Idaho Pollutant Discharge Elimination System

Effluent Limit Development Guidance

State of Idaho
Department of Environmental Quality

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December 2017

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Table of Contents

Abbreviations and Acronyms viii
1 Introduction 1
1.1 Purpose and Need 1
1.2 Effluent Limit Development Process 2
1.3 Relationship to Existing Rules and Guidance 2
1.3.1 Clean Water Act 4
1.3.2 Idaho Water Quality Standards 4
1.4 Regulatory Citations 4
1.5 Data Analysis and Considerations 4
2 Determining Technology-Based Effluent Limits 5
2.1 TBELs for Publicly Owned Treatment Works 5
2.1.1 Secondary and Equivalent to Secondary Treatment 6
2.1.2 Adjustments to Equivalent to Secondary Treatment 8
2.1.3 Applying Secondary and Equivalent to Secondary Treatment Standards 9
2.1.4 Pretreatment Standards 17
2.2 TBELs for Non-POTWs 18
2.2.1 Effluent Limit Guidelines and Statutory Foundation 19
2.2.2 Apply Effluent Limit Guidelines 22
2.2.3 Case-by-Case TBELs for Industrial Dischargers 40
3 Determining Water Quality-Based Effluent Limits 45
3.1 Characterize the Effluent 45
3.1.1 Identify Pollutants of Concern in Effluent 45
3.1.2 Identify Effluent Critical Conditions 47
3.2 Characterize Receiving Water Critical Conditions 48
3.2.1 Receiving Water Upstream Flow 48
3.2.2 Receiving Water Upstream Pollutant Concentration 52
3.2.3 Other Receiving Water Characteristics 52
3.3 Determine Applicable Water Quality Standards 52
3.3.1 Beneficial Uses 53
3.3.2 Water Quality Criteria 54
3.3.3 Antidegradation 61
3.4 Determine the Need for WQBELs 65
3.4.1 Define Reasonable Potential 65
3.4.2 Assess Critical Conditions 65
3.4.3 Establish an Appropriate Mixing Zone 66

3.4.4 Conduct a Reasonable Potential Analysis 104
3.5 Calculate Pollutant-Specific WQBELs 110
3.5.1 Calculate Pollutant-Specific WQBELs from Aquatic Life Criteria 110
3.5.2 Calculate Chemical-Specific WQBELs Based on Human Health Criteria for Toxic Pollutants 118
3.5.3 Calculate Pollutant-Specific WQBELs using Probabilistic Methods 119
3.6 Calculate RPA and WQBELs for Whole Effluent Toxicity 121
3.6.1 Express WET Limits or Test Results 122
3.6.2 WET WLA and RPA 124
3.6.3 Determine WET Triggers and Limits 126
3.6.4 Document RPA and WQBEL Calculations for WET in Fact Sheet 129
3.7 Special Considerations 129
3.7.1 Nutrients 129
3.7.2 Temperature 137
3.7.3 Water Quality Trading 140
3.7.4 Emerging Contaminants of Concern 140
3.7.5 Watershed Permitting 142
3.7.6 Metal Translators 142
3.7.7 Implementing Fish Tissue Criteria 142
3.7.8 Biotic Ligand Model 144
3.8 Antidegradation Implementation 145
3.8.1 Tier I Review 146
3.8.2 Tier II Analysis 146
3.8.3 Tier III Designation 147
4 Final Effluent Limits and Antibacksliding 148
4.1 Applying Antibacksliding Requirements 149
4.1.1 Antibacksliding Provisions 149
4.1.2 Antibacksliding Exceptions 149
4.2 Document Final Effluent Limit Rationale in Fact Sheet 152
References 152
Key Terms 156
Appendix A. Significant Figures and Precision for Permit Limits and Reporting 158
Appendix B. Potential Approaches for Limiting Toxic Pollutants 159
Appendix C. Pollutants Regulated by Categorical Pretreatment Standards 160
Appendix D. New Source Dates by Effluent Category 164
Appendix E. Equations 167

List of Tables

Table 1. Secondary treatment standards. 6
Table 2. Equivalent to secondary treatment standards..... 7
Table 3. Technology levels of control for indirect dischargers. 18
Table 4. Technology levels of control for direct non-POTW dischargers..... 20
Table 5. Example of BPT limits from 40 CFR 417.42 (glycerine concentration)..... 21
Table 6. Existing point source categories. 24
Table 7. Technology levels of control for new and existing dischargers. 26
Table 8. Example of calculating BOD_5 limits for milk (40 CFR 405). 27
Table 9. Performance standards for new sources (40 CFR 405.105). 29
Table 10. BPT limits for 40 CFR 414, Subpart G (bulk organic chemicals)..... 30
Table 11. PSES limitations for anodizing facilities discharging less than 38,000 liters per day.. 31
Table 12. BPT effluent limits for tungstic acid rinse, 40 CFR 421, Subpart J (Primary Tungsten)..... 33
Table 13. BPT effluent limitations for acid leach wet air pollution control, 40 CFR 421, Subpart J (Primary Tungsten)..... 33
Table 14. BPT effluent limitations for alkali leach wash, 40 CFR 421, Subpart J (Primary Tungsten)..... 34
Table 15. BAT effluent limitations for tungstic acid rinse, 40 CFR 421, Subpart J (Primary Tungsten)..... 35
Table 16. BAT effluent limitations for acid leach wet air pollution control, 40 CFR 421, Subpart J (Primary Tungsten)..... 35
Table 17. BAT effluent limitations for alkali leach wash, 40 CFR 21, Subpart J (Primary Tungsten)..... 35
Table 18. Available variances, waivers, and intake credits for IPDES permits. 39
Table 19. Receiving water low-flow design conditions for reasonable potential analysis and effluent limit development. 48
Table 20. Available variances and intake credits for IPDES permits..... 61
Table 21. Cross-reference of IDAPA mixing zone rules and ELDG sections..... 70
Table 22. Summary of key considerations for mixing zone evaluations..... 72
Table 23. Threshold concentrations observed to elicit avoidance responses in salmonids (DEQ 2000)..... 77
Table 24. Low-flow design discharge conditions to use in mixing zone evaluations. 82
Table 25. Mixing zone level of analysis data inputs..... 91
Table 26. Reasonable potential multiplying factors: 95% confidence level and 95% probability basis..... 106
Table 27. Reasonable potential multiplying factors: 99% confidence level and 99% probability basis..... 106
Table 28. Percentile to z-score conversion table. 108
Table 29. Acute and chronic WLA multipliers..... 114
Table 30. LTA multipliers to calculate maximum daily limits..... 116
Table 31. LTA multipliers to calculate AML. 117
Table 32. Ratio between maximum daily and average monthly permit limits. 119
Table 33. Example summary of statistical characteristics of the Monte Carlo simulated data—values used as inputs to steady-state method. 121

Table 34. Comparison of Monte Carlo and steady-state methods. 121
Table 35. Example WET data. 124
Table 36. Freshwater organisms used in WET. 125
Table 37. LTA at 95% probability basis; averaged limit at 99th-probability basis. 135
Table 38. Summary of freshwater temperature water quality criteria. 138

List of Figures

Figure 1. Effluent limit development process for IPDES permits. 3
Figure 2. Secondary and equivalent to secondary treatment standards decision tree. 10
Figure 3. Overview of TBELs calculation for non-POTW (Industrial) dischargers. 23
Figure 4. Process for determining protection tier for antidegradation purposes. 64
Figure 5. Examples of mixing zones in flowing (top) and nonflowing (bottom) waters. ZID indicates the zone of initial dilution. 67
Figure 6. Mixing zone process for new or reissued permit applications. 69
Figure 7. Decision flow chart for determining level of analysis. 90
Figure 8. Far-field plume, passive ambient diffusion processes (Jirka et al. 1996). 96
Figure 9. Example plots of water hardness versus flow. 102
Figure 10. Graphic illustration of the simple mass balance equation. 105
Figure 11. Process for developing chemical specific WQBELs; A—Toxics, B—Nonconventional. 111
Figure 12. BOD probability distribution plot. 136
Figure 13. Application of antibacksliding requirements. 151

