring runoff normally constitutes the bulk of the annual loading. Although the bulk of nutrient loading to lakes and reservoirs occurs in spring, undesirable aquatic life (e.g., phytoplankton algae blooms) may occur in lakes and reservoirs later, during summer and fall, if the annual nutrient load is excessive.

4.4.1 Discharges Directly to a Lake or Reservoir

Permittees who discharge nutrients directly to a lake or reservoir will be required to have year-round monitoring for TP and/or TN. Where MPDES effluent limits are required for direct discharges of nutrients to a lake or reservoir, the department may apply these effluent limits apply year-round. In addition, and in consultation with the department under their AMP monitoring plan, permittees must determine the proportion of their TP and/or TN load relative to the total annual load to the lentic waterbody. This data must be collected over at least two calendar years. Depending upon the permittee's proportion of the annual load, the permittee may be required to undertake in-lake response variable monitoring (e.g., phytoplankton chlorophyll *a*), to be determined in consultation with the department. AMP actions to protect, maintain, and potentially improve the lake condition shall be determined on a case-by-case basis. In determining their contribution to the annual load, permittees are advised to consider any current department guidance.

4.4.2 Discharges to a Flowing Waterbody that May Affect a Downstream Lake or Reservoir

Permittees whose discharge is likely to affect a downstream lake or reservoir will be informed by the department. The department may determine year-round TP and/or TN permit limits are necessary, to be determined on a case-by-case basis.

4.4.3 Discharges to a Flowing Waterbody that May Affect Beneficial Uses in a Downstream Reach

The department must ensure that beneficial uses downstream of point source discharges are protected. A reach of a wadeable stream or medium river considerably downstream from an MPDES discharge may have beneficial uses sensitive to phosphorus and/or nitrogen concentrations from the upstream point source. In these cases, the department may do a case-by-case evaluation of each applicable MPDES permit that may lead to MPDES nutrient limits to protect a downstream waterbody.

5.0 The AMP Monitoring Plan: Data Collection Requirements for Watershed Monitoring in Wadeable Streams and Medium Rivers

Permittees operating under the phase of the adaptive management program where phosphorus prioritization has been found to be appropriate (see **Figure 1-1**) are required to collect instream nutrients and response variable data identified in **Table 4-1**. This section addresses timeframes, site types, and methods of data collection. These requirements must be incorporated into individual AMP monitoring plans.

5.1 Data Collection Index Period

The index periods below in **Table 5-1** (which match those in **Table 4-2**) correspond to the summer and early fall baseflow period (aka growing season). Instream nutrient concentrations and instream response variable data (**Sections 5.3, 5.4**) should be collected during the time periods applicable to each ecoregion.

To identify the ecoregion index period applicable to a point source, start at the smallest geographic scale, which is the level IV ecoregions (e.g., 17i). Determine if the point source is located in one of the listed level IV ecoregions. If it is, use the indicated date range; if it is not, then use the index period applicable to the larger-scale level III ecoregion listed just above the level IV (e.g., 17).

If appropriate for the waterbody, the index period may be adjusted to include earlier or later dates on a case-by-case basis, subject to department review and approval. Permittees are advised to consider any current department guidance on this subject.

Table 5-1. Annual Timeframes for Nutrient and Response Variable Data Collection, Based on Ecoregion, for Wadeable Streams and Medium Rivers

Ecoregion (level III or IV) and Number	Time Period to Collect Data
Northern Rockies (15)	July 1 to September 30
Canadian Rockies (41)	July 1 to September 30
Idaho Batholith (16)	July 1 to September 30
Middle Rockies (17)	July 1 to September 30
Absaroka-Gallatin Volcanic Mountains (17i)	July 1 to September 30
Northwestern Glaciated Plains (42)	June 16 to September 30
Sweetgrass Upland (42l), Milk River Pothole Upland (42n), Rocky Mountain Front Foothill Potholes (42q), and Foothill Grassland (42r)	July 1 to September 30
Northwestern Great Plains (43) and Wyoming Basin (18)	July 1 to September 30
*Non-calcareous Foothill Grassland (43s), Shields-Smith Valleys (43t), Limy Foothill Grassland (43u), Pryor-Bighorn Foothills (43v), and Unglaciated Montana High Plains (43o)**	July 1 to September 30
River Breaks (43c)	NONE RECOMMENDED

*For the Unglaciated High Plains ecoregion (43o), limits only apply to the polygon located just south of Great Falls, MT.

5.2 Types of Sites in an AMP Monitoring Plan

Sampling site locations in a submitted AMP monitoring plan are subject to department review and approval. **At a minimum, an AMP monitoring plan must comprise one near field site upstream and one near field site downstream of each point source discharge** (**Figure 5-1**). The department expects the permittee to establish the sampling sites in an approved AMP monitoring plan as long-term monitoring locations. The permittee may request to modify the monitoring locations. Permittees are advised to consider any current guidance on locating these sites that has been developed by the department.

Data collected at the near field sites under the AMP monitoring plan, as well as other credible data (if available), shall be used by the department to determine if phosphorus prioritization has been successful in protecting beneficial uses and achieving the narrative nutrient standards. Other credible data include chemical and biological information from locations in the watershed useful for evaluating point source P-control effectiveness. Such data might, for example, be collected by a Conservation District, Water Quality Protection District, or similar entity.

For permittees in the initial phases of the adaptive management program (**Figure 1-1**), two near field sites may be all that is necessary (see example, **Figure 5-1**) to determine attainment of standards for the immediate receiving waterbody. However, downstream far field sites may be required by the department to ensure attainment of water quality standards of downstream waterbodies (far field sites are further discussed in **Section 8.0**).

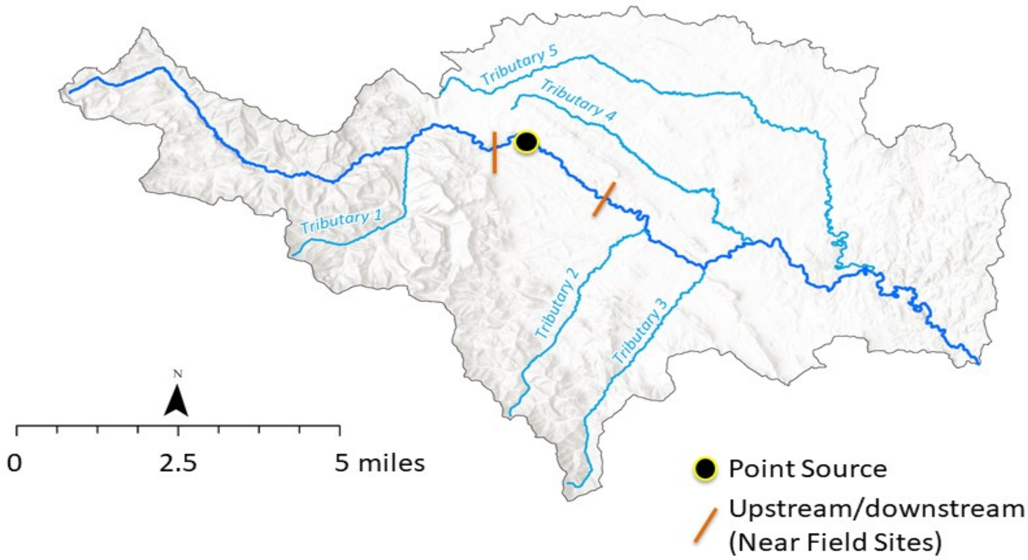

Figure 5-1. Example of an AMP Watershed with Near Field Sites Bracketing the Single Point Source

5.3 Nutrient Concentration Data Requirements

TP and TN must be monitored by the permittee in the effluent, and at all near field and far field department-approved sites. Instream TN and TP data must be collected at least at the same frequency and during the same monitoring events as the instream response variables. Nutrient data will be used to characterize nutrient concentrations and loads in the near field area upstream and downstream of the point-source discharge point. At a minimum, TP and TN must be measured, however soluble forms (e.g., nitrate, and soluble reactive phosphorus (SRP)) can provide important information about sources and the department encourages their collection during monitoring events for TN and TP.

