CHAPTER 2: 2016 303(D) ASSESSMENT METHODS

UTAH DEPARTMENT of ENVIRONMENTAL QUALITY
WATER QUALITY

2016 Draft Integrated Report

[This page is intentionally left blank].

EXECUTIVE SUMMARY

Changes from the March 2015 Draft 303(d) Assessment Methods

Since the development of *Utah's 303(d)Assessment Methods* for the 2016 IR which was submitted for public comment in March 2015, a number of changes and refinements have been made to the methods that are presented here as Chapter 2 of the Draft 2016 Integrated Report. In addition to editorial and formatting changes, a number of substantive changes have been made to address comments and to more accurately reflect the assessment process. UDEQ will only accept comments on these substantive changes. A responsiveness document to comments received on the original assessment methods is available on DWQ's **Assessment webpage**. A track change version showing all changes to the assessment methods since public notice of the draft in March 2015 is available upon request (contact Jim Harris at jameharris@utah.gov).

The following is a summary of significant changes made to the 2015 draft of the Assessment Methods:

1. Addition of a description for the 5-Alt category which reflects the revised 303(d) Vision.
2. Re-definition of Category 2 waters to better distinguish Category 2 from Category 3 definitions.
3. Clarification of public comment on the assessment methods allowing for comment on interim changes.
4. Clarification on the elements included in the 305(b) component.
5. Clarification of how DWQ will assess canals and seeps, namely "Canals, springs, and seeps will all be evaluated in the assessment results, but, with few exceptions, the results at individual monitoring locations will not be applied to the entire AU, as is the case with stream and river assessments. The exceptions include canals with specifically identified uses and site-specific standards in **UAC R317-2** or springs or seeps found to accurately represent water quality in a stream."
6. Revision of assessment unit delineation to include the process of defining, refining or establishing new assessment units.
7. Clarification of jurisdictional waters of the state excluding AUs on lands under tribal jurisdiction.
8. Addition of a provision to allow the evaluation of more recent data outside the period of record such that DWQ will reserve the discretion to integrate the newer information in the current cycle.
9. Clarification of *E. coli* assessment methods with regards to health advisories on rivers and streams.
10. Additional information on the process of integrating information regarding extreme conditions such as drought or flood that may come to light during the review of the 303(d) list and its associated datasets (see section on Representative Data).

11. Clarification of the minimum data requirements for performing *E. coli* assessments and provisions for placing sites with fewer than 5 samples in the index period in category 3 (insufficient data).

12. Description of how assessments of hardness dependent metals were evaluated in situations where hardness results are missing. Namely a default hardness of 100 milligrams per liter (mg/l) is used to evaluate the toxic results. Results were reviewed to ensure that a Category 5 (not supporting) decision was reached using surrogate hardness values.

13. Removal of fluoride data from the assessment until a more appropriate criterion is adopted in R317.2.

14. Interpretation of the standards for Boron assessments. **UAC R317-2** does not specify sample fraction (total or dissolved) for the boron criterion. All data for boron, both total and dissolved, were included in the assessment. The intent of the boron standard was for dissolved fraction. The criterion will be updated in future triennial reviews by the Standards Program. Until it is adopted in rule, results will be reviewed to ensure that no waterbody is listed based on total boron results.

15. More detail on supplemental indicators used to confirm harmful algal bloom assessments in lakes including cyanotoxins, chlorophyll a, phycocyanin, and harmful algal bloom–related beach closures.

16. Clarification on reporting causes of impairment. EPA requires each impairment to identify a cause. Added additional language on determining cause and sources for pollutants and pollution impairments.

17. The following statement was added to the weight of evidence criteria in the lake assessment section: "The weight of evidence criteria allow DWQ to use key lines of evidence in assessing a waterbody's support Utah's narrative standard that would be ignored by exclusively focusing on chemical water quality parameters."

18. Additional clarification and detail on the process for assessing waters for fish tissue consumption (see section "Beneficial Use Assessment Based on Tissue Consumption Health Advisories.")

19. Elaboration on "Good Cause" for delisting a waterbody.

HOW TO USE THIS DOCUMENT

Utah's Clean Water Action Section 303(d) Assessment Methods provide a framework for categorizing and determining whether a waterbody or segment within a waterbody supports or does not support the assigned water quality standards and designated uses found in **Utah Administrative Code (UAC) R317-2**. However, there may be site-specific considerations not identified in the 303(d) Assessment Methods that are appropriately factored into the final listing decision.

Generally, DWQ's decision to list or not list a waterbody will be based on the stringent application of the policies and procedures outlined in the data assessment sections of this document. As is also indicated in this document, best professional judgment may be applied when appropriate. If best professional judgment or any other deviations from the methods defined in this document are implemented, DWQ tracks these deviations and provides justification and supporting documentation.

All changes and supporting information will be available to stakeholders and other interested parties for their review during the IR and 303(d) public comment periods. DWQ encourages stakeholders and other reviewers to submit their own best professional judgment and mitigating evidence using the data and information requirements outlined in this methods and the IR **Call for Data**. All DWQ and stakeholder-generated data and information will be retained by DWQ and become part of the process for final consideration and approval of the IR and 303(d) List.

CONTENTS

EXECUTIVE SUMMARY 3
Changes from the March 2015 Draft 303(d) Assessment Methods 3
HOW TO USE THIS DOCUMENT 5
CONTENTS 6
ABBREVIATIONS 10
FIGURES 12
TABLES 13
INTRODUCTION 14
The Clean Water Act and the Integrated Report 14
Assessment Categories for Surface Waters 14
Utah's Numeric Criteria and Beneficial Uses 18
Priority and Assessed Parameters 19
ASSESSMENT PROCESS 20
Existing and Readily Available Data 20
Developing the Methods 20
Public Review of the Methods 21
Developing the Components of the Integrated Report and 303(d) List 22
Executive Summary 22
305(b) Summary of Lakes/Reservoirs and Rivers/Streams 22
303(d) Assessment Results 22
303(d) Assessment Metadata 23
Additional Assessment Metadata 23
Public Review of the 303(d) List 23
Finalizing the 303(d) List 25
SCOPE OF THE ASSESSMENT 26
Waters of the State 26
Waterbody Types 26
Great Salt Lake and Associated Wetlands 28
Assessment Units 28
Assessment Unit Delineation and Identification 28
Guidelines for Delineating Stream and River Assessment Units 28
Refining and Creating New Assessment Units 30
Stream Mileage Calculation for the DWQ 2016 Integrated Report 30
Waters within and Shared with Other States 31
Monitoring and the Rotating Basin 31
Credible Data: General Requirements 32
Data Types 32
Period of Record 33

General Credible Data Requirements 34
Assessed Waterbodies 36
Parameter Assessment under Development: Evaluation of Indicators 36
Addressing Nitrogen and Phosphorus 37
Screening Values 38

***ESCHERICHIA COLI* ASSESSMENTS 39**
Data Preparation 39
Recreation Season 39
Escherichia coli Collection Events and Replicate Samples 39
Data Substitution for Calculating the Geometric Mean 39
Use Designation 39
Annual Recreation Season Assessment 40
Summarizing Assessment Results 43
Not Supporting (Category 5) 43
Insufficient Data or Information Assessment Considerations (Category 3A) 44
Combinations of Category 3E, 2, and/or 1 44
Fully Supporting (Category 1 or 2) 44
Combining *E. coli* with Other Parameter Assessment Results 44

ASSESSMENT OF RIVERS, STREAMS, SPRINGS, SEEPS, AND CANALS 45
Data Preparation 45
Results below Detection Limits 45
Duplicate and Replicate Results 45
Initial Assessment: Monitoring Location Site Level 45
Conventional Parameters 45
Toxic Parameters 47
Equation-Based Toxic Parameters 48
Assessment Process 49
Biological Assessments 50
River Invertebrate Prediction and Classification System Models 51
Model Construction and Performance 52
Assessing Biological Use Support 55

ASSESSMENT OF LAKES AND RESERVOIRS 58
Monitoring Overview 58
Field Method Overview 58
Tier I Assessment 59
Drinking Water Use Support 59
Harmful Algal Blooms 59
Recreational Use Support 60
Escherichia coli 60
Harmful Algal Blooms 60
Aquatic Life Use Support 61
pH 61
Temperature 62

Dissolved Oxygen 64
Aquatic Life Use Assessment for Stratified Lakes and Reservoirs 64
Toxics: Dissolved Metals 66
Agricultural Use Support 67
Total Dissolved Solids 67
Tier II Assessment 68
Weight of Evidence Criteria 68
Carlson's Trophic State Index 69
Fish Kill Observations 71
Phytoplankton Community 71
Great Salt Lake 72

DETERMINATION OF IMPAIRMENT: ALL ASSESSMENT UNITS 73
Individual Assessment of Water Quality Standards 73
Conflicting Assessments of Water Quality Standards 73
Narrative Standards 74
Drinking Water Closures 75
Fish Kills 75
Beneficial Use Assessment Based on Tissue Consumption Health Advisories 75
Beneficial Use Supported (Category 1) 77
Insufficient Data with Exceedances (Category 3A) 77
Beneficial Use Not Supported (Category 5) 77
Overwhelming Evidence 77
Best Professional Judgment 77
Categorization of an Assessment Unit 78
Assessment of "All Tributaries" Segments 78

IDENTIFYING CAUSES OF IMPAIRMENTS 80
Pollutants 80
Pollution 80
Unknown Sources 81
Natural Conditions 81

REVISING THE 303(D) LIST AND OTHER CATEGORICAL ASSESSMENTS 82
Category 4A 82
Category 4B 83
Category 4C 84
Delistings 84
Delisting Categorical Pollutant Causes 88
Previous Categorical Listings 88
303(d) Listings 88
Non-303(d) Categorical Listings 88

303(D) VISION AND TMDL PRIORITY DEVELOPMENT 90

REVISION REQUESTS BETWEEN CYCLES 92

LITERATURE CITED **93**

APPENDIX 1: ASSESSMENT UNIT ROLL UP **95**

APPENDIX 2: DELISTING **98**

APPENDIX 3: 4B SUBMISSION POLICIES AND PROCEDURES **100**

APPENDIX 4: 2014 IR TMDL PRIORITIZATION PROCESS **102**

APPENDIX 5: APPLICATION OF BEST PROFESSIONAL JUDGEMENT **103**

APPENDIX 6. CREDIBLE DATA – DATA QUALITY GRADE LEVEL ASSIGNMENTS **106**

Dataset: Utah DWQ (internally-collected data) and Non-DWQ Cooperators. 106

Dataset: USGS 112

Dataset: Western Watersheds 115

Dataset: DOGM 118

ABBREVIATIONS

<	less than
>	greater then
≤	less than or equal to
≥	greater than or equal to
AGRC	Automated Geographic Reference Center
AU	assessment unit
BPJ	best professional judgment
CFR	Code of Federal Regulations
CWA	Clean Water Act
DO	dissolved oxygen
DWQ	Division of Water Quality
EPA	U.S. Environmental Protection Agency
GIS	geographic information systems
GSL	Great Salt Lake
HUC	hydrologic unit
IR	Integrated report
kg	kilogram
L	liter
mg	milligram
mg/kg	milligrams per kilogram
mg/l	milligram per liter
ml	milliliter
MLID	monitoring location ID
MPN	most probable number
NHD	National Hydrologic Dataset
O/E	observed/expected
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RIVPACS	River Invertebrate Prediction and Classification System
SD	standard deviation
TDS	total dissolved solids
TMDL	total maximum daily load

TSI	trophic state index
UAC	Utah Administrative Code
USGS	U.S. Geological Survey
WMU	watershed management unit
µg/l	microgram per liter

FIGURES

Figure 1. Utah Division of Water Quality assessment unit delineations. 29
Figure 2. A conceptual model of nutrient sources and their impacts on aquatic ecosystems. 38
Figure 3. Lakes and reservoirs with two or more closures or advisories. 40
Figure 4. Scenario A: a seasonal assessment using the maximum criterion at a monitoring location. 41
Figure 5. Scenario B: an assessment using the 30-day geometric mean for monitoring locations with five or more collection events within 30 days. 42
Figure 6. Scenario C: A seasonal geometric mean assessment. 43
Figure 7. Overview of the assessment process for conventional parameters. 47
Figure 8. Overview of the assessment process for toxic parameters. 50
Figure 9. A hypothetical example of O/E as a standardization of biological assessments. 52
Figure 10. Decision tree for making biological assessment decisions. 56
Figure 11. Process using conventional (nontoxic) parameters to assess lakes that are mixed 61
Figure 12. Plots of pH measurements (blue dots) against lake depth for a waterbody meeting (Panel A) and violating (Panel B) the pH water quality standards. 62
Figure 13. Plots of temperature measurements (blue dots) against lake depth for two waterbodies to provide an example of assessment procedures. 63
Figure 14. Beneficial use support based on the existence of adequate habitat. 65
Figure 15. Concept of the habitable zone where both DO and temperature are suitable for aquatic life. 66
Figure 16. Assessment process to determine support of the agricultural beneficial use with TDS data. 68
Figure 17. Tier II assessment process for lakes and reservoirs. 69
Figure 18. Plots of chlorophyll a, total phosphorus, and Secchi depth TSI values. 71
Figure 19. Overview of independent applicability process. 74
Figure 20. Process of assigning EPA categories to AUs based on results of monitoring location assessments. 79

TABLES

Table 1. U.S. Environmental Protection Agency and Utah Division of Water Quality subcategorization of assessed surface waterbodies for integrated report purposes.....15
Table 2. Subclassifications of Utah's beneficial uses.....18
Table 3. Waterbody types used for categorizing monitoring locations.....26
Table 4. Summary of the Division of Water Quality's 6-year rotating basin monitoring schedule and the Integrated Report data reporting cycle.....32
Table 5. Summary of data types considered in 303(d) assessment analysis work.....33
Table 6. Assessment decision for parameters and beneficial use classes.....36
Table 7. Conventional parameters and associated designated uses as identified for assessment purposes.....46
Table 8. Final predictor variables used in model construction.....54
Table 9. Beneficial use support determination for O/E values obtained from different sample sizes.....57
Table 10. World Health Organization thresholds of human health risk associated with potential exposure to cyanotoxins.....60
Table 11. Conditions likely limiting production.....70
Table 12. Milestones for 303(d) vision prioritization process.....90

INTRODUCTION

The Clean Water Act and the Integrated Report

The rules and regulations of the federal Clean Water Act (CWA) require the Utah Division of Water Quality (DWQ) to report the condition or health of all Utah surface waters to U.S. Congress every other year. The Integrated Report (IR) contains two key reporting elements defined by the CWA:

1. **Statewide reporting under CWA Section 305(b):** Section 305(b) reporting summarizes the overall condition of Utah's surface waters and estimates the relative importance of key water quality concerns. These concerns can include pollutants, habitat alteration, and sources of water quality problems.
2. **Water quality assessments under CWA Section 303(d):** Section 303(d) requires states to identify waters that are not attaining beneficial uses according to state water quality standards (Utah Administrative Code [UAC] R317.2.7.1). The Utah Section 303(d) List (hereafter the *303(d) List*) also prioritizes the total maximum daily loads (TMDL) required for each listed waterbody and the cause of nonattainment. This list includes waters impaired as a result of nonpoint sources, point source discharges, natural sources, or a combination of sources.

In addition to Utah's 303(d) List, DWQ also identifies waterbodies in the IR that DWQ suspects have water quality problems but cannot confirm due to uncertainty regarding the nature of the data, insufficient sample size, or other factors. Waterbodies without sufficient information to make an assessment determination are given priority by DWQ's Water Quality Assessment Program for follow-up monitoring to determine whether the waterbody is attaining water quality standards.

Waters that are not on the 303(d) List or on the Assessment Program's priority list for follow-up monitoring are either currently addressed by DWQ through a TMDL or other pollution-control mechanism or are attaining water quality standards. Full descriptions of these and other U.S. Environmental Protection Agency (EPA)–identified and state-identified waterbody assessment classifications are described in the following section.

Assessment Categories for Surface Waters

DWQ used five categories defined by EPA to assess surface waters of the state (EPA, 2005). DWQ has also developed several state-derived subcategories that are used for internal tracking and planning purposes in addition to EPA's categories. These categories and subcategories are described in Table 1.

Table 1. U.S. Environmental Protection Agency and Utah Division of Water Quality subcategorization of assessed surface waterbodies for integrated report purposes.

Category (EPA)	Subcategory (DWQ)	Category Description
1	n/a	**Supporting** All beneficial uses assigned to a waterbody are evaluated against one or more numeric criteria *and* each use is found to be fully attaining applicable water quality standards.
2	n/a	**No Evidence of Impairment** Some, but not all, beneficial uses assigned to a waterbody are evaluated against one or more numeric criteria *and* each assessed use is found to be fully attaining applicable water quality standards.
3	3A	**Insufficient Data, Exceedances** There are insufficient data and information to conclude support or nonsupport of a use, but the smaller dataset had water quality criteria exceedances. This category is also used where a best professional judgment (BPJ) was applied to a waterbody that was not attaining. See Best Professional Judgement Section for more information. In instances where BPJ is applied, DWQ requires that confirmational data are collected before listing the waterbody as impaired in a future IR cycle. These waterbodies are prioritized for follow-up monitoring by the Assessment Program.
3	3B	**Holding Place: Not Currently Used for Assessments** Historically, this category was used for lakes and reservoirs where there were insufficient data and information to conclude support or nonsupport of a use, but the dataset had water quality criteria exceedances. Currently, lakes with insufficient data to perform assessments or, through the application of BPJ, demonstrate atypical conditions not resulting in an impairment, are placed in a 3A category.
3	3C	**Assessment Methods in Development** This category is currently used for Great Salt Lake (GSL) (Class 5). Assessment of the designated uses of this ecosystem is complicated because, with the exception of a selenium standard applicable to bird eggs, GSL lacks numeric criteria. Also, the lake is naturally hypersaline, so traditional assessment methods are not appropriate. DWQ is working toward developing both numeric criteria and assessment methods for this ecosystem as outlined in the Great Salt Lake Water Quality Strategy. In the interim, the IR documents the progress that was made in the most recent 2-year reporting cycle.

Category (EPA)	Subcategory (DWQ)	Category Description
3	3D	**Further Investigations Needed** Waterbodies that are assessed against water quality parameters and characteristics and require further investigations as defined in UAC R317-2 or are currently undergoing standards development, numeric criteria revisions, or assessment methods development. These waterbodies are prioritized for follow-up monitoring by the Monitoring and Reporting Program.
3	3E	**Insufficient Data, No Exceedances** There are insufficient data and information to make an assessment, but the smaller dataset had no water quality criteria exceedances. These waterbodies are prioritized for follow-up monitoring by the Assessment Program.
3	3F	**Not Assessed** Waterbodies not assessed because assessment units (AUs) lack use designations, have improper use designations, or contain other inconsistency in the dataset. In cases where no recent data are available, historic-listing determinations will be maintained. These waterbodies are prioritized for use designation or clarification in the next assessment cycle.
4	4A	**TMDL-Approved** Waterbodies that are impaired by a pollutant, and that have had TMDL(s) developed and approved by EPA. Where more than one pollutant is associated with the impairment of a waterbody, the waterbody and the parameters that have an approved TMDL are listed in this category. If a waterbody has other pollutants that need a TMDL, the waterbody is still listed in Category 5 with an Approved TMDL.
4	4B	**Pollution Control** Consistent with 40 Code of Federal Regulations (CFR) 130.7(b)(I) (ii) and (iii), waterbodies that are not supporting designated uses are listed in this subcategory where other pollution-control requirements, such as best management practices required by local, state, or federal authority, are stringent enough to bring the waters listed in this category back into attainment in the near future with the approved pollution-control requirements in place. All waterbodies placed in this category must have a pollution control requirement plan developed and approved by EPA. Similar to Category 4A, if the waterbody has other pollutants that need a TMDL, or there is already a TMDL in place for another pollutant, the waterbody may also be listed in Categories 5 and 4A. Therefore, an AU with a pollution control in place can be listed in Categories 4B, 4A, and 5.

Category (EPA)	Subcategory (DWQ)	Category Description
4	4C	**Non-Pollutant Impairment** Waterbodies that are not supporting designated uses are placed in this category if the impairment is not caused by a pollutant but rather by pollution such as hydrologic modification or habitat degradation. Similar to Categories 4A and 4B, if the waterbody has other pollutants that need a TMDL, or there is an approved TMDL or pollution-control mechanism in place, the waterbody may also be listed in Categories 4A, 4B, and 5. Therefore, an AU with a pollution control in place can be listed in Categories 4C, 4B, 4A, and 5. Historic listings of these waterbodies and causes of impairment are identified in the IR as Utah's Section 303(d) list. However, DWQ is not placing new waterbodies into this category until a listing method is developed.
5	5	**Not Supporting** The concentration of a pollutant, or several pollutants, exceeds numeric water quality criteria, or quantitative biological assessments indicate that the biological designated uses are not supported. The latter determination is based on violation of the narrative water quality standard. In addition, waterbodies identified as "threatened" may also be placed in this category. In the case of a "threatened" waterbody, one or more of its uses are likely to become impaired by the next IR cycle. Water quality may be exhibiting a deteriorating trend) if pollution control actions are not taken. In the event that DWQ categorizes a waterbody as "threatened", documentation of listing rationale will be provided. These impaired waters constitute Utah's formal Section 303(d) List.
5	5-Alt	**TMDL Alternatives** The 303(d) program vision promotes the identification of alternative approaches to TMDL development for impaired waters where these approaches would result in a more rapid attainment of water quality standards. The alternatives include "4C candidates," waterbodies impaired by causes that cannot be addressed by a TMDL such as hydrologic and habitat modification; waterbodies impaired by total dissolved solids that fall within the auspices of the Colorado River Basin Salinity Control Program; impaired waters that have existing TMDLs in place for related parameters and are therefore already being addressed; waterbody impairments that are the result of natural uncontrollable pollutant sources and therefore require development of site-specific standards; and impaired waters that have taken a straight-to-implementation approach through ongoing watershed implementation activities. Note: This category is only referred to in DWQ's "303(d) Vision Document".

Note: While DWQ maintains subcategories for Category 3, due to limitations in EPA reporting requirements, all Category 3 subcategories will be reported in the report as "Category 3: Insufficient Data". However, resolution at the MLID level will be maintained in the individual data assessment reports and made available during public comment.

Utah's Numeric Criteria and Beneficial Uses

To determine the appropriate assessment categories for a waterbody (see Table 1), DWQ must first evaluate the impact of measured pollutant concentrations on environmental and human health effects. Under **UAC R317-2**, Utah has developed and adopted over 190 water quality numeric criteria (chemical concentrations that should not be exceeded) to protect the water quality of surface waters and the uses these waterbodies support. As noted in **UAC R317-2**, the water quality criteria for a pollutant can vary depending on the beneficial use assigned to a waterbody.

To identify the use and value of a waterbody for public water supply, aquatic wildlife, recreation, agriculture, industrial, and navigational purposes, EPA and DWQ developed several beneficial uses classifications (see **UAC R317-2-6**). Currently, DWQ uses four major classes to characterize the uses of surface waters within the state for 303(d) assessment purposes:

Class 1. Domestic water systems
Class 2. Recreational use and aesthetics
Class 3. Aquatic wildlife
Class 4. Agricultural

GSL has its own beneficial use classification (Class 5). Subclassifications also exist and are further defined in Table 2.

Table 2. Subclassifications of Utah's beneficial uses.

Beneficial Use Subclassification	Use Definition
1C*	Drinking water
2A	Primary contact recreation
2B	Secondary contact recreation
3A*	Cold water aquatic life
3B*	Warm water aquatic life
3C*	Nongame aquatic life
3D*	Wildlife
3E*	Habitat limited
4	Agriculture
5	Great Salt Lake
* There are human health (HH) criteria associated with these beneficial uses in UAC R317-2. For uses with a HH criteria associated to them (see Table 2.14.6 in UAC R317-2), the following use notation will be used in 303(d) data and assessment reports: HH1C, HH3A, HH3B, HH3C, and HH3D.	

For 303(d) assessment purposes, every beneficial use with numeric criteria and credible data is assessed and reported. DWQ does not just assess and report on the most environmentally protective criterion and/or use for a parameter and waterbody. Where waterbodies are unclassified and do not have assigned beneficial uses in DWQ data records, DWQ may assign default beneficial uses as articulated in **UAC R317-2-13.9, 13.10, 13.11, 13.12, and 13.13**. Alternately, these undefined waterbodies may be classified as Category 3F, and prioritized for assignment of AU definitions and uses for the next IR cycle.

For more information on how DWQ develops, adopts, and updates the numeric criteria and beneficial uses in **UAC R317-2**, please refer to DWQ's **Standards** website.

Priority and Assessed Parameters

To make the list of pollutants with numeric criteria in **UAC R317-2** more manageable for monitoring for assessment purposes, DWQ developed a priority parameter list that is used in routine water quality monitoring. This priority list is a subset of the pollutants listed in **UAC R317-2** and reflects the following constraints:

- Laboratory resources that limit DWQ's ability to assess all parameters in **UAC R317-2**.
- Significant monitoring and/or analysis costs associated with processing a sample or measuring a pollutant.
- Logistical constraints due to monitoring location and holding times for certain parameters.

As a result, water quality assessments may not report on all parameters listed in **UAC R317-2**. Instead, assessments reflect all parameters with adopted numeric criteria that also have readily available and credible datasets from the IR period of record against which they can be evaluated.

To view DWQ's list of priority parameters, please refer to the Parameters Currently Assessed table located on the IR **Call for Data**. Please be aware that priority parameters can change from one reporting cycle to the next if laboratory and financial constraints and monitoring priorities within a sampling area change.

ASSESSMENT PROCESS

Existing and Readily Available Data

To determine whether a waterbody is supporting or not supporting the assigned beneficial uses and numeric criteria in UAC R317-2, DWQ must compile all existing and readily available data. As part of the initial data compilation process, DWQ will take into account and consider the following parameters:

- Data and information referenced in 40 CFR 130.7(b)(5)(i), (iii), and (iv), which define readily available data for inclusion in water quality assessments. In addition to DWQ data collected for assessment purposes, DWQ also uses the raw data collected for other DWQ programs, such as waste load allocations, TMDL development, watershed, and use attainability analysis.
- Credible data and information that are submitted to or obtained by DWQ during the IR public Call for Data from October 1 to December 31 of even-numbered years.
- Data and information that are independently collected by DWQ and its cooperators between reporting cycles.
- Quantitative data that can be downloaded from publicly available databases from federal, state, and local agencies.
- Additional sources of data included in the Data Types Matrix link on the IR Call for Data website.

Existing data that are not brought forward through one the above mechanisms or otherwise presented to DWQ in accordance with the schedule as outlined in this document and on the Water Quality Assessments Program website will not be treated as "readily available" for the purpose of assessment decisions during the current assessment cycle.

Existing data that are available and submitted to DWQ or obtained by DWQ during the IR data compilation process are subject to DWQ's data management and quality assurance and quality control (QA/QC) processes. Depending on resource limitations and level of effort required to ensure compatibility of the data with DWQ's dataset, some data may be excluded from formal assessment calculations, although such data may still be used as supporting evidence for assessment decisions. To help ensure the inclusion of data in DWQ's assessment process, it is important for data to be submitted in a form that matches DWQ's existing data-management capabilities. Required formats and metadata submissions are provided on the IR Call for Data and will be updated October 1 of even-numbered years.

Should data not be included in the assessment process because of resource limitations or other limitations, DWQ will clearly define in the draft and final IR which dataset (or datasets) could not be included, why, and next steps DWQ will take to ensure future inclusion of these datasets and information. Updates on datasets that will be targeted by DWQ for the upcoming assessment cycle will be provided on the Water Quality Assessments Program website.

Developing the Methods

This document describes Utah's most current assessment methods that will be applied for Utah's 2016 IR. Although many of the methods described have been applied in past assessment cycles, other

methods are new or modified from previous cycles. Some of the assessment method revisions are simply intended to clarify ongoing DWQ practices. Other more substantive revisions to the methods are based on concerns that were raised during the public comment periods of the 2014 303(d) Assessment Methods and draft IR and 303(d) List.

DWQ updates and revises the 303(d) methods when concerns are raised and/or when program developments are released by DWQ staff. Additional modifications or clarifications to the Assessment Methods may also be made based on feedback provided by EPA during and after a reporting cycle or from the EPA's cycle-specific 303(d) guidance memorandum released to states on odd-numbered years.

Moving forward, all changes made to the 303(d) Assessment Methods will be reviewed and updated on odd-numbered years in anticipation of developing the IR and 303(d) List in the following even-numbered year. This process allows DWQ to consider comments and suggestions on assessment methods before a formal analysis is conducted which reduces the need to rework analyses from changes in methods.

Public Review of the Methods

The process for formal consideration and acceptance of the Assessment Methods is driven by a public review process that follows the following schedule:

1. DWQ released the proposed methods on March 11, 2015, for a 30-day public comment period. The notice for public comments on the methods was advertised in the *Salt Lake Tribune*, *Desert News*, DWQ's **News and Announcements** and **Public Notices** website, the IR **Program Information** and **Current Assessment Methods & Guidance** website, and DWQ's listserv.
2. At the close of the public comment period on April 12, 2015, DWQ compiled and began responding to comments that were received within the 30-day public comment period.
3. If substantial revisions to the methods are adopted by DWQ based on comments received in the first public comment period, DWQ has the discretion to hold a second public comment period of 30 days or less. Should DWQ proceed with a second public comment period, notifications will be advertised, at a minimum, on DWQ's **News and Announcements** and/or **Public Notices** website, the **Water Quality Assessments Program** website, and DWQ's listserv.
4. Following the conclusion of the public comment period(s), DWQ will post responses to comments on the Assessment Methods webpage. DWQ will release a final version of the methods that will be used in the upcoming assessment cycle with the results of the draft IR.
5. In the event that DWQ changes elements of the Assessment Methods in the interim between public comment and the issuing of the subsequent IR for public comment, reviewers will have the opportunity to make comments on the Assessment Methods during the IR public comment period only on the changes that were implemented. If stakeholders continue to have concerns with the final Assessment Methods, the public should submit their comments during future calls for public comments on 303(d) assessment methodologies that support future IR cycles.

Concerns and comments not received through the above processes cannot be guaranteed inclusion in current and future 303(d) methods updates and modifications. However, in the event that additional

changes or additions to the publicly vetted 303(d) Assessment Methods are made following the close of the public comment and during the current assessment process, those 303(d) method alterations will be documented and issued with the draft IR and 303(d) List for additional public comment.

Developing the Components of the Integrated Report and 303(d) List

Following the release of a final 303(d) Assessment Methods and compilation of all existing and readily available data, DWQ reviews all data and assigns a credible data "grade" as defined on the IR Call for Data website. All non-rejected, credible data are then assessed as defined in this document for the release of the following IR and associated 303(d) components.

The following minimum report elements will be included in the Integrated Report available for public review and comment. Please note that additional related program reports or chapters may be issued along with the Integrated Report.

Executive Summary

This component will include the following:

- A summary of report highlights and any deviations from the Assessment Methods contained in the IR analysis.

305(b) Summary of Lakes/Reservoirs and Rivers/Streams

At a minimum, this summary will address the following elements:

- EPA-defined assessment categories for each defined and evaluated Assessment Unit.
- Percentage of waters assessed versus not assessed.
    - Of those waters that were assessed, the percentage that are impaired versus not impaired.
    - Of those waters that were impaired, the percentage that have approved TMDLs versus those that do not have approved TMDLs.
- Percentage of impaired versus not-impaired waters by beneficial uses.
- Miles/acres and number of waterbodies that are impaired for a specific cause.
- Update on the miles/acres of causes of impairments.
- Number of approved TMDLs by pollutant and the number of causes addressed in the TMDL.