List of Equations

Equation 1. POTW secondary treatment standard mass-based limit calculations. 12
Equation 2. Macro composition calculation. 27
Equation 3. Constituent input calculation. 28
Equation 4. Average monthly limit for new dairy sources. 29
Equation 5. Maximum daily limit for new dairy sources. 29
Equation 6. Building block approach maximum daily limit calculation. 34
Equation 7. Calculation for tiered limits. 37
Equation 8. CV calculation. 48
Equation 9. Harmonic mean flow calculation. 50
Equation 10. 7Q10 calculation. 50
Equation 11. Alternative 7Q10 calculation. 50
Equation 12. 1Q10 calculation. 51
Equation 13. 30Q5 calculation (large rivers, low flow 600 cfs or more). 51
Equation 14. 30Q5 calculation (small rivers, low flow 50 cfs or less). 51
Equation 15. Calculation for hardness-dependent metals criteria (acute). 55
Equation 16. Calculation for hardness-dependent metals criteria (chronic). 55

Equation 17. Acute conversion factor calculation for cadmium. 56
Equation 18. Chronic conversion factor calculation for cadmium. 56
Equation 19. Acute and chronic conversion factor calculation for lead. 56
Equation 20. Calculation for ammonia criteria (acute). 57
Equation 21. Calculation for ammonia criteria (chronic, early life stages present). 57
Equation 22. Calculation for ammonia criteria (chronic, early life stages absent). 57
Equation 23. Acute TUs. 60
Equation 24. Chronic TUs. 60
Equation 25. Dilution factor calculation. 92
Equation 26. Simple mass-balance equation. 104
Equation 27. Simple mass-balance equation using dilution factor. 105
Equation 28. Calculation of critical effluent pollutant concentration. 107
Equation 29. Highest concentration reported percentile. 107
Equation 30. RPMF calculation using z-scores. 109
Equation 31. Simple mass-balance equation for calculating WLA for flowing water. 111
Equation 32. Simple mass-balance equation for calculating WLA for nonflowing water. 112
Equation 33. Nonflowing water dilution ratio. 113
Equation 34. Acute LTA for toxics. 114
Equation 35. Chronic LTA average for toxics. 115
Equation 36. Maximum daily limit for toxics. 116
Equation 37. Average monthly limit for toxics. 117
Equation 38. Human health maximum daily limit from AML. 118
Equation 39. ACR expression. 123
Equation 40. ACR in terms of TU. 123
Equation 41. WET trigger calculation. 126
Equation 42. WET acute LTA. 127
Equation 43. Acute WET maximum daily limit. 127
Equation 44. Acute WET average monthly limit. 127
Equation 45. Chronic WET long-term average. 128
Equation 46. Chronic WET maximum daily limit. 128
Equation 47. Chronic WET average monthly limit. 128
Equation 48. Concentration probability. 136
Equation 49. Temperature limit calculation. 139

Abbreviations and Acronyms

µ	microgram
§	section (usually a section of federal or state rules or statutes)
ACR	acute-to-chronic ratio
AML	average monthly limit
ASR	alternative state requirement
BAT	best available technology economically achievable
BCT	best conventional pollutant control technology
BLM	biotic ligand model
BMP	best management practice
BOD_5	5-day biochemical oxygen demand
BPJ	best professional judgment
BPT	best practicable control technology currently available
$cBOD_5$	carbonaceous 5-day biochemical oxygen demand
CCC	criterion continuous concentration
CFR	code of federal regulations (refers to citations in the federal administrative rules)
cfs	cubic feet per second
CL	confidence level
CMC	criterion maximum concentration
COD	chemical oxygen demand
CV	coefficient of variation
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
DMR	discharge monitoring report
E. coli	*Escherichia coli*
ELDG	IPDES Effluent Limit Development Guidance
ELG	effluent limit guideline
EPA	United States Environmental Protection Agency
gpd	gallons per day
IC	inhibition concentration
IDAPA	refers to citations of Idaho administrative rules
IDFG	Idaho Department of Fish and Game
I&I	infiltration and inflow
IPDES	Idaho Pollutant Discharge Elimination System
IU	industrial user
kg	kilogram
L	liter
lb	pound
LC_{50}	lethal concentration 50
LOEC	lowest observed effects concentration
LTA	long-term average
MCL	maximum contaminant level
mgd	million gallons per day
mg/L	milligrams per liter

ML	minimum level of quantitation
MOEC	maximum observed effluent concentration
MOVE	maintenance of variance extension
MPC	maximum probable concentrations
NAICS	North American industry classification system
NMFS	National Marine Fisheries Service
NOEC	no observed effects concentration
NPDES	National Pollutant Discharge Elimination System
NSPS	new source performance standard
ORW	outstanding resource waters
PCB	polychlorinated biphenyl
POTW	publicly owned treatment works
PSES	pretreatment standards for existing sources
PSNS	pretreatment standards for new sources
RPA	reasonable potential analysis
RPMF	reasonable potential multiplication factor
RPTE	reasonable potential to exceed
SIC	standard industrial classification
TBEL	technology-based effluent limit
TMDL	total maximum daily load
TOC	total organic carbon
TR	total recoverable
TSD	technical support document (EPA)
TSS	total suspended solids
TU	toxic unit
UAA	use attainability analysis
US	United States
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WER	water effects ratio
WET	whole effluent toxicity
WLA	wasteload allocation
WQBEL	water quality-based effluent limit
ZID	zone of initial dilution

1 Introduction

The Idaho Department of Environmental Quality's (DEQ's) Idaho Pollutant Discharge Elimination System (IPDES) Program developed this Effluent Limit Development Guidance (ELDG) to help DEQ personnel, the regulated community, and public users understand the process for developing effluent limits in IPDES permits, including how DEQ evaluates the reasonable potential to exceed (RPTE) water quality standards. IPDES permits implement both technology-based and water quality-based controls and contain effluent limits for point source dischargers consistent with the statutory and regulatory requirements of the IPDES Program, which governs the discharge of pollutants to waters of the United States in Idaho.

Effluent limits can have significant impacts to communities, businesses, the economy, and Idaho's environment. DEQ strives to minimize these impacts and to adhere to Clean Water Act (CWA) requirements and associated state and federal rules, regulations, and implementation policies.

IPDES permit writers consider water quality, data collection, laboratory analysis, treatment, and other issues relevant to permitting. While the IPDES Program faces challenging issues (e.g., toxics, temperature, and nutrients), the program adapts implementation strategies, as appropriate, to address emerging issues.

Every circumstance and permit is unique, and this ELDG allows for effluent limit development that addresses the issues, rather than a rigid framework. Documenting the permit process from the monitoring, data management, mathematical computations, and data interpretation to conclusions and effluent limits is essential, and DEQ recognizes an efficient and transparent process that provides access to permit writers with local knowledge and experience will lead to streamlined, more effective, and fewer contested permits, which benefits water quality and Idaho's citizens.

1.1 Purpose and Need

This guide provides Idaho-specific direction for developing effluent limits in IPDES permits, defines requirements for permits, and addresses Idaho's unique challenges and perspectives. Because many of Idaho's communities are small, with limited technical resources and funds, permit monitoring and implementation are challenging and expensive for permittees. To be beneficial, permit conditions and monitoring requirements must be clear and accurate, so a high level of data analyses and interpretation is critical.

Using the ELDG as a reference, permit writers can make reasonable assumptions and consider innovative approaches to develop permits that connect the water quality issues with effluent limits, monitoring requirements, and compliance frequencies that make sense, while aligning with data needs, statutory requirements, and water quality objectives. The ELDG explains the following:

- Framework and process for developing effluent limits
- Statutory/regulatory requirements and existing guidance
- Technical and statistical tools and constraints

While this guide provides direction in many cases, DEQ may have to develop specific effluent limits in a permit to address site-specific concerns and conditions.

1.2 Effluent Limit Development Process

Effluent limit development is complex. Figure 1 shows the general process for developing limits in IPDES permits.

1.3 Relationship to Existing Rules and Guidance

This guide supports implementation of the CWA, Idaho Code and administrative rules, federal regulations, and state and national policies, guidance, and standards and complies with Idaho's "Water Quality Standards" (IDAPA 58.01.02), "Wastewater Rules" (IDAPA 58.01.16), and "Rules Regulating the IPDES Program" (IDAPA 58.01.25).