Table 5-2 provides the required reporting values (RRVs) for TP and TN, the RRVs for nitrogen that can be used to compute total nitrogen, and the RRV for SRP. Permittees are also advised to consider any current department guidance on collecting instream nutrient samples.

Table 5-2. Required Reporting Values[a,b] for Phosphorus and Nitrogen Measurements

Nutrient		Method of Measurement	Required Reporting Value
Total phosphorus		Persulfate digestion	3 µg/L
Total nitrogen		Persulfate digestion	70 µg/L
Total nitrogen	Sum of:	(a) total kjeldahl nitrogen	225 µg/L
		(b) nitrate + nitrite	See RRVs below
Nitrate- as N			20 µg/L
Nitrite- as N			10 µg/L
Nitrate + Nitrite-as N			20 µg/L
Soluble reactive phosphorus (SRP)		Sampled filtered, 0.45 µm	1 µg/L

[a] See definition for required reporting values found in footnote 19 of Department Circular DEQ-7.

[b] The total nitrogen persulfate method is used for instream measurements only and cannot be used for effluent. Persulfate digestion is not a 40 CFR Part 136 approved method.

5.4 Requirements for Collection of Nutrient Concentration, Response Variable, and Other Data

Permittees should refer to ARM 17.30.607 through 613 and identify their receiving waterbody's use classification, then review the associated beneficial uses described in ARM 17.30.621 through 631. A proposed AMP monitoring plan must describe the applicable use class of the waterbody, which ecoregion and ecoregional zone (western or eastern) best applies to them, and which response variables will be measured, along with a justification; this is subject to department review and approval.

AMP monitoring plans are based on United States Geological Survey (USGS) hydrologic unit code (HUC) watershed boundaries. Different ecoregions may exist within a single watershed because ecoregions boundaries are not watershed-based (see **Figure 4-1**). This could result in a permittee identifying both western and eastern ecoregion nutrient concentrations and response variables as being applicable to their watershed. Permittees are advised to consider any current department guidance to address such situations, and to select the values most appropriate for their near field sites.

The department acknowledges that there may be streams within the main body of each ecoregional zone that do not fit the typical regional patterns. For streams that do not fit the typical expectations of the ecoregion, please refer to **Section 5.4.3.** When determining which response variables are most appropriate for such waterbodies, permittees are advised to consult the department early in AMP monitoring plan development and to consider any current department guidance.

5.4.1 Nutrient, Response Variable, and Other Monitoring Data for the Western Ecoregional Zone

Table 5-3 provides details on minimum data collection requirements for wadeable streams and medium rivers in the western ecoregional zone. When implementing sampling methods for purposes of meeting the requirements in **Table 5-3**, permittees are advised to consider any current department guidance.

Several response variables and thresholds are under development and will be updated when completed (projected completion: Spring 2023).

Section 7.0 will discuss the use of nutrient concentration and response variable data in decision making.

Table 5-3. Data Collection Requirements for Different Types of AMP Monitoring Sites in the Western Ecoregional Zone (*some response variables are currently under development*)

Parameter	Associated Beneficial Use	Site Type	Annual Index Period	Minimum Annual Sampling Requirements	Threshold
1. Physical Variables					
Water Surface Slope (%)	Recreation, Aquatic Life	All Near- and Far-Field Sites	n/a	Determined once, generally at the time the sampling reach is established	1%
2. Response Variables					
Reach average benthic algal chlorophyll *a* (Chl*a*)	Recreation	All Near Field Sites, All Downstream Far Field Sites	July 1 to September 30	Twice during the index period, with a minimum of 6 weeks between sampling events	150 mg Chla/m^2
Reach average benthic algal ash free dry weight (AFDW)					35 g AFDW/m^2
% Bottom cover by filamentous algae, reach average				Monthly during the index period; two of the events must pair with the Chl*a*/AFDW sampling	30% bottom coverage
Dissolved Oxygen* Delta (daily maximum minus daily minimum)	Aquatic Life			Instruments deployed annually for at least 30 continuous days with at least 21 days collected in August. Instruments must log a record at least every 15 minutes. Deployment locations must correspond to sampling reaches used to collect other response variable data.	TBD
Macroinvertebrates (reach composite)				Once per annual index period, corresponding to one of the other sampling events	Metric(s) and thresholds TBD
3. Nutrient Concentrations					
Total P, Total N	Recreation, Aquatic Life	Near Field	July 1 to September 30	Twice during the index period, with a minimum of 6 weeks between sampling events	Greater than applicable ecoregion concentration range in **Table 4-2**
Total P, Total N		Far Field		(1) Upstream Far Field Sites: As established in the AMP. (2) Downstream Far Field Sites: Twice during the index period, with a minimum of 6 weeks between sampling events.	
Total P, Total N		Tributaries		At a sufficient frequency to characterize tributary loads as established in the AMP	

*Dissolved oxygen concentration standards in Circular DEQ-7 also apply, and must be examined using the instrument datasets.

Data collection may not exceed 24 hours between upstream and downstream site sample collections.

Water surface slope is required for waterbodies in the western ecoregional zone and should be determined using a laser level over the longitudinal extent of each monitored sampling reach. Permittees are advised to consider any current guidance developed by the department. As an alternative, a GIS method may be used to determine slope, subject to department review and approval.

Extraction of Chl*a* from samples, and the subsequent determination of Chl*a* concentration, must be performed in an analytical laboratory by a qualified laboratory technician or chemist. Benthic Chl*a* must be reported as milligrams chlorophyll *a* per square meter of stream bottom (mg Chl*a*/m^2). Chlorophyll *a* may be analyzed spectrophotometrically or by the use of high-performance liquid chromatography (HPLC). If using spectrophotometric methods, use of the monochromatic equation for phaeopigment-corrected Chl*a* is required. **For both spectrophotometric and HPLC methods, Chl*a* extraction must be undertaken using warmed ethanol.** Analysis of benthic algae ash free dry weight (AFDW) must be undertaken using standard methods. Benthic algal AFDW must be reported as grams ash free dry weight per square meter of stream bottom (g AFDW/m^2). Percent bottom cover of the stream bottom may be assessed by eye or via the use of aerial drone technology (subject to review and approval by the department). Permittees are advised to consider any current guidance developed by the department.

Dissolved oxygen must be measured using logging instruments deployed instream that have been properly calibrated in accordance with the manufacturer's instructions. When selecting instruments and evaluating different instrument deployment options, permittees are advised to consider any current guidance developed by the department.

Macroinvertebrates must be collected using a reachwide composite method using a D-frame kick net, sampling from downstream to upstream along the reach and collecting a sample at each of 11 transects; the 11 kick samples are composited to obtain a single sample which is representative of the entire reach. Permittees are advised to consider any current guidance developed by the department.

*Please note that applicable macroinvertebrate metrics in the western ecoregional zone (**Table 5-3**) may, at a future date, be segregated by mountain vs. low-valley areas; analysis is under way and is expected to be completed by Spring 2023. Further details will be provided at that time.*

5.4.2 Nutrient and Response Variable Monitoring Data for the Eastern Ecoregional Zone

Table 5-4 provides details on minimum data collection requirements for medium rivers and wadeable streams in the eastern Montana ecoregional zone. When developing and implementing sampling methods to meet the requirements in **Table 5-4**, permittees are advised to consider any current department guidance.

Some response variables and thresholds are under development and will be updated when completed (projected completion: Spring 2023).

Section 7.0 will discuss the use of response variables and associated thresholds in decision making.