303(d) Assessment Results

At a minimum, the following information will be provided:

- 303(d) List and other EPA- and state-derived assessment categories by waterbody type. The two lists will include the following information:
    - EPA category 5 waters listed by Assessment Unit and parameter causing impairment.
    - Perrenial rivers and stream miles and lake/reservoir acreage.
    - Causes of impairment(s), if known.
    - Cycle first listed and the last cycle the waterbody and cause of impairment were assessed.
    - Impaired uses, if any.

  - TMDL priority for Category 5 waters and previous listing decisions (when new data do not result in delisting and in an update to an assessment category, or no new data existed and the assessment category from prior 303(d) listing is applied).
  - Not-supporting beneficial uses.
- Delistings by waterbody and parameter, cycle delisted, and why the waterbody and parameter were delisted.

303(d) Assessment Metadata

For archiving purposes and to assist with the review of the IR and 303(d) List, DWQ will also provide the following:

- Data reports and summaries of the assessment results by parameter.
- Data report reflecting a single categorization at the parameter, sample site location, and AU level. Also, included is information on the application of BPJ.
- Geolocation information on waterbodies that were assessed.
- The date and version of **UAC R317-2** that were used in the assessment cycle.
- The list of approved TMDLs that was used in the assessment cycle.

Note: On January 1 of odd-numbered years, DWQ will "freeze" and establish file versions of several working files to maintain consistency and data integrity. These files include geographic information system (GIS) point files of monitoring locations, layers of AUs, beneficial uses, and water quality standards.

Additional Assessment Metadata

For archiving purposes and to assist with the review of the IR, DWQ will also provide the following:

- Waters and parameters that were impaired but have an approved TMDL. DWQ will also indicate if the water and parameter moved from the previous reporting cycle's 303(d) List to a Category 4A (approved TMDL) in the current cycle vs. the water and parameter are newly impaired but are addressed in an approved TMDL and therefore move straight to a Category 4A.
- Summary list of the water and the assessment category.

Public Review of the 303(d) List

Similar to the consideration and final adoption of the 303(d) Assessment Methods, there will be a formal public review process for the IR and 303(d) List with the following steps:

1. Any person who has a pollution-control mechanism plan for a waterbody and would like to submit that plan for consideration and EPA approval as a Category 4B must submit that information to DWQ by July 1 of odd-numbered years (Appendix 3). If approved by DWQ, this information will then be submitted to EPA for review and final approval. It should be noted, however, that successful Category 4B determinations typically take a long time to receive EPA approval and would likely not be received in time to be included in the current IR cycle.
2. Waters and pollutants that are considered for a potential Category 4A (approved TMDLs) must be approved by DWQ's Water Quality Board per **UAC R317-1-7** and by EPA per 40 CFR 130.7 by September 30 of even-numbered years. TMDLs that are approved by DWQ and EPA after that date will be considered in future IRs.

3. After October 1 of odd-numbered years and no later than February 1 of even-numbered years, DWQ will release the proposed IR and 303(d) List for a 30-day public comment period. At a minimum, the notice for public comments on the IR will be advertised in the *Salt Lake Tribune*, *Desert News*, DWQ's **News and Announcements** and/or **Public Notices, Water Quality Assessments Program** website, and DWQ's listserv.
4. Stakeholders who wish to submit data for listing or delistings considerations are encouraged to submit that data and information during the Assessment Program's **Call for Data**. However, DWQ will also consider data that are submitted during the public comment period of the draft IR and 303(d) List when the public commenter can show that their submitted data results could result in a potential change to a specific waterbody assessment decision. Data that are submitted during the public comment period for the draft IR must be submitted in the format articulated in this document and on the IR **Call for Data** website and be of Grade A or B quality to be used in an assessment decision (see the Data Quality Matrices at the IR **Call for Data** website).
5. During the 30-day public comment period for the draft IR and 303(d) List, the Assessment Program will present a summary of the draft report and 303(d) List to DWQ's Water Quality Board. Concerns raised by the board will be documented and considered part of the public comment process.
6. At the close of the 30-day public comment period, DWQ will compile and begin responding to comments that were received within the 30-day public comment period.
7. If substantial revisions to the IR and 303(d) List are adopted by DWQ on the basis of comments received in the first public comment period, DWQ may grant or withhold its discretion to offer a second public comment period of 30 days or fewer. Should DWQ proceed with a second public comment period, notifications will be advertised, at a minimum, on DWQ's **News and Announcements** and/or **Public Notices** website, **Water Quality Assessments Program** website, and DWQ's listserv.
8. No later than April 1 of even-numbered years, DWQ will submit a response to the public comments that were received during the 30-day public comment period and a final version of the IR and 303(d) List to EPA for final approval. DWQ will post a status update on the **IR** website, letting stakeholders know that a final IR was submitted to EPA for final approval. After the submission of the IR to EPA for final approval, any concerns or rebuttals that stakeholders have with the IR will not be considered for the recently submitted IR. If stakeholders continue to have concerns with the IR and 303(d) List, they should submit their comments through future calls for public comments on future IRs.
9. EPA has 30 days to approve or disapprove the 303(d) List after receiving DWQ's formal submission letter, IR chapters, 303(d) List, categorization of non-303(d) waterbodies, public comments received and DWQ's response to them, delisting tables and justifications, list of approved TMDLs/pollution-control mechanisms, and GIS files of all assessment results. If EPA disapproves a state list, EPA has 30 days to develop a new list for the state; although historically EPA has rarely established an entire list for a state. EPA may also partially disapprove a list because some waters have been omitted, and EPA may add these waters to the state's list. If EPA's final approval of the IR takes longer than the timeframe identified above, DWQ will post updates on the **IR** website.

10. Any concerns and comments not received through the above processes cannot be guaranteed for inclusion in the IR. DWQ will apply discretion with regard to evaluating and responding to comments received after the ending of the comment period.

Finalizing the 303(d) List

Following EPA's approval, DWQ will release the following information on DWQ's **Water Quality Assessments Program** website:

- Draft and final versions of 303(d) Assessment Methods, including the public comments received and DWQ's response to comments
- Draft and final IR chapters and 303(d) Lists, including public comments received, DWQ's response to comments, all assessment information that was considered and evaluated in the finalization of the IR and 303(d) List, and a GIS file of the final assessments and 303(d) List

In addition, EPA maintains a **database** of state IR results and TMDL status. If additional information not available on the **Assessment Methods** website is needed, DWQ may require a **Government Records Access and Management Act request** to be filed. These requests can be submitted at any time.

SCOPE OF THE ASSESSMENT

Waters of the State

As defined in UAC R317-1-1, DWQ characterizes waters of the state as follows:

> … all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon this state or any portion thereof, except that bodies of water confined to and retained within the limits of private property, and which do not develop into or constitute a nuisance, or a public health hazard, or a menace to fish and wildlife, shall not be considered to be "waters of the state" under this definition (Section 19-5-102).

For 303(d) assessment purposes, DWQ reports on the following surface waters of the state:

- Rivers and streams
- Springs
- Seeps
- Canals as identified in site-specific standards in UAC R317-2
- Lakes and reservoirs

All other waters, such as ground water, are reported through other programs within DWQ. For more information on these waterbodies and their reports, please refer to DWQ's website.

Waterbody Types

Utah assesses waters at the monitoring-site level and then summarizes the site-level assessments up to a larger spatial scale (i.e., the AU scale). Each monitoring location can only represent one waterbody type. The monitoring locations are categorized by considering the definitions in Table 3 and applying BPJ where a site may be representative of another waterbody type. For instance, a monitoring location for a spring may be representative of downstream water quality in a stream. Canals, springs, and seeps will all be evaluated in the assessment results, but, with few exceptions, the results at individual monitoring locations will not be applied to the entire AU, as is the case with stream and river assessments. The exceptions include canals with specifically identified uses and site-specific standards in UAC R317-2 or springs or seeps found to accurately represent water quality in a stream.

Table 3. Waterbody types used for categorizing monitoring locations.

Waterbody Type	Description
Rivers and streams	A body of running water moving under gravity flow in a defined channel. The channel may be entirely natural or altered by engineering practices such as straitening, dredging, and/or lining. Both perennial and intermittent rivers and streams are included in this type. Ephemeral rivers and streams are not included in this type and are not reported on in the IR.

Waterbody Type	Description
	Note: If specific samples for this waterbody type were collected under stagnant conditions, the samples and data records will be flagged and not considered in the assessment of the monitoring location because these samples are not representative of free-flowing conditions.
Springs and seeps	A body of water or location where the water table intersects the land surface, resulting in a natural flow of ground water to the surface. Perennial, intermittent, and ephemeral springs and seeps are assessed, provided they are moving under gravity flow and connect, contribute, or are influencing water quality in a downstream river or stream. *Note:* Springs and seeps assessments will be placed in category 3. If specific samples for springs or seeps were collected during conditions that do not fit the above description or were collected under stagnant conditions, the samples and data records will be flagged and not considered in the assessment of the monitoring location.
Canals (general, irrigation, transport, or drainage)	A human-made water conveyance. *Note*: Canals are only assessed when identified in the site-specific numeric criteria in **UAC R317-2-14** or are named in the list of waters with designated use classifications in **UAC R317-2-13.**
Lakes and reservoirs	An inland body of standing fresh or saline water that is generally too deep to permit submerged aquatic vegetation to take root across the entire body. This type may include expanded parts of a river or natural lake, a reservoir behind a dam, or a natural or excavated depression containing a waterbody without surface water inlet and/or outlet.
Wetlands	Waterbodies that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. *Note*: Wetlands are not assessed by the 303(d) program. Utah is in the process of developing an assessment framework for wetlands.

Great Salt Lake and Associated Wetlands

DWQ is currently developing criteria and methods for the assessment of GSL as outlined in the **Great Salt Lake Water Quality Strategy**. In addition, DWQ is actively pursuing projects that continue to develop, test, and refine wetland condition assessment frameworks for GSL wetlands. For 2016, this waterbody will not be assessed for 303(d) reporting purposes.

Assessment Units

Assessment Unit Delineation and Identification

Streams, rivers, lakes, and reservoirs have been delineated into discrete units called assessment units (AUs). AUs are used in identifying waters of the state that have been assessed to determine if they are supporting their designated beneficial uses. Lakes and reservoirs have been delineated as individual AUs and their size is reported in acres. Rivers and streams have been delineated by specific river, river or stream reach, or several stream reaches in subwatersheds. AU size for streams is reported in total perennial stream miles. When using subwatersheds to delineate stream AUs, the new U.S. Geological Survey (USGS) 5th-level (10-digit) and 6th-level (12-digit) hydrologic unit codes (HUCs) for Utah are used. These HUCs allow for the aggregation of stream reaches into individual AUs that are hydrologically based watersheds. The 5th- and 6th-level HUCs were developed by individuals representing state and federal agencies, and have been certified by the Natural Resources Conservation Service.

Guidelines for Delineating Stream and River Assessment Units

When delineating river and stream AUs, DWQ followed the guidelines listed below with the first two guideline statements being fixed rules.

- The AU is within an 8-digit USGS HUC.
- Each river and stream AU comprises stream reaches having identical designated beneficial use classifications (i.e., a stream that has beneficial uses of Class 1C, 2B, and 3A and at another part of the stream has Class 2B and 3B). This stream would have at least two AUs because of the difference in beneficial use classifications.
- Large rivers, such as the Green River, Colorado River, and portions of other large rivers (e.g., the Bear River and Weber River) were delineated into "linear" or "ribbon" AUs. Where a major tributary enters these rivers or hydrological features such as dams exist, the river is further delineated into two or more AUs.
- Tributary rivers and streams were delineated primarily using the 5th- and 6th-level HUCs to define the AUs.
- Additional AUs were defined by combining or splitting 5th- or 6th-level watersheds using tributary streams, stream size, and ecological changes such as geology, vegetation, or land use.
- Small tributary streams to larger streams that could not be incorporated into a watershed unit were combined into separate unique AUs.

These AUs have been georeferenced (indexed) to the National Hydrologic Dataset (NHD) using a reach-indexing tool that provides the capability of using GIS techniques to display information and data for each AU. Beneficial use classifications and assessments for individual AUs can be mapped or displayed to provide visual representation of assessment results.

Individual stream AUs were assigned a unique identification code for indexing. Each stream AU identifier begins with the prefix "UT" followed by the associated 8-digit HUC and ending in a 3-digit DWQ sequential number. Similarly, lake and reservoir AUs were identified by adding the prefix "UT-L-" to the 8-digit HUC followed by a 3-digit sequential number.

Figure 1 illustrates one example of the results of using the above guidelines to delineate and identify AUs. The Weber River was delineated as a linear AU from its confluence with Chalk Creek upstream to the Wanship Dam, then designated as UT16020101-017. South Fork Chalk Creek (UT16020101-011) in the Chalk Creek watershed was delineated by combining two 12-digit HUCs comprising the South Fork Chalk Creek sub-basin. The first AU (UT16020101-010) in the Chalk Creek watershed above Echo Reservoir was delineated using the confluence of the South Fork as the upstream endpoint. This necessitated splitting the 12-digit HUC into two AUs, one for Chalk Creek below the confluence with South Fork (UT16020101-010) and another AU for Chalk Creek above the South Fork confluence and below the Huff Creek confluence to form UT16020101-012. An example of small tributary streams that could not be combined into a hydrological based AU is illustrated by the UT16020101-019 AU. These are very small tributaries, and the Weber River is not reflective of their stream order or the habitat that they flow through. Echo Reservoir (UT-L-16020101-001) and Rockport Reservoir (UT-L-16020101-002) are examples of lake or reservoir AUs.

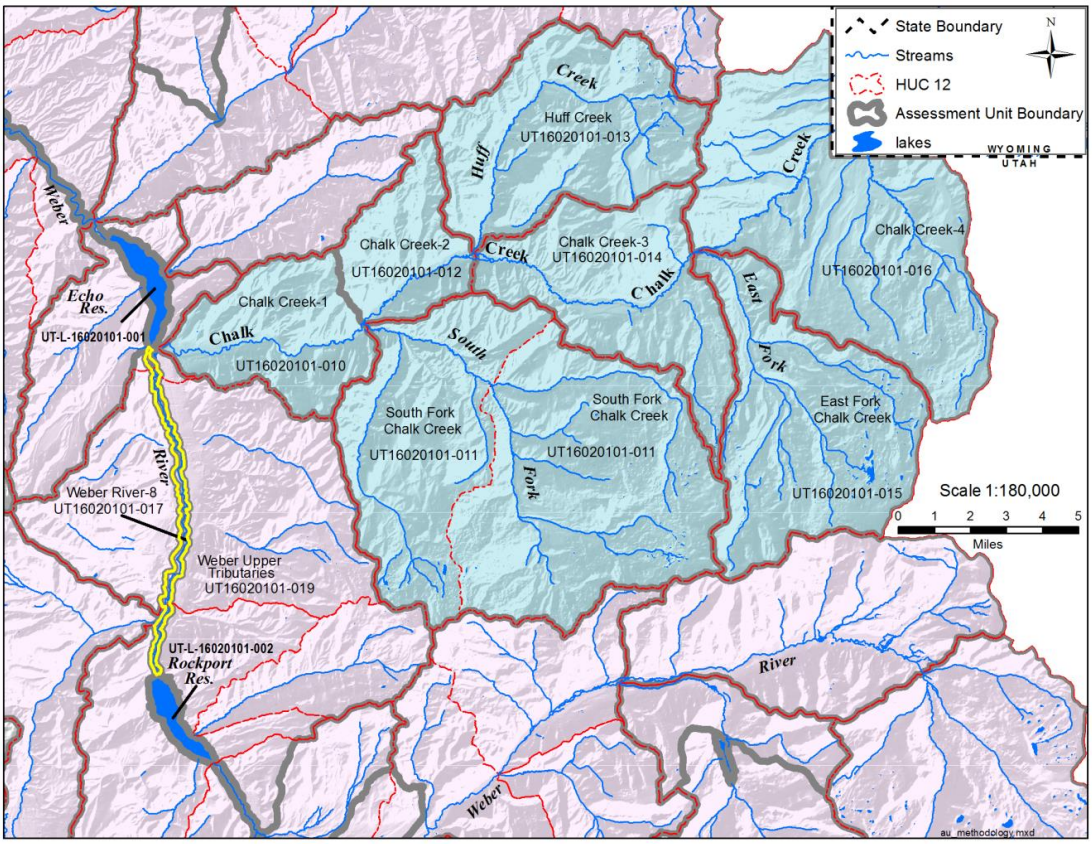


Figure 1. Utah Division of Water Quality assessment unit delineations.

Digital data representing all established AUs representing Utah's lakes and streams are stored as subwatershed polygons in GIS-formatted spatial data files. These data are georeferenced as North American Datum 1983 in Universal Transverse Mercator (Zone 12 North) projection, and units are in meters. Maps depicting statewide AUs on letter-sized paper require scales at approximately 1:2,200,000. Digital maps can be shown at various scales depending on the selected zoom magnification. All perennial streams or lake area represented within a defined AU receive the same beneficial use assessment category according to assessment results for each AU. Spatial statistics and assessment summaries are also available for hydrologic basins at various levels of detail.

Refining and Creating New Assessment Units

New AUs can be created based on ecological, geological, and beneficial use assessment information that provides greater resolution in identifying and delineating rivers and streams into additional AUs that provide for a more precise assessment of the state's rivers and streams. A number of considerations may be used in evaluating whether subdividing an AU is warranted to more accurately reflect its impairment status (i.e., should the whole AU be listed or just a portion?). A primary consideration is to identify which monitoring locations result in listing the AU as impaired and which are supporting uses. In the process, major hydrologic breaks within the AU are identified by viewing the HUC 12 boundaries. If impaired monitoring locations are located in both upper and lower watershed HUC 12 subwatersheds, existing AU boundaries are retained. If impaired monitoring locations are only located in lower subwatersheds but not in upper subwatersheds, the AU is suggested to be split along the HUC 12 boundary. Finally, if impaired monitoring locations are only located in upper subwatersheds but not in lower subwatersheds, the existing AU boundaries are also retained.

Stream Mileage Calculation for the DWQ 2016 Integrated Report

The following ArcGIS shapefiles were used to calculate stream miles for each AU in the DWQ 2016 IR:

The Utah Automated Geographic Reference Center (AGRC) State Geographic Information Database dataset known as "NHD streams" or Water.StreamsNHDHighRes, was derived by AGRC from the NHD. The derivation and modification process has been performed by AGRC to provide a general-purpose feature class of streams. Two fields have been added to this feature class (InUtah and IsMajor), and features have been split at the state boundary (see the **AGRC NHD Lakes, Rivers, Streams, Springs** GIS Data Layer website). These vector data are high resolution (1:24,000 scale) GIS stream features and attribute data used to represent water features across the country (see the USGS **NHD** website).

All line features within DWQ's established and geographically delineated AUs were assigned the unique AU identifier associated with that AU. The AU designation was completed by GIS overlay processing (e.g., spatial join) and by splitting line segments at AU boundaries in nearly all cases of AU boundary intersection.

Using coded NHD attributes describing waterbody characteristics, each waterbody, or segment, was defined as one of the following waterbody types: Artificial Path (allows for flow though lakes and reservoirs), Canal/Ditch, Connector, Intermittent Stream, Perennial Stream, or Pipeline (aqueduct).

Total stream mileage for each AU was obtained by the sum of the lengths of all perennial stream segments within each AU.

Waters within and Shared with Other States

Though readily available data may exist from locations near Utah's state boundaries, DWQ only assesses, for 303(d) purposes, monitoring location sites that are within the jurisdictional boundaries of the state. Assessment Units on lands under tribal jurisdiction are not assessed in the IR. Assessments Assessed surface waters of the state (as defined in Table 3) that flow into Utah but originate outside of Utah's borders will be assessed using DWQ monitoring locations residing within state boundaries. Lakes and reservoirs that overlap with other state jurisdictions (e.g., Lake Powell, Bear Lake, and Flaming Gorge) will be assessed using the monitoring locations that fall within Utah state jurisdictional boundaries. For these larger lakes, **UAC R317.2** specifies which portions of the lakes are assessed by Utah's water quality standards.

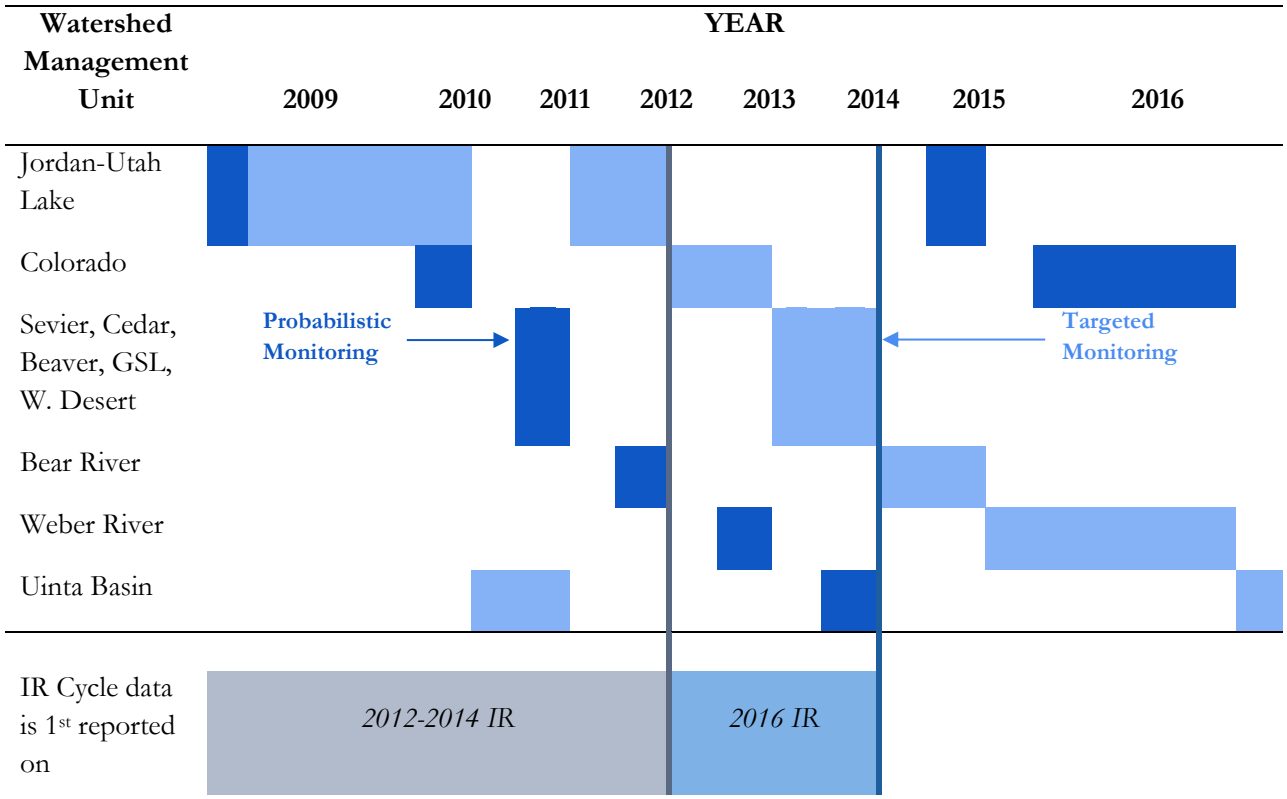
As resources allow, DWQ will work with neighboring states on any impairments that fall close to jurisdictional boundaries in other states by notifying the neighboring state of the impairments or exceedances and available data relevant to the impairment.

Monitoring and the Rotating Basin

To help coordinate and prioritize water quality monitoring and planning throughout the state, DWQ uses a "rotating basin" approach. Designed to meet the reporting requirements of the 305(b) component of the IR, DWQ begins monitoring a watershed management unit (WMU) through 50 randomly selected sites to better understand the significant causes of pollution throughout the WMU. Following the initial probabilistic-monitoring efforts within a WMU, DWQ returns to the watershed 2 years later for more intensive sampling based on the probabilistic-survey results and different programmatic needs within DWQ.

The following schedule (Table 4) sets out the relationship between the basin reviews and when assessments generated by those reviews are incorporated in the 303(d) Listing process for the first time.

Table 4. Summary of the Division of Water Quality's 6-year rotating basin monitoring schedule and the Integrated Report data reporting cycle.



Though DWQ will consider and assess any readily available data throughout the state that fall within the Assessment Program's Data Quality and Procedures outlined on the IR Call for Data website, datasets collected by DWQ will be heavily focused in the Colorado, Sevier/ Cedar/ Beaver, and Great Salt Lake/ West Desert WMUs for the 2016 cycle.

For more information on DWQ's WMUs and DWQ's rotating basin plan, please refer to DWQ's Watershed Protection and Monitoring and Reporting websites.

Credible Data: General Requirements

A key component of assessing a waterbody against numeric criteria as defined in UAC R317-2 is ensuring that the data and information from different sources are comparable, sufficient in size, representative, and of good quality. To minimize potentially flawed assessment decisions based on inaccurate data, DWQ will evaluate all chemical, physical, and biological data used in assessing waters of the state against the following interpretive, sampling, and analytical considerations and protocols.

Data Types

As referenced in 40 CFR 130.7(b)(5), DWQ will consider all existing and readily available data. However, based on the type of data submitted to or obtained by DWQ during the Assessment Program's Call for Data for generating the IR and 303(d) List, the data may not be appropriate for

303(d) assessments. As recommended in EPA's July 29, 2005, guidance (EPA, 2005), DWQ will consider several quantitative and qualitative types of data described in Table 5 for 303(d) assessments.

Table 5. Summary of data types considered in 303(d) assessment analysis work.

Quantitative Data	Qualitative Data
• Laboratory or field data for parameters contained in Utah's Water Quality Standards (UAC R317-2) and Safe Drinking Water Act Standards (UAC R309-200). • Segment-specific ambient monitoring of biological measures of health (**observed/expected** [O/E] scores).	• Observed effects (e.g., fish kills). • Complaints and comments from the public. • Human health/consumption closures, restrictions, and/or advisories.

Data types not included in Table 5 will be used by the Assessment Program but not necessarily for 303(d) evaluation purposes. To review how other data types will be used by the Assessment Program, please refer to DWQ's Assessment Program's Data Types Matrix link on the IR **Call for Data** website.

Period of Record

Quantitative and qualitative data types that are used for a 303(d) analysis are separated into two groups based on water year (see Table 5). Using DWQ's 6-year rotating basin monitoring schedule as a guide, DWQ defines the period of record for a 6-year assessment from October 1, 2008 to September 31, 2014 for the 2016 IR.

Data and information from the 6-year assessment are considered to be most reflective of the current conditions of a waterbody. Provided the data from this record period meet the interpretive, sampling, and analytical considerations and protocols outlined in this document and on the Assessment Program's **Call for Data** website, DWQ will analyze and assign EPA- and state-derived assessment categories to the assessed waterbodies from this record period (see Table 1). DWQ will not consider information or data older than 6 years in the current IR and 303(d) List. Instead, DWQ will encourage the data submitter to collect newer information and submit that data and information in future calls for data.

Newer Data and Information

Quantitative and qualitative data types that are considered in 303(d) assessments but are collected or represent conditions after the closing date specified in the **Call for Data** request (after September 31, 2014 for the 2016 IR) are not considered in the current reporting cycle. DWQ does not include these newer datasets because of the time required to compile data, perform data quality checks, format data from different sources, assess, review assessments, and generate the IR and 303(d) for public comment by April 1 of even-numbered years. If more recent data are submitted, DWQ will reserve the discretion to integrate the newer information in the current cycle or they will be retained and used in the subsequent assessment cycle. For more information, please refer to the General Questions section on the **Call for Data** website.

General Credible Data Requirements

All biological, physical, and chemical data and information that fall within the defined period of record for an assessment cycle are evaluated against a series of sampling, analytical, and interpretive protocols. These protocols include an evaluation of sample site geospatial information, QA/QC of field and laboratory protocols, sampling and laboratory methods, analytical detection limits, field observations, and variability within a dataset. Data that meet DWQ's credible data requirements will be evaluated against the numeric criteria associated with the beneficial uses assigned to waterbodies in **UAC R317-2**. Data and information that do not meet DWQ's credible data requirements will receive a rejection flag and justification. At no point during the data evaluation or assessment process will DWQ intentionally delete or remove data from a dataset.

Monitoring Location

To assess a waterbody against the numeric criteria assigned in **UAC R317-2** , DWQ must review all of the monitoring location information associated within the 6-year datasets. This process involves validating the location's geospatial information in GIS, assigning beneficial uses to DWQ-validated locations, and merging monitoring locations and their associated data where locations are representative of the same waterbody or segment. At a minimum, the information that must be included with a monitoring location measurement is as follows:

- MLID.
- Monitoring location name.
- Monitoring location description.
- Monitoring location waterbody type.
- Waterbody type description.
- Monitoring location latitude/longitude measurements and associated metadata as defined on the Assessment Program's **Call for Data** website.
- Monitoring location elevation measurements and associated metadata as defined on the Assessment Program's **Call for Data** website.
- State.

If, during DWQ's geospatial review of the monitoring location information, a monitoring location has insufficient or inaccurate information (e.g., it cannot be mapped or is improperly recorded by the sampler in the field), the monitoring location and its associated data will not be included in the assessment process of assigning an EPA- and state-derived assessment category (see Table 1). Stakeholders will be able to review any rejection results from this evaluation process during the draft IR and 303(d) List public comment period.

Credible Data

Where beneficial uses can be assigned to a DWQ-validated and approved monitoring location, DWQ will then consider the scientific rigor of the sampling information and measurements associated with that site. To assess the validity of the sampling and analytical protocols associated with a sample measurement, DWQ uses a data type–specific credible-data matrix. As noted in the credible-data matrices on the Assessment's **Call for Data** website, each credible-data matrix considers the field and laboratory QA/QC protocols, sampling and laboratory methods, analytical detection or

instrumentation limits, and field observations associated with a sample measurement. Based on the level of information provided and the strength of the metadata associated with the sample measurement, DWQ assigned a grade level (A–D) to the associated sample measurement(s) (see Appendix 6 and the Data Quality Matrices at the IR **Call for Data** website for more information).

Measurements that receive an A or B grade are considered to be of high quality by DWQ and will be considered and used by DWQ in the process of assigning an EPA- and state-derived assessment category to a waterbody (see Table 1). Measurements that receive a C or D grade are considered by DWQ to be of lower quality and will not be used for assessment and 303(d) listing purposes. Though DWQ does not use these lower-grade data for generating the IR and 303(d) List, the Assessment Program still considers some of the lower-quality data for different programmatic purposes such as targeted/future monitoring for 303(d) Assessment purposes.

Representative Data

To minimize potentially flawed assessment decisions that are driven by extreme events, DWQ screens all high-quality (Grade A or B) data for representativeness. For IR and 303(d) assessment purposes, examples of extreme events include the following:

- Accidental spills of toxic chemicals.
- Scouring storm flows that lead to diminished aquatic-life beneficial uses.
- Extreme drought conditions.

Given the scope of these assessments, it is not always possible to identify where such circumstances may be influencing a specific sample, but DWQ will consider any evidence presented that a sample is not representative of ambient conditions. Where these conditions are present in a dataset, DWQ will run the analysis without the extreme events/data record and will apply and document an appropriate assessment result for the waterbody using the methods outlined below.

- **Category 1: Supporting**: If analyses with and without the extreme events are supporting (Category 1).
- **Category 2: No evidence of impairment**: If analyses with the extreme events are supporting (Category 1), but the analyses without the extreme events show no evidence of impairment (Category 2).
- **Category 2: No evidence of impairment**: If analyses with and without the extreme events do not indicate evidence of impairment (Category 2).
- **Category 2: No evidence of impairment**: If analyses with the extreme events are evidence of impairment (Category 3A), but the analyses without the extreme events show no evidence of impairment (Category 2).
- **Category 2: No evidence of impairment**: If analyses with the extreme events are not supporting (Category 5), but the analyses without the extreme events show no evidence of impairment (Category 2).
- **Category 3A: Isufficient Data, Exceedances**: If analyses with and without the extreme events show evidence of impairment (Category 3A).
- **Category 3A: Insufficient Data, Exceedances**: If analyses with the extreme events are not supporting (Category 5), but the analyses without the extreme events are supporting (Category 1).