Some sections of this guide are newly developed to address rules, regulations, and conditions specific to Idaho, while other sections reference or adapt existing state and United States Environmental Protection Agency (EPA) guidance documents, including but not limited to, the following:

- *NPDES Permit Writer's Manual* (EPA 2010a): *https://www3.epa.gov/npdes/pubs/pwm_2010.pdf*
- *NPDES Decision Analysis Report #2 – Appendix 4. Guidance for Water Quality-Based Effluent Limits* (DEQ 2002): *www.deq.idaho.gov/media/529907-npdes_primacy_report2.pdf*
- *Technical Support Document for Water Quality-based Toxics Control* (EPA 1991): *https://www3.epa.gov/npdes/pubs/owm0264.pdf*
- *EPA NPDES website: https://www.epa.gov/npdes*

This guide does not replace, supplant, or change any requirements under state or federal rules and regulations but does identify and reference relevant regulations, policies, and other guidance documents.

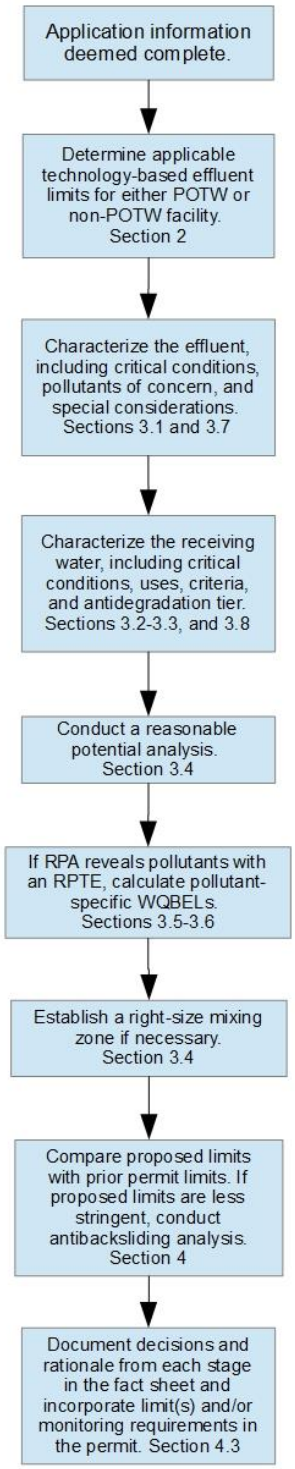


Figure 1. Effluent limit development process for IPDES permits.

1.3.1 Clean Water Act

The Federal Water Pollution Control Act, or CWA, is the primary law in the United States addressing pollutants in receiving waters (e.g., streams, rivers, lakes, and reservoirs). The CWA was originally enacted in 1948 and was revised by amendments in 1972 (P.L. 92-500), 1977 (P.L. 95-217), 1981 (P.L. 97-117), and 1987 (P.L. 100-4). The CWA requires controls on discharges to meet the statutory goal of eliminating the discharge of pollutants under the National Pollutant Discharge Elimination System (NPDES) permit program.

1.3.2 Idaho Water Quality Standards

A water quality standard defines the water quality goals for a water body. Water quality-based effluent limits (WQBELs) in IPDES permits are a mechanism to achieve and maintain water quality standards in specific receiving waters. The federal rules regulating water quality standards at 40 CFR 131 describe state requirements and procedures for developing water quality standards and EPA procedures for reviewing and, where appropriate, promulgating water quality standards. Idaho's water quality standards were developed according to these federal requirements.

1.4 Regulatory Citations

The following conventions are used to cite legislation and regulations throughout this guide:

- Idaho Code—Title of the code follow by the code citation: "Approval of State NPDES Program" (Idaho Code §39-175C). After initial use, the code is then referred to by the citation (e.g., Idaho Code §39-175C).
- Idaho Administrative Rules—Title of the rule is followed by the rule citation: "Rules Regulating the Idaho Pollutant Discharge Elimination System Program" (IDAPA 58.01.25). After initial use, the rule is then referred to by the rule citation (e.g., IDAPA 58.01.25).
- Code of Federal Regulations—Initial and subsequent references to CFRs use the regulation citation (e.g., 40 CFR 136).
- US Code—Initial and subsequent references to US code use the code citation (e.g., 16 U.S.C. §1531 et seq. or 33 U.S.C. §§1251–1387).
- Clean Water Act (CWA)—Title of the act is followed by the act citation: Clean Water Act section 402 (e.g., CWA §402). After initial use, the act is then referred to by the act citation (e.g., CWA §402).

Guidance and other documents are referenced in full citation when used for the first time.

1.5 Data Analysis and Considerations

Section 12 (Data Analysis and Considerations) of DEQ's *Idaho Pollutant Discharge Elimination System User's Guide to Permitting and Compliance Volume 1—General Information* (DEQ 2016a) identifies procedures for IPDES permit writers and permittees to follow when reporting or performing calculations on permit-related water quality data, including data relevancy and representativeness.

In IPDES permits, permit writers should include the information in Appendix A or similar language, clarifying how permittees should report significant figures on the discharge monitoring report (DMR). Appendix B identifies some potential approaches to consider when limiting toxic pollutants.

2 Determining Technology-Based Effluent Limits

Effluent limits are restrictions imposed by DEQ on the quantities, discharge rates, and concentrations of pollutants that are discharged from point sources. Establishing effluent limits based on available pollutant control technologies is the first step in reducing the discharge of pollutants to waters of the United States in Idaho. These technology-based effluent limits (TBELs) are the treatment requirements set under CWA §301(b), and represent the minimum level of control used to achieve these limits. The effluent limit determination and derivation process carefully considers cost of applying control technologies, the age of equipment, processes employed, engineering aspects of control technologies, and nonwater quality environmental impacts at each facility applying for an IPDES permit. The resulting effluent limits may be expressed as mass- or concentration-based values. TBELs reflect process controls and do not consider the receiving water's ability to assimilate the discharged pollutants.

The impact to receiving water will be determined using a reasonable potential analysis (RPA). Any impacts to the receiving water will be considered when WQBELs are assessed (section 4). The more stringent of the two effluent limit types, technology-based or water quality-based, must be identified in an IPDES permit and met by the discharger.

There are two general approaches to derive TBELs: (1) federal effluent limit guidelines (ELG) and standards, if they are applicable and appropriate, or, if no applicable ELG or standard exists, (2) develop effluent limits specifically for an individual discharger or pollutant on a case-by-case basis employing best professional judgement (BPJ). It is possible that a permit may contain effluent limits derived from either or both methods.

Point source pollutant discharges to surface water requiring an individual permit are typically either a publicly owned treatment works (POTWs) or non-POTW (e.g., industrial, commercial, mining, or silvicultural). The following sections address establishing TBELs for POTWs (section 2.1), industrial discharges to POTWs (section 2.1.4), and non-POTW dischargers (section 2.2).

2.1 TBELs for Publicly Owned Treatment Works

POTWs are the largest category of dischargers requiring individual IPDES permits. A POTW is owned by a state or municipality as defined in IDAPA 58.01.25.010.73, and includes any devices and systems used in storing, treating, recycling, and reclaiming municipal sewage or industrial liquid wastes. A POTW also includes the sewage collection system, pipes, mains, lift stations, and other conveyances that deliver wastewater to the facility. As defined in CWA §502(4), the term also means the municipality with jurisdiction over the indirect discharges to and discharges from such a treatment works.

IDAPA 58.01.25.010.55 defines municipality as follows:

> A city, town, county, district, association, or other public body created by or under state law and having jurisdiction over disposal of sewage, industrial wastes, or other wastes, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under the Clean Water Act section 208.

EPA established TBELs for POTWs that set minimum technology-based limits. These minimum levels are called secondary treatment and are equivalent to secondary treatment standards in 40 CFR 133 (IDAPA 58.01.25). In general, POTWs are required to meet discharge limits based on secondary treatment standards. However, if the facility meets specific criteria described in section 2.1.1.2, it may be eligible for equivalent to secondary treatment standards. Secondary treatment and equivalent to secondary treatment standards may also be appropriate for privately owned domestic sewage treatment works and sewer districts because they receive sewage of similar quality and use comparable treatment technologies, supporting the permit writer's application of these standards by BPJ.