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Table 5-4. Data Collection Requirements for Different Types of AMP Monitoring Sites in the Eastern Ecoregional Zone (*some response variables are currently under development*)

Parameter	Associated Beneficial Use	Site Type	Annual Index Period	Minimum Annual Sampling Requirements	Threshold
1. Response Variables					
Dissolved Oxygen* Delta (daily maximum minus daily minimum)	Aquatic Life	All Near Field Sites, All Downstream Far Field Sites	See Applicable Ecoregion in **Table 5-2**	Instruments deployed annually for at least 30 continuous days with at least 21 days collected in August. Instruments must log a record at least every 15 minutes. Deployment locations must correspond to sampling reaches used to collect other response variable data.	5.3 mg DO/L computed as a weekly (7-day) average
Macroinvertebrates (reach composite)				Once per annual index period, corresponding to one of the other sampling events	Metric(s) and thresholds TBD
2. Nutrient Concentrations					
Total P, Total N	Aquatic Life	Near Field	See Applicable Ecoregion in **Table 5-2**	Twice during the index period, with a minimum of 30 days between sampling events	Greater than applicable ecoregion concentration range in **Table 4-2**
Total P, Total N		Far Field		(1) Upstream Far Field Sites: As established in the AMP. (2) Downstream Far Field Sites: Twice during the index period, with a minimum of 30 days between sampling events.	
Total P, Total N		Tributaries		At a sufficient frequency to characterize tributary loads as established in the AMP	

*Dissolved oxygen concentration standards in Circular DEQ-7 also apply, and must be examined using the instrument datasets.

Data collection may not exceed 24 hours between upstream and downstream sample collection.

Dissolved oxygen must be measured using logging instruments deployed instream that have been properly calibrated according to the manufacturer's instructions. When selecting instruments and evaluating different instrument deployment options, permittees are advised to consider any current guidance developed by the department.

Macroinvertebrates must be collected using a reachwide composite method using a D-frame kick net, sampling from downstream to upstream along the reach and collecting a sample at each of 11 transects; the 11 kick samples are composited to obtain a single sample which is representative of the entire reach. Permittees are advised to consider any current guidance developed by the department.

5.4.3 Identifying Response Variables for Waterbodies which are Atypical of the Ecoregional Zone

It is possible that a small fraction of permittees may find that although they are located within the main geographic area of an ecoregional zone (**Figure 4-1**), their receiving waterbody does not appear to fit the general stream characteristics outlined in **Section 4.1**. Permittees in this situation are advised to contact the department early in the process of developing their AMP monitoring plan so that the department can assist with identifying appropriate response variables and thresholds. Permittees are also advised to consider any current department guidance.

In some cases, it may be concluded that some type of modeling is more appropriate for a waterbody, including conceptual water quality modeling. If, after consultation with the department, it is concluded that modeling is the most appropriate approach, refer to **Section 9.0**.

5.6 Collecting Monitoring Data: Department Field Audits

This circular requires the implementation of complex field data-collection methods. To ensure high quality data are collected the department shall carry out field audits to ensure all data collection protocols are being properly adhered to. The department shall audit a minimum of 10% of permittees under the adaptive management program per year. Audits will be performed in the field by department staff having expertise in the applicable data collection methods and who will accompany the data-collection entity (permittee, their consultant, or other responsible agent) to observe the data collection event as it proceeds. The department shall prepare an annual report on their findings and permittees not properly adhering to protocols established in their AMP monitoring plan will be informed in writing and requested to correct the issue prior to the next field sampling event.

6.0 Pollutant Minimization Activities for Point Sources, including Optimization

Permittees entering the phase of the adaptive management program allowing focus on phosphorus reduction are required to examine all possible pollutant minimization activities which may reduce nutrient concentrations in the effluent. This section provides requirements, recommendations, and resources for undertaking this work. Permittees are advised to consider any current department guidance on these topics.

A strong optimization effort should begin with monitoring of the influent, effluent and internal points within the system such as between cells, tanks, or zones. The permittee should monitor ammonia, nitrate, nitrite, dissolved oxygen, alkalinity, pH, and oxidation-reduction potential at all of these locations to assess the wastewater chemistry at each treatment phase. This chemistry can inform decision making regarding nitrification or denitrification (modify anaerobic and aerobic zones) in the system. The department recommends consultation with our technical assistance staff through the department's optimization program or with qualified third-party wastewater optimization experts.

For lagoons, the department recommends regular sludge depth recording and sludge removal when needed to ensure proper health and function of the lagoon. Proper sludge maintenance increases retention time and thus treatment effectiveness.

7.0 Evaluation of Near Field Data to Determine if Beneficial Uses are Protected and Narrative Nutrient Standards are Achieved

A permittee under the adaptive management program is required, at a minimum, to collect nutrient and response variable data at near field sites upstream and downstream of their facility (**Section 5.2**). Per NEW RULE I(2)(d), the department shall use these data, along with other relevant, credible data, to determine if beneficial uses are protected and narrative nutrient standards are achieved. These data also inform if phosphorus control alone has resulted in the protection of beneficial uses in the water body.

Figure 7-1 below is a guide to assist readers in selecting the data review process applicable to them and identifying the appropriate section or subsection in this circular to refer to.

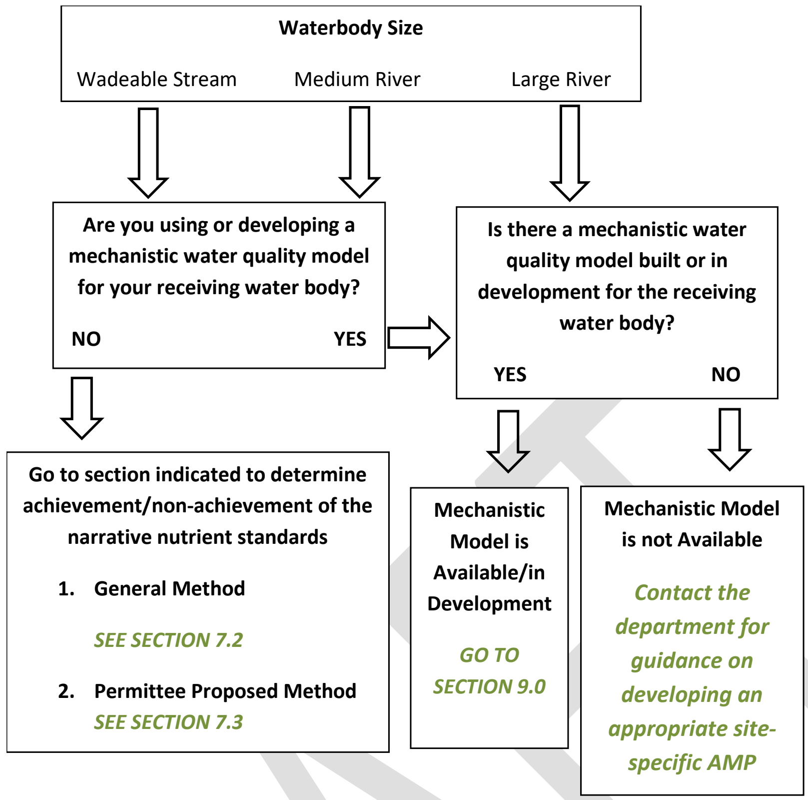

Figure 7-1. Guide to Sections and Subsections in this Document

If the department finds that phosphorus-focused control at a point source is not protecting beneficial uses nor achieving the narrative nutrient standards based on credible data including response variable data collected from near field monitoring sites, and the permittee would like to continue under adaptive management program, the department will require the permittee to develop and execute an AMP implementation plan (**Section 8.0**).

7.1 Expression of Nutrient Concentration and Response Variables Data

Data collected for purposes of determining if the narrative nutrient standards are achieved must be reduced and expressed as described in **Table 7-1**. The table provides information on how to express the data for individual sampling events/months, and also for larger datasets which have been collected over 3-5 years. The department believes datasets 3-5 years in length will be necessary to accurately evaluate an MPDES permittee's achievement of the narrative nutrient standards in waterbodies under this process.

Some specific parameters and thresholds are still under development and are expected to be completed in Spring 2023.