- **Category 5: Not supporting:** If analyses with the extreme events are evidence of impairment (Category 3A), but the analyses without the extreme events are not supporting (Category 5).
- **Category 5: Not supporting:** If analyses with the extreme events are not supporting (Category 5), but the analyses without the extreme events show evidence of impairment (Category 3A).
- **Category 5: Not supporting:** If analyses with and without the extreme events are not supporting (Category 5).

Assessed Waterbodies

Parameter Assessment under Development: Evaluation of Indicators

Several parameters in UAC R317-2 have footnotes indicating that further investigations should be conducted to develop more information when levels are exceeded. Parameters and beneficial-use combinations with these footnotes are noted in Table 6.

Table 6. Assessment decision for parameters and beneficial use classes.

Parameter Name	Beneficial Uses Classes	Special Assessment Notes
Biochemical oxygen demand	2A, 2B, 4, 3A*, 3B*, 3C*, 3D	Where exceedances occur, these AUs will be Category 3d: Further investigation needed.
Gross alpha	3A, 3B, 3C, 3D	This parameter will be assessed as a toxicant and appropriately categorized based on results of the assessment.
Gross beta	3A*, 3B*, 3C*, 3D*	This parameter will be assessed as a toxicant and appropriately categorized on the basis of results of the assessment.
Nitrate as N	1C, 2A, 2B, 3A*, 3B*, 3C*	Nitrate as N in assessed waterbodies of the state with a 1C beneficial use is considered an inorganic toxicant and will be assessed as so (UAC R317-2). The parameter will be assessed as a toxicant, but all categorical assessments for aquatic life uses (Class 3) will be overwritten to Category 3D until DWQ adopts new criteria. See the Addressing Nitrogen and Phosphorus section of this document.
Total phosphorus as P	2A, 2B, 3A*, 3B*	Phosphorus will be assessed in the same manner as toxic parameters, but all categorical assessments will be overwritten to Category 3D until DWQ adopts new criteria. See the Addressing Nitrogen and Phosphorus section of this document.

* Footnote 11 in UAC R317-2 is wrongly applied to this parameter and uses. The footnote that should be applied is number 10.

Note: Assessment decisions articulated in the notes section of the table will be applied to all assessed waterbodies of the state identified in Table 4.

Addressing Nitrogen and Phosphorus

DWQ is currently developing a multifaceted nutrient reduction program to address water quality problems associated with nitrogen and phosphorus pollution. One important aspect of this program is the development of assessment methods that accurately identify streams and lakes with nutrient-related problems.

Development of robust assessments to address nitrogen and phosphorus pollution is important for several reasons. There are many different nutrient responses with the potential to degrade the designated uses of aquatic ecosystems (Figure 2). Each causal path needs to be assessed to ensure that excess nutrients are not resulting in water quality impairments. Moreover, there are several physical characteristics (shading, temperature) of these systems that both reduce and exacerbate nutrient responses. Further complications arise because different deleterious responses manifest at different times of the year. Together, these complications mean that it is not easy to generalize about the concentration of nitrogen and phosphorus that must be avoided to ensure ongoing support of designated uses, nor a single, isolated ecological response that can reliably identify nutrient-related problems.

DWQ is developing comprehensive assessment methods that use multiple lines of evidence to accurately identify sites with nutrient-related problems. These assessments incorporate both historic and recently developed (Ostermiller et al. 2014) water quality indicators to accurately assess whether excess nutrients have degraded conditions to the extent that the designated uses are impaired. DWQ anticipates publishing and seeking public comment on draft procedures for conducting nutrient-related assessments during the reporting cycle for the 2016 IR. **DWQ's website** will provide updates on this document.

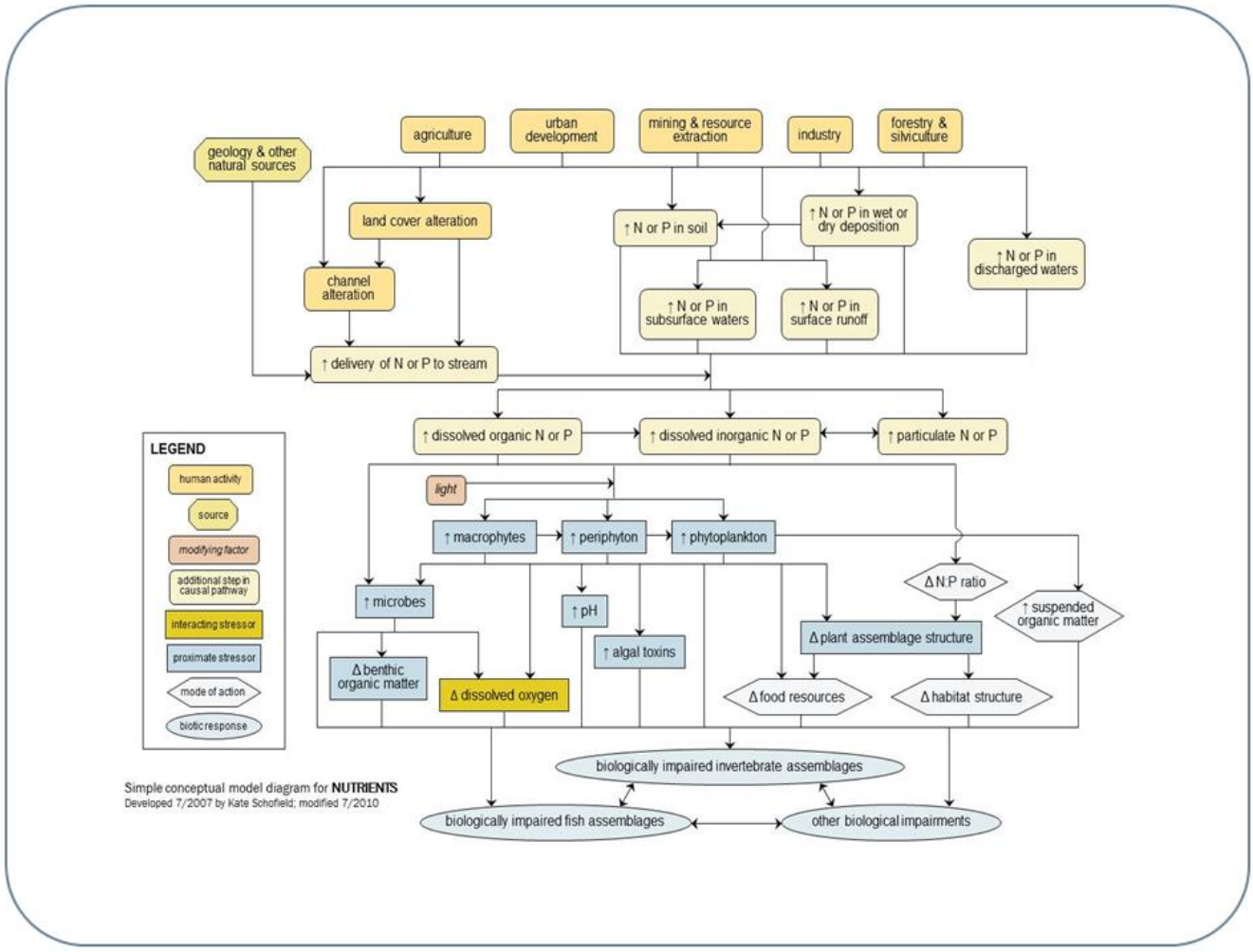


Figure 2. A conceptual model of nutrient sources and their impacts on aquatic ecosystems.

Screening Values

DWQ may also use percentage saturation of dissolved oxygen (DO) as a screening value for sites that may exhibit high daytime values above 110% saturation. As discussed in peer-reviewed literature and white papers, the collection of DO using grab sampling methods is problematic because single daytime measurements may not be indicative of nighttime minima. As algae produce DO during the day, excessively high saturation values may indicate that the stream may exhibit a corresponding drop in DO as the algae respire during the night. Therefore, the saturation data may be evaluated to guide decisions regarding assessment results and prioritizing sites for future monitoring.

ESCHERICHIA COLI ASSESSMENTS

Data Preparation

Following a credible data review and additional QA/QC checks as outlined in DWQ's *Quality Assurance Program Plan For Environmental Data Operations* (DWQ, 2014), DWQ compiles all credible data within the period of record of concern and makes several adjustments based on the reported limits and sampling frequencies necessary to conduct the assessment. Similar to the other QA/QC and assessment procedures outlined in this document, the raw data and accompanying metadata values in *Escherichia coli (E. coli)* datasets are not altered; instead, a series of database comments and flags is used.

Recreation Season

To ensure protection of recreation uses, *E. coli* assessments will be conducted on data collected during the recreation season from May 1 through October 31. The recreation season may be adjusted either longer or shorter based on site-specific conditions. Any site-specific adjustments made to the recreation season will be documented in the IR.

Escherichia coli Collection Events and Replicate Samples

Due to sampling design, datasets at a single monitoring location may contain replicate samples or multiple samples collected in the same day. For *E. coli* assessments, single daily values, or collection events, are required. DWQ defines a collection event as follows:

- The daily most probable number (MPN) result value.
- A geometric mean of replicates where multiple samples are collected on the same day.
- The daily MPN as a quantified value reported as being obtained from a dilution.

In cases where there is a quantified MPN value reported from a dilution and the value reported is greater-than-detect, the quantified value will be used as the collection event for assessment purposes. Furthermore, MPNs reported as greater-than-detect are not used to calculate the geometric mean for the collection event.

Data Substitution for Calculating the Geometric Mean

Attainment of *E. coli* standards is assessed using the geometric mean of representative samples. *E. coli* data that are reported as less than detect (< 1) or 0 will be treated as a value of 1 to allow for the calculation of a geometric mean. Similarly, *E. coli* data that are reported as greater than detect (> 2,419.6) will be treated as 2,420 to allow for the calculation of the geometric mean.

Use Designation

Once the data are compiled as described above, DWQ assesses use support for each monitoring location. All waters of the state are classified for contact recreation (Class 2), and some waters are classified as drinking water sources (Class 1C). These uses have associated specific *E. coli* standards that are used for determining use support. The following default use classifications will be used for waters that are not designated for specific uses in **UAC R317-2**:

- Lakes and reservoirs not designated in **UAC R317-2** as 2A are designated as Class 2B waters by default. If a lake or reservoir is > 10 acres and not listed in UAC R317-2-13.12, the lake or reservoir is assigned by default to the classification of the stream with which they are associated.
- River and streams, springs, seeps, and canals that are unclassified and do not have assigned beneficial uses in DWQ data records will be assigned default beneficial uses as articulated in **UAC R317-2-13.9, 13.10, 13.11, and 13.13**.

Based on the beneficial use assignments to a waterbody or segment within a waterbody, the numeric criteria within **UAC R317-2** are applied to Class 2 and Class 1C uses.

Annual Recreation Season Assessment

The first step in the assessment process for lakes and reservoirs is to determine if there were two *E. coli*–related beach closures or health advisories in a recreation season. Lakes and reservoirs with two or more closures or advisories are impaired, and no further assessment is conducted (Figure 3). DWQ does not currently have assessment methods for rivers and streams due to *E. coli*–related health advisories. If there were fewer than two closures or advisories for lakes, or the AU is a river or stream, the assessment process continues using *E. coli* concentrations.

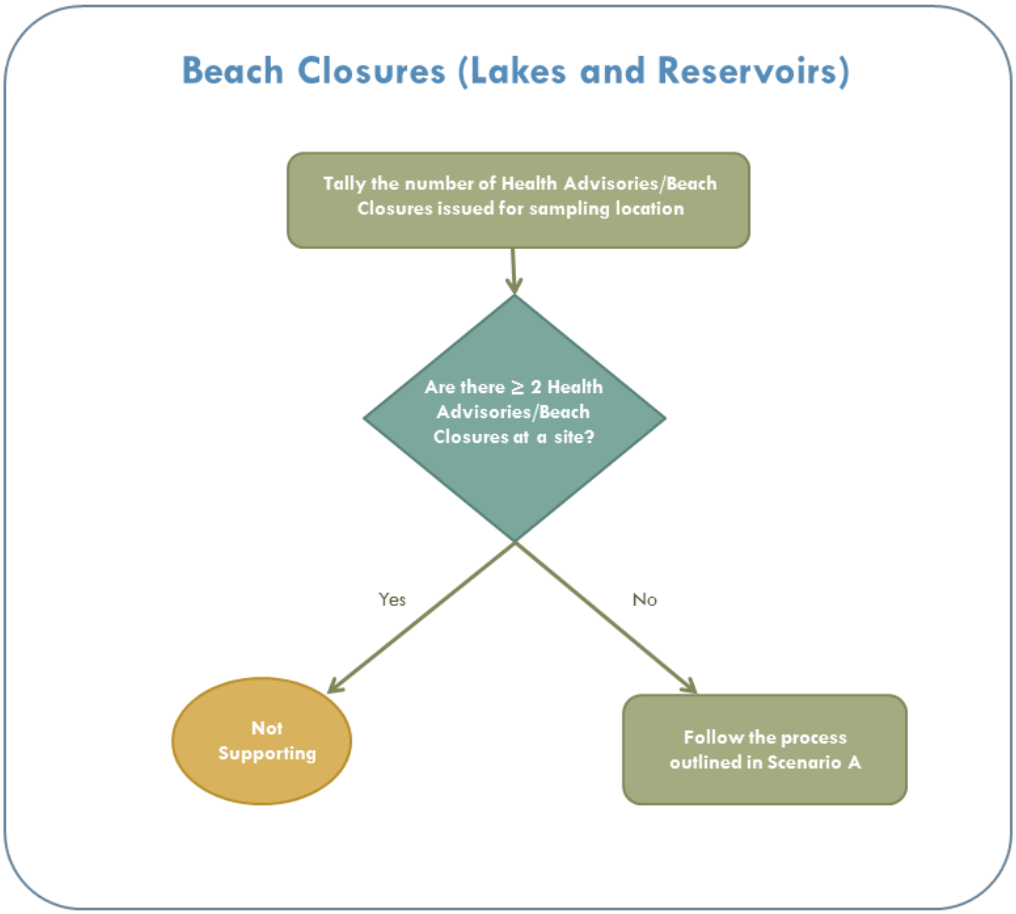


Figure 3. Lakes and reservoirs with two or more closures or advisories.

To ensure protection of recreation and drinking water uses of assessed waterbodies of the state, DWQ considers three scenarios based on sampling frequency and the number of collection events at a monitoring location:

- **Scenario A:** A seasonal assessment against the maximum criterion (Figure 4).
- **Scenario B:** A 30-day geometric mean assessment (Figure 5).
- **Scenario C:** A seasonal geometric mean assessment (Figure 6).

Each monitoring location is assessed against the maximum criterion first if there are five or more samples (see Figure 4).

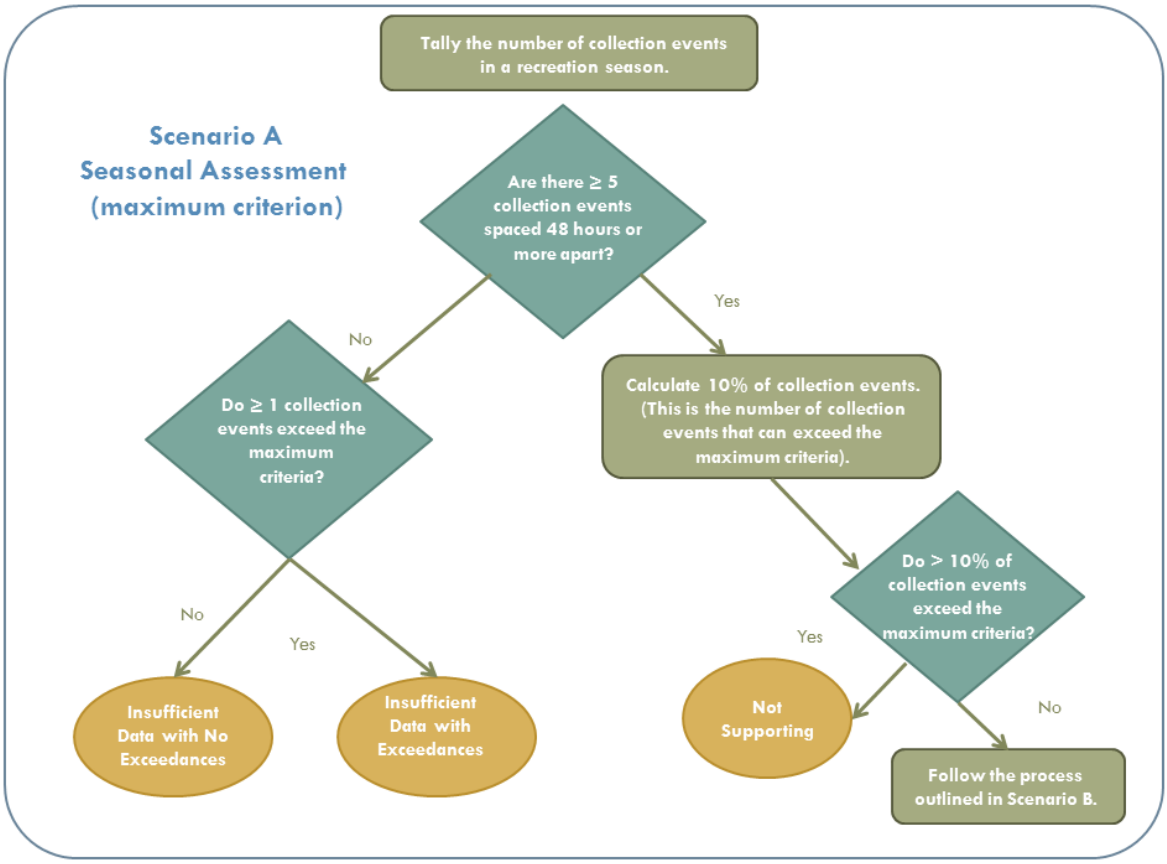


Figure 4. Scenario A: a seasonal assessment using the maximum criterion at a monitoring location.

If less than 10% of collection events exceed the maximum criterion, the site is then assessed using the 30-day geometric mean criterion (see Figure 5). In order to assess against the 30-day geometric mean criterion directly, there must be a minimum of five collection events in 30 days, with at least 48 hours between collection events. This ensures that collection events are adequately spaced and are representative of ambient conditions.

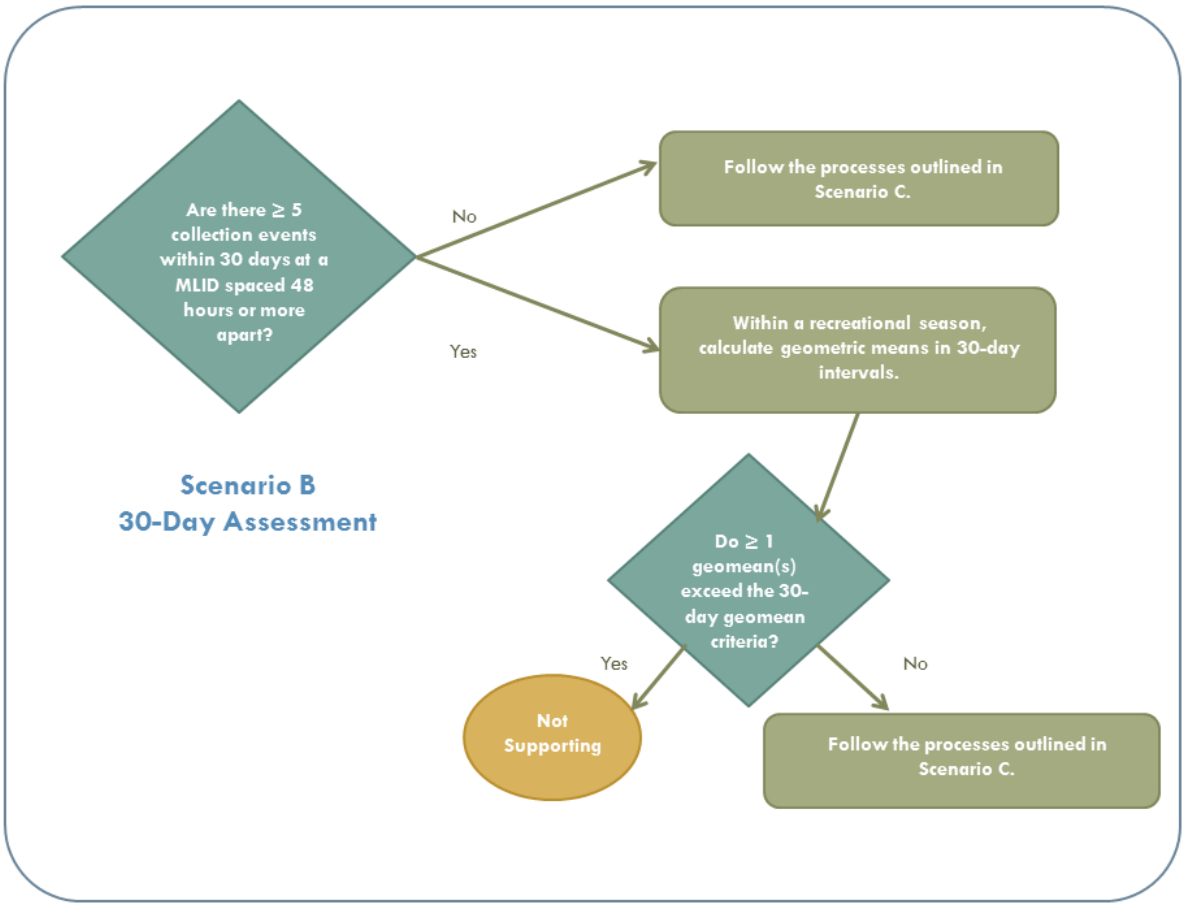


Figure 5. Scenario B: an assessment using the 30-day geometric mean for monitoring locations with five or more collection events within 30 days.

If adequate (at least five samples) and/or representative data spaced by at least 48 hours are not available to assess against the 30-day geometric mean, DWQ will assess *E. coli* data for the recreation season provided there are at least five collection events during the season (May–October). Exceedances of the geometric mean criterion will result in the site being classified either as impaired (minimum of 10 collection events in a recreation season) or as insufficient data (sample size is more than five but fewer than 10) (see Figure 6).

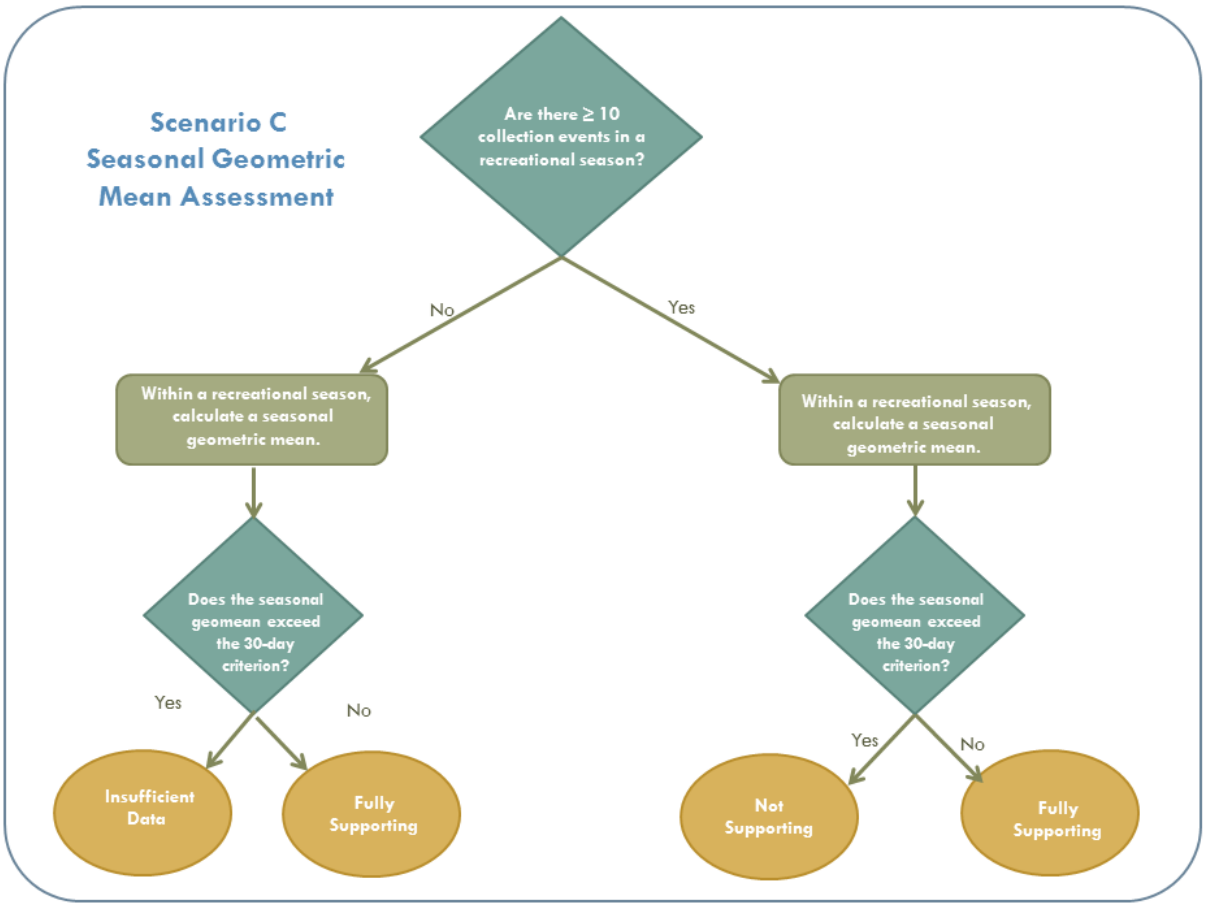


Figure 6. Scenario C: A seasonal geometric mean assessment.

Summarizing Assessment Results

When determining the attainment of a monitoring location with assessment results across multiple years, the following rules are applied (in the following order):

<u>Not Supporting (Category 5)</u>

A waterbody is considered to be impaired (not meeting its designated uses) if any of the following conditions exist:

- A lake or reservoir that has two or more posted health advisories or beach closures during any recreation season.
- Any monitoring location where *E. coli* concentrations from 10% or more of the collection events exceed the maximum criterion.
- Any monitoring location where the 30-day geometric mean exceeds the 30-day geometric mean criterion (minimum five collection events with at least 48 hours between collection events).
- Any monitoring location where the recreational season (May–October) geomean exceeds the 30-day geometric mean criterion (minimum of 10 collection events).

Insufficient Data or Information Assessment Considerations (Category 3A)

- Sites with four or fewer samples in all seasons evaluated will be listed as not assessed, provided impairment is not suggested by a posted health advisories or beach closure. This applies at lakes and reservoirs only.
- All Category 3A sites will be prioritized for future monitoring, especially if limited data suggest impairment.

Combinations of Category 3E, 2, and/or 1

- When making a final attainment decision of a site after all recreation season assessments are complete, DWQ uses the approach that if there is no evidence of impairment at a site by any of the assessment approaches over the period of record of concern, the assessment analysis from the most recent year outweighs the results from previous years. DWQ has a process for merging assessment results from multiple locations within an AU (Assessment of Lakes and Reservoirs section).

Fully Supporting (Category 1 or 2)

- No evidence of impairment by any assessment approach for all recreation seasons over the most recent 6 years. A fully supporting determination can be made with a minimum of five collection events during the recreational season.

Combining *E. coli* with Other Parameter Assessment Results

Until the determination of impairment and the review of additional supporting information are completed by internal reviewers, parameter assessments at an individual monitoring location and results from multiple monitoring locations within the same AU are not summarized and combined (Assessment Unit Roll-up; Appendix 1).

ASSESSMENT OF RIVERS, STREAMS, SPRINGS, SEEPS, AND CANALS

Data Preparation

DWQ determines attainment or nonattainment of numeric standards for rivers, streams, springs, seep, and canals by assessing credible data against the numeric criteria in UAC R317-2 through the protocols outlined below. Though *E. coli* and biological assessments also are performed on rivers, streams, springs, seeps, and canals, assessment methods unique to those parameters are described in separate sections of this document.

Results below Detection Limits

Environmental chemistry laboratories often report sample results as below their detection limit for a given analytical method. These limits are variously reported as minimum detection limit, minimum reporting limit, and/or minimum quantitation limit. DWQ first screens and flags laboratory result values that are empty and that have detection limits higher than the water quality criteria in UAC R317-2. These flagged data records are not considered for the analysis. For sample results below detection, the reported result value or a value of 0.5 times the lowest reported detection limit is applied for purposes of the assessment. However, if one-half of the detection limit is above the water quality standard, the data will not be used in the assessment.

Duplicate and Replicate Results

Following credible data requirements and additional QA/QC checks as outlined in DWQ's *Quality Assurance Program Plan For Environmental Data Operations* (DWQ, 2014), datasets may contain duplicate and replicate sample results either due to reporting errors or sampling design. In these cases, a single daily value is determined by accepting the highest result for parameters with not-to-exceed criteria in UAC R317-2, or the lowest reported value for parameters with minimum criteria in UAC R317-2. All data are retained in the assessment dataset and flagged as rejected because of replicate or duplicate values.

Initial Assessment: Monitoring Location Site Level

Once data records reflect the corrections described above, DWQ analyzes each beneficial use for a parameter at a single monitoring location. DWQ developed this protocol because individual assessments offer a more direct measure of supporting or not-supporting water quality standards in UAC R317-2.

Multiple parameter assessments at an individual monitoring location and results from multiple monitoring locations within the same AU are not summarized and combined until the determination of impairment and the additional supporting information are completed by internal reviewers. See the Determination of Impairment: All Assessment Units section.

Conventional Parameters

Currently, DWQ assesses six parameters within UAC R317-2 as conventional parameters and assesses them against the beneficial use–specific criteria established in UAC R317-2. Several waterbodies with conventional numeric criteria have site-specific standards articulated in self-explanatory footnotes

within DWQ's surface water standards (UAC R317-2). Site-specific standards that require further clarification for 303(d) assessment purposes are noted and explained in Table 7.

Table 7. Conventional parameters and associated designated uses as identified for assessment purposes.

Parameters	Designated Use	Notes
DO*	Aquatic life	Numerous recurrence intervals are listed. 30-day averages are used for assessments based on grab samples. Some site-specific standards have been generated, which are used for assessment purposes.
Maximum temperature*	Aquatic life	Some site-specific standards have been generated, which are used for assessment purposes
pH*	Domestic Recreation Aquatic life	Criteria are identical across uses.
E. coli	Domestic Recreation	Criteria are different for uses. Several seasonal scenarios are evaluated.
Total dissolved solids (TDS)	Agriculture	Many site-specific standards have been generated, which are used for assessment purposes. Clarification on how three site-specific standards are used for 303(d) purposes are provided below: • For South Fork Spring Creek from the confluence with Pelican Pond Slough Stream to U.S. Route 89, two seasonal assessments are not performed. Instead, each sample is compared to the monthly corrected criteria in the footnote in UAC R317-2. • Ivie Creek and its tributaries from the confluence with Muddy Creek to the confluence with Quitchupah Creek. If TDS exceeds the site-specific standard, the site is not attaining site-specific criteria. If TDS is not exceeding, total sulfate is assessed. • Quitchupah Creek from the confluence with Ivie Creek to Utah State Route 10: If TDS exceeds the site-specific standard, it is not attaining site-specific criteria. If TDS is not exceeding, total sulfate is assessed.
Sulfate	Agriculture	Site-specific standard associated with sulfate for the following areas: • Ivie Creek and its tributaries from the confluence with Muddy Creek to the confluence with Quitchupah Creek: When TDS is not exceeding site-specific criteria and total sulfate exceeds site-specific criteria, it is not attaining. • Quitchupah Creek from the confluence with Ivie Creek to Utah State Route 10: When TDS is not exceeding site-specific criteria and total sulfate exceeds site-specific criteria, it is not attaining.