2.1.1 Secondary and Equivalent to Secondary Treatment

IDAPA 58.01.25.302.03 requires that IPDES permits include applicable technology-based limits and standards, while 40 CFR 125.3(a)(1) (IDAPA 58.01.25) states that TBELs for POTWs must be based on secondary treatment standards (including *equivalent to secondary treatment standards*) specified in 40 CFR 133. The following sections explain how to determine TBELs for the conventional pollutants discharged by POTWs: 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and pH.

2.1.1.1 Secondary Treatment Standards

In 40 CFR 133, EPA published secondary treatment standards based on evaluating performance data for POTWs that combine physical and biological treatment to remove biodegradable organics and suspended solids. The regulation applies to all POTWs and identifies the technology-based performance standards achievable based on secondary treatment for BOD_5, TSS, and pH.

Table 1 presents the secondary treatment standards established in 40 CFR 133.

Table 1. Secondary treatment standards.

Parameter	Average Concentration	
	30-day	**7-day**
BOD_5	30 mg/L (or 25 mg/L $cBOD_5$)	45 mg/L (or 40 mg/L $cBOD_5$)
TSS	30 mg/L	45 mg/L
Percent removal (BOD_5 and TSS)	≥85%	NA
pH	Within the range 6.0 to 9.0 standard units (instantaneous minimum or maximum limits)[a]	

a. Unless the POTW demonstrates (1) inorganic chemicals are not added to the waste stream as part of the treatment process; and (2) contributions from industrial sources do not cause the pH of the effluent to be less than 6.0 or greater than 9.0.
Notes: milligram per liter (mg/L); carbonaceous 5-day biochemical oxygen demand ($cBOD_5$)

2.1.1.2 Equivalent to Secondary Treatment Standards

Some widely used and inexpensive wastewater treatment processes, like trickling filters and waste stabilization ponds, provide significant pollutant reduction, but their consistency may not always attain the levels and efficiencies specified in the secondary treatment standards. These processes are typically found serving small communities that may have difficulty implementing more expensive treatment processes. These processes may not consistently achieve the secondary treatment standards for TSS and BOD_5, or attain the 85% reduction requirement under extreme conditions. During warm, clear weather, waste stabilization ponds tend to experience algal blooms, resulting in excessive TSS. Trickling filters may experience excessive biofilm growth on the media, which then sluffs off, contributing to excessive TSS. In cold weather, both waste stabilization ponds and trickling filters may have lower efficiency, resulting in higher BOD_5 values in the effluent. These effluent performance deficiencies contribute to lower removal efficiencies.

Congress recognized that small communities were ill-suited to shoulder the expense of upgrading to processes that meet secondary treatment standards and increased periodic maintenance costs. Recognizing that the secondary treatment standards may be overly restrictive for these communities, Congress authorized EPA to develop treatment standards suitable for these processes. A wastewater facility that uses these treatment processes must meet certain criteria before the equivalent treatment standards should be used in the permit (Table 2).

Table 2. Equivalent to secondary treatment standards.

Parameter	Average Concentration	
	30-day	7-day
BOD_5	45 mg/L (or 40 mg/L $cBOD_5$)	65 mg/L (or 60 mg/L $cBOD_5$)
TSS	45 mg/L	65 mg/L
Percent removal (BOD_5 and TSS)	≥65%	NA
pH	Within the range 6.0 to 9.0 standard units (instantaneous minimum or maximum limits)[a]	

a. Unless the POTW demonstrates (1) inorganic chemicals are not added to the waste stream as part of the treatment process; and (2) contributions from industrial sources do not cause the pH of the effluent to be less than 6.0 or greater than 9.0.

The equivalent to secondary treatment standards are not automatically granted to facilities that use the processes identified, or meet other criteria that allows equivalent to secondary treatment standards to be applied in their permit. As specified by 40 CFR 133.105(f) the equivalent to secondary treatment standards may be made more restrictive (e.g., 30-day average concentration for BOD_5 and/or TSS ≤ 37 milligrams per liter (mg/L), and/or 30-day removal efficiency ≥ 75%), if the permit writer determines that the facility can attain higher effluent quality through proper operation and maintenance. If the POTW is a new facility, and the facility's design capacity, with geographical and climatic conditions, and proper operation and maintenance indicate that effluent limits more restrictive than equivalent to secondary treatment standards are warranted, the permit may reflect this.

Criteria to Qualify for Equivalent to Secondary Treatment Standards

For a POTW to be eligible for discharge limits based on equivalent to secondary standards, the facility must meet all three of the following criteria:

Criterion 1: Principal Treatment Process—The principal treatment process must be a trickling filter or waste stabilization pond (i.e., the largest percentage of BOD_5 and TSS removal results from a trickling filter or waste stabilization pond system).

Criterion 2: Consistently does not Achieve Secondary Treatment Standards—Demonstrate that the BOD_5 and TSS effluent concentrations consistently achievable through proper operation and maintenance of the treatment works cannot attain the secondary treatment standards in Table 1. Regulation 40 CFR 133.101(f) defines "effluent concentrations consistently achievable through proper operation and maintenance" as follows:

- For a given pollutant parameter, the 95th-percentile value for the 30-day average effluent quality achieved by a treatment works in a period of at least 2 years, excluding values attributable to upsets, bypasses, operational errors, or other unusual conditions.
- A 7-day average value equal to 1.5 times the 30-day average value as derived above.

Some facilities might meet this criterion only for the BOD_5 limits or only for the TSS limits. DEQ believes it is acceptable to adjust the limits for only one parameter (BOD_5 or TSS) if the effluent concentration of only one of the parameters is demonstrated to consistently not attain the secondary treatment standards.

Criterion 3: Provides Significant Biological Treatment—The treatment works provides significant biological treatment of municipal wastewater. Regulation 40 CFR 133.101(k) defines significant biological treatment as using an aerobic or anaerobic biological treatment process in a treatment works to consistently achieve a 30-day average of at least 65% removal of BOD_5.

Consider each facility on a case-by-case basis to determine whether it meets those three criteria. To apply the criteria, enough influent, effluent, and flow data from the facility should be collected to adequately characterize the facility's performance or require the discharger to provide an appropriate analysis. If the facility has made substantial changes in its operations or treatment processes during the current permit term, data for a period representing the current discharge quality may be necessary to establish limits.

Facilities not meeting all three criteria do not qualify as equivalent to secondary treatment facilities, and the secondary treatment standards apply. EPA noted in the *Draft Guidance for NPDES Permits and Compliance Personnel—Secondary Treatment Redefinition* (EPA 1985) that a treatment works operating beyond its design hydraulic or organic loading limit is not eligible for application of equivalent to secondary standards. If overloading or structural failure is causing poor performance, the solution to the problem is construction, not effluent limit adjustments.

2.1.2 Adjustments to Equivalent to Secondary Treatment

The adjustments to limits presented in this section apply to properly operated and maintained POTWs that use trickling filters or waste stabilization ponds as their primary treatment process.

The facilities must be located in a contiguous area where other POTWs, similarly configured, experience the same difficulty meeting the BOD_5 and TSS limits.

The revised secondary treatment regulations (adopted in 1984) include provisions in 40 CFR 133.105(d) allowing flexibility to address potential variations in facility performance from geographic, climatic, or seasonal conditions. The provisions allow modifying the maximum allowable concentrations of both BOD_5 and TSS for trickling filter facilities and for BOD_5 for waste stabilization pond facilities. The limits are set at levels consistently achievable through proper operation and maintenance (40 CFR 133.101(f)) by the median facility in a sample representing facilities within the appropriate contiguous geographical area that meet the definition for facilities eligible for equivalent to secondary treatment standards. These relaxed limits are classified in 40 CFR 133.105(d) as alternative state requirements (ASRs). Establishing these limits requires both the public's input and EPA's approval. Currently, Idaho does not have approved ASRs and does not foresee proposing ASRs.