Table 7-1. Expression of Nutrient Concentration and Response Variables, and Associated Thresholds, for Purposes of Assessing Achievement of the Narrative Nutrient Standards in Wadeable Streams and Medium Rivers of Montana

Applicable Ecoregional Zone	Parameter	How the Parameter is Expressed	How the Parameter is Aggregated across Time (normally 3-5 years)	Threshold
Western and Eastern	Instream nutrient concentrations	Monthly arithmetic average	Arithmetic average of monthly average concentrations	Upper bound of applicable ecoregional range in **Table 4-2**
Western	Benthic algal chlorophyll *a* (Chl*a*)	Weighted average of samples (normally 11) collected across a reach*	Arithmetic average of sampling-event reachwide weighted averages	150 mg Chla/m^2
Western	Benthic algal ash free dry weight (AFDW)	Weighted average of samples (normally 11) collected across a reach*	Arithmetic average of sampling-event reachwide weighted averages	35 g AFDW/m^2
Western	% Bottom cover by filamentous algae	Arithmetic average of samples (normally 11) visually assessed across a reach	Arithmetic average of sampling-event reachwide values	30% bottom coverage
Western and Eastern	Macroinvertebrates	A single metric score generated from reachwide composite sample	Arithmetic average of sampling-event metric scores	Metrics and thresholds TBD
Western and Eastern	Dissolved Oxygen Delta (daily maximum minus daily minimum)	Weekly average of daily DO deltas	All available weekly-average DO delta values compared to exceedence rates applicable during the time period the data were collected	Western: TBD. Eastern: 5.3 mg DO/L, with exceedence rate conforming to specific environmental conditions (see **Table 7-6**)

*Assuming that individual samples of specific types (hoop, template, core) will be composited by the analytical laboratory; otherwise, use the arithmetic average of all 11 individual sample results.

7.2. Determining if Narrative Nutrient Standards are Achieved in Wadeable Streams and Medium Rivers (General Method)

Tables 7-2 through **7-5** below provide all result combinations for the **Table 7-1** parameters and their associated thresholds. The tables apply to the specific beneficial uses and the geographic region(s) indicated. **For a monitoring location, "Meets" means the parameter is at or below the threshold provided in Table 7-1, "Exceeds" means the parameter has exceeded the threshold.** Different result combinations inform achievement or non-achievement of the narrative nutrient standards. This construct is a weight-of-evidence approach in which each data type (nutrients and response variables) provides key information and, collectively, the results inform achievement/non-achievement of the narrative nutrient standards.

Several result combinations lead to "To Be Determined" (TBD). In these circumstances, the next iteration of a permittee's annual AMP monitoring plan must include a plan on how to collect all necessary data to address these inconclusive circumstances. If a reasonable scientific explanation for the observed results can be identified within two field seasons, the department will consider the results and work with the permittee to derive a conclusion as to achievement/non-achievement of the narrative nutrient standards in the receiving waterbody. **If no scientific work is undertaken within the two-year timeframe the department will conclude that the narrative nutrient standards are not achieved.**

Table 7-2. Evaluation of Narrative Nutrient Standards Related to the Recreational Use for Western and Transitional Ecoregional Zones

Parameter				
Nutrient Causal Variables	**Benthic Chlorophyll *a*, Ash Free Dry Weight***	**% Filamentous Algae Cover**	**Is the Narrative Nutrient WQ Standard Achieved?**	**Notes**
Meets	Meets	Meets	Yes	
Meets	Meets	Exceeds	No	
Meets	Exceeds	Meets	No	
Meets	Exceeds	Exceeds	No	High nutrient uptake likely lowering nutrient concentrations
Exceeds	Meets	Meets	Yes	
Exceeds	Meets	Exceeds	No	
Exceeds	Exceeds	Meets	No	
Exceeds	Exceeds	Exceeds	No	

*If either benthic chlorophyll *a* or ash free dry mass exceed their respective threshold, the conclusion is "Exceeds."

Table 7-3. Evaluation of Narrative Nutrient Standards Related to the Aquatic Life Use for Western and Transitional Ecoregional Zones in Streams and Medium Rivers with Gradient <1%

Parameter				
Nutrient Causal Variables	**Dissolved Oxygen Delta**	**Macroinvertebrate Metric**	**Is the Narrative Nutrient WQ Standard Achieved?**	**Notes**
Meets	Meets	Meets	Yes	
Meets	Meets	Exceeds	TBD	Needs additional data—what might cause the macroinvertebrates to exceed their threshold even though the other parameters are met?
Meets	Exceeds	Meets	TBD	Needs futher investigation—what other factors might be influencing DO delta? Naturally high macrophyte populations?
Meets	Exceeds	Exceeds	No	High uptake of nutrients by flora likely lowering nutrient concentrations.
Exceeds	Meets	Meets	Yes	
Exceeds	Meets	Exceeds	No	
Exceeds	Exceeds	Meets	No	
Exceeds	Exceeds	Exceeds	No	

Table 7-4. Evaluation of Narrative Nutrient Standards Related to the Aquatic Life Use for Western and Transitional Ecoregional Zones in Streams and Medium Rivers with Gradient ≥1%

Parameter			
Nutrient Causal Variables	**Macroinvertebrate Metric**	**Is the Narrative Nutrient WQ Standard Achieved?**	**Notes**
Meets	Meets	Yes	
Meets	Exceeds	TBD	Needs additional data—what might cause the macroinvertebrates to exceed their threshold when nutrieint concentrations are low?
Exceeds	Meets	Yes	
Exceeds	Exceeds	No	

Table 7-5. Evaluation of Narrative Nutrient Standards Related to the Aquatic Life Use for Eastern Ecoregional Zone

Parameter				
Nutrient Causal Variables	**Dissolved Oxygen Delta**	**Macroinvertebrate Metric**	**Is the Narrative Nutrient WQ Standard Achieved?**	**Notes**
Meets	Meets	Meets	Yes	
Meets	Meets	Exceeds	TBD	Needs additional data—what might cause the macroinvertebrates to exceed their threshold even though the other parameters are met?
Meets	Exceeds	Meets	TBD	What other factors might be influencing DO delta to be high?
Meets	Exceeds	Exceeds	No	High uptake of nutrients by flora likely lowering nutrient concentrations.
Exceeds	Meets	Meets	Yes	
Exceeds	Meets	Exceeds	No	
Exceeds	Exceeds	Meets	No	
Exceeds	Exceeds	Exceeds	No	

In the eastern ecoregional zone, an acceptable dissolved oxygen delta threshold (i.e., one that "Meets") can change in accordance with specific environmental conditions prevalent in the receiving waterbody at the time the dissolved oxygen data were collected (**Table 7-6**). In determining dominant land use and drought conditions prevalent during the data collection period, permittees are advised to consider any current guidance developed by the department.

In the eastern ecoregional zone, average weekly dissolved oxygen delta values during non-drought periods have an allowable exceedance frequency of one occurrence per one month's worth of data (25%; **Table 7-6**). That is, for a four-week data-collection time period one of the four weekly-average dissolved oxygen delta values can exceed the thresholds in **Table 7-6** and the dissolved oxygen delta parameter is considered "Meets." Applicable exceedance rates in **Table 7-6** apply to collated multi-year datasets but consideration may be given to whether the longer time period comprises drought and non-drought years. Permittees are advised to consider any current guidance developed by the department.

Table 7-6. Environmental Factors Modifying Dissolved Oxygen Delta (DO Δ) Thresholds and Allowable Exceedance Frequency for the Eastern Ecoregional Zone

Scenario	Modifying Environmental Condition		Stream Dissolved Oxygen Delta		
	US Drought Monitor Index*	Managed Lands in the Watershed (%)†	DO Δ Threshold (mg/L)	Averaging Period for Threshold (duration)	Allowable number of weeks per month threshold may be exceeded
1	No information	No information	5.3	7 days (1 week)	1
2	<6 consecutive weeks at drought severity level D_{ZERO}	<16%	5.3	7 days (1 week)	1
3	>6 consecutive weeks at drought severity level D_{ZERO}	<16%	5.3	7 days (1 week)	1
4	<6 consecutive weeks at drought severity level D_{ZERO}	>16%	5.3	7 days (1 week)	1
5	>6 consecutive weeks at drought severity level D_{ZERO}	>16%	8.5	7 days (1 week)	>1

*The spatial extent of the drainage basin, not the location of the sampling station, must be considered when applying county-based drought meaures. Please see DEQ Guidance for area & time-weighted calculation procedure and directions to the web-based US drought monitor index data source.