* Indicate that assessments are performed from field measurement only. Springs and seeps will not be assessed by field level measurements.

A minimum of 10 samples for conventional parameters are required to determine if a site is attaining or not attaining water quality standards (Figure 7). Where locations have sufficient sample sizes of 10 or more, 10% of the total samples are calculated. This 10% calculation becomes the maximum number of samples that can exceed the numeric criterion For example, if there are 10 samples in a dataset for a site, one sample can exceed the criterion and the site still supports uses. If more than 10% of the total samples collected exceed the criterion, the site is not attaining the beneficial use. If 10% or less of the total samples collected exceed the criterion, the site is attaining its beneficial uses. Where locations have insufficient samples to make an attaining or non-attaining determination, DWQ prioritizes the sites and parameters for future monitoring, depending on whether the dataset contains criterion exceedances. In the case of waterbodies with site-specific standards for TDS and sulfate, both criteria must be met or the waterbody will be listed as not supporting its agricultural use.

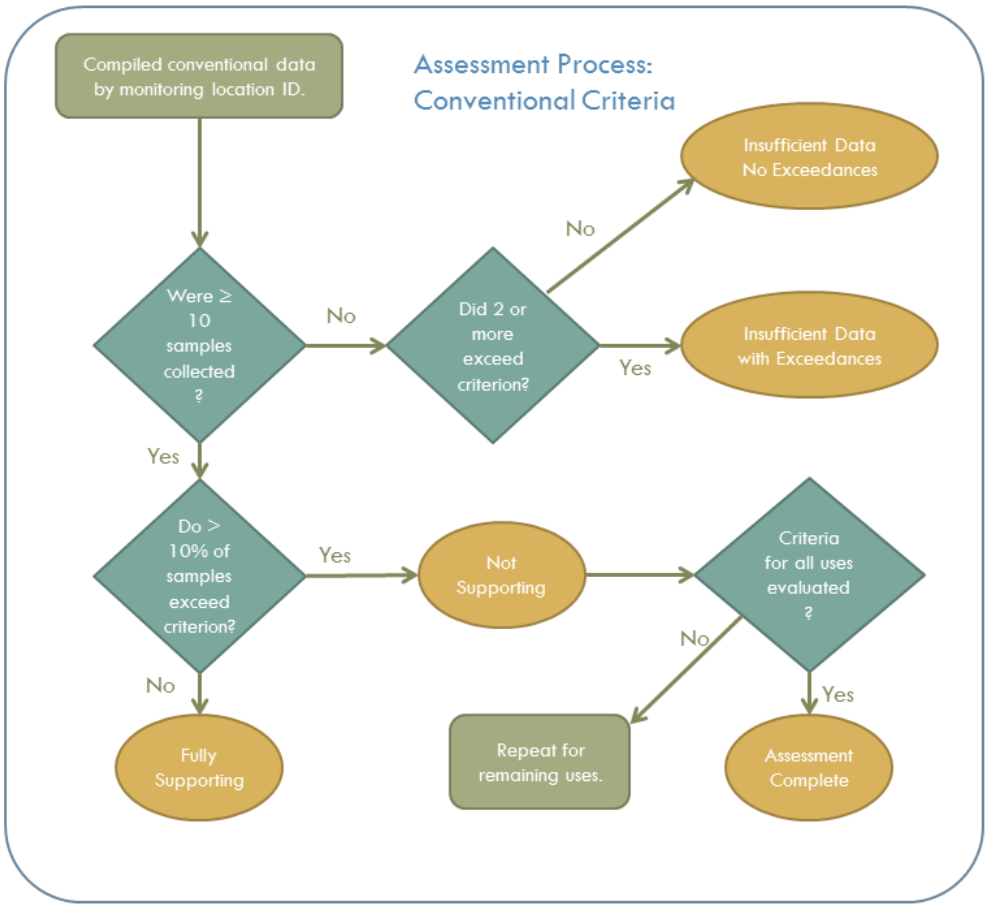


Figure 7. Overview of the assessment process for conventional parameters.

Toxic Parameters

DWQ identifies *toxics* as all parameters within UAC R317-2 that are not defined as conventional parameters (see Table 7). Assessment procedures for toxics are more conservative than conventional parameters for the following reasons:

- Many toxic substances accumulate in the tissue of aquatic organisms and become increasingly toxic with prolonged exposure to high pollutant concentrations.
- Toxic substances can biomagnify, or increase, in tissue concentration from lower to higher trophic levels.
- High concentrations of many of these substances can lead to the direct mortality of many species at various life stages.

To ensure protection of designated uses, data are compared against one or more toxic criteria, sample size requirements are smaller, and sites are considered degraded with two or more violations of a criterion.

Multiple toxic parameters can also have multiple criteria for a single beneficial use, depending on the averaging period: a lower, chronic criterion and a higher, acute criterion (UAC R317-2). For 303(d) assessment purposes, one daily measurement at each monitoring location is compared to the chronic and/or acute criteria. Currently, the acute and chronic averaging periods defined in UAC R317-2are not applied for 303(d) assessment analysis because monitoring and sampling frequencies are different and more widely spaced than the acute and chronic periods typically defined in UAC R317-2.

Equation-Based Toxic Parameters

A number of toxic criteria are specified as equations rather than specific values (see footnotes in UAC R317-2). The equations include variables of other chemical constituents or water properties that either reduce or magnify the extent to which a toxic is harmful to aquatic life. To properly apply the correction factor equations, it is necessary to use measured data for the variables in the equation to calculate the appropriate numeric criteria for the sample. To calculate the correct criterion for a pollutant-result value, only the monitoring location site and date of sample must match between the pollutant of concern and the additional parameter(s) needed for the equation. In the case where there are missing supplemental data values to apply the equation, the following rules will be applied:

- Only hardness-dependent toxics:
  For hardness-dependent criteria where a calcium (Ca) or magnesium (Mg) value is missing and the hardness cannot be calculated, a hardness value reported from the laboratory will be used. If a hardness value cannot be calculated from a measured Ca and Mg value and the laboratory did not provide a hardness value, a default hardness of 100 milligrams per liter (mg/l) is used to evaluate the toxic results. Results were reviewed to ensure that a Category 5 (not supporting) decision was not reached using surrogate hardness values.

- Aluminum, chronic only:
  If either a field pH or calculated or laboratory hardness is missing, the aluminum acute default value of 750 microgram per liter (µg/l) provided in Table 2.14.2 of UAC R317-2 will be applied. Otherwise, the following pH and hardness combination and numeric criteria are applied:

  - pH ≥ 7.0 and (calculated or laboratory reported) hardness ≥ 50 parts per million (ppm): 750 µg/l.
  - pH < 7.0 and (calculated or laboratory reported) hardness ≥ 50 ppm: 87 µg/l.

  - pH ≥ 7.0 and (calculated or laboratory reported) hardness < 50 ppm: 87 µg/l.
  - pH < 7.0 and (calculated or laboratory reported) hardness < 50 ppm: 87 µg/l.

- Ammonia, chronic:
  DWQ assumes fish early life stages are present at all monitoring locations and the following equation is used:

  $$((0.0577/(1+10^{7.688-pH})) + (2.487/(1+ 10^{pH-7.688}))) * MIN (2.85, 1.45*10^{0.028*(25-T)})$$

  Where $(1.45*10^{0.028*(25-T)})$ is ≤ 2.85, $(1.45*10^{0.028*(25-T)})$ is applied and if $(1.45*10^{0.028*(25-T)})$ is > 2.85, 2.85 is applied. However, if a field pH or temperature reading is unavailable, a correction factor cannot be made and the result value for ammonia will be removed from the assessment.

- Ammonia, acute:
  If a field pH is missing, a correction factor cannot be made, and the result value for ammonia will be removed from assessment.

- Fluoride:
  UAC R317-2 currently provides a range of criteria for fluoride depending on air temperature. This sliding criterion was determined to be inappropriately applied. Fluoride data were not assessed in 2016.

- Hydrogen sulfide:

  DWQ has discovered that the formula in **UAC R317-2** used to convert dissolved sulfide to un-disassociated hydrogen sulfide is not correct. This formula will be updated in the future by DWQ's Standards Program. Until the equation and/or criteria are reviewed and corrected by DWQ's Standards Program and Triennial Review work group and DWQ's board, all hydrogen sulfide data will not be assessed.

Additional Standards Interpretations

- Boron:

  UAC R317-2 does not specify sample fraction (total or dissolved) for the boron criterion. All data for boron, both total and dissolved, were included in the assessment. The intent of the boron standard was for dissolved fraction. The criterion will be updated in future triennial reviews by the Standards Program. Until it is adopted in rule, results will be reviewed to ensure that no waterbody is listed based on total boron results.

Assessment Process

Once chronic and acute criteria are calculated, where applicable, toxicant sampling results are compared to the criteria to determine if the monitoring location is supporting designated uses or is impaired due to exceedances of the standard. Sites with sufficient data (4 or more samples) with two or more exceedances of the acute and/or chronic criteria will result in nonattainment of the beneficial

use. For sites to be attaining beneficial uses, four or more samples will be required with one or zero samples exceeding acute or chronic criteria. In cases where there are fewer than four samples and one or zero samples are exceeding the acute or chronic criteria, sites will be placed in 3A or 3E categories (Figure 8).

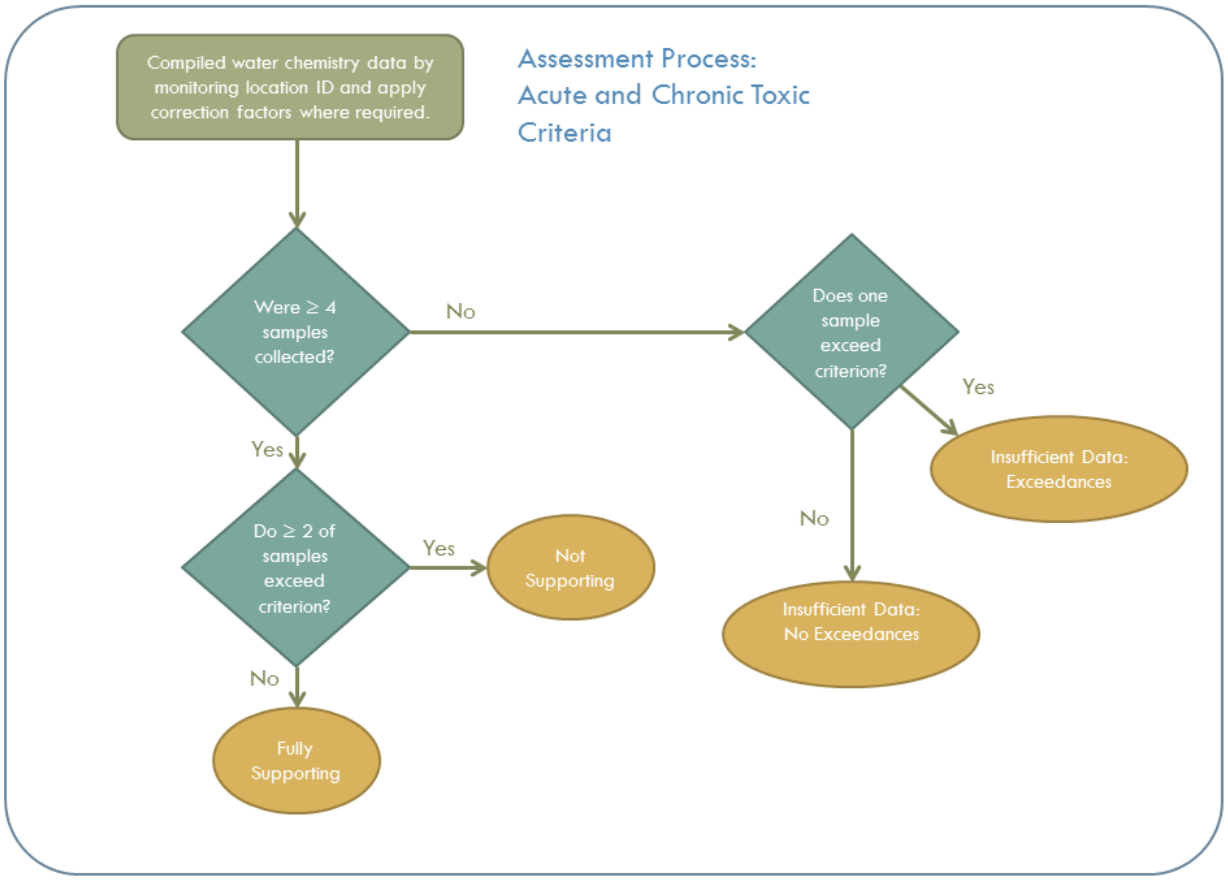


Figure 8. Overview of the assessment process for toxic parameters.

Biological Assessments

Utah's beneficial uses for aquatic life require the protection of fish (cold water or warm water species) and the organisms on which they depend (UAC R317-2-6.3). Historically, DWQ assessed these beneficial uses using water chemistry sampling and associated standards that are protective of aquatic organisms. Now, DWQ uses an empirical model that directly assesses attainment of aquatic life uses by quantifying the integrity of macroinvertebrate assemblages. Measuring biological communities directly has the advantage of integrating the combined effects of all pollutants, which allows a direct examination of how pollutants are interacting to affect the condition of a stream ecosystem (Karr, 1981). Moreover, because aquatic macroinvertebrates spend most of their life in aqueous environments, they are capable of integrating the effects of stressors over time, providing a measure of past and transient conditions (Karr and Dudley, 1981).

Biological assessments are often conducted by comparing the biological assemblage observed at a site with the expected biological assemblage in the absence of human-caused disturbance. Ideally, these comparisons are made using historical data to measure changes to the current biological community. However, in most cases, historical data are not available. As a result, biological conditions representing an absence of human-caused stress are typically set using reference sites as controls, or benchmarks, to establish the biological condition expected in the absence of human-caused disturbance. The biological integrity of sites can be evaluated by comparing the biological composition observed at a site against a subset of ecologically similar reference sites. Collectively, such comparisons are referred to as biological assessments.

In aquatic biological assessments, reference sites are selected to represent the best available condition for waterbodies with similar ecological, physical, and geographical characteristics (Hughes et al., 1986; Suplee et al., 2005; **Western Center for Monitoring and Assessment of Freshwater Ecosystems** website). When reference sites are selected for water quality programs, conditions vary regionally depending on adjacent historical land use. For example, reference sites in Utah mountains are generally more pristine than in valleys. As a result, there are more biological benchmarks in areas of the state that receive less human-made disturbance than those with more disturbances.

A numeric index is a useful tool that quantifies the biological integrity, or biological beneficial use, of stream and river segments. Data obtained from biological collections are complex, with hundreds of species found throughout Utah that vary both spatially and temporally. Similarly, the physical template on which biota depend also varies considerably across streams. A robust index of biological integrity should simultaneously account for naturally occurring physical and biological variability and summarize these conditions through a single, easily interpretable number.

River Invertebrate Prediction and Classification System Models

DWQ uses the River Invertebrate Prediction and Classification System (RIVPACS) model approach to quantify biological integrity (Wright, 1995). RIVPACS is a classification of freshwater sites based on macroinvertebrate fauna. It was first derived in 1977 and has subsequently been used in numerous biological assessment programs worldwide. In the early 1970s, scientists and water managers recognized a need to understand the links between the ecology of running waters and macroinvertebrate communities. This began some of the very early biological assessment work in Europe. A 4-year project was initiated to create a biological classification of unpolluted running waters in Great Britain based on the macroinvertebrate fauna (Clarke et al., 1996; Furse et al., 1984; Moss et al., 1999; Wright, 1995).

Over the past 30 years, equivalent RIVPACS models have been developed for aquatic ecosystems throughout the world, including Australia (Davies et al., 2000; Marchant and Hehir, 2002; Metzeling et al., 2002) and Indonesia (Sudaryanti et al., 2001). In the United States, scientists have developed RIVPACS models to assess the biological integrity of the country's aquatic habitats (Hawkins et al., 2000; Hawkins and Carlisle, 2001). Recently, many western states have adopted the RIVPACS model to determine beneficial uses of aquatic life in the rivers of state's such as Colorado (Paul et al., 2005), Montana (Feldman, 2006; Jessup et al., 2006), and Wyoming (Hargett et al., 2005).

To quantify biological condition, RIVPACS models compare the list of taxa (the lowest practical taxonomic resolution to which taxonomic groups are identified) that are observed (O) at a site to the

list of taxa expected (E) in the absence of human-caused stress. Predictions of E are obtained empirically from reference sites that together are assumed to encompass the range of ecological variability observed among streams in the region where the model was developed. In practice, these data are expressed as the ratio O/E, the index of biological integrity (Figure 9).

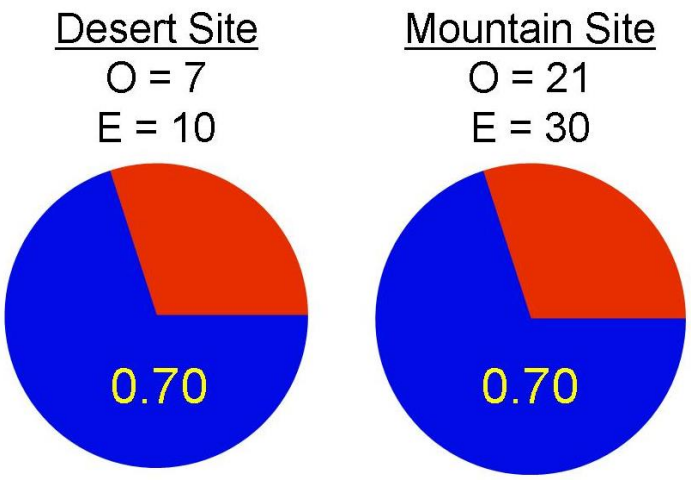


Figure 9. A hypothetical example of O/E as a standardization of biological assessments.

Interpretation of RIVPACS models requires an understanding of the O/E ratio. In practice, O/E quantifies loss of predicted taxa. However, it is not a measure of raw taxa richness because O is constrained to include only those taxa that the model predicted to occur at a site. The fact that O/E only measures losses of native taxa is an important distinction, because the stream ecological template changes in response to disturbance, and taxa richness can actually increase as conditions become more advantageous to taxa that are more tolerant of the degraded condition. Despite the mathematical complexities of model development, O/E is easily interpreted because it simply represents the extent to which taxa have become locally extinct as a result of human activities. For example, an O/E ratio of 0.40 implies that, on average, 60% of the taxa have become locally extinct as a result of human-caused alterations to the stream.

O/E has some very useful properties as an index of biological condition. First, it has an intuitive biological meaning. Species diversity is considered the ecological capital on which ecosystem processes depend; therefore, O/E can be easily interpreted by researchers, managers, policy-makers, and the public. Second, O/E is universally spatial, which allows direct and meaningful comparison throughout the state. This is particularly important for Utah, where streams vary considerably from high-altitude mountain environments to the arid desert regions. Third, its derivation and interpretation do not require knowledge of stressors in the region; it is simply a biological measuring tool. Finally, the value of O/E provides a quantitative measure of biological condition.

Model Construction and Performance

Construction of a RIVPACS model for Utah began in 2002, which involved developing and evaluating dozens of models. Details of model development procedures can be found elsewhere (Clarke et al., 1996; Moss et al. 1999; Wright et al., 1993; Wright 1995). Additionally, specific detailed

instructions can be viewed on the **Western Center for Monitoring and Assessment of Freshwater Ecosystems** website and the **EPA** website. A brief summary is provided here to help the reader better understand Utah's model results and subsequent assessments.

As mentioned earlier, predictions of expected "E" taxa are obtained empirically from reference site collections made throughout Utah. Reference sites are those that represent the reference conditions in different biogeographical settings throughout Utah. The initial list of candidate reference sites is independently ranked by different scientists familiar with the waterbodies. Only reference sites with a consensus representing best available conditions are used in model development. Subsequent reference sites are added using scores from reference scoring metrics developed during site visits and averaging with independent rankings from field scientists.

Some of the calculations involved in obtaining the list of expected taxa are complex. A heuristic description of the steps involved in predicting "E" provides some context of the Assessment Methods. The first step in model development is to classify reference sites into groups of sites with similar taxonomic composition using a cluster analysis. Next, models are developed based on watershed descriptors such as climatic setting, soil characteristics, and stream size to generate equations that predict the probability of a new site falling within each group of reference sites. These equations account for environmental heterogeneity and ensure that when a new site is assessed, it is compared against ecologically similar reference sites. When a new site is assessed, predictions of group membership are then coupled to the distributions of taxa across groups of reference sites to estimate the probability of capturing (Pc) each taxon from the regional pool of all taxa found across all reference sites. E is then calculated as the sum of all taxa Pcs that had a greater than 50% chance of occurring at a site given the site's specific environmental characteristics. Using a Pc limit set at greater than 50% typically results in models that are more sensitive and precise, which results in a better ability to detect biological stress (Hawkins et al., 2000; Simpson and Norris, 2000).

The accuracy and precision of RIVPACS models depend in part on the ability of the models to discriminate among groups of biologically similar reference sites. An extensive list of 74 GIS-based watershed descriptors is evaluated for potential predictor variables in models that predict the probability of membership within biological groups for sites not used in model construction. GIS-based predictor variables, such as soils, meteorology, and geography, instead of field-derived descriptors, are evaluated for a couple of reasons. First, GIS-based descriptors are unlikely to be influenced by human disturbance and are therefore unlikely to bias estimates of expected conditions (Hawkins, 2004). Second, these predictors are easily obtained for any site that allows inclusion of additional macroinvertebrate samples collected by others. Various subsets of potential predictors are evaluated in an iterative, analytical process that explores different combinations of predictors able to explain the biological variability among reference sites. The current RIVPACS model used by DWQ includes 15 variables that resulted in the most precisely predictive model (Table 8).

Table 8. Final predictor variables used in model construction.

General Category	Description
Geography	Mean watershed elevation (meters) from National Elevation Dataset.
Geography	Minimum watershed elevation (meters) from National Elevation Dataset.
Geography	Watershed area in square kilometers.
Geography	Latitude of the sample location.
Climate	Watershed average of the mean day of year (1–365) of the first freeze derived from the PRISM data.
Climate	Watershed average of the annual mean of the predicted mean monthly precipitation (millimeters) derived from the PRISM data.
Climate	Watershed average of the annual maximum of the predicted mean monthly precipitation (millimeters) derived from the PRISM data.
Climate	Watershed average of the annual mean of the predicted mean monthly air temperature derived from PRISM data.
Climate	Average of the annual mean of the predicted maximum monthly air temperature at the sample location derived from PRISM data.
Climate	Watershed average of the annual mean of the predicted maximum monthly air temperature derived from PRISM data.
Climate	Watershed average of the annual mean of the predicted minimum monthly air temperature derived from PRISM data.

Climate	Watershed average of the annual mean of the predicted mean monthly relative humidity derived from PRISM data.
Climate	Average of the annual mean of the predicted mean monthly air temperature at the sample location derived from PRISM data
Climate	Watershed maximum of mean 1961–1990 annual number of wet days.
Vegetation	Watershed maximum of mean 2000–2009 annual enhanced vegetation index.

The RIVPACS model used for the 2016 assessments was reconstructed to accommodate broader spatial and temporal data. Models used earlier were limited to samples from streams ranging from second to fifth order and were collected during a 'fall' window of September–November. The updated model accepts data collected from first- to eighth-plus- order rivers and streams with no limitations on season of collection. In addition, new predictor variables were tested, and new and updated reference site data were included. However, to include data collected from agencies using different taxonomic laboratories, the taxon levels required adjustment, which resulted in a more coarse resolution of taxonomy. However, the resulting model was capable of scoring nearly 1,800 samples collected across the state by various agencies.

The updated model is nearly as accurate and precise as previous models. If the model was perfectly accurate and precise, the O/E score for all reference sites would equal 1. Instead, reference O/E values are typically spread in a roughly normal distribution centered on 1 (Wright, 1995). Model precision is often expressed as the standard deviation (SD) of reference O/E values with lower SDs indicating higher model precision. The RIVPACS model to be used for the 2016 IR assessments has an SD of 0.19, which is within the range of "accepted" water quality models. The precision was likely affected by the more coarse resolution of taxonomy and the inclusion of a few large river sites as reference. The average reference O/E score for the current model is 1.00, which means that the model has high precision calculating O/E values. The accuracy of the model was evaluated by examining the distribution of reference O/E scores across environmental settings and determined that reference O/E values are not biased by stream size, elevation, or ecoregion.

Assessing Biological Use Support

DWQ does not have numeric biological criteria. However, DWQ has narrative biological criteria (**UAC R317-2-7.3**) that specify how quantitative model outputs are used to guide assessments. To make the narrative assessments as rigorous as possible, a systematic procedure was devised to use the RIVPACS model O/E values to determine aquatic life beneficial use support (Figure 10). The goal

of this assessment process is to characterize each AU as fully supporting or not supporting aquatic life beneficial uses.

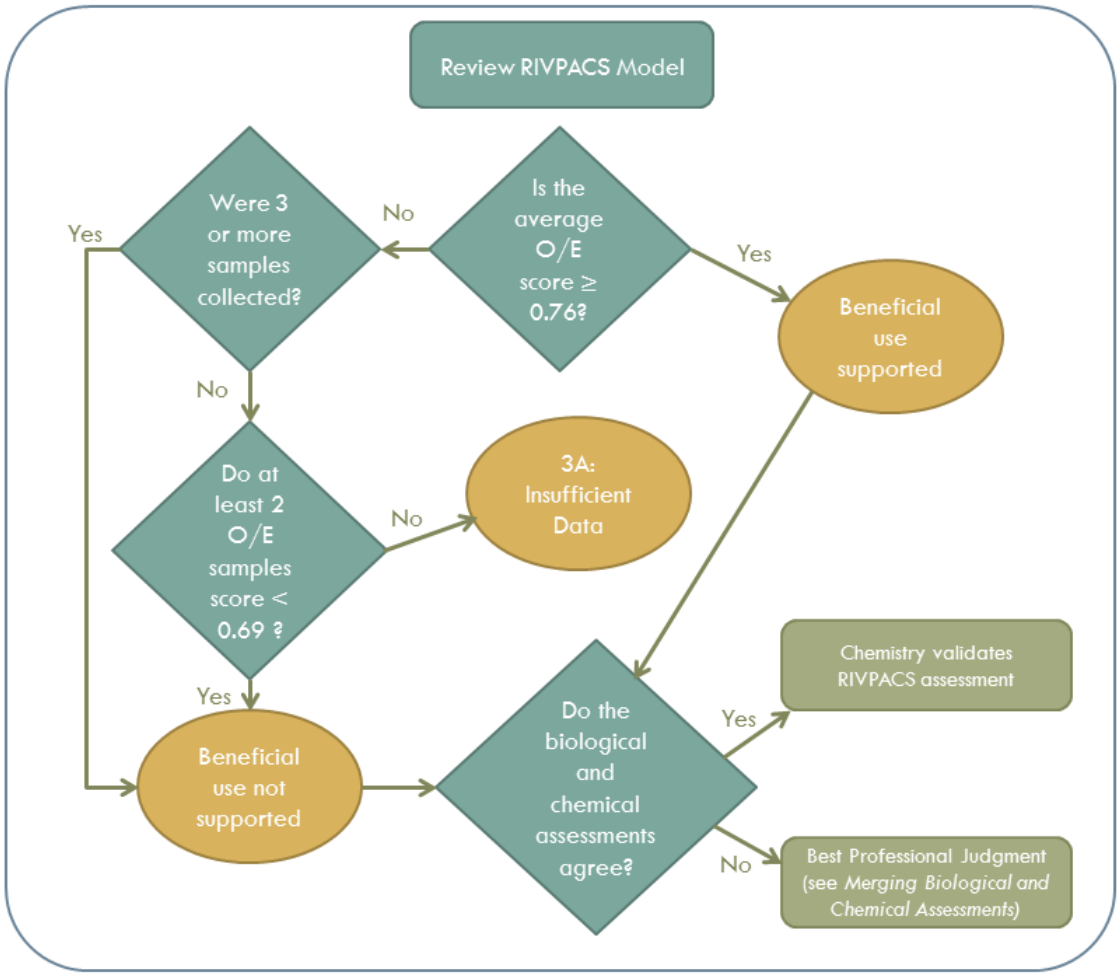


Figure 10. Decision tree for making biological assessment decisions.

Utah currently assesses watersheds based on established AUs. Although many AUs contain a single biological monitoring location, some AUs contain multiple sites. In such instances, DWQ staff examines available data to determine if multiple sites in an AU score similarly. When comparisons suggest that sites in one AU are ecologically similar, O/E scores from all sites in an AU are averaged for assessment purposes, provided that conclusions of biological condition are similar. If O/E scores differ appreciably among multiple sites in an AU, DWQ will investigate possible explanations for such discrepancies. If DWQ finds multiple sites within an AU from different environmental settings, AUs may be subdivided into smaller watershed units whenever clear boundaries can be identified (e.g., political/land use boundaries, tributary confluence). Additionally, if only one site is sampled in an AU, it is examined to determine whether it is an appropriate representation of the AU.

To translate the O/E values into assessment categories, it is necessary to devise thresholds, or O/E scores that indicate whether or not a site is meeting biological beneficial uses (Table 9). For these assessments, the 10th and 5th percentiles of reference sites were used. Essentially, the data used for

the 2016 Assessment calculate the threshold based on 5th percentile at 0.69, whereas the 10th percentile is 0.76. These thresholds will provide the bounds according to sample strength. The data will be averaged across 6 years since the most recent year of available data (2014). Multiple years are preferred for assessments because O/E scores can vary from year to year and assessments are based on average conditions. Assessments based on the average condition of three or more samples reduce the probability of making an error of biological beneficial-use support as a result of an unusual sampling event (e.g., following a flash flood, an improperly preserved sample).

Table 9. Beneficial use support determination for O/E values obtained from different sample sizes.

Sample Size	O/E Threshold	Use Determination	Comments
≥ 1 sample collected over 5 years	Mean O/E score ≥ 0.76	Fully Supporting	Threshold based on 10th percentile of reference sites.
≥ 3 samples collected over 5 years	Mean O/E score < 0.76	Not supporting	Threshold based on 10th percentile of reference sites.
< 3 samples	Mean O/E score ≥ 0.76	Fully supporting	Threshold based on 10th percentile of reference sites.
< 3 samples	Mean O/E score ≥ 0.69–≤ 0.76	Insufficient Data	Lower threshold based on 5th percentile of reference sites.
< 3 samples	2 O/E scores < 0.69	Not Supporting	Threshold based on 5th percentile of reference sites
< 3 samples	< 2 O/E scores < 0.69	Insufficient Data	Threshold based on 5th percentile of reference sites

These errors can be costly to DWQ by increasing staff time and resources for follow-up assessments on erroneous assessments. AUs not meeting biological thresholds will be assessed as non-supporting, or they will be required for follow-up sampling if additional information is needed. Assessments of more than three samples with average O/E scores of greater than or equal to 0.76 have a low probability of being misclassified as nonsupport. Alternatively, assessments with fewer than three samples with an average O/E score of less than 0.69 have a 5% probability of being misclassified as nonsupport. To ensure that one sample was not incorrectly misapplied, at least two samples with a score of 0.69 or less will be required to consider an AU not meeting the aquatic life use. Assessments with fewer than three samples that have a mean O/E score of greater than or equal to 0.69 and less than 0.76 will be placed in Category 3A, which indicates that there are insufficient data to make an assessment. All sites listed as 3A will be given a high priority for future biological monitoring.

ASSESSMENT OF LAKES AND RESERVOIRS

Lakes and reservoirs are defined in UAC R317-2-13.12 by county along with the designated beneficial uses for which they are protected. Waterbodies not specifically listed are assigned beneficial uses by default to the classification(s) of the tributary stream(s). Other than GSL, each waterbody has been assigned an AU for purposes of assessment. In UAC R317-2-14, numeric water quality criteria for both toxic and conventional parameters are assigned for each designated use. Deeper lakes naturally stratify thermally, which will affect how conventional water quality parameters are assessed (UAC R317-2-14). Therefore, each waterbody will be evaluated for thermal stratification and assessed appropriately.