The permit writer can adjust the maximum allowable TSS concentration for waste stabilization ponds upward from those specified in equivalent to secondary treatment standards to conform to TSS concentrations achievable with waste stabilization ponds. Regulation 40 CFR 133.103(c) defines "SS concentrations achievable with waste stabilization ponds" as the effluent concentration achieved 90% of the time within an appropriate contiguous geographical area by waste stabilization ponds that are achieving the levels of effluent quality for BOD_5 specified in 40 CFR 133.105(a)(1) (45mg/L as a 30-day average). This higher TSS concentration requires EPA approval. To qualify for an adjustment up to the maximum concentration allowed, a facility must use a waste stabilization pond as its principal process for secondary treatment, and its operations and maintenance data must indicate that it cannot achieve the equivalent to secondary standards.

2.1.3 Applying Secondary and Equivalent to Secondary Treatment Standards

Determining whether secondary treatment standards or equivalent to secondary standards apply to a POTW and determining the specific discharge limits for the facility based on either set of standards can be a complex process. Compliance with established permit limits requires that both influent and effluent must be measured to calculate the percent removal. Figure 2 shows a protocol to establish TBELs for POTWs.

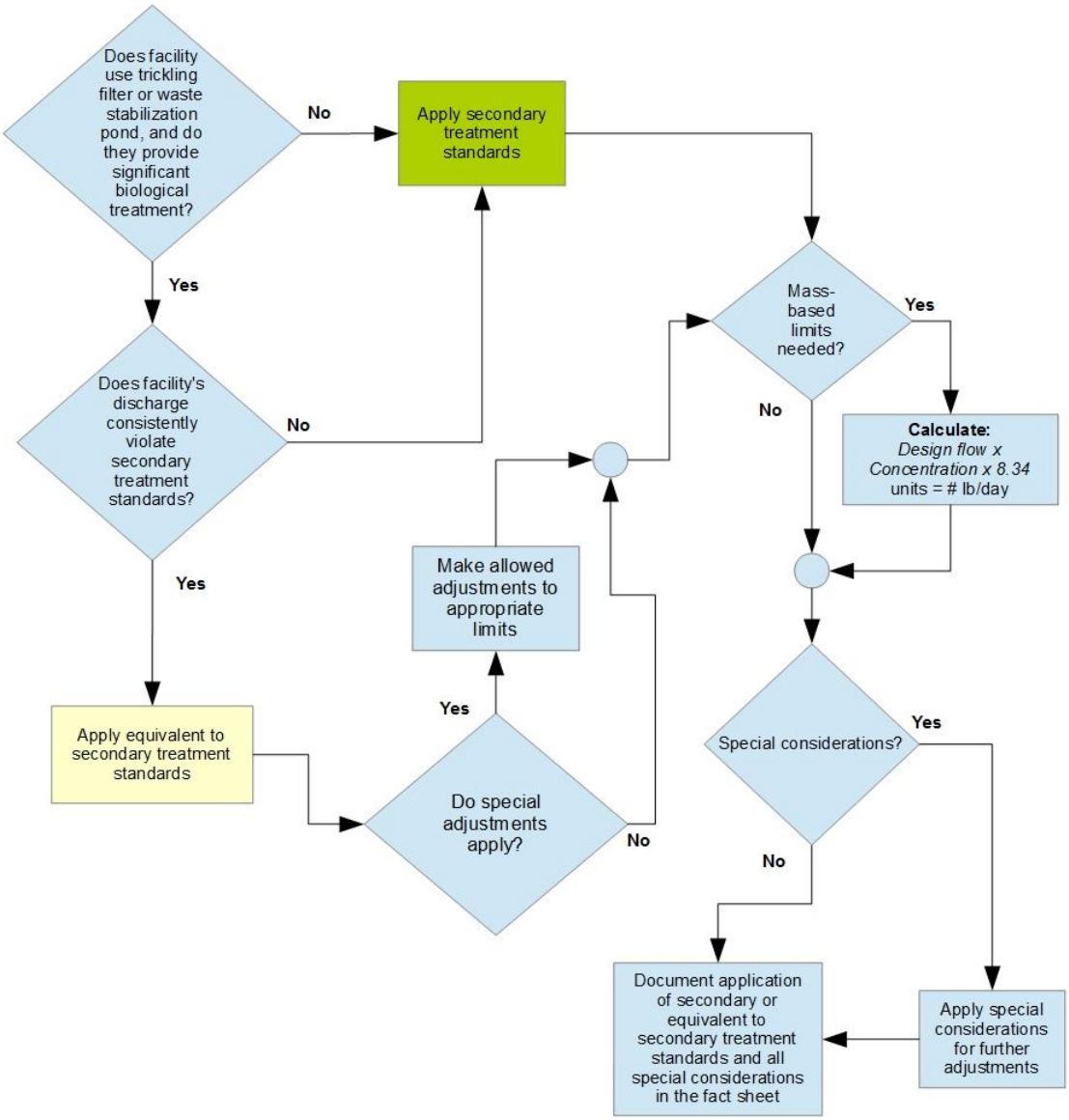


Figure 2. Secondary and equivalent to secondary treatment standards decision tree.

2.1.3.1 Determine Appropriate Standards to Apply

Initially, a facility evaluation must be completed to determine whether secondary treatment, equivalent to secondary treatment, or some adjustment to the equivalent to secondary treatment standards apply to the facility. New facilities using tricking filters or waste stabilization ponds will, with a high probability, achieve secondary treatment standards. The ultimate design capability of the treatment processes (waste stabilization ponds, trickling filters, or both), geographical and climatic conditions, and the performance capabilities of recently constructed facilities in similar situations should be considered when determining which standard applies.

Once the secondary or equivalent to secondary standard is selected, set the permit limits. Section 2.1.3.2 addresses developing permit limits if secondary treatment standards are appropriate. If equivalent to secondary treatment standards are appropriate, follow section 2.1.3.3 to develop the permit limit. When a new waste stabilization pond or trickling filter is permitted, adjustments to the permit limits may apply, but no adjustment less stringent than specified in 40 CFR 133.105(a)–(e) will be made. For existing facilities, it may be determined that more stringent limits may apply for a reissued permit after reviewing past performance data as specified in 40 CFR 133.105(f).

2.1.3.2 Calculate Effluent Limits Based on Secondary Treatment

If a permit writer deems secondary treatment standards are appropriate for the POTW, use the following procedures to establish concentration- and mass-based limits. If the secondary treatment standards do not apply, move to Section 2.1.3.3, “Calculate Effluent Limits Based on Equivalent to Secondary Treatment Standards.”

Applying secondary treatment standards is straightforward. If these standards apply, the permit should contain the permit limits listed in Table 1. These limits will be used to calculate the load limits for the permit.

First, the secondary treatment standards are stated as 30-day and 7-day averages, whereas IDAPA 58.01.25.303.04 requires that effluent limits for POTWs be expressed, unless impracticable, as average monthly and average weekly limits. IPDES regulations define average monthly (or average weekly) discharge limits as the average of daily discharges over a calendar month (or week), calculated as the sum of all daily discharges measured during a calendar month (or week) divided by the number of daily discharges measured during that month (or week). DEQ recommends using the 30-day and 7-day average secondary treatment standards as average monthly (calendar month) and average weekly (calendar week) discharge limits.

Second, IDAPA 58.01.25.303.06 requires that all permit limits, standards, or prohibitions be expressed in terms of mass except in the following cases:

- For pH, temperature, radiation, or other pollutants that cannot appropriately be expressed by mass limits.
- When applicable standards and limits are expressed in terms of other units of measure.
- If in establishing permit limits on a case-by-case basis under 40 CFR 125.3, limits expressed in terms of mass are infeasible because the mass of the pollutant discharged cannot be related to a measure of operation, and permit conditions ensure that dilution will not be used as a substitute for treatment.