†See DEQ Guidance for description of managed land types and data sources. If managed lands in a watershed are not applying all reasonable land, soil and water conservation practices, use the "no information" scenario (scenario 1) for assessment until more is known.

7.3. Permittee-Proposed Method

A permittee may propose an alternative method to evaluate beneficial use protection and achievement of the narrative nutrient standards. The department will review and approve or deny all alternate method proposals.

7.4. Identifying Nutrient Concentrations for Use in MPDES Permits and Other Department Programs

The translator in **Table 4-1** in conjunction with the decision tables in **Section 7.2** (and, as applicable, **Section 7.3**) provide the means to determine if the narrative nutrient standards are achieved. When it is concluded that narrative nutrient standards are not achieved, or depending on other circumstances, it may be necessary to identify a TP and possibly TN concentration protective of recreation and aquatic life beneficial uses for application in MPDES permits and in other department programs. TP and/or TN concentrations must be selected from the applicable ecoregional range in **Table 4-2** unless compelling waterbody-specific scientific information indicates a value outside of these ranges is protective of beneficial uses.

Different department work units may have program-specific guidance on how they select a TP and/or TN concentration from the **Table 4-2** ranges. When a department work unit identifies a nutrient concentration(s) they will be using for their purposes, the work unit must communicate this information to other department work units who are working in the same subject area.

7.5 Dataset Reset

Nutrient reduction activities undertaken in the AMP watershed may justify a reset of the nutrient and response variable dataset used to evaluate nutrient control effectiveness and achievement of the narrative nutrient standards. The datasets must properly represent current conditions. A dataset reset means establishing a new period of record for evaluating instream nutrient and response variable data which begins after nutrient reduction activities have been implemented and these changes have had the potential to affect response variables at the monitoring sites. Changes could come from improvement in the facility discharge, nonpoint source controls, or both. Permittees may request that a dataset be reset. The department will determine if and when a dataset reset is appropriate, in accordance with the AMP and the conditions of the MPDES permit.

7.6 Information Provided by Changes Upstream and Downstream of a Point Source

Near field site datasets collected upstream and downstream of a point source provide important information about relative changes in nutrient concentrations and response variables and the effectiveness of phosphorus-focused point source control. These data (and other relevant information) shall be used to inform next steps in adaptive management. Based on the outcomes of the upstream- and downstream-near field sites, different scenarios will be encountered; these are outlined in **Table 7-7**. The implications/actions in the table's right column should be used to guide next steps.

Table 7-7. Scenarios Resulting from the Outcome of Analyses Undertaken Per Subsections 7.2 through 7.3 above. Achieving/not achieving refers to whether beneficial uses are protected/the narrative nutrient standards are achieved at the near field monitoring location indicated.

Scenario	Upstream Site(s)	Downstream Site(s)	Implication/Action
A	Achieving	Achieving	Uses are supported/the narrative nutrient standards are achieved; continue to monitor
B	Achieving	Not Achieving	Uses are not supported/the narrative nutrient standards are not achieved; proceed to AMP implementation plan with further phosphorus control and/or nitrogen control considerations for the point source
C	Not Achieving	Achieving	Uses are not supported/the narrative nutrient standards are not achieved; any watershed nutrient reduction work undertaken should focus on the upstream watershed
D	Not Achieving	Not Achieving	Uses are not supported/the narrative nutrient standards are not acheived; proceed to AMP implementation plan with further phosphorus control and/or nitrogen control which may begin upstream of the point source, at the point source, or both

8.0 AMP Implementation Plan Elements

All elements in this section must be incorporated into an AMP implementation plan. If the department finds that (1) phosphorus-focused control at the point source was unsuccessful in supporting beneficial uses and achieving the narrative nutrient standards (per **Section 7.0**), or that (2) phosphorus prioritization was not appropriate for the point source or receiving water body (per **Figure 1-1**), the permittee must develop and execute an AMP implementation plan.

8.1 Identification, Quantification, and Characterization of All Sources of Nutrient Contributions in the AMP Watershed

The permittee(s) must identify, quantify, and characterize all nutrient sources in the watershed. The AMP must list all identified sources of nutrients in the watershed with specific locations.

Robust monitoring within the watershed will be necessary for a successful AMP implementation plan. Existing scientific information concerning algal growth dynamics, applicable scientific data specific to the region, locally collected data from the waterbody, and characterization of the point source effluent(s) and the nonpoint sources may all be used by the permittee to quantify and describe nutrient sources and loads in the watershed. Consideration should be given to the magnitude and extent of nonpoint source nutrients already in the receiving waterbody and the degree to which the point source(s) alone can reduce nutrient concentrations below algal growth saturation concentrations. Nutrient control projects downstream of a point source can be undertaken and may be credited to the point source's permitted load so long as hot spots (localized areas of water quality exceedances) are not occurring downstream of the facility.

For small, simple watersheds with a single point source (**Figure 8-1**), the two near field sites, a downstream far field site, and strategically selected tributary sites may be all that are necessary to adequately characterize nutrient loads in the watershed. A downstream far field site should normally be placed near the terminus of the AMP watershed (i.e., the point where the waterbody flows into the next watershed) but may be placed further upstream subject to department review and approval. Tributary sites are used to track tributary nutrient loading and, as illustrated in **Figure 8-1**, they may be used to monitor the effect of nonpoint source nutrient reduction projects (see Tributary 4 in the figure).

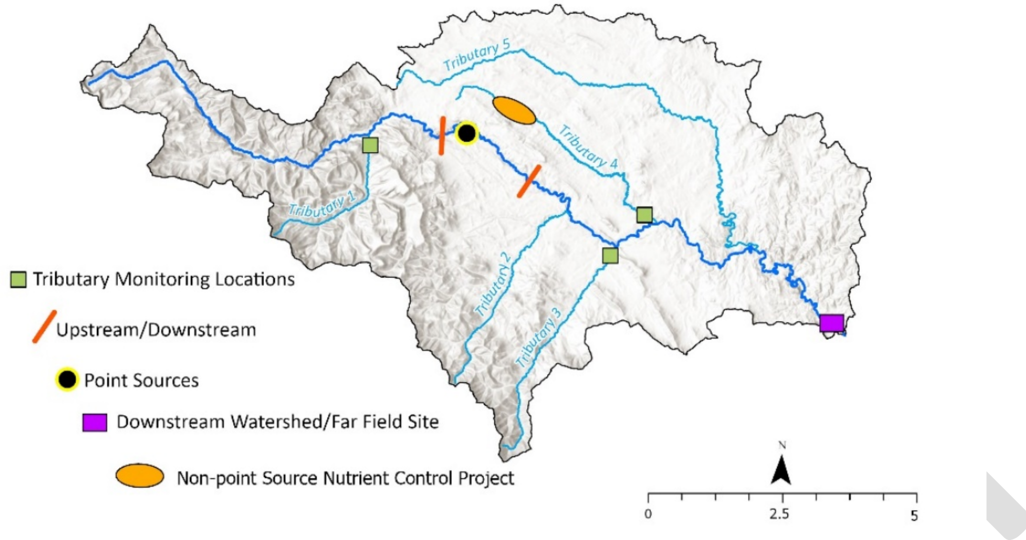

Figure 8-1. Example of a Simple AMP Watershed. Monitoring sites include near field sites, a downstream far field site, and tributary sites. In this example a tributary site is placed on Tributary 4 so effects of an upstream nonpoint source nutrient control project on that tributary can be tracked.