Monitoring Overview

DWQ has identified 137 lakes based on size and public interest to receive consistent, programmatic monitoring. These waterbodies account for 93% of the water surface acres in Utah. Additional lakes are targeted for monitoring to ensure public health due to potential harmful algal blooms. Waters that are classified as having a high recreational use or are protected for drinking water are prioritized. DWQ transitioned to a rotating basin (n = 6) approach where monitoring is focused in a basin through sampling. Lakes within the focused basin are sampled once during the year, typically May–September. Waterbodies deemed high priority (Category 3A and 5) will be sampled more frequently per year regardless of their location. For most lakes, the change to a basin-intensive approach results in collecting a single sample every 6 years, which necessitated changes to the Assessment Methods. The 2016 assessments are based on the last 6 years of data (for instance, the 2016 data used data from 2009 to 2014). If data for this time period were unavailable, data from the previous 4 years (total of 12 years) were assessed. DWQ also participates in the National Lake Assessment (NLA) component of the National Aquatic Surveys conducted every 5 years by EPA. For these surveys, Utah adopts a state-intensification approach where 50 probability-based sites are selected within the state using the NLA design. Data that are compatible with DWQ's lake assessment methods are also used for determining beneficial use support.

Field Method Overview

For most waterbodies, data collection occurs in the deepest location of the lake. Although some waterbodies have multiple locations where data are collected, data used for assessments rely on, but are not limited to, samples collected from the location with the deepest depth. Water column profile data are collected at the surface and at every meter of the water column depth. The collection is completed when the probe is one meter above the bottom. Surface samples are collected from a depth of 0.5 meter. All water chemistry samples, except dissolved metals and algae, are collected at the surface, 1 meter above the thermocline, 1 meter below the thermocline, and near the bottom. The dissolved metals sample is collected 1 meter above the bottom at the deepest site of the waterbody. The algal sample, which is analyzed for taxonomic composition and primary production (chlorophyll *a*), is collected as a composite sample from two times the depth of the Secchi disc reading to the surface up to a maximum of 2 meters.

The assessment of Utah lakes and reservoirs consists of two tiers:

- **Tier 1:** The tier I assessment is the preliminary determination of support status for recreational use (Class 2), aquatic life (Class 3), and agricultural (Class 4) classes based on conventional parameters, such as DO, temperature, pH, toxicants, and *E. coli*. When Tier I data are not available, DWQ may rely on Tier II data to make an initial assessment. When considering Aquatic Life Use attainment within this tier, the waterbody will be classified as mixed or stratified based on the depth profile information. If it is a stratified waterbody, the evaluation of conventional parameters will follow the protocol designed to evaluate the sufficiency of aquatic life habitat. If the waterbody is mixed, it will follow the assessment protocol that evaluates the entire depth profile.
- **Tier II:** The tier II assessment looks further into the weight of evidence criteria (trophic state index [TSI], fish kills, and algal composition) using BPJ. The Tier I preliminary support status may be modified through an evaluation of the TSI, water quality–related fish kills, and the composition and abundance of blue-green algae. The Tier II evaluation could adjust the preliminary support status ranking if at least two of the three criteria indicate a different support status.

DWQ will prioritize waterbodies that are assessed as Category 3A for subsequent monitoring so that conclusive beneficial use assessments can be made.

Tier I Assessment

Drinking Water Use Support

Assessing for Drinking Water Use support involves evaluations of *E. coli*, harmful algal blooms, pH, and metals. *E. coli* is collected at waterbodies designated for the Drinking Water Use. For further information, please review the *E. coli* Assessment section discussed earlier in this document. The evaluation process of pH and metals is the same as the requirements for Aquatic Life Uses (other than criteria thresholds), which are described below.

Harmful Algal Blooms

DWQ is actively developing a monitoring and reporting program for harmful algal blooms. In the interim, DWQ will use the recommendations by the World Health Organization to guide this assessment. These recommendations prescribe human health risks associated with aggregated cyanobacteria cell counts (Table 10). Excessive growth of cyanobacteria can lead to taste and odor problems, which increase drinking water treatments costs. In some instances, sources of drinking water may need to be temporarily excluded from the water supply until a cyanobacteria bloom subsides. Some species of cyanobacteria, particularly *Anabaena* sp., *Aphanizomenon* sp., *Microcystis* sp., and *Planktothrix* sp., can produce cyanotoxins that are harmful to people and other animals. Currently, DWQ prioritizes monitoring for harmful algal blooms in waters designated for drinking water and those waters that experience significant recreational usage, such as motor boating, water skiing, and swimming. This monitoring will be in partnership with the Utah Division of Drinking Water and Utah Division of State Parks, as resources allow. Data and assessments will be shared with the Utah Department of Health and local health departments.

Beneficial Use Supported

The beneficial use is supported if cyanobacteria cell counts are < 20,000 cells/milliliter (ml).

Beneficial Use Not Supported
The beneficial use is categorized as "Threatened" if the cyanobacteria cell count exceeds 100,000 cells/ml once for waters that have Drinking Water Use (1C) designation.
The beneficial use is not supported if the cyanobacteria cell count exceeds 100,000 cells/ml for more than one sampling event for waters that have Drinking Water Use (1C) designation.

Insufficient Data and Information
The waterbody will be categorized 3A if there is one exceedance of > 20,000 cells/ml. These waterbodies will be prioritized for further evaluation with respective public health managing partners such as the Utah Department of Health, respective drinking water agencies, and state parks departments.

Table 10. World Health Organization thresholds of human health risk associated with potential exposure to cyanotoxins.

Indicator (units)	Low Risk	Moderate Risk	High Risk
Chlorophyll *a* (µg/l)	< 10	10–50	> 50
Cyanobacteria cell counts (cells/ml)	< 20,000	20,000–100,000	> 100,000

Recreational Use Support

Assessing for Recreational Use support involves evaluations of pH, *E. coli*, and harmful algal blooms. The evaluation of pH is the same as the requirements for Aquatic Life Uses, which are described in that section below. The methods for assessing the remaining indicators are described below.

Escherichia coli
E. coli is collected at select waterbodies to ensure the protection of Recreational Uses. For further information, please review the *E. coli* Assessment section for further information.

Harmful Algal Blooms
A person's health can be put at risk when exposed to algal toxins through skin contact, inhalation, or ingestion. This exposure pathway exists through multiple methods of recreation in lakes such as boating, water-skiing, and swimming. DWQ is working with partner agencies to develop a monitoring, evaluation, notification, and mitigation strategy to address the public's potential exposure to these toxins.

Beneficial Use Supported
The beneficial use is supported if cyanobacteria cell counts are < 20,000 cells/ml.

Beneficial Use Not Supported
The beneficial use is not supported if the cyanobacteria cell count exceeds 100,000 cells/ml for more than one sampling event or other narrative indicators (e.g., phycocyanin, chlorophyll *a*, harmful algal bloom–related beach closures) suggest recreational uses are not being attained.

Insufficient Data and Information

The waterbody will be categorized 3A if there is one exceedance of 20,000 cells/mL. These waterbodies will be prioritized for further evaluation with respective public health managing partners such as the Utah Department of Health and state parks departments.

Aquatic Life Use Support

Lake monitoring routinely involves collecting pH, temperature, and DO measurements at 1-meter intervals throughout the water column, from the surface to the lake bottom. If more than one site is sampled, the profile measurements collected at the deepest location of the waterbody are used for assessment calculations, unless there is sufficient reason to use profile data from other locations on the lake. These water column measurements are compared against Utah water quality standards to assess beneficial use support (Figure 11). For waterbodies that are thermally stratified, a separate process is used to determine whether sufficient habitat is available for aquatic life (Figure 15).

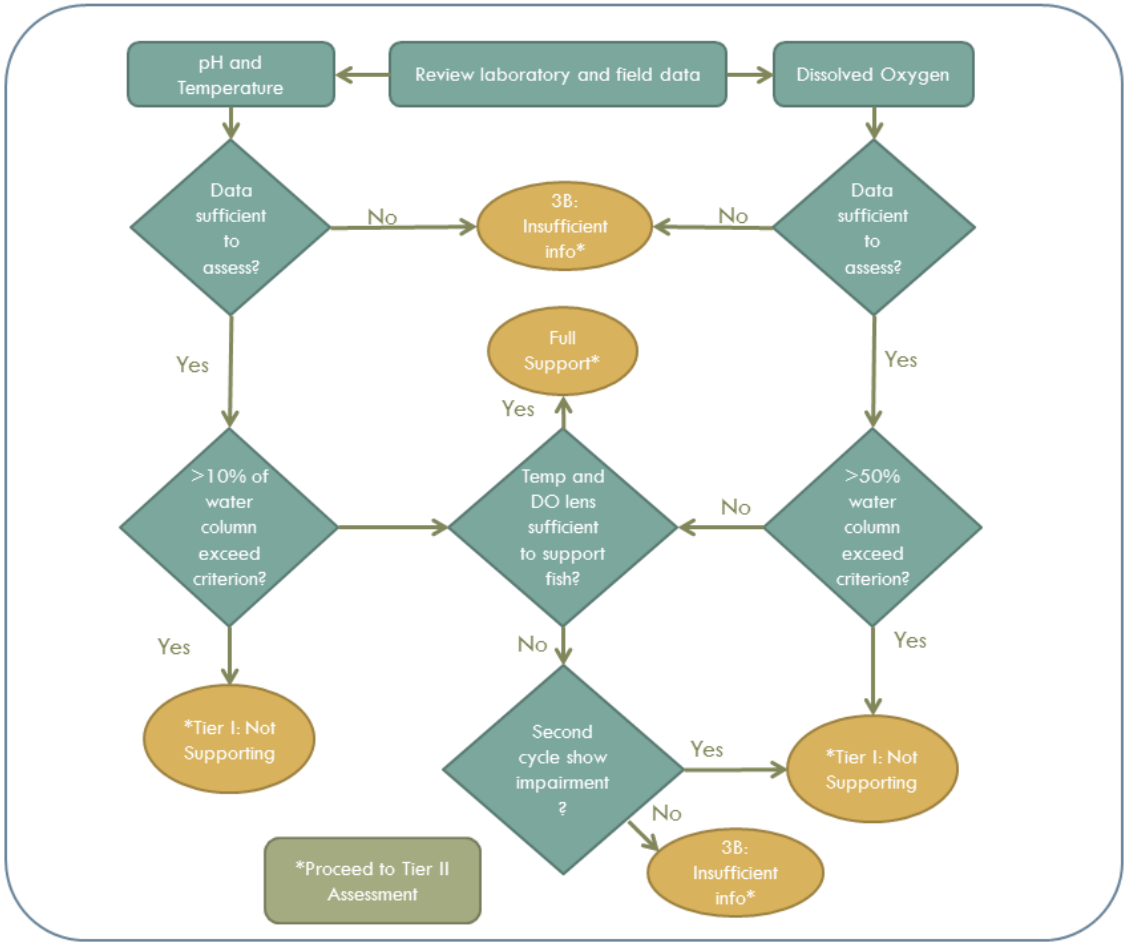


Figure 11. Process using conventional (nontoxic) parameters to assess lakes that are mixed.

For stratified waterbodies, an alternative test is used to evaluate whether aquatic life has sufficient habitat. In all cases, these assessments are followed by a second, Tier II, assessment process.

<u>pH</u>

Two pH criteria, maximum (9.0) and minimum (6.5), are used to assess support of beneficial uses:

Beneficial Use Supported
The beneficial use is supported if the number of violations are less than or equal to 10% of the measurements (see Figure 12, Panel A).

Beneficial Use Not Supported
The beneficial use is not supported if greater than 10% of the measurements (minimum of two discrete measures outside thresholds) violate the pH criterion (see Figure 12, Panel B).

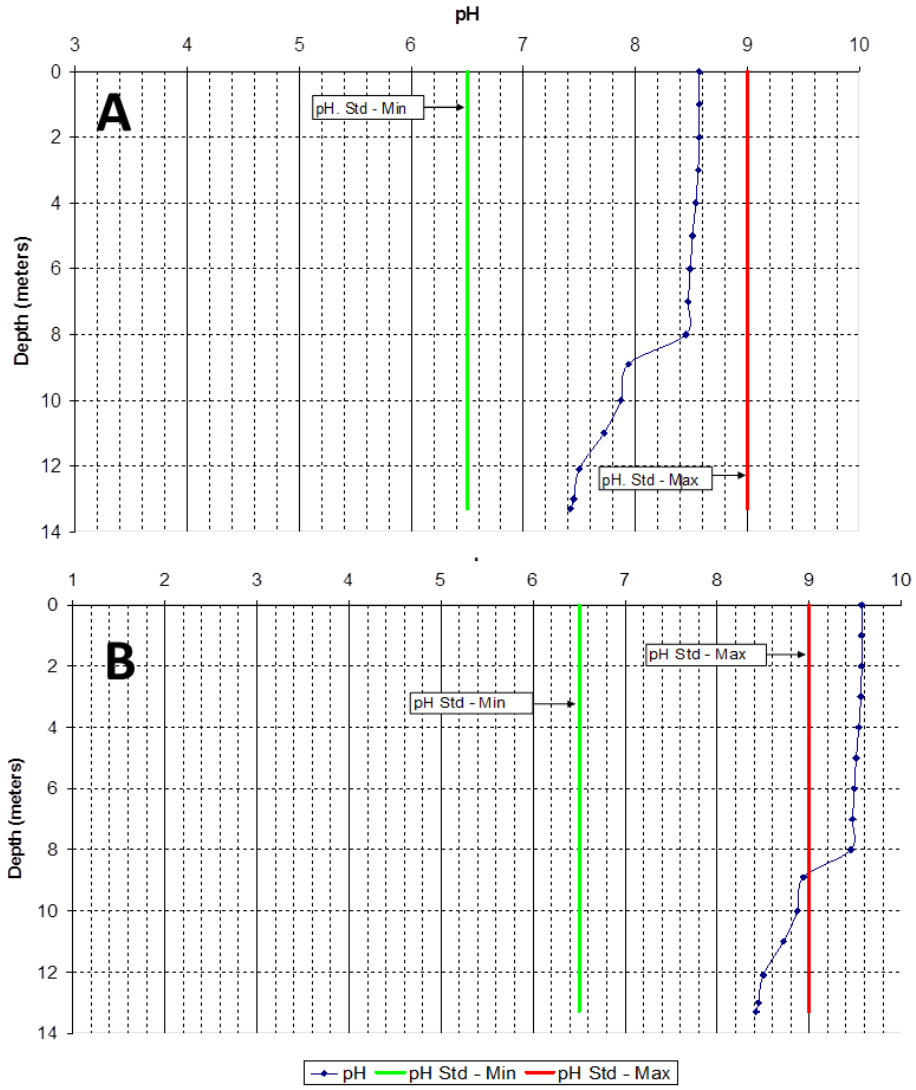


Figure 12. Plots of pH measurements (blue dots) against lake depth for a waterbody meeting (Panel A) and violating (Panel B) the pH water quality standards.

<u>Temperature</u>

The temperature assessment uses the criteria of 20 degrees Celsius for Class 3A waters and 27 degrees Celsius for Class 3B and 3C waters. The criteria used to assess the beneficial use support are based on profile data. Data collected from the deepest location of the waterbody during the critical time period (May–September) are used to calculate the percentage of violations for each sampling date. If the temperature criterion is exceeded in more than 10% of the measurements with a minimum of two discrete measures exceeding criteria from any individual sampling event, the waterbody is not supporting the aquatic life uses.

Beneficial Use Fully Supported
The beneficial use is supported if the number of violations is less than or equal to 10% of the measurements (see Figure 13, Panel A).

Beneficial Use Not Supported
The beneficial use is not supported if more than 10% of the measurements violate the temperature standard (see Figure 13, Panel B).

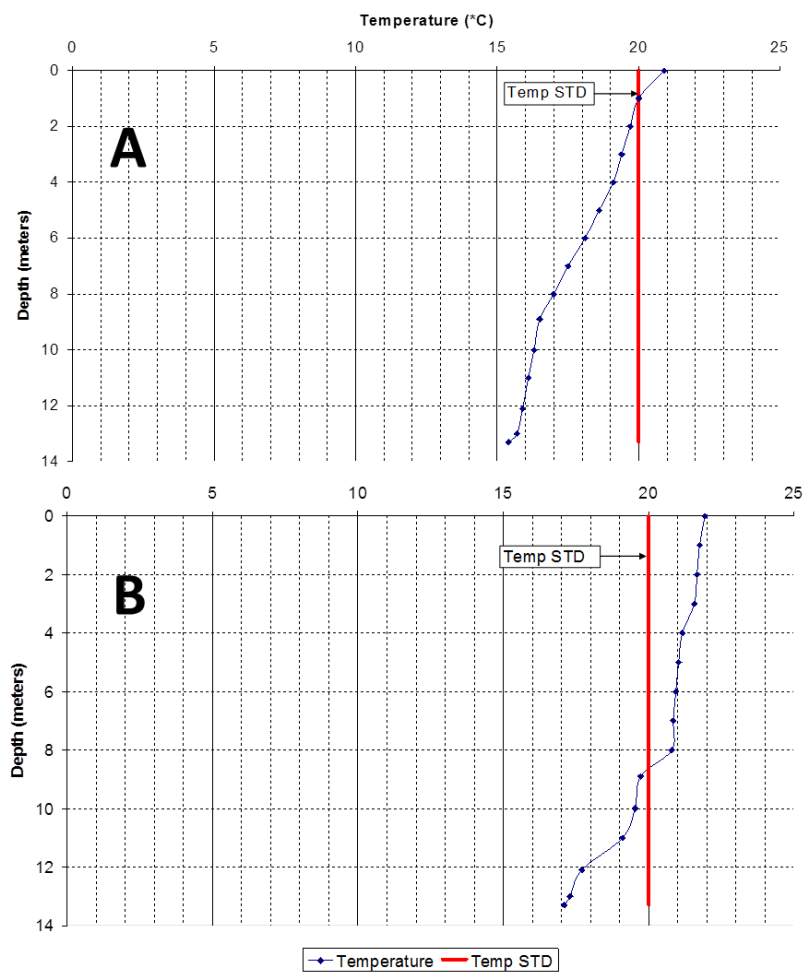


Figure 13. Plots of temperature measurements (blue dots) against lake depth for two waterbodies to provide an example of assessment procedures.

Notes: The red line illustrates a temperature criterion of 20 degrees Celsius: Class 3A beneficial use. Panel A (top) illustrates a waterbody meeting the beneficial use because less than 10% of the temperature measures are greater than the criterion, whereas Panel B (bottom) illustrates a waterbody not meeting the beneficial use because greater than 10% of the temperature measures exceed the criterion.

Dissolved Oxygen

Like the temperature assessment, the DO assessment uses data that are gathered from the lake profile The DO assessment uses the minimum criteria of 4.0 mg/l for Class 3A waters and 3.0 mg/l for Class 3B and 3C waters (**UAC R317-2-14**, Table 2.14.2). State standards account for anoxic or low DO conditions that may exist in the bottoms of deep waterbodies (**UAC R317-2-14**). For that reason, DO measures in deep, stratified waterbodies used in the assessment are limited to the layer above the thermocline. See the next section for further explanation of this method.

Beneficial Use Supported

The beneficial use is supported if at least 90% of the oxygen measurements are greater than the standard.

Beneficial Use Not Supported

The beneficial use is not supported if greater than 10% of the oxygen measurements are below the DO standard during any single sampling event.

Aquatic Life Use Assessment for Stratified Lakes and Reservoirs

For lakes that are thermally stratified, a separate assessment technique is needed to ensure sufficient habitat exists. If a lake profile indicates that the aquatic habitat is reduced by high temperatures or limited DO in the water column, an assessment is conducted to determine if there is sufficient habitat for aquatic life. Habitat is considered sufficient if at least 3 continuous meters of the water column are meeting the criteria for both temperature and DO. The only exception to this rule is if, after consulting with the Utah Division of Wildlife Resources, that the waterbody is meeting the requirements of a healthy fishery and is not limited due to poor water quality. For waterbodies that are subject to human-controlled operations or instances where severe drought has been documented (e.g., Palmer Drought Severity Index), water levels are taken into consideration. Water levels can change from year to year based on the spring runoff and how full the waterbody was at the end of the previous irrigation season, or how much water was needed for culinary purposes. Figure 15 provides an example of supporting and not supporting the beneficial use based on the DO and temperature data above the thermocline. The rationale for a conclusion of beneficial use support based on the existence of adequate habitat follows the decision diagram (Figure 14).

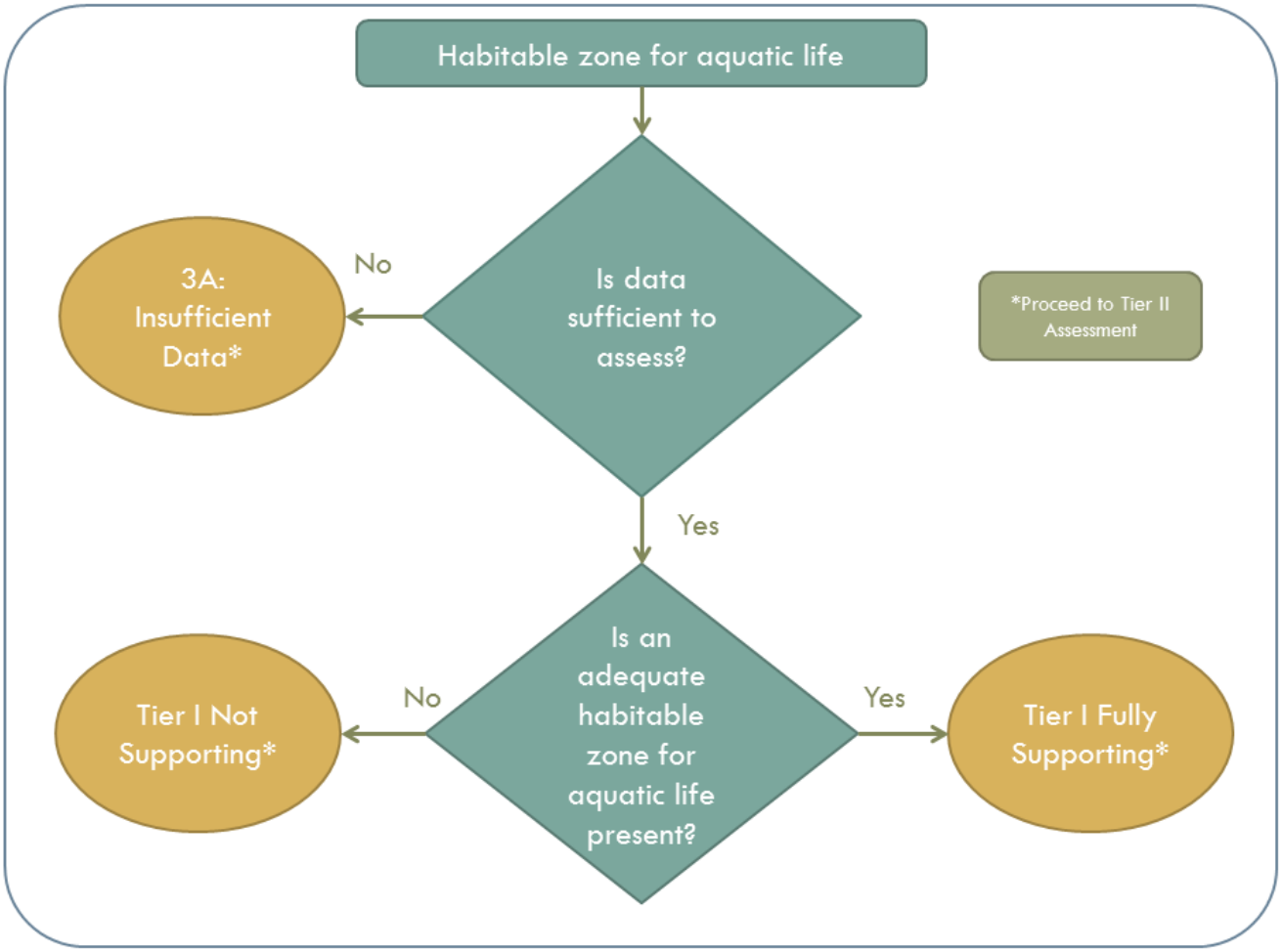


Figure 14. Beneficial use support based on the existence of adequate habitat.

Beneficial Use Supported
The beneficial use is supported if there is sufficient habitat, defined as 3 continuous meters of the water column meeting the criteria for both temperature and DO.

Beneficial Use Not Supported
The beneficial use is not supported if there is insufficient habitat for aquatic life based on DO and temperature profile.

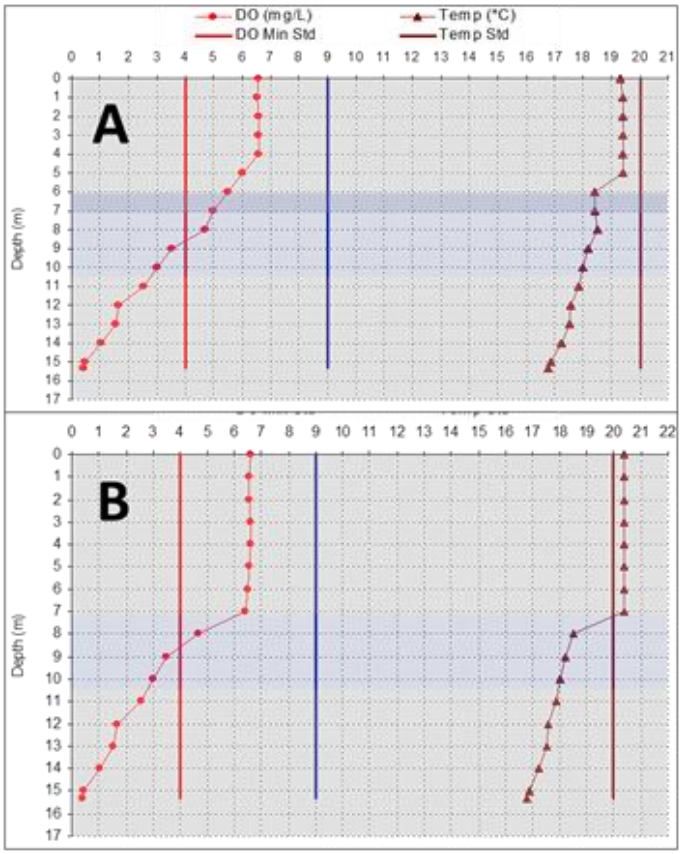


Figure 15. Concept of the habitable zone where both DO and temperature are suitable for aquatic life.

The waterbody depicted on the top (Panel A) would be considered supporting because the lens where both temperature and DO provide sufficient habitat. Conversely, the lake on the bottom is not meeting aquatic life uses because the habitable zone is minimal.

Toxics: Dissolved Metals

To obtain dissolved metals data, one sample is collected near the bottom at the deepest point in the waterbody. The sample is obtained here because this area generally has the highest dissolved metal concentrations.

Insufficient Data and Information

If the concentration of these pollutants exceeds the criteria, the waterbody is categorized as 3A, and DWQ will return to the site to conduct sampling the following year. In other words, because of the potentially toxic nature of these contaminants, DWQ will not wait until the next rotating basin cycle before following up on these potential water quality problems.

Beneficial Use Supported

The beneficial use is supported if there are less than two exceedances of the chronic or acute standard across consecutive reporting cycles.

Beneficial Use Not Supported

The beneficial use is not supported if the concentration exceeds the chronic or acute standard two or more times across consecutive reporting cycles.

Agricultural Use Support

Total Dissolved Solids

The TDS criterion is 1,200 mg/l unless a site-specific standard for the waterbody has been established. If TDS data are unavailable but conductivity data are available, the conductivity data are used to estimate TDS (USGS, 2006). An exceedance using conductivity as a surrogate will result in a Category 3A listing, and the waterbody will be targeted for TDS sampling.

The following rules are used to determine whether a lake is supporting its agricultural beneficial use (Figure 16):

Beneficial Use Supported

The beneficial use is supported if the standard is exceeded in 10% or fewer of TDS samples.

Beneficial Use Not Supported

The beneficial use is not supported if the TDS standard is exceeded in more than 10% of TDS samples.

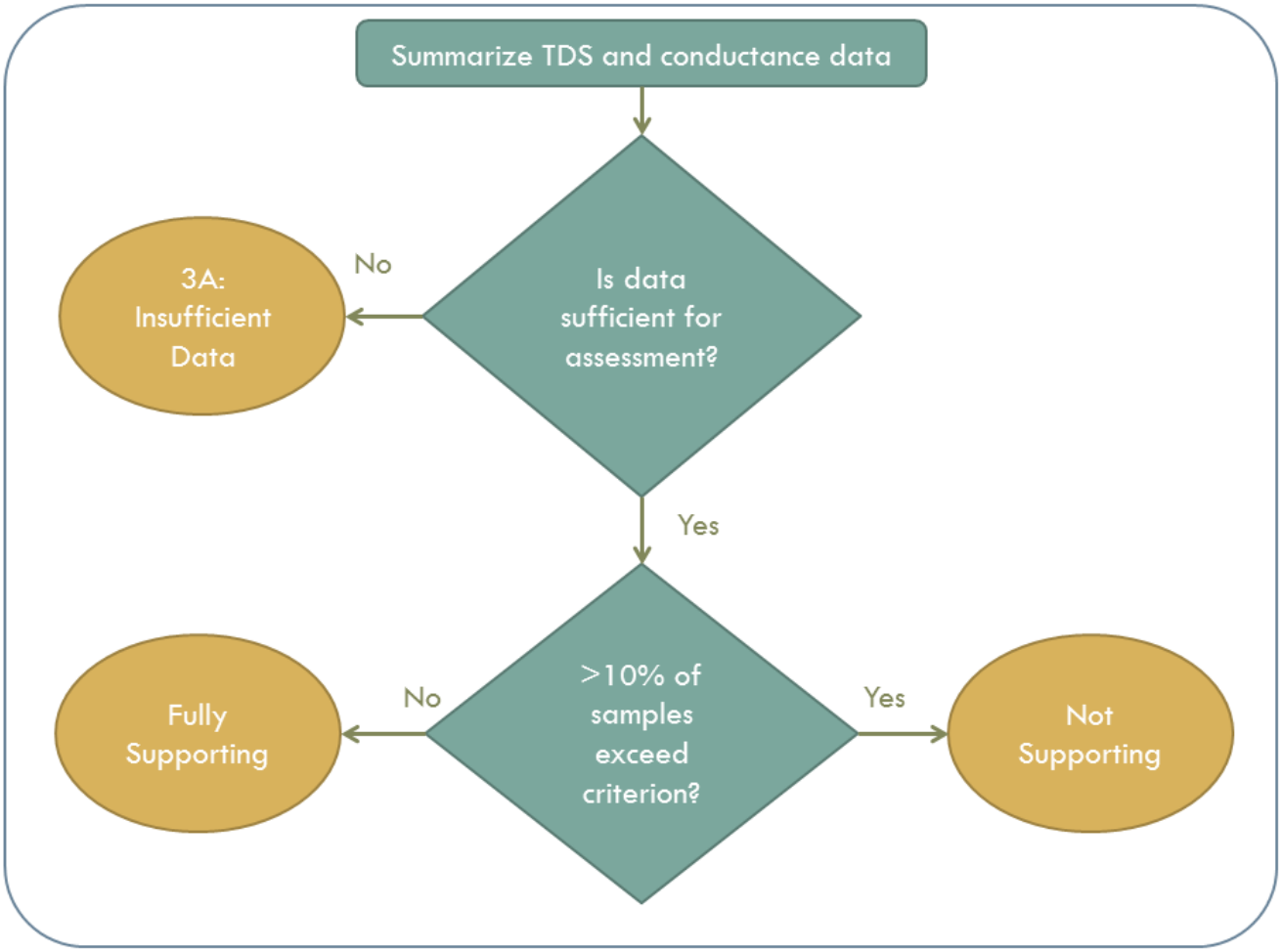


Figure 16. Assessment process to determine support of the agricultural beneficial use with TDS data.