The first condition applies to pH requirements established by secondary treatment standards. Because the 30-day and 7-day average requirements for BOD5 and TSS, including percent removal, are expressed in terms of concentration, the second condition applies to these standards. Thus, mass-based discharge limits are not specifically required to implement secondary treatment standards, yet valid reasons may exist to include mass-based limits in the permit. Both concentration- and mass-based limits may be necessary to safeguard the environment and human health. IDAPA 58.01.25.303.02 requires using the POTW's design flow rate to calculate limits. To calculate a mass-based limit for a POTW (in pounds per day [lb/day]), follow the equations and procedures below (Equation 1):

$$\boldsymbol{L_l = Q_d \times [C] \times C_f}$$

Equation 1. POTW secondary treatment standard mass-based limit calculations.

Where:

L_l = Load limit	Calculated value
Q_d = POTW's design wastewater flow rate	In million gallons per day (mgd)
[C] = Concentration limit of pollutant	BOD_5, TSS, or other pollutant in mg/L
C_f = Conversion factor	8.34 (lb*L)/(mg*MG)

A POTW with a design flow of 2.0 mgd would have mass-based limits calculated from secondary treatment standards as follows:

$$\text{Mass-based limits} = \text{POTW design flow} \times \text{concentration-based limits} \times \text{conversion factor}$$

BOD_5

$$Average\ monthly = (2.0\ mgd) \times \left(30\frac{mg}{L}\right) \times \frac{8.34\ (lb * L)}{(mg * millions\ of\ gallons)} = 500\ lb/day$$

$$Average\ weekly = (2.0\ mgd) \times \left(45\frac{mg}{L}\right) \times \frac{8.34\ (lb * L)}{(mg * millions\ of\ gallons)} = 750\ lb/day$$

TSS

$$Average\ monthly = (2.0\ mgd) \times \left(30\frac{mg}{L}\right) \times \frac{8.34\ (lb*L)}{(mg*millions\ of\ gallons)} = 500\ lb/day$$

$$Average\ weekly = (2.0\ mgd) \times \left(45\frac{mg}{L}\right) \times \frac{8.34\ (lb * L)}{(mg * millions\ of\ gallons)} = 750\ lb/day$$

2.1.3.3 Calculate Effluent Limits Based on Equivalent to Secondary Standards

For facilities that qualify for equivalent to secondary standards for any pollutant, effluent limits must meet the requirements specified in 40 CFR 133.105 and summarized in Table 2 (not accounting for any further approved adjustments). The equivalent to secondary standards specify the maximum allowable discharge concentration of BOD5 and TSS and a minimum percent removal requirement for qualified facilities. Regulation 40 CFR 133.105(f) requires the permit writer to include more stringent limits when it is determined that the 30-day average and 7-day

average BOD5 and TSS concentrations are achievable through proper operation and maintenance of the treatment works. This determination is based on analyzing past performance for an existing facility or considering the design capability of the treatment process and geographical and climatic conditions for a new facility, which would enable the treatment works to achieve more stringent limits than the least stringent effluent quality allowed by the equivalent to secondary standards. Regulation 40 CFR 133.101(f) defines "effluent concentrations consistently achievable through proper operation and maintenance" as the 95th-percentile value for the 30-day average effluent quality achieved by a treatment works in a period of at least 2 years, excluding values attributable to upsets, bypasses, operational errors, or other unusual conditions. The 7-day average value is set to equal 1.5 times the 30-day average value. As with limits based on secondary treatment standards, limits based on equivalent to secondary standards are expressed as average monthly (calendar month) and average weekly (calendar week) limits. Mass balance calculations for equivalent to secondary standards are presented below using Equation 1.

A POTW with a design flow of 1.25 mgd would have mass-based limits calculated from equivalent to secondary treatment standards using Equation 1.

BOD_5

$$Average\ monthly = (1.25\ mgd) \times \left(45\frac{mg}{L}\right) \times \frac{8.34\ (lb * L)}{(mg * millions\ of\ gallons)}$$
$$= 470\ lb/day$$

$$Average\ weekly = (1.25\ mgd) \times \left(65\frac{mg}{L}\right) \times \frac{8.34\ (lb * L)}{(mg * millions\ of\ gallons)} = 680\ lb/day$$

TSS

$$Average\ monthly = (1.25\ mgd) \times \left(45\frac{mg}{L}\right) \times \frac{8.34\ (lb*L)}{(mg*millions\ of\ gallons)} = 470\ lb/day$$

$$Average\ weekly = (1.25\ mgd) \times \left(65\frac{mg}{L}\right) \times \frac{8.34\ (lb * L)}{(mg * millions\ of\ gallons)} = 680\ lb/day$$

If an existing facility does not have sufficient data to establish past performance, the permit writer should include a compliance schedule item in the permit that requires monitoring and reporting to generate the necessary data. IDAPA 58.01.25.201.02.c.ii provides provisions allowing the permitting authority to reopen and, if necessary, modify the permit after reviewing the additional data submitted by the discharger.

2.1.3.4 Apply Special Considerations and Adjustments

Regulation 40 CFR 133 allows the permit writer to make further adjustments when calculating effluent limits derived from secondary treatment standards or equivalent to secondary standards based on several special considerations described below. The calculated limits, after making adjustments to concentration limits or percent removal requirements, are the final TBELs for the POTW.

2.1.3.4.1 Substitute $cBOD_5$ for BOD_5

Wastewater contains carbonaceous oxygen demanding substances and nitrogenous oxygen demanding substances. A carbonaceous 5-day biochemical oxygen demand ($cBOD_5$) test measures $cBOD_5$ while the BOD_5 test measures both the carbonaceous biochemical oxygen demand and the nitrogenous biochemical oxygen demand. During nitrification, nitrifying bacteria use a large amount of oxygen to consume nitrogenous oxygen demanding substances (e.g., unoxidized ammonia, urea, and proteins) and convert these to oxidized nitrate. For wastewaters with significant nitrogen content, basing permit limits on $cBOD_5$ instead of BOD_5 eliminates the impact of nitrification on discharge limits and compliance determinations. The $cBOD_5$ test can provide accurate information on treatment plant performance in many cases, and 40 CFR 133 allows using $cBOD_5$ limits in place of BOD_5 limits to minimize false indications of poor facility performance as a result of nitrogenous oxygen demand.

EPA established $cBOD_5$ standards for cases where secondary treatment standards or equivalent to secondary treatment standards are applied.

Secondary Treatment:

- The $cBOD_5$ secondary treatment performance standards specified by the regulations are as follows:
  - 25 mg/L as a 30-day average
  - 40 mg/L as a 7-day average
- The EPA-approved test procedures in 40 CFR 136 include a $cBOD_5$ (nitrogen inhibited) test procedure. Permits can specify these $cBOD_5$ limits along with $cBOD_5$ monitoring requirements in any POTW permit requiring performance based on secondary treatment standards (40 CFR 133.102(a)(4)).

Equivalent to Secondary Treatment:

- The $cBOD_5$ equivalent to secondary treatment performance standards specified by the regulations are as follows:
  - No greater than 40 mg/L as a 30-day average
  - No greater than 60 mg/L as a 7-day average
- Where data are available to establish $cBOD_5$ limits, permit writers may require $cBOD_5$ instead of BOD_5 and specify $cBOD_5$ limits and monitoring requirements when applying equivalent to secondary standards.

2.1.3.4.2 Substitute COD or TOC for BOD_5

Chemical oxygen demand (COD) and total organic carbon (TOC) laboratory tests can provide an accurate measure of the organic content of wastewater in a shorter time frame than a BOD_5 test (i.e., several hours versus 5 days). Regulation 40 CFR 133.104(b) allows permit limits for COD or TOC instead of BOD_5 if a long-term BOD_5:COD or BOD_5:TOC correlation has been demonstrated. If the applicant has sufficient data to establish a correlation between BOD_5 and either COD or TOC, these alternate monitoring methods may be included in the permit.

2.1.3.4.3 Adjust for Industrial Contributions

Under 40 CFR 133.103(b), treatment works receiving wastes from industrial categories with ELGs and standards or pretreatment standards for BOD_5 or TSS, which are less stringent than the secondary treatment standards or, if applicable, the equivalent to secondary treatment standards in 40 CFR 133, can qualify to have their 30-day BOD_5 or TSS limits adjusted upward provided that the following are true:

- Permitted discharge of pollutants for the applicable industrial category is not greater than the limits in ELGs for the industrial category
- Flow or loading introduced by the industrial category exceeds 10% of the design flow or loading to the POTW

When making this adjustment, 40 CFR 133 values for BOD_5 and TSS should be adjusted proportionately using a flow-weighted or loading-weighted average of the two concentration limits (i.e., the limits developed from ELGs for the industrial facility and the secondary or equivalent to secondary limits).