In complex watersheds, such as those with multiple dischargers and various types of non-point sources of nutrients, there will need to be multiple sampling sites. These include near field sites bracketing the point source(s), far field sites, tributary sites, and mainstem monitoring sites (**Figure 8-2**). Tributary sites may be used to characterize nutrient concentrations and loads from principal tributaries, while far field sites characterize nutrient concentrations and loads at the far upstream and downstream extent of an AMP watershed (**Figure 8-2**), and response variables where applicable. One downstream far field site is required, at a minimum. When locating sites for an AMP watershed, permittees are advised to consider any current department guidance.

A downstream far field site should normally be placed at the terminus of the AMP watershed (i.e., at the point where the waterbody flows into the next watershed; see the downstream far field site in **Figure 8-2**), although there may be exceptions subject to department review and approval. Far field sites may be used to help assess achievement of the narrative nutrient standards at a larger waterbody or watershed (multiple waterbody) scale, if the permittee identifies this as an objective in the AMP monitoring plan and coordinates with the department to select sites for this objective. Upstream far field sites provide data on nutrient concentrations and loads entering the AMP watershed, and inform AMP loading calculations, TMDLs, etc. These do not necessarily have to be placed at the upper-most boundary of the HUC; they may be placed within the HUC if appropriate.

Site locations should be strategically located to monitor the effect of any nonpoint source control activities. For illustration, there are two nonpoint source nutrient control projects in the watershed in

Figure 8-2. The effects of the nonpoint source project on Tributary 2 are tracked at the monitoring site at the mouth of that tributary. Similarly, changes resulting from the nonpoint source project on the mainstem are tracked using a mainstem location placed downstream of it (red square, **Figure 8-2**).

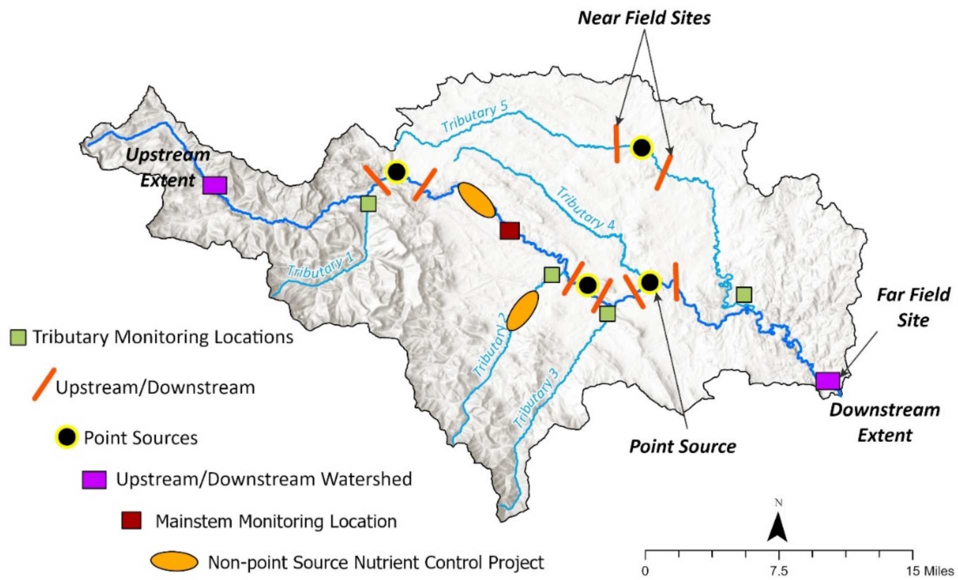

Figure 8-2. Example of a Complex AMP Watershed, Showing Different Types of Monitoring Sites

8.2 Identifying All Partners that will Assist in Implementing Nutrient Reductions

Permittees must identify partners to work with, including landowners, conservation districts, watershed groups, water quality districts, municipalities, counties, and others to target point and nonpoint sources of nutrients to minimize their overall fiscal outlays while achieving compliance with narrative nutrient water quality standards and improving water quality.

8.3 Develop and Document Action Items for the Reduction of Nutrients in the Watershed

Permittees must develop action items and goals to achieve nutrient reductions. Evaluation of information from the near field upstream and downstream monitoring sites (**Table 7-7**) should be used to inform these decisions. The permittee may choose to improve their individual facility and/or proceed with a broader nitrogen-focused watershed approach, possibly including additional phosphorus control or offsetting point and nonpoint sources in order to meet necessary nutrient reductions and achieve compliance.

8.3.1 Implementing Facility Improvements

A permittee may achieve nutrient reductions through conventional capital improvements or through additional work via Montana's optimization program. Montana offers technical support and training to municipal wastewater treatment plant operators to achieve nutrient reductions through operational optimization.

8.3.2 Implementing Nonpoint Source Projects

A permittee may achieve nutrient reductions in the watershed through nonpoint source project implementation. A TMDL wasteload allocation, or WLA (more on TMDLs in **Section 10**), requires reasonable assurance that the load reduction expected will in fact be achieved. Permittees are advised to consider any current department BMP guidance on this subject. All significant pollutant sources—including natural background, permitted point sources, and nonpoint sources—need to be quantified at the watershed scale so that the relative pollutant contributions and reductions can be determined. Because the effects of pollutants on water quality can vary throughout the year, assessing pollutant sources must include an evaluation of the seasonal variability of the pollutant loading in relation to the time period nutrient controls are in place (most commonly, the summer/fall growing season). This loading and reduction analysis may be done using a department approved watershed-loading model and, in all cases, must be based on sound scientific and engineering practices.

Once necessary reductions have been calculated and allocated to nutrient sources, the permittee must select nonpoint source projects that will reduce nutrients to a level which will achieve the narrative nutrient standards in the waterbody or waterbody segment. Further, the permittee must demonstrate reasonable assurance by having secured funding and landowner/partner agreements to implement nonpoint source projects in the watershed either individually, or in conjunction with other permittees and nonpoint sources, or other partners, including municipal and county governments. If partners are used to implement nutrient reduction actions in lieu of permittees, AMP implementation plans must include enforceable written agreements reflecting commitments by partners to implement actions.

8.3.3 Nutrient Trading

A permittee may achieve nutrient reductions through nutrient trading. *See* Department Circular DEQ-13. Trading is an approach to achieving water quality standards in which a point source acquires pollutant reduction credits from another point source or a nonpoint source in the applicable trading region; these credits are then used to meet the source's pollutant discharge obligations.

8.4. Demonstrate the Ability to Fund and Implement the AMP Implementation Plan

Permittees who choose to invest in nonpoint source projects in the watershed to reduce nutrient loading must provide funding documentation in the AMP implementation plan. This documentation must include enforceable written agreements that document a commitment to fund, implement, and complete projects with stakeholders. The documentation must identify all stakeholders participating, include cost estimates, assign specific contribution amounts to each stakeholder, and identify timelines for project completion that include responsibilities for each project implementation step. The agreement must also specify the period nonpoint source controls will be maintained.

8.5 Continued Data Collection for Response Variables as Performance Indicators

Ongoing and potentially expanded collection and monitoring of response variables and thresholds, as well as nutrient concentrations, are the principal means by which the department will conclude if an AMP watershed is achieving the narrative nutrient standards. Data collection locations, frequency, and types must be linked to the action items and on-the-ground activities planned for a permittee's AMP implementation plan; these actions in turn must inform any updates to the AMP watershed monitoring plan, subject to department review and approval.

Data collection at the near field sites must be on-going and remain relatively consistent. However, data collection that best supports an AMP implementation plan needs to be adaptive. For example, potential nutrient sources identified during a watershed inventory may prompt the selection of new or additional monitoring sites to quantify nutrient loads or isolate potential nutrient reduction projects. Initial characterization at tributary sites may clarify which tributaries contribute greater or lesser nutrient loads to the receiving waterbody and therefore may lead to tributary sites being added or discontinued. Additional or different monitoring sites—particularly far field sites—may be required in order to demonstrate effectiveness of nonpoint source reduction projects or to affirm achievement of the narrative nutrient standards. Far field sites may be required in order to demonstrate protection of downstream beneficial uses and to monitor changes over time.