Tier II Assessment

Weight of Evidence Criteria

The weight of evidence criteria allow DWQ to use key lines of evidence in assessing a waterbody's support Utah's narrative standard that would be ignored by exclusively focusing on chemical water quality parameters.

The weight of evidence criteria consist of the following three data types. These evaluations are based on data collected by DWQ and sometimes by outside agencies that follow DWQ procedures.

- Increasing TSI trend over the long term (approximately 10 years) or a TSI-Chl-*a* greater than 50.
- Water quality–based fish kills or winter DO measures not meeting the criterion when measured.
- Evaluation of phytoplankton community.

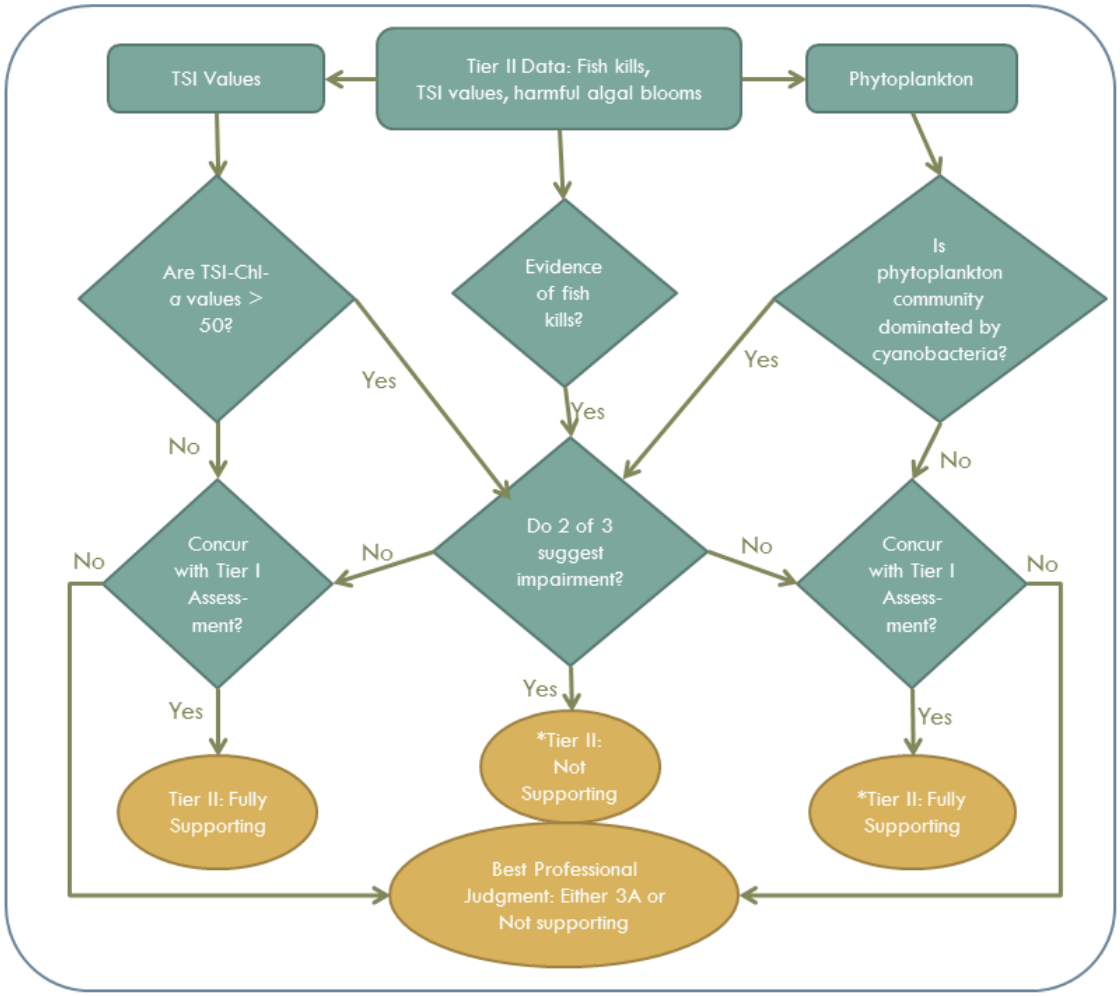


Figure 17. Tier II assessment process for lakes and reservoirs.

Carlson's Trophic State Index

The Carlson's TSI is calculated using Secchi disk transparency, total phosphorus, and chlorophyll *a*. TSI value ranges from 0 to 100, with increasing values indicating a more eutrophic condition, as follows (Table 11).

Carlson's TSI estimates are calculated using the following equations:

- Trophic Status Based on Secchi Disk (TSI-SD)
  TSI-SD = 60 - 14.41 ln (SD), where SD = Secchi disk transparency in meters.

  The abbreviation "ln" indicates the natural logarithm.

- Trophic Status Based on Total Phosphorus (TSI-TP)
  TSI-TP = 14.20 ln (TP) + 4.15, where TP = total phosphorus concentration in µg/l.

- Trophic Status Based on Chlorophyll *a* (TSI-Chl-*a*)

$$TSI\text{-}Chl\text{-}a = 9.81 \ln(Chl\text{-}a) + 30.60$$, where Chl-a = chlorophyll *a* concentrations in µg/l.

Once calculated, these independent TSI indicators can be used to interpret how various factors interact to influence lake production (see Table 11). In each case, individual TSI values can also be used to generalize the overall trophic state of the lake as follows:

- TSI value less than 40: oligotrophic
- TSI value 40–50: mesotrophic
- TSI value 51–70: eutrophic
- TSI value greater than 70: hypereutrophic

Table 11. Conditions likely limiting production.

Relationship Between TSIs	Conditions Limiting Algae Production
TSI (Chl-a) = TSI (SD) = TSI (TP)	**Algae conditions dominate light attenuation.**
TSI (Chl-a) > TSI (SD)	**Large particulates, such as *Aphanizomenon* flakes, dominate.**
TSI (TP) = TSI (SD) > TSI (Chl-*a*)	**Nonalgal particulates or color dominate light attenuation.**
TSI (SD) = TSI (Chl-*a*) > TSI (TP)	**Phosphorus limits algal biomass (total nitrogen/total phosphorus ratio greater than 33:1).**
TSI (TP) > TSI (Chl-a) = TSI (SD)	**Zooplankton grazing, nitrogen, or some factor other than phosphorus limits algal biomass.**

TSIs are calculated independently for each indicator (i.e., Secchi disk, chlorophyll *a*, and total phosphorus) and are not averaged. The most reliable indicator of trophic status is chlorophyll *a* (TSI-Chl-*a*), followed by Secchi disk (TSI-SD), and total phosphorus (TSI-TP) (Carlson, 1977). In some lakes, the TSIs for each index are similar. For other lakes, large differences may be observed.

For this reporting cycle, the TSI (May through September) for each measure is reported. Large discrepancies between TSIs can be suggestive of specific lake conditions that may provide additional context for interpreting the TSI (Figure 18). If TSI has increased from past reporting cycles, DWQ will elevate the priority status of the waterbody for more frequent and urgent sampling. However, the weight of evidence (see Figure 18) using TSI is activated when TSI-Chl-*a* values are > 50.

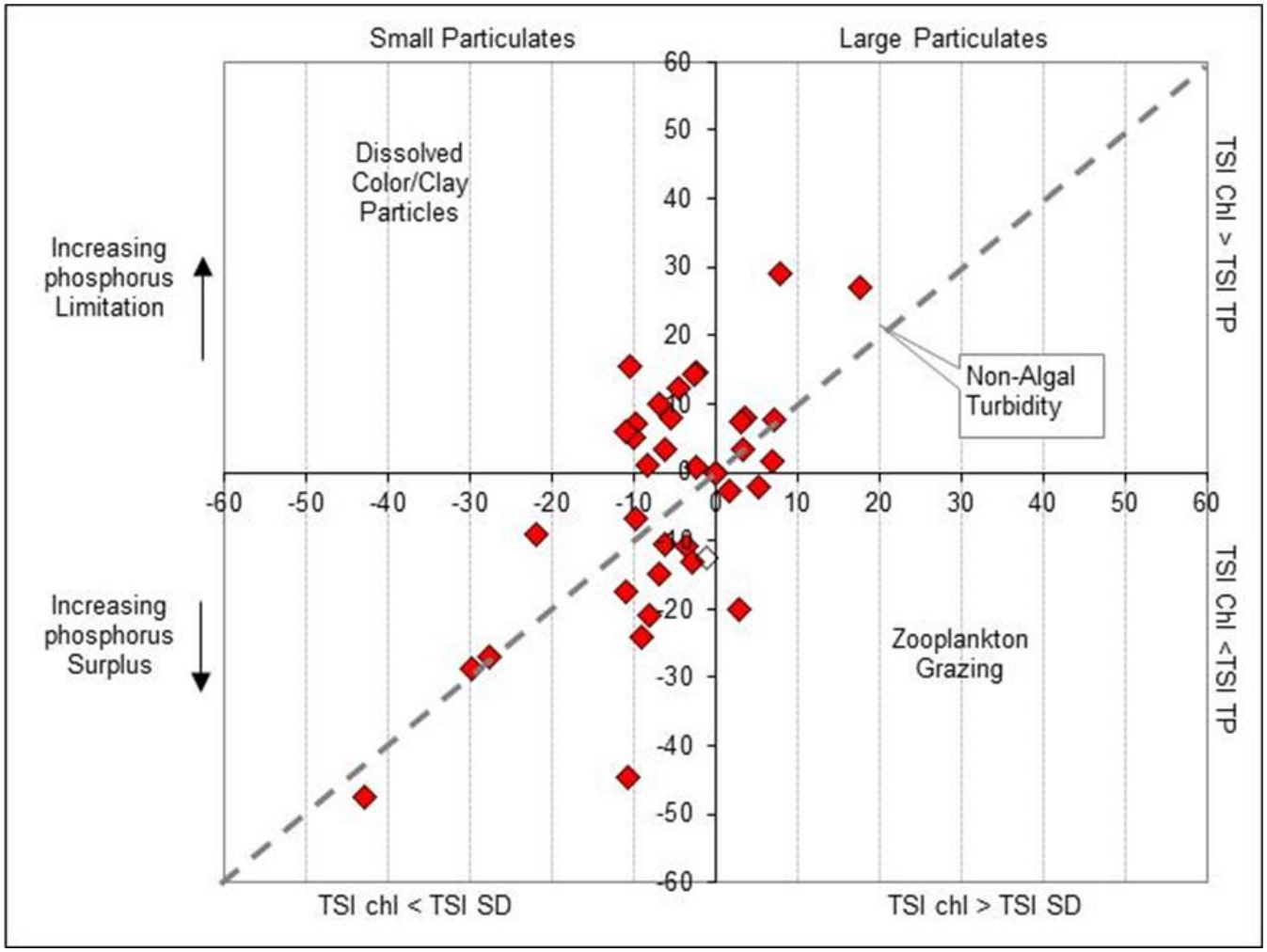


Figure 18. Plots of chlorophyll *a*, total phosphorus, and Secchi depth TSI values.

Fish Kill Observations

Fish kills can result from poor water quality, although not exclusively, and can provide an important line of evidence that a waterbody is not meeting the beneficial uses. To obtain this information, DWQ contacts regional biologists at the Utah Division of Wildlife Resources to obtain fish kill records and proposed rationale for death. However, reliable fish kill data are not available for many waterbodies due to their remoteness.

Phytoplankton Community

DWQ routinely collects phytoplankton to evaluate the composition and relative abundance of algae and cyanobacteria. These data are used to determine if a waterbody is not meeting beneficial uses due to eutrophication and whether the public are at risk of exposure to toxins secreted by cyanobacteria. Phytoplankton (algal) data are used in the Tier II assessment process because they reflect nutrient availability and nutrient ratios. The observation that a waterbody has a diverse assemblage of diatoms or green algae relative to cyanobacteria or other potentially harmful taxa is used as a line of evidence that the waterbody is supporting its designated uses. In contrast, a phytoplankton assemblage dominated by cyanobacteria may be indicative of eutrophic conditions,

pose a potential risk to human health or aquatic life through the production of cyanotoxins, and may reflect a loss of aquatic biodiversity.

Great Salt Lake

GSL is assigned its own beneficial use class (Class 5) and is further divided into five subclasses (5A–5E) that represent the four main bays (Gilbert, Gunnison, Bear River, and Farmington) and transitional waters (**UAC R317-2-6**). With the exception of a numeric selenium egg tissue standard for Class 5A (Gilbert Bay), no other numeric criteria are available to assess GSL. Instead, the beneficial uses of GSL are protected and assessed by the Narrative Standard (**UAC R317-2-7.2**). The **Great Salt Lake Water Quality Strategy**, finalized and endorsed by the Water Quality Board in 2014, outlines the process for the future development of numeric criteria for each of the lake's bays as well as monitoring and research.

DETERMINATION OF IMPAIRMENT: ALL ASSESSMENT UNITS

Following the initial assessment of credible data against the numeric criteria in **UAC R317-2**, each parameter within a waterbody is assigned a provisional EPA- and state-derived assessment category. To verify the parameter-specific assessment results and consolidate the often multiple parameter assessments into one result per waterbody, DWQ must consider the strength of the quantity of data and the extent to which such data demonstrate clear and convincing evidence of supporting or not supporting the beneficial uses assigned to the waterbody in **UAC R317-2**. In determining the strength of whether or not a waterbody is supporting or not supporting its beneficial uses, DWQ considers the following information:

- Individual assessment of water quality standards at a single site.
- Multiple lines of evidence.
- Independent applicability.
- DWQ's narrative criterion, to make a final decision based on the overwhelming evidence.
- Several levels of BPJ.

Individual Assessment of Water Quality Standards

In determining whether or not a waterbody or segment within a waterbody is supporting or not supporting the beneficial uses assigned in **UAC R317-2**, DWQ first considers the individual parameter-specific assessment results that were derived from the data assessment protocols described earlier in this document. Unless noted in the waterbody-specific data assessment protocols, the assessment policies outlined in this document provide a direct and quantifiable method and documentation of data supporting or not supporting DWQ's water quality standards versus data and information that are developed using surrogate parameters or indicators. Because individual assessments at a single monitoring location site offer a more direct measure of supporting or not supporting water quality standards in **UAC R317-2**, DWQ places a greater weight on individual assessment decisions that follow the data assessment protocols in this document.

Conflicting Assessments of Water Quality Standards

Following the review of the individual water quality standard assessments, DWQ looks across the multiple parameter-specific assessment results that exist for a waterbody or segment within a waterbody and then consolidates the results into a final assessment. That is, DWQ assigns one EPA- and state-derived assessment decision category as defined in Table 1. To address the possibility of conflicting results among different types of data (e.g., biological versus conventionals, toxics versus *E.coli*), DWQ applies the policy of independent applicability and goes through a series of considerations to determine if the discrepancies are because of

- differences in data quality, or
- environmental factors such as the application of the water effects ratio, development of site-specific criteria, revision to numeric criteria in **UAC R317-2**, or conducting a use attainability analysis.

Figure 19 elaborates on DWQ's use of the independent applicability policy.

In cases where concerns about the quality of independent datasets cannot be rectified through an evaluation and documentation of the QA/QC issues that resulted in accepting one dataset and the resulting assessment result, sites with conflicting assessment results may be listed as 3A (requiring additional study or monitoring) to better understand the seemingly conflicting lines of evidence. Specific assumptions regarding model applicability applied during the biological assessment process are discussed above. Similarly, if the application of water effects ratio, justifiable site-specific criteria change, or change in beneficial uses based on a use attainability analysis cannot rectify the difference in the assessment results, then a 3A categorization may be warranted. All evaluations of conflicting assessment decisions will be made in consultation with EPA on a case-by-case basis.

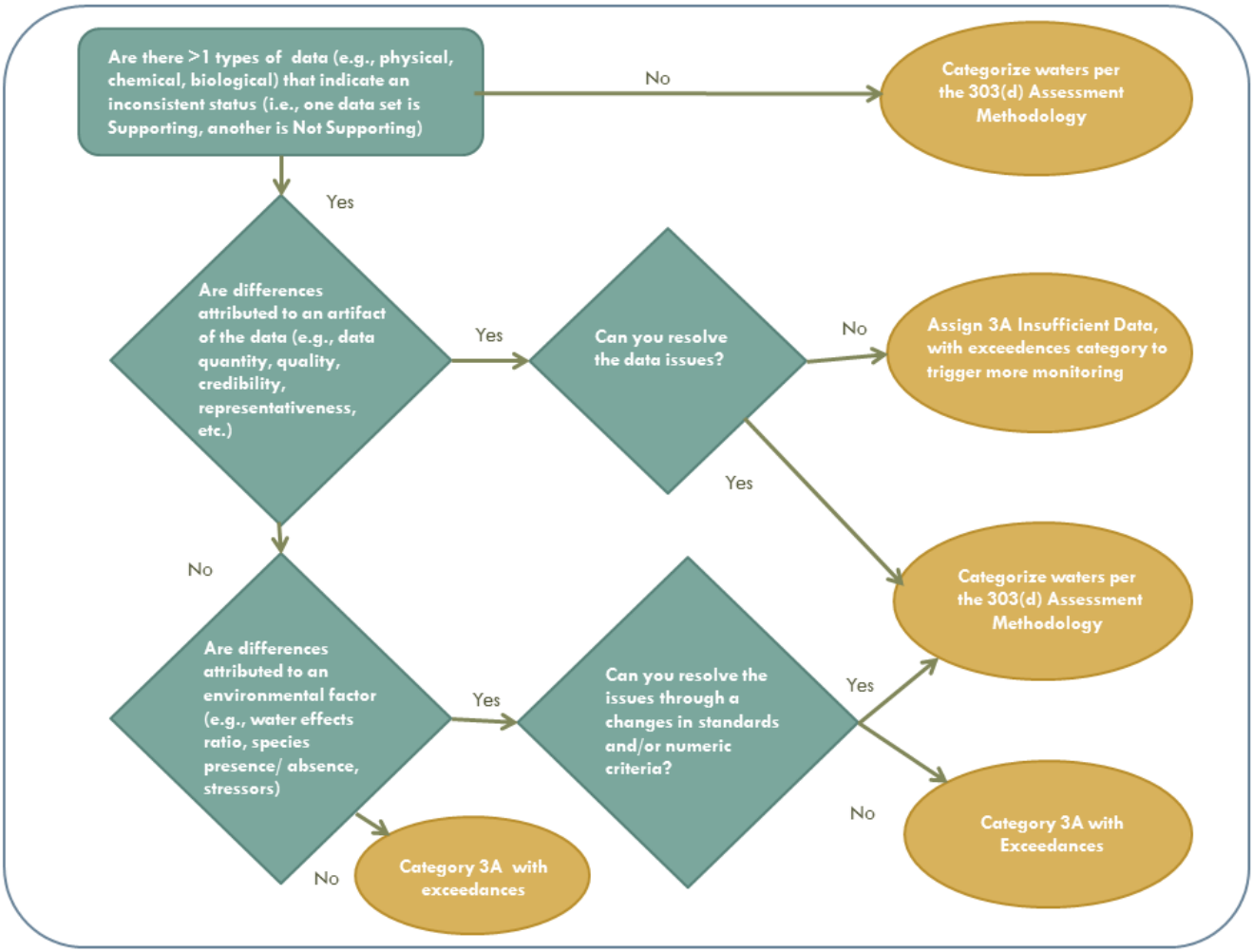


Figure 19. Overview of independent applicability process.

Note: These judgment decisions are based in part on EPA's *Consolidated Assessment and Listing Methods* guidance published in 2002.

Narrative Standards

In addition to the numeric criteria used to perform water quality assessments, Utah's water quality standards contain provisions for the application of narrative criteria to protect uses. The narrative criteria state the following:

> It shall be unlawful, and a violation of these rules, for an person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum, or other nuisances such as color, odor to taste; or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentration or combinations of substance which produce undesirable human health effect, as determined by bioassay or other tests performed in accordance with standard procedures; or determined by biological assessments in (UAC) Subsection R317-2-7.3.

Under circumstances where evidence exists that human-caused actions have produced any of these undesirable outcomes in a waterbody, DWQ will apply the narrative criteria to protect human health and aquatic life. Examples where the Narrative Standards may be used to make an impairment determination include drinking-water closures, fish kills, beach closures for swimming, and health advisories for the consumption of fish. The assessment of *E. coli* data and associated beach closures to protect human health is an additional weight of evidence for defining the impairment of recreational uses and is addressed in more detail earlier in this document in the *E. coli* Assessment section. DWQ will also apply a cyanobacterial cell count threshold for determining impairments due to harmful algal blooms (see Assessment of Lakes and Reservoirs section).

Drinking Water Closures

If the Utah Division of Drinking Water or a local municipality issues an advisory or closure for a surface drinking water source, DWQ will assess the site as impaired for 1C uses, unless data show that the problem has been solved.

Fish Kills

DWQ requests information on reported fish kills from the Utah Division of Wildlife Resources and other stakeholders. These data are used in concert with water quality data to make final assessment decisions. For example, sites that would generally not be assessed due to small sample sizes may be listed as impaired if fish kills have also been observed in the waterbody.

Beneficial Use Assessment Based on Tissue Consumption Health Advisories

DWQ has collected fish tissue samples for mercury analysis in waterbodies throughout the state since 2000. Since that time, consumption advisories have been issued for 24 waterbodies (16 reservoir and 8 river sites).

DWQ staff develop an annual fish sampling plan. Sampling criteria currently include the following:

- Sampling when a current consumption advisory is greater than 5 years old.
- Sampling when there is no advisory but the existing data are greater than 5 years old.
- Sampling to address uncertainties from previous years' data.
- Sampling waterbodies that have no mercury data.

Regional Utah Division of Wildlife Resources staff collect fish from locations that are both identified in the sampling plan and that they will already be visiting for their own purposes. All

fish are submitted to DWQ by December 1, at which time DWQ staff process samples from fillets and submit them to the EPA Region 8 Laboratory for total mercury analysis.

DWQ performs basic statistical analyses on the results, including minimum concentration, maximum concentration, mean, standard deviation, p-value, and 95% confidence intervals.

DWQ currently uses the EPA-published ambient water quality criterion for methylmercury for the protection of people who eat fish and shellfish. This criterion is 0.3 milligram (mg) methylmercury per kilogram (kg) fish tissue wet weight. If all fish (small and large) of the same species at a monitoring location have a mean mercury concentration of > 0.3 mg/kg, additional statistical tests are used to determine if a consumption advisory is necessary. If the mean is < 0.3 mg/kg, no advisory is issued. In several instances, size class advisories have been issued when it is apparent that only the larger size class exceeds the safe consumption criterion.

For locations with a mean mercury concentration of > 0.3 mg/kg, the p-value is considered. The p-value refers to the probability of obtaining a result equal to or greater than those that were measured at that location. DWQ uses a p-value of 0.05 to be 95% certain an advisory is not unnecessarily issued. Therefore, if a species has a mean of > 0.3 mg/kg and a p-value < 0.05, then a consumption advisory is issued. If a species has a mean of > 0.3 mg/kg but a p-value of > 0.05, then an advisory is not issued. The consumption advisories are based on long-term consumption; therefore, the mean is the most appropriate and commonly used parameter to estimate exposure.

In an effort to control for false negatives, DWQ calculates 95% confidence limits of the mean mercury concentration. If the upper confidence limit is above 0.3 mg/kg, that site is targeted for additional sampling.

When an advisory is warranted, DWQ sends the data to the Utah Department of Health toxicologist who uses the mean mercury concentration to calculate the actual consumption recommendations. Those calculations are based on the following:

- Average Adult Weight: 70 kg (154 pounds) | Average Adult Meal Size: 227 grams (8 ounces)/meal
- Average Child Weight: 16 kg (35 pounds) | Average Child Meal Size: 113 grams (4 ounces)/meal

Consumption amounts are calculated for three target populations: Pregnant Women and Children < 6, Women of Child Bearing Age and Children 6–16, and Adult Women Past Child Bearing Age and Men >16.

Mercury Assessment Process

The current approach for making assessments of aquatic life use support for mercury is different than the consumption advisory process. The assessment is based on the U.S. Food and Drug Administration recommended value of 1.0 mg/kg. The U.S. Food and Drug Administration set the consumption concentration at 1.0 mg/kg, which correlates to the water column mercury concentration of 0.012 µg/l in previous studies by EPA (EPA, 1985). Utah's water quality standard

for mercury is 0.012 µg/l as a 4-day average. Therefore, the corresponding fish tissue concentration of 1.0 mg/kg is used for assessment.

Beneficial Use Supported (Category 1)

- No fish consumption advisories for mercury are in place.
- Mean fish tissue mercury concentration for all individuals of the same species at a location is less than 0.3 mg/kg and p-value is < 0.5.

Insufficient Data with Exceedances (Category 3A)

- Fish consumption advisories for mercury are in place, but the mean fish tissue mercury concentration for all individuals of the same species at a location is less than or equal to 1.0 mg/kg.

Beneficial Use Not Supported (Category 5)

- Fish consumption advisory for mercury is in place.
- Mean fish tissue mercury concentration is greater than 1.0 mg/kg.

For additional information and the most up-to-date list of consumption advisories, please visit fishadvisories.utah.gov.

Overwhelming Evidence

Following the consolidation of all of the individual assessment results and data information that exist for a waterbody or segment within a waterbody, DWQ may review individual listing decisions if there is overwhelming evidence of a waterbody or segment of a waterbody supporting or not supporting its associated beneficial uses and numeric criteria in **UAC R317-2**.

Where there is a lack of overwhelming evidence of a waterbody or segment within a waterbody supporting or not supporting its beneficial uses, BPJ can be used to verify a preliminary assessment. Where this is overwhelming evidence for credible data as defined earlier in this document, assessment decision are considered confirmed.

Best Professional Judgment

DWQ recognizes that BPJ from internal and external reviewers during the public comment periods may provide useful feedback on determining the strength of the quantity of data and the extent to which such data demonstrate clear and convincing evidence of a waterbody or segment of a waterbody supporting or not supporting its beneficial uses and numeric criteria. To ensure consistency in when and how BPJ is used among different professionals, DWQ will use BPJ in a select number of scenarios using a standard set of guidelines. Appendix 5 elaborates on when and how DWQ's assessment and 303(d) BPJ policy will be implemented.

Where BPJ documentation for overriding a preliminary assessment decision is insufficient in strength, vague, or cannot be provided, the preliminary assessment decision based on the data assessment procedures outlined in this document will carry forward.

- Where BPJ documentation for overriding a preliminary assessment decision is sufficient in strength and can be provided, the preliminary assessment decision based on the data assessment procedures outlined in this document will be overwritten. Preliminary listings for Category 5 or Category 1 and Category 2 waters could be re-assigned as Category 3A, insufficient data with exceedances or Category 3E, insufficient data with no exceedances, respectively.

For tracking and transparency to the public, DWQ will retain the original category assignment and a justification for the BPJ in the data files.

Categorization of an Assessment Unit

To summarize the water quality of a waterbody or segment of a waterbody, DWQ compiles and aggregates all credible and representative water quality data from multiple data sources and monitoring locations into one EPA- and state-derived assessment category for the AU (see Table 1). Appendix 5 elaborates on the processes and procedures DWQ goes through when rolling up the individual assessments that have undergone the reviews and considerations outlined earlier in this document into one category for each defined AU within the state. For a brief summary on how DWQ summarizes the individual assessments at a monitoring location site to an AU, see Figure 20.

Assessment of "All Tributaries" Segments

If after aggregating all of the assessments into one EPA- and state-derived assessment category for an AU, DWQ believes that there is some reason that the supporting or not supporting assessment result decision is not representative of the entire AU, DWQ will investigate further to determine whether the supporting or not supporting decision is widespread or limited to individual portions of the waterbody, such as specific tributaries or reaches. Results from the above analysis will be categorized as follows:

- Whole AU is Not Supporting (Category 5)

  If all of the data from multiple tributaries within a segment indicate only (or a combination of) not supports (Category 5) and insufficient data with exceedances (Category 3A) , DWQ will recommend that the entire AU be listed as not supporting.

- Only Not Supporting Tributaries are listed as Not Supporting (Category 5)

  If data from one or more tributaries indicate a combination of any of the following, DWQ may recommend that only the tributaries with data indicating an impairment be listed as not supporting.

- Supporting (Category 1)
- No Evidence of Impairments (Category 2)
- Insufficient Data with Exceedances (Category 3A)
- Insufficient Data with No Exceedances (Category 3E)
- Needs Further Investigations (Category 3D)
- Not Assessed (Category 3F)

The rest of the AU will be assigned a category following procedures as outlined in Figure 20.

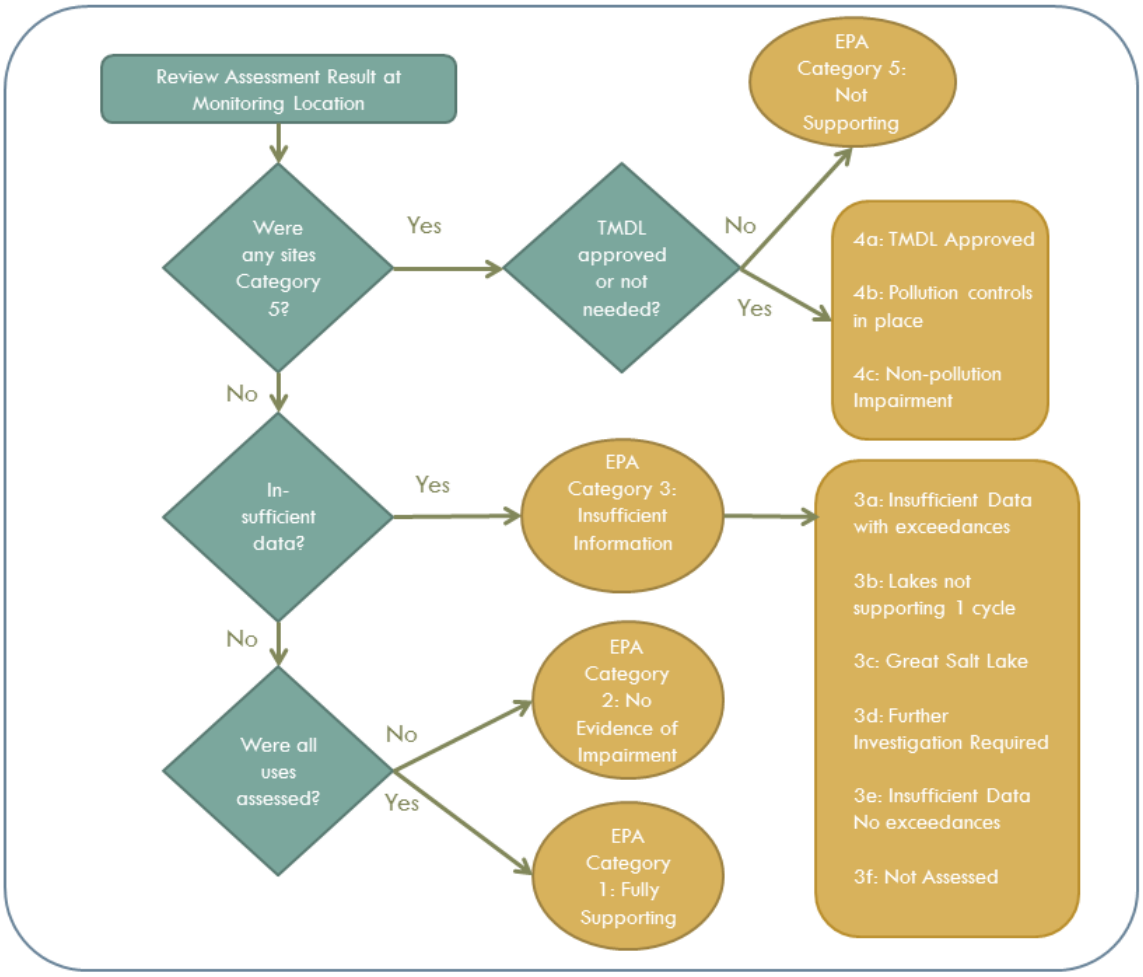


Figure 20. Process of assigning EPA categories to AUs based on results of monitoring location assessments.