2.1.3.4.4 Adjust Percent Removal Requirements

The 85% removal requirement, for a 30-day average, in secondary treatment standards was originally established to achieve two objectives:

1. Encourage municipalities to remove high quantities of infiltration and inflow (I&I) from their sanitary sewer systems.
2. Prevent intentional dilution of influent wastewater.

In facilities with dilute influent that is not attributable to high quantities of I&I or intentional dilution, the percent removal requirement could result in forcing advanced treatment rather than the intended secondary treatment. Advanced treatment generally refers to treatment processes following secondary treatment (e.g., filtration, chemical addition, or two-stage biological treatment). Advanced treatment can achieve significantly greater pollutant removals than secondary treatment processes but at a higher cost.

Regulation 40 CFR 133.103(a), (d) and (e) provides, under certain circumstances, less stringent limits for BOD_5, and TSS percent removal may be established. The specific circumstances and potential adjustments to the percent removal requirement are as follows:

- Treatment works that receive less concentrated wastes from *combined sewer systems* are eligible to have less stringent monthly percent removal limits during wet-weather events (40 CFR 133.103 (a)) and, under certain conditions, less stringent percent removal requirements or a mass loading limit instead of a percent removal requirement during dry weather (40 CFR 133.103 (e)).

  Determining an attainable percentage removal level during wet weather must be evaluated on a case-by-case basis. To qualify for a less stringent percent removal requirement or substitute a mass limit during dry weather, the discharger must satisfactorily demonstrate the following:

  - The facility is consistently meeting, or will consistently meet, its permit effluent concentration limits but cannot meet its percent removal limits because of less concentrated influent.
  - To meet the percent removal requirements, the facility would have to achieve significantly more stringent effluent concentrations than otherwise required by the concentration-based standards.
  - The less concentrated influent wastewater does not result from either excessive infiltration or clear water industrial discharges during dry weather periods. Regulation 40 CFR 35.2005(b)(28) discusses determining whether the less concentrated wastewater results from excessive infiltration**.** This regulation defines nonexcessive infiltration as the quantity of flow that is less than 120 gallons per capita per day (domestic base flow and infiltration) or the quantity of infiltration that cannot be economically and effectively eliminated from a sewer system as determined in a cost-effectiveness analysis.
  - Regulation 40 CFR 133.103(e) includes the additional criterion that either 40 gallons per capita per day or 1,500 gallons per inch diameter per mile of sewer may be used as the threshold value for that portion of dry-weather base flow attributed to infiltration. If the less concentrated influent wastewater is the result of clear water industrial discharges, the treatment works must control such discharges pursuant to 40 CFR 403.

- Treatment works that receive less concentrated wastes from *separate sewer systems* can qualify for a less stringent percent removal requirement or receive a mass loading limit instead of the percent removal requirement if the treatment plant demonstrates all of the following (40 CFR 133.103(d)):
  - The facility consistently meets or will consistently meet its permit effluent concentration limits but cannot meet its percent removal limits because of less concentrated influent wastewater.
  - To meet the percent removal requirements, the facility would have to achieve significantly more stringent limits than would otherwise be required by the concentration-based standards.
  - The less concentrated influent wastewater does not result from excessive I&I. The regulation indicates that determining whether the less concentrated wastewater is the result of excessive I&I will use the definition of excessive I&I at 40 CFR 35.2005(b)(16), plus the additional criterion that flow is nonexcessive if the total flow to the POTW (i.e., wastewater plus I&I) is less than 275 gallons per capita per day.
  - Regulation 40 CFR 35.2005(b)(16) defines excessive I&I as the quantities of I&I that can be economically eliminated from a sewer system as determined in a cost-effectiveness analysis that compares the costs for correcting the I&I conditions to the total costs for I&I transportation and treatment. This regulation also refers to definitions of nonexcessive I&I in 40 CFR 35.2005(b)(28) and 40 CFR 35.2005(b)(29).

2.1.3.5 Document the Application Standards, Adjustments, and Considerations in the Fact Sheet

The permit writer will clearly document the following in an IPDES POTW permit fact sheet:

- Application of secondary or equivalent to secondary treatment standards
- Data and information used to determine whether secondary treatment standards or equivalent to secondary treatment standards apply
- How that information was used to derive the permit's effluent limits
- All adjustments and special considerations

The information in the fact sheet will provide the IPDES permit applicant and the public a transparent, reproducible, and defensible description of how the IPDES permit properly incorporates secondary treatment standards.

2.1.4 Pretreatment Standards

The National Pretreatment Program authorizes a POTW to control industrial discharges to its facility through a DEQ-approved pretreatment program. These controls are developed to protect the POTW's equipment and personnel from damage. Regulatory national pretreatment standards that apply to a POTW's industrial users (IUs) include prohibited discharges, categorical standards, and local limits.

POTWs, or a group of POTWs operated by the same entity, with a total design flow of more than 5 mgd and receiving industrial pollutants that may cause pass-through or interference are required to establish a pretreatment program under IPDES. In some cases, a POTW with a total design flow of less than 5 mgd may be required to establish a pretreatment program if the nature or volume of the industrial discharge causes POTW treatment process upsets, effluent limit violations, contamination of municipal sludge, or other circumstances as warranted. All POTWs meeting the above criteria must submit a pretreatment program for DEQ evaluation and approval within 1 year of written notification from DEQ for the need of a pretreatment program.

Prohibitions and categorical standards are designed to provide a minimum acceptable level of control over IU discharges. Site-specific controls can be developed and enforced by the POTW through local limits. DEQ will not develop or approve a POTW's local limits but will evaluate the POTW's local limits development processes for appropriateness during program review. Local limits are not discussed here. For additional information on developing local limits, see EPA's *Local Limits Development Guidance* (EPA 2004).

2.1.4.1 Prohibited Discharges

Prohibited discharges, comprised of general and specific prohibitions, apply to all IUs regardless of the size or type of operation. A user may not introduce into a POTW any pollutants that causes pass-through or interference. These general prohibitions and the specific prohibitions below apply to each user introducing pollutants into a POTW whether or not the user is subject to other National Pretreatment Standards or any national, state, or local pretreatment requirements.

- General prohibitions (40 CFR 403.5(a)) forbid the discharge to a POTW of any pollutant that causes pass-through or interference.

- Specific prohibitions (40 CFR 403.5(b)(1) to (8)) are categories of pollutant discharges that shall not be introduced to POTWs that are volatile, explosive, corrosive, or a hazard to the health and safety of personnel

2.1.4.2 Categorical Standards

Categorical standards (40 CFR 405–471) apply to specific process wastewater discharges from particular industrial categories. Developed by EPA, these standards are uniform, technology-based, and apply nationwide. These standards apply to specific categories of IUs and limit the discharge of specified toxic and nonconventional pollutants to POTWs. Expressed as numerical limits and management standards, the categorical standards include specific limitations for 35 industrial sectors. Appendix C lists the pollutants regulated by the categorical pretreatment standards.

2.1.4.3 Pretreatment Standards for Existing Sources

Pretreatment standards for existing sources (PSES) prevent the discharge of pollutants that cause pass-through or interference at a POTW or cause contamination of a POTW's biosolids from IU discharges (Table 3). The categorical pretreatment standards for existing IU discharges are technology-based and are analogous to best available technology economically achievable (BAT) for non-POTWs. The general pretreatment regulations (40 CFR 403) set the framework for implementing the national pretreatment standards (CWA §307(b)).

2.1.4.4 Pretreatment Standards for New Sources

Like PSES, pretreatment standards for new sources (PSNS) prevent the discharge of pollutants that cause pass-through or interference at a POTW or cause contamination of a POTW's biosolids from IU discharges (Table 3). PSNS are issued in concurrence with new source performance standards (NSPS). New IU dischargers can incorporate the best available demonstrated technologies into their facilities at the time of construction. The same factors for NSPS are considered when assessing PSNS.