8.6 Timeframes for Completing and Submitting Items in Sections 8.1 through 8.5; Annual Reports

Permittees or multiple permittees must identify the timeframe for completing and submitting to the department each of the components in **Sections 8.1** through **8.5** as part of their AMP implementation plan (or updated plan). Annual progress reports must be submitted to the department and must address all of the relevant actions taken under the AMP implementation plan in the year prior to the report. Annual reports are required to maintain communication and accountability between the point source and the department. Additionally, annual reports provide the permittee with the opportunity to modify their adaptive management strategy. Adjusted plans and accompanying justifications should be submitted with the annual report. Annual reporting, which must include electronic data submittal of collected biological, chemical, and physical measurements, is due by January 31st of each year in a format provided by the department.

9.0 Water Quality Models: Data Collection, Calibration and Validation, Assessment of Beneficial Use/Water Quality Impacts, Simulating the Effect of Potential Management Activities

The department may develop mechanistic water quality models for the state's large rivers (**Table 2-1**) where feasible. Once calibrated and validated, the models must be used to derive phosphorus limits for MPDES permits that protect beneficial uses and achieve water quality standards along the modeled reach.

A permittee may also opt to pursue a mechanistic model for their adaptive management plan. In so doing, permittees must conform to the requirements in this section.
Field data to support model development serve multiple purposes. The data inform and constrain the range of model parameters. The data must be collected at a sufficient number of strategically selected sites to ensure that the built model can properly simulate the effect of different management options and their resulting effects on water quality. The data are also used to determine if the narrative nutrient standards (and other water quality standards) have been achieved, per NEW RULE I (3)(c); more on this in **Section 9.2**.

Figure 9-1 (reproduced from Chapra 2003)[7] shows the overall methodology for developing and using a mechanistic model in an AMP watershed. Once developed, the model becomes a decision support system (DSS) which involves the integration of science and data for waterbody and water quality management. AMPs for nutrient management that are model-based must follow the water-quality modeling process identified in **Figure 9-1**, including each step starting with the problem specification (i.e., nutrient management), the water-quality modeling process (model selection, data collection for modeling, calibration and confirmation procedures, uncertainty analysis, and decision support, as detailed in the right side of the figure), and finally use of the model-based DSS to evaluate beneficial use support and achievement of water quality standards. Since the DSS can directly simulate (1) management activity impacts on surface water and (2) hypothetical load reduction(s) necessary to achieve the narrative nutrient standards and other water applicable water quality standards (dissolved oxygen, pH), the department shall use the modeling results to inform MPDES permit limits. Simulation of potential management activities within the DSS must reasonably balance all factors impacting a waterbody while considering the feasibility of treatment options and the expected water quality improvements.

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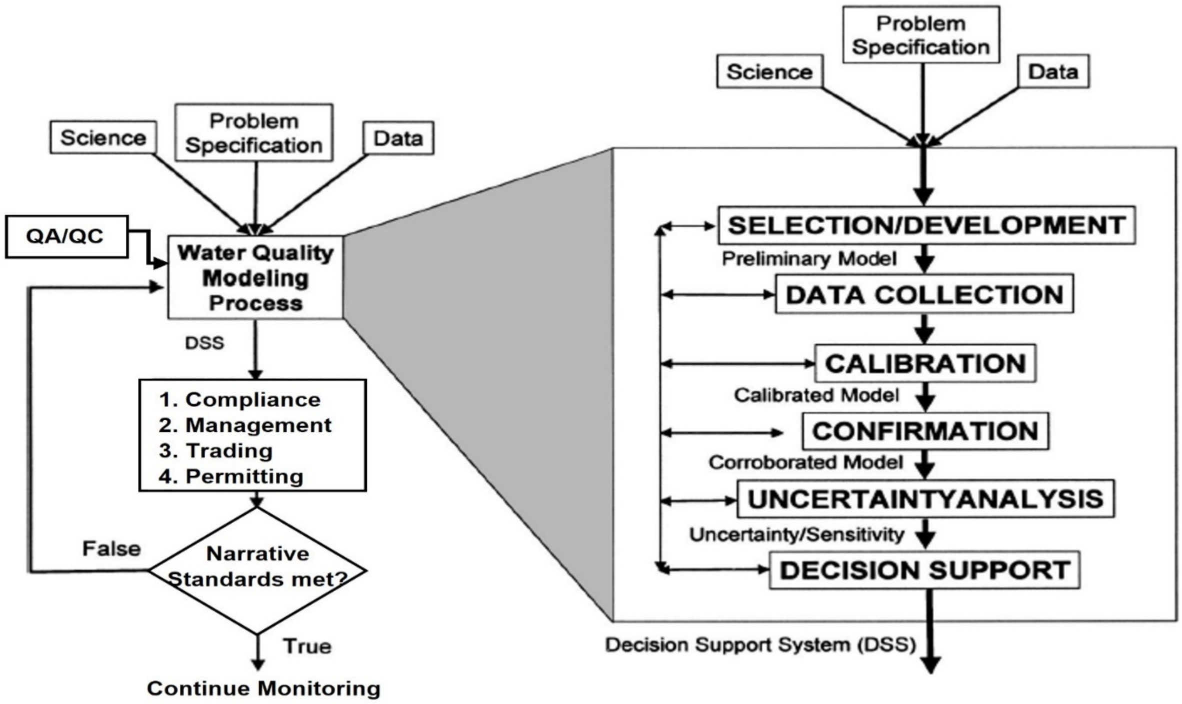

Figure 9-1. Process for Applying Water Quality Modeling in an AMP Watershed. The principal components for developing, calibrating, and confirming a model are contained in the break-out box shown on the right-hand side of the figure. The developed model then becomes a decision support system (DSS) for evaluating the effect of different management options, determining potential compliance pathways, and establishing permit limits.

9.1. TYPES OF MODELS, REPORT REQUIREMENTS

The department and permittees shall use non-proprietary modeling tools for AMPs. This means using only standardized modeling applications that are readily available to the public, are widely supported by federal agencies, and are also well known through both the professional and academic literature. In selecting a non-propriety modeling tool, permittees are advised to consider any current department guidance.

Once modeling activities are completed the modeling process must be documented in a report; it must describe the application of the model and report on outcomes and AMP planning decisions. Although reporting requirements will be project specific, minimum requirements for AMP defensibility must include the following: (1) an executive summary, (2) numeric table of contents, (3) project information and background, (4) model overview, (5) model construction overview, (6) model parameterization section, (7) model calibration, (8) model confirmation, and (9) the final modeling results. The report must have sufficient detail to document all phases of the modeling project in order that the process could be completed by an experienced user to generate similar modeling results. In developing models and the associated report, permittees are advised to consider any current department guidance.

9.2. Determining If Narrative Nutrient Standards are Achieved

Field data collected to support model development may be used to assess if the narrative nutrient standards are achieved. Such an assessment may be completed even before a model is completed.

Protection of beneficial uses and achievement of water quality standards in large rivers—as well as for other flowing waterbodies which are being modeled—must be evaluated using all of the following response variables: (1) dissolved oxygen concentrations, (2) pH, (3) chlorophyll *a* (as bottom-attached [benthic] algal biomass) in river-edge areas ≤ 1 m deep, (4) turbidity (as a function of increased phytoplankton biomass), and (5) total dissolved gas (TDG). Water quality standards and thresholds associated with these response variables are found or referenced in: (1) for dissolved oxygen, Circular DEQ-7; (2) for pH, within specific water-use classifications found in ARM Title 17, chapter 30, subchapter 6; (3) for benthic algal biomass at a density of ≤150 mg chlorophyll *a*/m^2, per this circular; (4) for turbidity (as a function of increased phytoplankton biomass), within specific water-use classifications found in ARM Title 17, chapter 30, subchapter 6; and (5) for TDG, in Department Circular DEQ-7, but accounting for the fact the dissolved oxygen is only a fraction of TDG.