IDENTIFYING CAUSES OF IMPAIRMENTS

Once an AU is assigned an EPA- and state-derived assessment category that is representative of conditions with the AU, DWQ will determine if the impairment or impairments are driven by pollutants, pollution, unknown, or natural causes (see Table 1). With the exception of naturally occurring causes, only one cause will be applied to a not-supporting waterbody and parameter. Procedures on how DWQ identifies the cause of impairments are described in more detail below.

Pollutants

Using the CWA's definition of a pollutant as a guide, DWQ defines pollutant-driven impairments (Category 5) as those resulting from the following:

> … dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under Atomic Energy Act of 1954, as amended), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (UAC R317-2)

Notwithstanding the federal definition cited above, DWQ will also identify certain radiological constituents that are regulated under the state's Water Quality Control Act. For the purpose of the 303(d) List, causes for impairments due to toxic parameters will be identified as the parameter for which there is an impairment. In the case of conventional parameters such as DO, temperature, pH, and biological scores, the cause will be assigned as the parameter that was assessed until such time as a TMDL or pollution prevention plan identifies an alternative cause of the impairment.

Once an impairment for a waterbody or segment within a waterbody is identified as pollutant-driven, DWQ will list the waterbody and the not-supporting parameter(s) as impaired for that pollutant (cadmium, iron, etc.). Waterbodies that are not supporting their beneficial uses due to pollutant impairments require future development of a TMDL or application of a TMDL alternative. Information on DWQ's process of prioritizing and developing a TMDL, and TMDL alternatives, is described later in this document and on **DWQ's website**.

Pollution

Where DWQ can identify that an impairment was not driven by a pollutant, DWQ may consider if the not-supporting assessment was driven solely by pollution versus a pollutant or by an unknown cause. Using the CWA's definition of pollution as a guide, DWQ will go through an evaluation to determine if an impairment resulted from "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." Waterbodies and not-supporting parameters that are driven solely by pollution problems do not require the future development of a TMDL and are candidates for a non-pollutant impairment (4C) assessment category. Details on DWQ's process for using EPA's 4C assessment category are described later in this document.

Unknown Sources

For the purpose of the IR, sources of pollution contributing to an impairment will be reported in the 303(d) list to EPA as "unknown" until such time as a TMDL or special study identifies the sources and any additional causes of impairment.

Natural Conditions

In cases where DWQ or a stakeholder can demonstrate that the natural conditions of the waterbody or segment within a waterbody are the key factor for an impairment(s), DWQ will still retain the not-supporting assessment decision. However, DWQ's response to such exceedances differs unless a site-specific standard has been promulgated. Site-specific standards require documentation that demonstrates the extent to which the violations were due to natural conditions. Once this documentation is developed, the proposed changes to standards will be developed. For more information on the review and approval process for developing standards and numeric criteria surrounding exceedances caused by naturally occurring conditions, please review DWQ's **Standards** website.

REVISING THE 303(D) LIST AND OTHER CATEGORICAL ASSESSMENTS

Upon validating the strength and extent of the impairments within a waterbody or segment within a waterbody, DWQ will include newly proposed and previously listed not supporting (Category 5) waterbodies on the updated 303(d) List unless the waterbody or waterbody segment(s) is currently included in the IR's TMDL-approved (Category 4A), pollution control (Category 4B), non-pollutant impairment (Category 4C), or delisting lists. Details on how and when DWQ will not apply or carry an impaired listing (not supporting, Category 5) forward on DWQ's 303(d) List are described below.

Category 4A

The first alternative DWQ has available for not listing or removing an impaired waterbody or segment within a waterbody on the state's 303(d) List is to calculate the maximum amount of a pollutant that a waterbody can receive while still meeting the state's water quality standards. This calculation and analysis work must be formalized in a TMDL and go through a thorough internal and external review process. This calculation and analysis work must be formalized in a TMDL and submitted for approval from the Natural Resource Committee (for implementation costs exceeding $10 million), the state legislature (for implementation costs over $100 million), and EPA. Information on DWQ's process for developing and implementing a TMDL can be found on DWQ's **Watershed Management Program** website and **EPA's TMDL 303(d)** website. Where DWQ has documentation of a DWQ Water Quality Board- and EPA-approved TMDL for an impaired parameter within a not-supporting waterbody or segment within a waterbody, DWQ will override a current or previous not supporting Category 5 listing decision at the AU level as follows:

- Whole AU Category 4A, TMDL-approved if:

  The only impairments within the waterbody or segment within the waterbody are included in the approved TMDL.

  There are additional impairments within the waterbody or segments within the waterbody that are addressed in a Category 4B demonstration plan (described below in this document) and are not included in the approved TMDL. If the parameters included in the approved Category 4B demonstration plan are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters have an approved Category 4B demonstration plan in place.

  There are additional impairments within the waterbody or segments within the waterbody that are pollution-driven (Category 4C) and not included in the approved TMDL. If the pollution-driven parameters are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters are pollution- versus pollutant-driven.

- Whole AU Category 5, Not Supporting if:

  There are any additional pollutant impairments within the waterbody or segments within the waterbody that are not included in the approved TMDL. If the parameters included in the approved TMDL are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters have an approved TMDL in place.

Category 4B

DWQ's second alternative to not listing or removing an impaired waterbody or segment within a waterbody on the state's 303(d) List is to develop a plan that ensures upon implementation that the waterbody will meet state water quality standards within a reasonable time period and through state- and EPA-approved pollution-control mechanisms. Similar to a TMDL, a Category 4B demonstration plan must go through a robust internal and external review process. For example, once DWQ or a stakeholder develops a plan for consideration, DWQ will present the plan to DWQ's Water Quality Board and submit the board-approved plan to EPA for final approval. More information on the Category 4B demonstration plan process can be found in Appendix 7 and in EPA's **Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act** and **Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions**.

Where DWQ has documentation of an EPA-approved Category 4B demonstration plan for an impaired parameter within a not-supporting waterbody or segment within a waterbody, DWQ will override a current (or previous) not-supporting Category 5 listing decision at the AU level as follows:

- Whole AU Category 4A, TMDL-approved if:

  There are any additional impairments within the waterbody or segments within the waterbody that are addressed in an approved TMDL (Category 4A) and are not included in the approved Category 4B demonstration plan. If the parameters included in the approved Category 4B demonstration plan are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters have an approved Category 4B demonstration plan in place.

- Whole AU Category 4B, Pollution Control if:

  The only impairments within the waterbody or segment within the waterbody are included in the approved Category 4B demonstration plan.

  There are additional impairments within the waterbody or segments within the waterbody that are pollution-driven (Category 4C) and are not included in the approved Category 4B demonstration plan. If the pollution-driven parameter impairments are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters are pollution- rather than pollutant-driven.

- Whole AU Category 5, Not Supporting if:

  There are any additional pollutant impairments within the waterbody or segments within the waterbody that are not included in the approved Category 4B demonstration plan. If the parameters included in the approved Category 4B demonstration plan are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters have an approved Category 4B demonstration plan in place.

Category 4C

The third alternative for not listing or removing an impaired waterbody or segment within a waterbody on the state's 303(d) List is to demonstrate that the parameter-specific impairment (or impairments) is driven by pollution and not by a pollutant or pollutant that causes pollution. Unlike a TMDL or Category 4B demonstration plan, the analysis works to determine if the cause of impairment is driven by pollution and does not require formal approval from DWQ's Water Quality Board or EPA. Pollution analysis work is instead reviewed internally by DWQ and by stakeholders during the public comment period of the draft IR and 303(d) List.

For the draft IR and 303(d) List, DWQ will temporarily assume "approval" of any pollution-driven analysis work and supersede a current or previous not supporting Category 5 listing decision at the AU level as follows:

- Whole AU Category 4A, TMDL-approved if:

  All impairments within the waterbody or segments within the waterbody are addressed in an approved TMDL (Category 4A). For pollution-driven impairments that are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters are pollution- rather than pollutant-driven.

- Whole AU Category 4B, Pollution Control if:

  All impairments within the waterbody or segments within the waterbody that are addressed in an approved Category 4B demonstration plan. For pollution-driven impairments that are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters are pollution-driven.

- Whole AU Category 4C, Non-Pollutant Impairment if:

  The only impairments within the waterbody or segment within the waterbody are included in the approved Category 4B demonstration plan.

- Whole AU Category 5, Not Supporting if:

  There are any additional pollutant impairments within the waterbody or segments within the waterbody. The pollution-driven impairments that are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters are pollution-driven.

DWQ will provide to stakeholders during the public comment period of the draft IR and 303(d) List documentation as to why the impaired parameter within the waterbody or segment within the waterbody is pollution- and not pollutant-driven and will not require the future development of a TMDL.

Delistings

The fourth and final alternative DWQ has at its disposal is to demonstrate good cause to stakeholders and EPA that the previously impaired parameter and waterbody or segment within a

waterbody are now meeting water quality standards in **UAC R317-2**. Good cause occurs when DWQ can demonstrate one or more of the following categories and scenarios:

- Improvements in Watershed Conditions:

  Because of the implementation of nonpoint source projects and/or revised effluent limits, the waterbody has improved such that post-implementation data indicate that the impairment has been resolved. This assessment may be based on additional data, beyond that which is typically used in assessments, including before and after project implementation monitoring. In some cases, demonstration of improvement may be based on a different time period for data collection that corresponds with known watershed improvements.
- Changes to Water Quality Standards:

  Adoption of revised water quality standards and/or uses such that the water is now in attainment of the revised standards and/or uses.

- Changes to the 303(d) Assessment Methods:

  Development of a new listing method consistent with the state water quality standards and classifications and federal listing requirements. This includes all information contained in this document and credible data requirements posted on DWQ's **Call for Data** website.

- Reassessment (new data and information):

  Assessment and interpretation of older data that were not originally included in the previous assessment and/or more recent or more accurate data that demonstrate that the applicable classified uses and numeric and narrative standards are being met.

- Geo-location Information Error:

  Inappropriate listing of a water that is located within Indian lands as defined in 18 United States Code 1151.

- Analysis Errors:

  Flaws in the original analysis of data and information that led to the waterbody-pollutant combination being incorrectly listed. Such flaws may include the following:

  - Calculation errors in the data assessment methods outlined in the 303(d) Assessment Methods from that Assessment cycle.
  - Errors produced when reviewing credible and representative data information.
  - Mapping errors generated during the validation of monitoring location information and assigning AU designations.

  - Discrepancies between the beneficial use assignments in **UAC R317-2** and the IR geo-location information files for internal and external data.
  - Wrong identification and assessment of a waterbody type.
  - Application of the wrong numeric criteria to a beneficial use.

- New Modeling:

  Results of more sophisticated water quality modeling that demonstrate that the applicable classified uses and numeric and narrative standards are being met.

- Effluent Limitations:

  Demonstration pursuant to 40 CFR 130.7(b)(1)(ii) that there are effluent limitations required by state or local authorities that are more stringent than technology-based effluent limitations, required by the CWA, and that these more stringent effluent limitations will result in attainment of classified uses and numeric and narrative standards for the pollutant causing the impairment.

- Other:

  There is other relevant information that supports the decision not to include the segment on the Section 303(d) List.

In order to first justify a delisting of an AU for a given parameter based on new data, the dataset must be of sufficient quantity and quality to make an assessment based on methods outlined earlier in this document. There are two mechanisms for justifying a delisting based on assessment results:

- Delisting an AU for all parameters.
- Delisting individual parameters for an AU.

To demonstrate good cause, DWQ will compare the previous IR cycle's final assessment categories and 303(d) List to the current IR's assessment categories and 303(d) List. Where differences in categorical assignments exist, DWQ will only further investigate the following scenarios for good cause:

- The AU/waterbody or segment within the waterbody was previously not supporting (Category 5) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).
- The AU/waterbody or segment within the waterbody was previously not supporting but had an approved TMDL (Category 4A) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).
- The AU/waterbody or segment within the waterbody was previously not supporting but had an approved Category 4B demonstration plan and is now supporting (Category 1), shows no

evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).

- The AU/waterbody or segment within the waterbody was previously not supporting but had pollution-driven impairment (Category 4C) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).

Note: The next set of scenarios describes the methods that apply to delisting individual parameters rather than entire AUs.

- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting (Category 5) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).
- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting but had an approved TMDL (Category 4A) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).
- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting but had an approved Category 4B demonstration plan and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).
- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting but had pollution-driven impairment (Category 4C) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3E).

Where assessment category assignments at the AU- and parameter-level warrant a further investigation for good cause as articulated above, DWQ will reevaluate the data from the following:

- The period of record from when the AU and/or parameter was first listed.
- The period of record in the current assessment cycle.
- The data that were collected between when the AU and/or parameter were first listed and the period of record considered in the current assessment cycle.

As part of the demonstration of good cause process, DWQ will review the data from all assessed sample locations (as defined in Table 3) in the three above scenarios to confirm whether or not there were exceedances at the sample sites. Where exceedances occur, DWQ must demonstrate that the exceedances no longer exist, no longer are of concern, or that water quality has improved. If a sample site had exceedances (and newer data do not exist), DWQ will provide documentation and a justification as to why the site was not re-sampled and/or whether water quality conditions have improved. If documentation cannot be provided, the AU and parameter will not be delisted, and the previous categorical assignment will carry forward.

Delisting Categorical Pollutant Causes

In the case of TMDLs or special studies which identify parameters contributing to a cause of impairment, but are not the original cause for listing on the 303(d) list, there may be good cause justification for delisting the categorical cause if the original impaired parameter is no longer impaired and a linkage of the additional causes can be documented in a TMDL or other study. For instance, in some circumstances DWQ has identified phosphorus as a contributing cause of impairment to an existing dissolved oxygen listing and subsequently made a categorical listing for phosphorus as a cause on subsequent 303(d) lists. Since DWQ does not have assessment methods for phosphorus, a delisting based on process outlined here is not feasible. Therefore, if the assessment results for the original DO listing can justify a delisting (as outlined above), any additional parameters associated with that cause may also be delisted with proper documentation of a direct linkage.

Appendix 6 elaborates on the process DWQ will follow when evaluating good cause at the AU-level, and also describes, in more detail, the process DWQ will go through when evaluating good cause at the parameter-level. For EPA review and approval, DWQ applies several delisting codes (also included in Appendix 2).

If a waterbody or parameter is shown to have good cause for not being listed or removed as an impaired waterbody or segment within a waterbody on the state's 303(d) List, DWQ will state the good cause as defined earlier in this document and provide a more detailed description of the good cause. Details of the good-cause evaluation process such as the data-analysis work will not be posted online during the draft public comment period or after the final approval and publication of the final IR and 303(d) List. DWQ will, however, summarize the data analysis work in the description of the good cause. The analyses will be available to the public upon request through Utah's Government Records Access and Management Act (GRAMA) requirements.

Previous Categorical Listings

303(d) Listings

Without the proper documentation, as described above, to support changing a previous not-supporting (Category 5) listing decision to a TMDL-approved (Category 4A), pollution control (Category 4B), non-pollutant impairment (Category 4C), or delisting (demonstration of good cause), DWQ must continue to list all previous impairments. At a minimum, this includes carrying forward all waterbodies or segments within a waterbody that were previously not supporting (Category 5), indicating the cause of impairment, listing the beneficial use (or uses) that is failing to meet water quality standards, providing the priority of developing a TMDL, and indicating the assessment cycle the waterbody or segment within the waterbody were first listed.

Non-303(d) Categorical Listings

Where DWQ has the proper documentation to support changing a previous not supporting (Category 5) listing decision to a TMDL-approved (Category 4A), pollution control (Category 4B), non-pollutant impairment (Category 4C), or delisting (demonstration of good cause), DWQ will do so as outlined by the policies and procedure described earlier in this document.

DWQ will also carry forward all previous categorizations of waterbodies or segments within a waterbody if the waterbody does not have any credible or representative data from the period of record of the current assessment cycle (a 6-year period of record). This includes carrying forward the following:

- Previous TMDL-approved (Category 4A), pollution control (Category 4B), and non-pollutant impairment (Category 4C) categorizations that do not demonstrate good cause as defined earlier in this document.
- Previous categorizations that have insufficient data with exceedances (Category 3A), require further investigations (Category 3D), have insufficient data with no exceedances (3E), are not assessed (Category 3F), show no evidence of impairment (Category 2), or are supporting (Category 1).
- Historical Category 3A waters will remain in that category unless there is new data for assessment.

Waterbodies or segments within a waterbody that are supporting or show no evidence of impairment (Categories 1 and 2, respectively) may carry forward for six consecutive assessment (or two rotating basin) cycles. On the seventh consecutive assessment cycle, DWQ will not continue to carry forward a supporting or no evidence of impairment categorization for waterbodies or segment within a waterbody that do not have any new data collected in the last 12 years. As noted earlier in this document, data older than a 12-year period of record may not be reflective of current condition, and will not be used for assessment purposes unless there is information or a rationale with supporting documentation that shows the data are reflective of current conditions.

If there is evidence that the data are reflective of current conditions, the previous supporting (Category 1) or no evidence of impairment (Category 2) categorization will carry forward for one more assessment cycle (the current one) and be re-evaluated in the next cycle. If there is no or not enough supporting evidence that the data are reflective of current conditions, DWQ will not carry forward the supporting or no evidence of impairment categorization for a seventh consecutive assessment cycle. Instead, DWQ will change the categorization to insufficient data no exceedances (Category 3E) to prioritize and encourage DWQ and stakeholders to collect newer information and submit that data and information in future calls for data.

303(D) VISION AND TMDL PRIORITY DEVELOPMENT

For waterbodies or segments within a waterbody that are impaired by a pollutant, DWQ must ensure that TMDLs will be developed following the final release of the current IR and 303(d) List. Recognizing that all TMDLs cannot be completed at once and that certain risks may be greater than others, the CWA Section 303(d) allows states to prioritize impaired waterbodies or segments within a waterbody on the Section 303(d) List for the future development of TMDLs.

To help guide states on how to best prioritize and demonstrate progress on addressing the water quality concerns highlighted and reported on in the IR and 303(d) List, EPA announced on December 5, 2013, a new collaborative framework for implementing the CWA Section 303(d) Program with states (See **A Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program**). This document outlines a framework on how states can focus their resources to support the development of TMDLs and other water quality improvement programs (such as the antidegradation program, nonpoint source implementation program, and 401 water quality certification program). In response to the release of this document, DWQ will be engaging with stakeholders while updating and developing new policies and procedures for the following IR and 303(d) reporting-specific elements:

- Assigning TMDL priorities to impaired waterbodies and segments within waterbodies on DWQ's 303(d) List.
- Performing cost–benefit analyses that estimate the environmental, economic, and social costs and benefits, and time needed to achieve the objectives of the CWA and state water quality standards.
- Tracking the statuses and developments of TMDLs.

DWQ is scheduled to release its new state-specific 303(d) vision policy and procedures in 2016 for public comment and final approval from EPA (Table 13). To minimize the potential for conflicting information between the release of the draft 2016 IR and 303(d) vision priority TMDL list and the public comment period and adoption of the DWQ 303(d) vision, DWQ will only incorporate new TMDL priority criteria once the DWQ 303(d) vision document has been through a public review. Please refer to Appendix 4 for how DWQ prioritized the future developments of TMDLs on DWQ's 303(d) List.

Table 12. Milestones for 303(d) vision prioritization process.

Milestone	Date
Presentation to Water Quality Board	1/21/15
Criteria Development and Application	
Compile all priorities and criteria developed internally.	1/15/15
Rank criteria and priorities based on DWQ needs and mission.	2/06/15

Apply criteria to 303(d) list using spreadsheet ranking tool.	2/20/15
Presentation of draft TMDL priorities to Water Quality Board.	9/24/15
Report	
Internal draft of 303(d) priorities report.	11/15/15
Evaluation of DWQ resources for high priorities (funding/feasibility).	12/01/15
Internal review.	12/15/16
Public draft report.	1/15/16
Public comment period.	1/15–2/15/16
Final draft report.	3/15/16

REVISION REQUESTS BETWEEN CYCLES

Barring unforeseen circumstances, DWQ will only propose to revise the IR and 303(d) List during the regularly scheduled reviews, which are currently biennially and on even-numbered years. Interested persons may petition DWQ at any time to request a revision to the IR and 303(d) List, whether it is an addition or deletion to the final 303(d) List. However, such revisions may only be considered if failing to either *add* a segment to the list or *delete* a segment from the list before the next scheduled review will result in a substantial hardship to the party or parties requesting the revision(s). If such hardship is shown, DWQ will take the potential revision under strong consideration and begin a dialogue with the interested party or parties and EPA.

LITERATURE CITED

Carlson, R.E. 1977. A Trophic Status Index for Lakes. *Limnology and Oceanography* 22:361–364.

Clarke, R.T., M.T. Furse, J.F. Wright, and D. Moss. 1996. Derivation of a biological quality index for river sites: comparison of the observed with the expected fauna. *Journal of Applied Statistics* 23:311–332.

Davies, N.M, R.H. Norris, and M.C. Thoms. 2000. Prediction and assessment of local stream habitat features using large-scale catchment characteristics. *Freshwater Biology* 45:343–369.

Feldman, D. 2006. *A Report to the DEQ Water Quality Planning Bureau on the Proper Interpretation of Two Recently Developed Bioassessment Models*. Helena, Montana: Montana Department of Environmental Quality.

Furse, M.T., D. Moss, J.F. Wright, and P.D. Armitage. 1984. The influence of seasonal and taxonomic factors on the ordination and classification of running-water sites in Great Britain and on the prediction of their macro-invertebrate communities. *Freshwater Biology* 14:257–280.

Hargett, E.G., J.R. ZumBerge, and C.P. Hawkins. 2005. *Development of a RIVPACS Model for Wadable Streams of Wyoming*. Wyoming Department of Environmental Quality, Water Quality Division.

Hawkins, C.P. 2004. Predictive Model Assessments: A Primer. The Western Center for Monitoring and Assessment of Freshwater Ecosystems, Utah State University, 29 September 2004. Available at: **http://129.123.10.240/wmcportal/DesktopDefault.aspx**.

Hawkins, C.P., and D.M. Carlisle. 2001. Use of Predictive Models for Assessing the Biological Integrity of Wetlands and Other Aquatic Habitats. In *Bioassessment and Management of North American Freshwater Wetlands*, edited by Russell B. Rader, Darold P. Batzer, and Scott A. Wissinger. Hoboken, New Jersey: John Wiley & Sons, Inc.

Hawkins, C.P, R.H. Norris, J.N. Hogue, and J.W. Feminella. 2000. Development and evaluation of predictive models for measuring the biological integrity of streams. *Ecological Applications* 10:1456–1477.

Hughes, R.M., D.P. Larsen, and J.M. Omernik. 1986. Regional reference sites: a method for assessing stream potential. *Environmental Management* 5:629–635.

Jessup, B., C.P. Hawkins, and J. Stribling. 2006. *Biological Indicators of Stream Condition in Montana Using Benthic Macroinvertebrates*. Tetra Tech. Technical report prepared for the Montana Department of Environmental Quality, Helena, Montana.

Karr, J.R. 1981. Assessment of biotic integrity using fish communities. *Fisheries* 6:21–27.

Karr, J.R., and D.R. Dudley. 1981. Ecological perspectives on water quality goals. *Environmental Management* 5(1):55–68.

Marchant, R., and G. Hehir. 2002. The use of AUSRIVAS predictive models to assess the response of lotic macroinvertebrates to dams in south-east Australia. *Freshwater Biology* 43:1022–1050.

Metzeling, L., D. Robinson, S. Perris, and R. Marchant. 2002. Temporal persistence of benthic invertebrate communities in south-eastern Australian streams: taxonomic resolution and implications for the use of predictive models. *Marine and Freshwater Research* 53:1223–1234.

Moss, D. J.F. Wright, M.T. Furse, and R.T. Clarke. 1999. A comparison of alternative techniques for prediction of the fauna of running-water sites in Great Britain. *Freshwater Biology* 41:167–181.

Paul, M. J., J. Gerritsen, C.P. Hawkins, and E. Leppo. 2005. *Development of Biological Assessment Tools for Colorado*. Tetra Tech. Technical report prepared for the Colorado Department of Public Health and Environment, Water Quality Control Division – Monitoring Unit, Denver, Colorado.

Simpson, J.C., and R.H. Norris. 2000. Biological assessment of river quality: development of AusRivAS models and outputs. In *Assessing the Biological Quality of Fresh Waters*, edited by J.F. Wright, D.W. Sutcliffe, and M.T. Furse, pp. 125–142. Ambleside, United Kingdom: Freshwater Biological Association.

Sudaryanti, S., Y. Trihadiningrum, B.T. Hart, P.E. Davies, C. Humphrey, R.H. Norris, J. Simpson, and L. Thurtell. 2001. Assessment of the biological health of the Brantas River, East Java, Indonesia using the Australian River Assessment System (AUSRIVAS) methodology. *Aquatic Ecology* 35(2):135–146.

Suplee, M., R. Sada de Suplee, D. Feldman, and T. Laidlaw. 2005. *Identification and Assessment of Montana Reference Streams: A Follow-Up and Expansion of the 1992 Benchmark Biology Study*. Helena, Montana: Montana Department of Environmental Quality. Available at: **http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB4QFjAA&url=http%3A%2F%2Fdeq.mt.gov%2Fwqinfo%2Fstandards%2FPDF%2FRefsites_writeup_FINALPrintReady.pdf&ei=KmMcVMyzA9DgoASZ_4HoCw&usg=AFQjCNHS63p2dYBFultDKPsz9AspHt9wGg**.

U.S. Environmental Protection Agency (EPA). 1985. *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Uses*. EPA-PB85-227049.

———. 2005. *Guidance for 2006 assessment, listing and reporting requirements pursuant to Sections 303(d) and 305(b) of the Clean Water Act*. Available at: **http://www.epa.gov/owow/tmdl/2006IRG/report/2006irg-report.pdf**. Accessed September 19, 2014.

U.S. Geological Survey (USGS). 2006. *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting*. Available at: **http://pubs.usgs.gov/tm/2006/tm1D3/pdf/TM1D3.pdf**. Accessed September 19, 2014.

Utah Division of Water Quality (DWQ). 2014. *Quality Assurance Program Plan For Environmental Data Operations*. Final Plan. Available at: **http://www.deq.utah.gov/Compliance/monitoring/water/docs/2014/05May/DWQ_QAPP_5.1.14_Rev0.pdf**. Accessed September 19, 2014.

Wright, J.F. 1995. Development and use of a system for predicting the macroinvertebrate fauna in flowing waters. *Australian Journal of Ecology* 20:181–197.

Wright, J.F., M.T. Furse, and P.D. Armitage. 1993. RIVPACS: a technique for evaluating the biological water quality of rivers in the UK. *European Water Pollution Control* 3:15–25.

APPENDIX 1: ASSESSMENT UNIT ROLL UP

Going from a multiple beneficial uses assessments for a parameter (i.e., a Parameter Summary Report) to 1 Parameter Category per Monitoring Location ID (MLID)*.

IRAnalysisAction: 3A: (insufficient Data)

- 1,2, or 3 exceedances (with **no** data rejected for a use)
  - 3Aexcceds is populated with a "Y" → ParamDWQCat: 3a → ParamEPACat: 3

- 1,2, or 3 exceedances (with **some** data rejected for a use)
  - 3Aexcceds is populated with a "Y" → ParamDWQCat: 3a → ParamEPACat: 3

- 0 exceedances (with **no** data rejected for a use)
  - No Data is populated with a "Y" → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

- 0 exceedances (with **some** data rejected for a use)
  - No Data is populated with a "Y" → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

- All data removed for every use
  - No Data is populated with a "Y" → ParamDWQCat: 3f: No Beneficial Uses → ParamEPACat: 3

IRAnalysisAction: Not Assessed

- All data removed for every use (this would be populated in use_comment columns)
  - No Data is populated with a "Y" → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

IRAnalysisAction: Not Assessed

- **IRAnalysisComment:** "NonRejected data available for MLID/AU, but data available for individual use assessment was all rejected"
  - No Data is populated with a "Y" → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

IRAnalysisAction: Not Assessed

- **IRAnalysisComment:** "No Uses assigned to site"
  - No Data is populated with a "Y" → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

IRAnalysisAction: Assessed By Use

- **FS Only** → ParamDWQCat: 1 → ParamEPACat: 1
- **FS Only + some data rejected by use** → ParamDWQCat: ~~1~~ 2 → ParamEPACat: ~~1~~ 2
- **Contains an NS** → ParamDWQCat: 5 → ParamEPACat: 5
- **Only combo: all data was rejected for a use** → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

- **FS Only + 3As by Use (exceedances) + some data rejected by use** → ParamDWQCat: 3a → ParamEPACat: 3
- **FS Only + 3As by Use (NO exceedances) + some data rejected by use** → ParamDWQCat: 2 → ParamEPACat: 2

- **FS Only + 3As by Use (exceedances) + NO data rejected by use** → ParamDWQCat: 3a → ParamEPACat: 3
- **FS Only + 3As by Use (NO exceedances) + NO data rejected by use** → ParamDWQCat: 2 → ParamEPACat: 2

- **3As by Use (exceedances) + some data rejected by use** → ParamDWQCat: 3a → ParamEPACat: 3
- **3As by Use (NO exceedances) + some data rejected by use** → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

- **3As by Use (exceedances) + NO data rejected by use** → ParamDWQCat: 3a → ParamEPACat: 3
- **3As by Use (NO exceedances) + NO data rejected by use** → ParamDWQCat: 3e: Not Assessed → ParamEPACat: 3

- **BOD, TP, and Nitrate (for non 1C uses)** → ParameterDWQCat: MLIDDWQCat =3d: Further Investigations → ParamEPACat: 3

*Note: after this rollup there will be multiple parameter assessment categories for 1 MILD. For example, MLID "X" will have 1 Iron, 1 Copper, 1 Temperature, 1 Dissolved Oxygen, etc.

Going from many Parameter Categories within an MLID to 1 Category for the MLID

- Take MLID_Param Cats and Group them by MLID. Then assign the MLID category by the following logic:
  - **Parameter_DWQCat = 5 → MLIDDWQCat = 5 **AND** MLIDEPACat = 5
  - Parameter_DWQCat = 3a → MLIDDWQCat =3a **AND** MLIDEPACat = 3
  - Parameter_DWQCat = 1 → (Cat1 Matrix Check is a match)→MLIDDWQCat =1 **AND** MLIDEPACat = 1
  - Parameter_DWQCat = 1 → (Cat1 Matrix Check is a **NOT** a match)→MLIDDWQCat =2 **AND** MLIDEPACat = 2
  - Parameter_DWQCat = 2 →MLIDDWQCat =2 **AND** MLIDEPACat = 2
  - Parameter_DWQCat = 3d →MLIDDWQCat =3d: Further Investigations Needed **AND** MLIDEPACat = 3
  - Parameter_DWQCat = 3e →MLIDDWQCat =3e: Not Assessed **AND** MLIDEPACat = 3
  - Parameter_DWQCat = 3f →MLIDDWQCat =3f: No Beneficial Uses **AND** MLIDEPACat = 3

** Should be able to see a concatenation of the uses for a parameter that created a 5 category (needs validation too)

Going from many MLID Categories within an Assessment Unit (AU) to 1 Category for the AU

- Take MLID Cats and Group them by AUID. Then assign the AUID category by the following logic:
  - **MLIDDWQCat = 5 → AUIDDWQCat = 5 **AND** AUIDEPACat = 5
    - AUIDDWQCat = 5 (and TMDL in Place) → AUIDDWQCat = 5 **AND** AUIDEPACat = 4a
    - AUIDDWQCat = 5 (and non-TMDL in Place) → AUIDDWQCat = 5 **AND** AUIDEPACat = 4b
  - **MLIDDWQCat = 5 → (and TMDL is in place & only parameter assessed for that AUID is being considered) → AUIDDWQCat = 4a **AND** AUIDEPACat = 4a
    - AUIDDWQCat = 5 (and non-TMDL in place) → AUIDDWQCat = 4a **AND** AUIDEPACat = 4b
  - **MLIDDWQCat = 5 → (and non-TMDL is in place & only parameter assessed for that AUID is being considered) → AUIDDWQCat = 4b **AND** AUIDEPACat = 4b
    - NOTE: for the 2014IR this should not happen. The only 4Bs we have are KL's and AD's – may happen for AD's?
  - MLIDDWQCat = 3a → AUIDDWQCat =3a **AND** AUIDEPACat = 3
  - MLIDDWQCat = 2 →AUIDDWQCat =2 **AND** AUIDEPACat = 2
  - MLIDDWQCat = 1 →AUIDDWQCat =1 **AND** AUIDEPACat = 1
  - MLIDDWQCat = 3d → AUIDDWQCat =3d: Further Investigations Needed **AND** AUIDDWQCat = 3
  - MLIDDWQCat = 3e → AUIDDWQCat =3e: Not Assessed **AND** AUIDDWQCat = 3
  - MLIDDWQCat = 3f → AUIDDWQCat =3f: No Beneficial Uses **AND** AUIDDWQCat = 3

** Should be able to see a concatenation of the uses for a parameter that created a 5 category (needs validation too)

Extra Checks

Biological assessments only assess 3A, 3B, 3C, or 3D beneficial uses. For an AU to be Category 1, all assigned beneficial uses must be assessed. Query AUs with biological assessments in them and confirm that the AU assessment category follows the roll up process described in this document. One example is only if a biological assessment is performed for an AU and the AU is Category 1 (should be changed to a Category 2).

APPENDIX 2: DELISTING

1. Does the AU/AU-parameter combination warrant further investigation? (see 303(d) Assessment Methods for more details).
2. What was the AU originally impaired for?
3. What IR assessment cycle was the AU and parameter first listed?
    a. What datasets were used for that listing (e.g., the agency/sample collector)?
    b. What was the period of record? (If unknown, use the longer period of record as defined in the 303(d) Assessment Methods.)
    c. What MLIDs are in the AU?
4. For impairments listed in the previous assessment cycle, compile the data. (Query data for all MLIDs in the AU. Ignore waterbody types.)
    a. What MLID has > = 1 exceedances?
    b. For MLIDs with impairments/exceedances **and** not assessed in the current IR cycle: why did DWQ (or someone else) not resample? (Provide documentation as to why resampling was not done and why (by not re-sampling) the site should meet water quality standards. Please refer to the good cause descriptions in the 303(d) methods. **Check for good cause.** If it is a reason other than good cause, the documentation will need to be EPA-approved).
    c. Where all MLIDs with exceedances are assessed in the current IR cycle:
        i. For MLIDs with impairments/exceedances and the current parameter assessment for the MLID **is not** 1, 2, or 3E –> **no delisting.**
        ii. Is the current parameter Category 1, 2, or 3E? Was there a BPJ applied to this parameter (e.g., an assessment category overwrite for the whole:
            1. Parameter?
                a. If the BPJ created a Category 1, 2, or 3E, the BPJ justification will need to be EPA-approved if it is consider to be a delisting. **Check for good cause.**
            2. MLID?
                a. If the BPJ created a Category 1, 2, or 3E, the BPJ justification will need to be EPA-approved if it is consider to be a delisting. **Check for good cause.**
            3. AU?
                a. If the BPJ created a Category 1, 2, or 3E, the BPJ justification will need to be EPA-approved if it is consider to be a delisting. **Check for good cause.**
        iii. Is the current parameter Category 1, 2, or 3E? (No BPJ applied to this parameter) → **Check for good cause.**

Note: Need to confirm that if no new data are collected, the new assessment analysis is not a Category 1,2, or 3E, because the exceedances are out of the period of record for assessment analysis (i.e., not a delisting).

Double check before delisting:

d. If the current Parameter Category 1, 2, or 3E – what is the oldest date in that period of record for that MLID/Parameter combo in the current Assessment cycle?
e. For every MLID in the AU (Ignore waterbody types), compile all data for that parameter between the max date from the cycle the parameter was first listed and the oldest date in that period of record for that MLID/Parameter combo in the current Assessment cycle?
f. What MLID has > = 1 exceedances
g. For MLIDs with impairments/exceedances **and** not assessed in the current IR cycle: why did DWQ (or someone else) not resample? (Provide documentation as to why resampling was not done and why (by not re-sampling) the site should meet water quality standards. Please refer to the good cause descriptions in the 303(d) methods. If it is a reason other than good cause, the documentation will need to be EPA-approved). **Check for good cause.**
h. Where all MLIDs with exceedance are assessed in the current IR cycle:
    i. For MLIDs with impairments/exceedances and the current parameter assessment for the MLID **is not** 1, 2, or 3E –> **no delisting.**
    ii. Is the current parameter Category 1, 2, or 3E? Was there a BPJ applied to this parameter (e.g., an assessment category overwrite for the whole:
        1. Parameter?
            a. If the BPJ created a Category 1, 2, or 3E, the BPJ justification will need to be EPA-approved if it is consider to be a delisting. **Check for good cause.**
        2. MLID?
            a. If the BPJ created a Category 1, 2, or 3E, the BPJ justification will need to be EPA-approved if it is consider to be a delisting. **Check for good cause.**
        3. AU?
            a. If the BPJ created a Category 1, 2, or 3E, the BPJ justification will need to be EPA-approved if it is consider to be a delisting. **Check for good cause.**
    iii. Is the current parameter Category 1, 2, or 3e? (No BPJ applied to this parameter) → **Check for good cause**

Note: Need to confirm that if no new data are collected, the new assessment analysis is not a Category 1,2, or 3e, because the exceedances are out of the period of record for assessment analysis.

APPENDIX 3: 4B SUBMISSION POLICIES AND PROCEDURES

Process for Determining Category 4B Classification

An alternative to listing an impaired segment on the state's 303(d) List is an approved Category 4B demonstration plan. A Category 4B demonstration plan, when implemented, must ensure attainment with all applicable water quality standards through agreed-upon pollution-control mechanisms within a reasonable time period. These pollution-control mechanisms can include approved compliance schedules for capital improvements or plans enforceable under other environmental statutes (such as Comprehensive Environmental Response, Compensation, and Liability Act) and their associated regulations. A Category 4B demonstration can be used for segments impaired by point sources and/or nonpoint sources. Both DWQ and EPA must accept a Category 4B demonstration plan for the affected segment to be placed in Category 4B. In the event that the Category 4B demonstration plan is not accepted, the segment at issue will be included on the 303(d) List, Category 5.

Generally speaking, the following factors will be considered necessary for Category 4B demonstration plan acceptance: 1) appropriate voluntary, regulatory, or legal authority to implement the proposed control mechanisms (through permits, grants, compliance orders for Utah Pollutant Discharge Elimination System permits, etc.); 2) existing commitments by the proponent(s) to implement the controls; 3) adequate funding; and 4) other relevant factors appropriate to the segment.

The following evidence must be provided as a rationale for a Category 4B demonstration plan:

1) A statement of the problem causing the impairment.
2) A description of
    a. the pollution controls to be used,
    b. how these pollution controls will achieve attainment with all applicable water quality standards, and
    c. requirements under which those pollution controls will be implemented.
3) An estimate of the time needed to meet all applicable water quality standards.
4) A schedule for implementation of the necessary pollution controls.
5) A schedule for tracking progress, including a description of milestones.
6) A commitment from the demonstration plan proponent to revise the implementation strategy and pollution controls if progress toward meeting all applicable water quality standards is not shown.

<u>Timing for Proposal Submittal and Acceptance by DWQ and EPA</u>

• Category 4B demonstration plans should be submitted to DWQ by <u>August 30, 2015,</u> in order for DWQ to submit the plan to EPA by <u>September 6, 2015</u>. Parties are encouraged to work with DWQ before this date as states are the entity required to submit these plans to EPA.

• Acceptance from EPA must be obtained by <u>October 31, 2015;</u> otherwise, DWQ will <u>continue to</u> propose that the segment in question is included on the <u>2016</u> 303(d) List.

• If EPA and DWQ accept the Category 4B plan, DWQ will notify the Utah Water Quality Board and the public through proposed statement of basis and purpose language in its proposal that a Category 4B demonstration plan is accepted and is appropriate for this segment.

EPA has several documents that contain additional information on Category 4B demonstration requirements, including: "2006 Integrated Report Guidance," available at **http://www.epa.gov/OWOW/tmdl/2006IRG/#documents**; and "Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions," available at: **http://yosemite.epa.gov/R10/WATER.NSF/TMDLs/CWA+303d+List/**.

APPENDIX 4: 2014 IR TMDL PRIORITIZATION PROCESS

The Clean Water Act (CWA) requires total maximum daily loads (TMDLs) be developed for all impaired waterbodies on the 303(d) List. Recognizing the many limitations in data, time, and staff resources to accomplish this, the CWA also requires states to prioritize where they will dedicate resources toward TMDL development. However, defining an impaired waterbody as high priority does not necessarily mean that a TMDL will be developed before lower priority segments. For some high-priority TMDLs, the development may take considerably longer due to data collection, stakeholder involvement, and other factors.

The Utah Division of Water Quality (DWQ) prioritizes impairments to human and ecological health. These priorities translate into the protection and restoration of waters designated for culinary, recreational, and aquatic wildlife uses. Considerations for TMDL prioritization in Utah also include the level of partner agency and stakeholder involvement and potential for restoration as defined by the Recovery Potential Screening tool. Other factors considered in setting TMDL priorities include programmatic needs such as permitting and addressing watershed-wide water quality issues.

DWQ is currently engaged in an effort to solicit stakeholder input into the prioritization process as part of putting the 303(d) vision into action. This effort is related but separate from the Integrated Report. Public input is critical for the success of the 303(d) vision because it will promote support for protecting and restoring water quality and define the values that best serve the public interest.

APPENDIX 5: APPLICATION OF BEST PROFESSIONAL JUDGEMENT

Best Professional Judgement Concern	Pre-Best Professional Judgement Review Process	Best Professional Judgement Application
Temporal variation within a dataset	• Insufficient sampling frequency within an assessment period of record.	Individual data records.
Bias in sampling design	• Event monitoring (review flow, weather, and spill data; narrative criteria; field observations and photographs; satellite imagery; other data types collected in same (and around the) period of concern, etc.). • Sample time of day (literature review to determine if parameter is impacted by the time of day sample is collected). • Sampling a specific season (unless approved by DWQ in a SAP or is data-type specific (e.g., *E. coli* sampling during the rec. season)].	Individual data records.
Data quality	• *Quality Assurance Program Plan For Environmental Data Operations*. • Field calibration documentation. • Laboratory method. • Standard operating procedures. • Demonstration of capability (if applicable to data type). • Discussion with sample collector.	Individual data records, and/or, parameter(s) in period of record, and/or monitoring location.
Wrongly monitored	• Measured point source (vs. main water body), review imagery of area, flow, etc. • Waterbody type DWQ does not assess (as defined in the 303(d) Methods). • Grab sample vs. composite. • Flow conditions (too low or not flowing). • Field observation that impacts quality of data.	Individual data records and/or monitoring location.

Outlier	Need more than a statistical test. Should be based on scientific or QA basis. • QA/QC field sampling blanks, duplicates/replicate. • Laboratory Analytical Batch QC. • Value is nonsensical (e.g., cannot be measured with field/laboratory method). • Refer to data quality (above).	Individual data records
Magnitude of exceedance	• Significant figures • Review narrative criteria	Individual data records
QA/QC concerns	• Holding time • Laboratory Comment • Dilutions, Spikes • Other laboratory QC Performance Checks	Individual data records
Environmental factors	• Extreme Event Captured [see definition of extreme event in 303(d) Assessment Methods]: review flow, weather, and spill data, narrative criteria, field observations and photographs, satellite imagery, other data types collected in same (and around the) period of concern, etc.).	Individual data records
Assessment unit grouping/spatial variation	• Multiple locations not grouped correctly (either should or should not have been grouped). • Assessment of All Tributary Segments (please refer to 303(d) Assessment Methods section on "All tributaries" for more information on the process). • Non-river/stream sampled in AU and is not supporting (this waterbody is still a water of the state and should be assessed. See the 303(d) Assessment Methods for more details).	Monitoring location.

Credible data	• Data type applied incorrectly. • Data type not considered. (Data type must meet credible and representative data requirements in 303(d) Assessment Methods and if included in the assessment analysis would result in a change in the categorization of the waterbody and parameter.	Individual data records and/or parameter(s) in period of record, monitoring location.
Other	• Parameters wrongly grouped (by CAS, fraction, or methods). • Data type is laboratory measurement (when the data assessment requires a field measurement). • IR QA/QC flagged data. • Errors in standards.	Individual data records. Entire parameter assessments.

APPENDIX 6. CREDIBLE DATA – DATA QUALITY GRADE LEVEL ASSIGNMENTS

Dataset: Utah DWQ (internally-collected data) and Non-DWQ Cooperators.

Summary: Data quality can be improved upon, but most results meet the Data Validation Criteria from the Credible Data Quality Matrix for data submission and can move forward to IR-specific QC checks to determine if they can used for all assessment purposes. Overall Grade: A-

Data Type	Data Validation Criterion from Credible Data Quality Matrix	Grade Level Assigned	Justification	Areas for Future Improvement
Field Data	Quality Assurance Project Plan (QAPP)	A	DWQ's QAPP approved by DEQ Quality Assurance Council (May 2014).	Implement all components of DWQ's QAPP.
	Sampling & Analysis Plan (SAP)	B	Multiple planning documents that constitute key SAP components were approved informally for targeted runs. Some projects such as UCASE have formal SAPs.	Formalize SAP documentation and approval process and make sure all required SAP components (listed in QAPP) are completed. Lakes SAP needs to be updated.
	Calibration Documentation	A	Calibration documentation available for most field records but recalibration information typically not recorded. Individual results may be flagged or rejected if calibration documentation cannot be found.	Maintain documentation of recalibration; make sure recalibration is occurring according to SOP. Make calibration documentation more accessible and tied to results.
	Field Documentation	A	Field notes, if collected, are scanned into file and available for review.	Few field notes are being collected; find solution to simplify/automate recording field notes, especially when they apply to representativeness of sampling conditions, and make sure they get transferred into AWQMS.

	Flow Data	A	Flow data is routinely collected and final value is stored in file and available for review.	Perform second flow measurement at replicate sites. Record cross-sectional measurements, depths, velocity readings, equipment used, and any other notes related to flow measurement on a form.
	Water Temperature Methods	B	Accuracy and resolution of thermistor acceptable. However the traceable, certified thermistors have not been rechecked against NIST reference thermometer annually.	Purchase a new NIST reference thermometer and perform check of all thermistors against NIST reference thermometer annually, as required by QAPP and SOP.
	pH Methods	A	Probe is calibrated according to SOP and manufacturer's instructions. Accuracy and resolution of probe acceptable.	Perform and record recalibration when needed as required by SOP.
	Dissolved Oxygen – Percent Saturation for Calibrated Meter	A	Probe is calibrated according to SOP and manufacturer's instructions. Accuracy and resolution of probe acceptable.	Perform check of all barometers against NIST reference barometer annually, as required by QAPP and SOP. Any new equipment should have a built-in barometer.
	Dissolved Oxygen – Concentration Methods for Calibrated Meter	A	Probe is calibrated according to SOP and manufacturer's instructions. Accuracy and resolution of probe acceptable.	Perform check of all barometers against NIST reference barometer annually, as required by QAPP and SOP. Any new equipment should have a built-in barometer.
Data Type	**Data Validation Criterion from Credible Data Quality Matrix**	**Grade Level Assigned**	**Justification**	**Areas for Future Improvement**
Water Chemistry Data	Quality Assurance Project Plan (QAPP)	A	DWQ's QAPP approved by DEQ Quality Assurance Council (May 2014). All analyzing laboratories have approved QAPPs.	Implement all components of DWQ's QAPP.

	Sampling & Analysis Plan (SAP)	B	Multiple planning documents that constitute key SAP components were approved informally for targeted runs. Some projects such as UCASE have formal SAPs.	Formalize SAP documentation and approval process and make sure all required SAP components (listed in QAPP) are completed. Lakes SAP needs to be updated.
	Laboratory Method	A	All methods approved by DWQ and/or Utah Public Health Laboratory.	Obtain and review copies of method SOPs from all methods from analyzing laboratories.
	Detection Limits	B	Detection limits are approved and submitted by some labs. State Lab detection limits are approved and available but not routinely submitted (only reporting limits are submitted with all non-detect results).	Require State Lab to submit a reporting and detection limit with every result value. Work with State Lab to achieve greater sensitivity for IR analytes for which detection limit > numeric criteria.
	Lab Certification	B	State Lab is certified by EPA. Other analyzing labs are certified by Utah Public Health Laboratory or NELAC.	State Lab plans to be certified by NELAC in 2016.
	QC Samples	A	QC sample results are available for DWQ review.	Build QC sample performance review into project SAPs. Perform occasional assessment of laboratory internal/batch QC sample performance.
	Laboratory Comments	A	Analyzing laboratories submit comments with individual results when applicable. Individual results are flagged or rejected if comment indicates data quality issue. Laboratories are available for follow-up explanation on comments.	Require State Lab to provide more detail in comments, for example if comment indicates recovery limits for MS/MSD are out of range, the actual recovery percentage should be included in the comment.
	Field Documentation	A	All field documentation associated with samples submitted to laboratory is stored in file and available for review.	Few field notes are being collected; find solution to simplify/automate recording field notes, especially when they apply to representativeness of sampling conditions, and make sure they get transferred into AWQMS.

	Metals	A	Results for assessed metals are submitted with hardness values (or Ca and Mg values) as requested by sampler.	Add into SOPs/SAPs a check to make sure these conditions are including in project planning process (i.e. when a field value or important lab parameter such as hardness must accompany an analyte result for assessment).
	Organics	A	Results for pentachlorophenol are routinely submitted with field pH; individual results are flagged or rejected if this is not the case.	Add into SOPs/SAPs a check to make sure these conditions are including in project planning process (i.e. when a field value or important lab parameter must accompany an analyte result for assessment).
	Inorganics	B	Results for fluoride are not routinely collected and may not be submitted with air temperature. Results for Total Ammonia as N are routinely submitted with field pH and water temperature. When these requirements are not met, individual results are flagged or rejected.	Add into SOPs/SAPs a check to make sure these conditions are including in project planning process (i.e. when a field value or important lab parameter must accompany an analyte result for assessment).
Data Type	**Data Validation Criterion from Credible Data Quality Matrix**	**Grade Level Assigned**	**Justification**	**Areas for Future Improvement**
E. coli Data	Quality Assurance Project Plan (QAPP)	A	DWQ's QAPP approved by DEQ Quality Assurance Council (May 2014).	Implement all components of DWQ's QAPP.
	Sampling Analysis Plan (SAP)	B	Multiple planning documents that constitute key SAP components were approved informally for targeted runs. Some projects such as UCASE have formal SAPs.	Formalize SAP documentation and approval process and make sure all required SAP components (listed in QAPP) are completed. Lakes SAP needs to be updated.
	Standard Operating Procedures (SOPs)	A	Samplers follow DWQ's SOPs for E. coli Sample Collection & Analysis.	SOPs need to be revisited and possibly updated/revised.

	EPA Approved Method	A	IDEXX Colilert (USEPA-approved) used for all samples.	
	Demonstration of Capability (Annual)	A	DOC or SOP training/review signatures available and stored in file.	
	Data	A	All data submitted in template on time.	
	Field Documentation	B	All bench sheets stored in file met but QA info about materials often not recorded.	Make sure all samplers are filling out bench sheet for materials QA info.
	QA/QC	B	Holding times and incubation period routinely met but QA info about materials often not recorded.	
	Geo Information	A	Geo information is provided in form of MLID associated with each sample.	
	NIST Thermometer for Incubator	B	NIST certification has expired for the majority of traceable, certified incubator thermometers.	Purchase a new NIST reference thermometer and perform check of all incubator thermometers against NIST reference thermometer annually, as required by QAPP and SOP.
Data Type	**Data Validation Criterion from Credible Data Quality Matrix**	**Grade Level Assigned**	**Justification**	**Areas for Future Improvement**
Biological Data	Quality Assurance Project Plan (QAPP)	A	DWQ's QAPP approved by DEQ Quality Assurance Council (May 2014).	Implement all components of DWQ's QAPP.
	Sampling Analysis Plan (SAP)	A	UCASE Field Manual constitutes approved SAP.	
	Standard Operating Procedures (SOPs)	A	Samplers follow SOPs included in UCASE Field Manual.	
	Field Documentation	A	All field documentation is scanned into file and available for review.	

	DWQ approved taxonomy lab	A	All samples analyzed by approved taxonomy lab.	

Dataset: USGS

Summary: Data quality is good, results meet the Data Validation Criteria from the Credible Data Quality Matrix for data submission and can move forward to IR-specific QC checks to determine if they can used for all assessment purposes. Overall Grade: A

Data Type	Data Validation Criterion from Credible Data Quality Matrix	Grade Level Assigned	Justification
Field Data	Quality Assurance Project Plan (QAPP)	A	USGS Utah Water Science Center maintains a general QAPP. In additional an approved QAPP and SAP is required for each study as described in the USGS National Field Manual for the Collection of Water-Quality Data. The USGS National Water Quality Laboratory and other national USGS labs maintain their own QAPPs.
	Sampling & Analysis Plan (SAP)	A	
	Calibration Documentation	A	Calibration documentation is maintained and available for review as required in the USGS National Field Manual for the Collection of Water-Quality Data.
	Field Documentation	A	Calibration documentation is maintained and available for review as required in the USGS National Field Manual for the Collection of Water-Quality Data.
	Flow Data	A	Flow data is routinely collected with water samples and is accessible online in real-time and in Annual Reports.
	Water Temperature Methods	A	Accuracy and resolution of thermistor acceptable. Thermistors checked against NIST reference thermometer every 6 to 12 months, depending on the manufacturer's recommendation and as required by USGS National Field Manual for the Collection of Water-Quality Data.
	pH Methods	A	Probe is calibrated according to USGS National Field Manual for the Collection of Water-Quality Data and manufacturer's instructions. Accuracy and resolution of probe acceptable.
	Dissolved Oxygen – Percent Saturation for Calibrated Meter	A	

	Dissolved Oxygen – Concentration Methods for Calibrated Meter	A	
Data Type	**Data Validation Criterion from Credible Data Quality Matrix**	**Grade Level Assigned**	**Justification**
Water Chemistry Data	Quality Assurance Project Plan (QAPP)	A	USGS Utah Water Science Center maintains a general QAPP. In additional an approved QAPP and SAP is required for each study as described in the USGS National Field Manual for the Collection of Water-Quality Data. The USGS National Water Quality Laboratory and other national USGS labs maintain their own QAPPs.
	Sampling & Analysis Plan (SAP)	A	
	Laboratory Method	A	Most methods approved by DWQ; research methods used in some USGS studies may be flagged during IR QC checks.
	Detection Limits	A	Detection limits are approved by DWQ and submitted with results.
	Lab Certification	A	USGS National Water Quality Laboratory maintains accreditation through NELAC.
	QC Samples	A	QC sample results are available for DWQ review.
	Laboratory Comments	A	Lab comments submitted with individual results when applicable. Individual results are flagged or rejected during IR QC checks if comment indicates data quality issue.
	Field Documentation	A	Field documentation is available for DWQ review.
	Metals	A	Results for assessed metals are submitted with hardness values (or Ca and Mg values).
	Organics	A	Results for pentachlorophenol are routinely submitted with field pH; individual results are flagged or rejected if this is not the case.

	Inorganics	A	If fluoride collected, air temperature is typically also collected. Results for Total Ammonia as N are routinely submitted with field pH and water temperature. When these requirements are not met, individual results are flagged or rejected.

Dataset: Western Watersheds

Summary: Data quality can be improved upon, but most results meet the Data Validation Criteria from the Credible Data Quality Matrix for data submission and can move forward to IR-specific QC checks to determine if they can used for all assessment purposes. Overall Grade: B

Data Type	Data Validation Criterion from Credible Data Quality Matrix	Grade Level Assigned	Justification	Areas for Future Improvement
Field Data	Quality Assurance Project Plan (QAPP)	B	QAPP/SAP approved by WY DEQ (May 2010). Utah informally accepted this plan but for future submittal years.	For future submission years, DWQ would prefer WW to submit a Utah-specific QAPP/SAP. Or if WW is to have DWQ "Cooperator" status, they must submit a SAP for DWQ approval and operate under DWQ's QAPP requirements.
	Sampling & Analysis Plan (SAP)	B		
	Calibration Documentation	B	Calibration documentation available for review according to SAP.	DWQ SOPs require daily calibration of Dissolved Oxygen probes. If WW is to have DWQ "Cooperator" status, calibration documentation must be submitted quarterly with field data.
	Field Documentation	A	Field notes submitted with data.	
	Flow Data	n/a	Not submitted; not collected according to SAP.	
	Water Temperature Methods	B	Accuracy and resolution of thermistor acceptable. SAP does not indicate whether the traceable, certified thermistors have been checked against NIST reference thermometer annually.	For "A" grade, a more accurate probe must be used and traceable, certified thermistors must be rechecked against NIST reference thermometer annually, and recalibrated, if needed.
	pH Methods	B	Probe is calibrated daily according to SAP and manufacturer's instructions. Accuracy and resolution of probe acceptable.	For "A" grade, a more accurate probe must be used.

	Dissolved Oxygen – Percent Saturation for Calibrated Meter	n/a	Not submitted; not collected according to SAP.	
	Dissolved Oxygen – Concentration Methods for Calibrated Meter	B	Probe is factory-calibrated according to SAP and manufacturer's instructions. Accuracy and resolution of probe acceptable.	DWQ SOPs require daily calibration of dissolved oxygen probes used for instantaneous measurements. If WW is to have DWQ "Cooperator" status, calibration documentation must be submitted quarterly with field data.
Data Type	**Data Validation Criterion from Credible Data Quality Matrix**	**Grade Level Assigned**	**Justification**	
E. coli Data	Quality Assurance Project Plan (QAPP)	B	QAPP/SAP approved by WY DEQ (May 2010). Utah informally accepted this plan.	For future submission years, DWQ would prefer WW to submit a Utah-specific QAPP/SAP. Or if WW is to have DWQ "Cooperator" status, they must submit a SAP for DWQ approval and operate under DWQ's QAPP requirements.
	Sampling Analysis Plan (SAP)	B		
	Standard Operating Procedures (SOPs)	B	Sampler follows WY-approved E. coli-related SOPs. These have been initially determined to be equivalent to DWQ SOPs for E. coli sample collection and analysis.	For future submission years, and if WW is to have DWQ "Cooperator" status, WW should be trained on and sign they have read and follow DWQ's E. coli Program SOPs, and pass an annual DOC. This should be included in a Utah-specific SAP.
	Demonstration of Capability (Annual)	B	Sampler acknowledges review of DWQ's E. coli-related SOPs (via email confirmation) and follows WY-equivalent SOP and IDEXX instructions.	
	EPA Approved Method	A	IDEXX Colilert (USEPA-approved) used for all samples.	

	Data	B	Data submitted in template; extension provided for submission following deadline.	If WW is to have DWQ "Cooperator" status, they must submit data quarterly. This will ensure that data is provided to IR Assessment staff in a timely manner and in the proper format.
	Field Documentation	A	Bench sheet information and field notes provided with data submission.	
	QA/QC	B	SAP indicates that holding times and incubation conditions will be met and the reagents will be used before expiration.	For "A" grade, these items should be included in a filled out bench sheet and provided to DWQ with data submission.
	Geo Information	A	Provided with data submission.	If WW is to have DWQ "Cooperator" status, they must include sampling sites in approved SAP and MLIDs will be assigned prior to data collection.
	NIST Thermometer for Incubator	B	SAP indicates that incubator temperature will be checked for accuracy but does not specify if a NIST-traceable incubator thermometer will be used.	For "A" grade, DWQ SOP requires a certified internal incubator thermometer in additional to the digital display from the built-in incubator thermistor.

Dataset: DOGM

Summary: Data quality is difficult to assess because DWQ did not review actual QAPPs or SAPs, but DWQ assumes most results meet the Data Validation Criteria from the Credible Data Quality Matrix for data submission and can move forward to IR-specific QC checks to determine if they can used for all assessment purposes. In-depth IR-specific QC checks will thoroughly evaluate the quality of each result.
Overall Grade: B

Data Type	Data Validation Criterion from Credible Data Quality Matrix	Grade Level Assigned	Justification
Field Data	Quality Assurance Project Plan (QAPP)	B	DWQ assumes data collected under a QAPP and SAP as R645-301-723 requires monitoring follow "Standard Methods" which outlines Quality Assurance Plan requirements in Chapter 1020. Permit application also requires a monitoring plan (SAP). Further sampling and analysis requirements outlined in DOGM Technical Directives.
	Sampling & Analysis Plan (SAP)	B	
	Calibration Documentation	B	Calibration documentation available for DWQ's review if needed as per email communication with DOGM officials (calibration documentation and demonstration of capability required during facility inspections).
	Field Documentation	B	DWQ assumes field notes are available for DWQ review, if needed, as per typical SAP requirements.
	Flow Data	B	DWQ assumes flow data is available for DWQ review, if needed, as the rule requires it be collected.
	Water Temperature Methods	B	DWQ assumes monitoring conducted according to 40 CFR Part 136 and/or "Standard Methods for the Examination of Water and Wastewater", which ensures acceptable accuracy and resolution of thermistors.
	pH Methods	B	DWQ assumes monitoring conducted according to 40 CFR Part 136 and/or "Standard Methods for the Examination of Water and Wastewater", which ensures calibration and acceptable accuracy and resolution of pH probes.

	Dissolved Oxygen – Percent Saturation for Calibrated Meter	B	DWQ assumes monitoring conducted according to 40 CFR Part 136 and/or "Standard Methods for the Examination of Water and Wastewater", which ensures calibration and acceptable accuracy and resolution of dissolved oxygen probes.
	Dissolved Oxygen – Concentration Methods for Calibrated Meter	n/a	Not submitted or collected.
Data Type	**Data Validation Criterion from Credible Data Quality Matrix**	**Grade Level Assigned**	**Justification**
Water Chemistry Data	Quality Assurance Project Plan (QAPP)	B	DWQ assumes data collected under a QAPP and SAP as R645-301-723 requires monitoring follow "Standard Methods" which outlines Quality Assurance Plan requirements (including laboratory QAPPs) in Chapter 1020. Permit application also requires a monitoring plan (SAP). Further sampling and analysis requirements outlined in DOGM Technical Directives.
	Sampling & Analysis Plan (SAP)	B	
	Laboratory Method	A	All methods approved by DWQ and/or Utah Public Health Laboratory; any results collected with unapproved methods will be flagged/rejected during IR QC Checks.
	Detection Limits	B	Detection limits are approved by DWQ and submitted with results.
	Lab Certification	A	Analyzing labs are certified by Utah Public Health Laboratory or NELAC; any results from unapproved labs will be flagged/rejected during IR QC Checks.
	QC Samples	B	Unknown whether field QC samples are collected. Laboratory QC samples are available for DWQ review if needed.
	Laboratory Comments	B	Laboratory comments available for DWQ review, if needed, as per policy of any certified laboratory.
	Field Documentation	B	DWQ assumes field notes are available for DWQ review, if needed, as per typical SAP requirements.

	Metals	A	Results for assessed metals are submitted with hardness values or Ca and Mg values.
	Organics	n/a	Organics data not submitted.
	Inorganics	n/a	Fluoride and Total Ammonia data not submitted.