9.3. Conceptual Water Quality Model

An alternative modeling approach to the mechanistic modeling methods described above is the development of a conceptual water quality model. Conceptual water quality models are a formal and rigorous process to identify stressors causing biological impairments in aquatic ecosystems (i.e., impacts to aquatic life beneficial uses), and a structure for organizing the scientific evidence supporting the conclusions. However, they do not provide for carrying out "what if" scenarios (e.g., "what will be the effect on diel pH fluctuations if the phosphorus load from source X is reduced by 25%?"), which is a distinct advantage of mechanistic models. The department must review and approve the use of a conceptual water quality model.

Permittees may develop conceptual water quality models to assess the array of factors which may be affecting their receiving waterbody and AMP watershed. This can include analysis of physicochemical factors which enhance or mute the effects of nutrients, analysis of conditions that may impact the macroinvertebrate community, etc. In developing conceptual models and the associated report, permittees are advised to consider any current department guidance.

10.0 Integration of the Adaptive Management Program with the Total Maximum Daily Load Program

When a waterbody is not achieving the narrative nutrient standards for TP and/or TN, it is considered impaired, and a total maximum daily load (TMDL) must be developed. To calculate the TMDL load allocations and waste load allocations, the department will translate the narrative nutrient water quality standard to TP and TN target values from a range of TN and TP concentrations derived from relevant studies (see translator in **Table 4-1)** and concentration ranges in **Table 4-2** and per **Section 7.4**. Once the TMDL is determined, reductions will be allocated to the source(s) of the pollutant in order to meet the TMDL.

Pollutant sources are characterized as either point sources, which receive a waste load allocation (WLA), or as nonpoint sources, which receive a load allocation (LA). For purposes of assigning WLAs, point sources include all sources subject to regulation under the MPDES program. To the extent possible, the department will coordinate TMDL development or revision in conjunction with active adaptive management program implementation and monitoring plans to promote robust data collection and analysis, detailed source assessment, and implementation efficiency and consistency.

10.1. Integrating AMP Implementation Plans and TMDL Waste Load Allocations with MPDES Permits

Effluent limits developed in MPDES permits will be consistent with the assumptions and requirements of any available TMDL waste load allocation, including staged implementation plans. The MPDES permit must also be consistent with the assumptions of the adaptive management implementation plan.

The department may find, based on the continued adaptive management watershed monitoring plan or other department assessment, that additional actions may be required in the watershed. The department may require the permittee to evaluate adaptive management implementation to find additional ways to reduce nutrients in the watershed, which may include adjustments to TN and TP limits in a permit. Adaptive management plan review and adaptation may prompt modifications to existing TMDL documents.

10.2. TMDL Revisions

In situations where a permittee opts into the adaptive management program and a nutrient TMDL already exists, any TMDL revision must be based on 3-5 years of data collected through an approved AMP monitoring plan. A subsequent translation of the narrative nutrient standards to TP and/or TN target values would be conducted in accordance with **Table 4-2** and per **Section 7.4.** The TMDL would be revised to reflect recalculated WLAs and LAs using the appropriately determined target value(s) from the ecoregional ranges in **Table 4-2** and per **Section 7.4**. Revised TMDLs would be periodically evaluated based on AMP data collection efforts and subsequent reassessments. Further TMDL revisions could be required if response variable data indicate a different target concentration is more reflective of watershed conditions to ensure protection of beneficial uses.

The U.S. Environmental Protection Agency (EPA) has drafted considerations for revising and withdrawing TMDLs. Any changes or re-allocation between the WLA and LA or changes in the TMDL's loading capacity will be released for public comment and be submitted to EPA for review and approval as a revised TMDL according to the same procedures as for a new TMDL. TMDL revisions would be prioritized by the department in accordance with 75-5-702, MCA, through consultation with the Statewide TMDL Advisory Group, and based on data collected via an approved AMP monitoring plan.

During the interim 3–5-year AMP data collection period, previously approved nutrient TMDLs with WLAs will remain in place. For permittees opting into the adaptive management program in these areas, information would be added to the existing TMDL to outline a staged implementation of the WLA consistent with the AMP.

Previously approved TMDLs without WLAs would not be prioritized for revision as part of the AMP process, but they could be addressed if prompted by subsequent monitoring and assessment activities.

10.3. The Adaptive Management Program and Alternative Restoration Plans

Under the EPA Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act (CWA) Section 303(d) Program, EPA recognizes that there are cases in which pursuing alternative restoration plans before developing a TMDL may provide a more immediate and practicable path to restore water quality. An alternative restoration plan (ARP) is a near-term plan for water quality improvement with a schedule and milestones. Impaired waters for which the department pursues an ARP would remain on the CWA 303(d) list and still require a TMDL until all beneficial uses are attained. If beneficial uses are attained, the relevant waterbody-pollutant pairing would be removed from the CWA 303(d) list and a TMDL would no longer be required.

The department will submit AMP implementation plans to EPA for acceptance as ARPs in watersheds impaired for nutrients with no existing TMDL. Acceptance of an AMP implementation plan as an ARP would prompt the department to lower the priority ranking of TMDL development for the waterbody-pollutant pairing in question, in accordance with 75-5-702, MCA. Accepted ARPs would be evaluated on the same schedule as their accompanying AMP implementation plans to ensure they are still the most practicable path toward achieving water quality standards. If the ARP is determined not to be the most immediate and practicable approach to attain all beneficial uses, DEQ would require updates to the AMP implementation plan and/or increase the priority ranking of TMDL development for the waterbody-pollutant pairing.

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11.0 Endnotes

(1) Please refer to **Figure 4-1**. The most western zone (in green) comprises Montana sections of the ecoregions Canadian Rockies (41), Northern Rockies (15), Middle Rockies (17), and the Idaho Batholith (16). The transitional zone (dark gray) comprises Montana sections of the level IV ecoregions Sweetgrass Upland (42l), Milk River Pothole Upland (42n), Rocky Mountain Front Foothill Potholes (42q), and Foothill Grassland (42r) Non-calcareous Foothill Grassland (43s), Shields-Smith Valleys (43t), Limy Foothill Grassland (43u), Pryor-Bighorn Foothills (43v), and Unglaciated Montana High Plains (43o). The transitional zone has water quality and biological characteristics more in common with the far western zone than the eastern zone. The eastern zone (in dark orange) comprises Montana sections of the ecoregions Northwestern Glaciated Plains (42) and Northwestern Great Plains (43) which are not part of the aforementioned transitional zone.

(2) Omernik, J.M., 1987. Ecoregions of the Conterminous United States. *Annals of the Association of American Geographers* 77:118-125.

(3) Suplee, M.W., A. Varghese, and J. Cleland, 2007. Developing Nutrient Criteria for Streams: An Evaluation of the Frequency Distribution Method. *Journal of the American Water Resources Association* 43: 453-472.

(4) Suplee, M.W., V. Watson, A. Varghese, and J. Cleland, 2008. Scientific and Technical Basis of the Numeric Nutrient Criteria for Montana's Wadeable Streams and Rivers. Helena, MT: Montana Dept. of Environmental Quality. For more specificity, refer to scientific citations within the document.

(5) Suplee, M.W., and V. Watson, 2013. Scientific and Technical Basis of the Numeric Nutrient Criteria for Montana's Wadeable Streams and Rivers—Update 1. Helena, MT: Montana Dept. of Environmental Quality. For more specificity, refer to scientific citations within the document.

(6) Suplee, Michael W., V. Watson, M. Teply, and H. McKee. 2009. How Green Is Too Green? Public Opinion of What Constitutes Undesirable Algae Levels in Streams. *Journal of the American Water Resources Association* 45: 123-140.

(7) Chapra, S.C., 2003. Engineering Water Quality Models and TMDLs. *Journal of Water Resources Planning and Management* 129: 247-256.

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