PSNS applies to nonconventional and toxic pollutants because POTWs are designed to treat conventional pollutants. However, the permit writer has the authority to establish categorical pretreatment standards for conventional pollutants as surrogates for toxic or nonconventional pollutants or to prevent interference.

Table 3. Technology levels of control for indirect dischargers.

Pollutants Regulated	PSES	PSNS
Nonconventional pollutants	✓	✓
Toxic (priority) pollutants	✓	✓

2.2 TBELs for Non-POTWs

TBELs are the treatment requirements under CWA §301(b). These controls are promulgated by DEQ through the IPDES program for direct dischargers while indirect dischargers are controlled through DEQ-approved POTW pretreatment programs.

Under the CWA, the requirements for discharge controls on industries were to first meet limits that could be achieved by using the best practicable control technology currently available (BPT) for wastewater treatment, and later by improved BAT. In 1986 EPA added the best conventional pollutant control technology (BCT) to evaluate conventional pollutant control processes using a two part cost-reasonableness test. BPT, BAT, and BCT are *technology-based* discharge limits based on what the treatment technology could reasonably achieve and not necessarily what was needed to protect the receiving water quality for its designated uses, such as aquatic life habitat.

When developing TBELs for industrial (non-POTW) facilities, the permit writer considers all applicable technology standards and requirements for all pollutants discharged and determines how much of a pollutant can be removed from the facility's effluent using available technology. TBELs represent the minimum level of industrial wastewater control that must be imposed in a discharge permit for all industrial facilities within a 40 CFR 405–471 category or subcategory. The type of technology-based effluent control required for each facility depends on whether the discharge is from a new or existing source and the type of pollutants discharged. In cases where a single facility is permitted for several different effluent limits, a building block approach is used to develop the final TBEL.

ELGs can include numeric and narrative limits, including best management practices (BMPs), to control the discharge of pollutants from categories of point sources. The limits are based on data characterizing the performance of technologies available and, in some cases, from modifying process equipment or using raw materials. Although the regulations do not require using any particular treatment technology, they do require facilities to achieve effluent limits that reflect the proper operation of the model technologies selected as the basis for the ELGs and from which the performance data were obtained to generate the limits. Each facility can select any technology and process necessary to meet the performance-based discharge limits and standards specified by the ELGs.

If no applicable ELGs exist for a discharge or pollutant, the permit writer must identify any needed site-specific TBELs on a case-by-case basis according to CWA §§301(b)(2) and 304(b). The site-specific TBELs reflect the permit writer's best professional judgment (BPJ), taking into account the same factors EPA would use in establishing a national ELG but applying them to the permit circumstances. The permit writer will identify if state laws or regulations might require more stringent performance standards than those required by federal regulations.

2.2.1 Effluent Limit Guidelines and Statutory Foundation

For dischargers other than POTWs, TBELs are based on BPT, BCT, BAT, or NSPS. For industrial discharges to a POTW, the discharger must adhere to TBELs established for PSES, or if the facility is new, they must comply with the PSNS. Section 2.1.4 includes additional information related to the standards required for IU discharges into a POTW with an approved pretreatment program. The performance standard required for each discharger is evaluated based on its current status as a new source, existing source, or new discharger (Figure 2) and the types of pollutants regulated (Table 4).

Table 4. Technology levels of control for direct non-POTW dischargers.

Pollutants Regulated	BPT	BCT	BAT	NSPS
Conventional pollutants	✓	✓		✓
Nonconventional pollutants	✓		✓	✓
Toxic (priority) pollutants	✓		✓	✓

Conventional pollutants include BOD_5, TSS, pH, *Escherichia coli* (*E. coli*), and oil and grease. EPA has identified 65 pollutants and classes of *toxic pollutants* (*https://www.epa.gov/eg/toxic-and-priority-pollutants-under-clean-water-act*). All other pollutants are considered *nonconventional*.

2.2.1.1 Best Practicable Control Technology Currently Available

BPT is the first type of technology-based control for direct dischargers and applies to all pollutants. When applying BPT to effluent limits, the following considerations must be made:

- Total cost of applying the control technology in relation to the benefits of the effluent reduction
- Age of the equipment and facilities
- Processes employed by the industry and any required process changes
- Engineering aspects of the control technologies
- Nonwater quality environmental impacts, including energy requirements

BPT effluent limits have traditionally been based on the average of the best performance of well-operated facilities within each industrial category or subcategory. Where existing performance is uniformly inadequate, BPT may reflect higher levels of control than currently in place in an industrial category if the permit writer determines that the technology can be practically applied.

The economic reasonableness of BPTs must be evaluated before applying them to an IPDES permit; however, currently no precisely defined test exists to determine economic reasonableness, and it must be considered from industry to industry.

Limits for industrial facilities are stated in the 40 CFR 405–71 subcategories, and these limits can take numerous forms. Most commonly, tables for each technology-based requirement will explicitly state the 1-day maximum and 30-day average values for each pollutant controlled under that subcategory (Table 5). In other cases, narrative requirements may be included, or a technology-based requirement may be excluded completely (noted as [Reserved] in the subcategory). Section 2.2.2.2 further explains categories and subcategories.

Table 5. Example of BPT limits from 40 CFR 417.42 (glycerine concentration).

Pollutant or Pollutant Property	BPT Limits	
	1-Day Maximum	Average of Daily Values (30 Consecutive Days)
	English units (pounds per 1,000 lb of anhydrous product)	
BOD_5	4.50	1.50
COD	13.50	4.50
TSS	0.60	0.20
Oil and grease	0.30	0.10
pH	6.0–9.0	6.0–9.0

2.2.1.2 Best Conventional Pollutant Control Technology

BCT is the second type of technology-based control and applies to conventional pollutants only. The control of conventional pollutants under BCT is always at least as stringent as under BPT. The following factors are considered when evaluating the applicability of BCT:

- Age of the equipment and facilities
- Processes employed by the industry and any required process changes
- Engineering aspects of the control technologies
- Nonwater quality environmental impacts, including energy requirements

In addition to using these factors, BCT consideration uses a two-part economic reasonableness test, described in 40 CFR 125.3(d)(2)(i) and (ii). Consistent with CWA §304(b)(4)(B), the permit writer will consider the following:

- Reasonableness between the costs of attaining a effluent reduction and the effluent reduction benefits derived.
- Comparison of the cost and level of the POTW's pollutant reduction from the discharge to the cost and level of pollutant reduction from a class or category of industrial sources.

This test compares the economic burden of an IU removing conventional pollutants beyond the limits set in BPT to a POTW's economic burden of removing the same pollutants beyond secondary treatment. More information on EPA's methodology for developing BCT limits is available in 51 FR 24974: *https://www3.epa.gov/npdes/pubs/fr_bct_1986.pdf.*

2.2.1.3 Best Available Technology Economically Achievable

Limits for the direct discharge of nonconventional and toxic pollutants are promulgated using BAT. BAT is defined on the basis of the performance associated with the best control and treatment measures that facilities in an industrial category are capable of achieving. Factors to consider when assessing BAT include the following:

- Total cost of applying the control technology related to the benefits of the effluent reduction
- Age of the equipment and facilities
- Processes employed by the industry and any required process changes
- Nonwater quality environmental impacts, including energy requirements

Unlike the cost analysis in BPT, BAT does not require the permit writer to balance the cost of implementation against the pollution reduction benefit. BAT may be based on process changes or internal controls, even when those technologies are not common industry practice.

2.2.1.4 New Source Performance Standards

NSPS, like BPT, applies to direct dischargers for all pollutants. NSPS reflect effluent reductions that are achievable based on best available demonstrated control technology. New sources have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. NSPS should represent the most stringent controls attainable by applying the best available demonstrated control technology for all pollutants. Factors to consider when assessing NSPS include the following:

- Total cost of applying the control technology related to the benefits of the effluent reduction
- Nonwater quality environmental impacts, including energy requirements
- Other factors DEQ deems appropriate

2.2.2 Apply Effluent Limit Guidelines

ELGs are implemented and enforced through the IPDES permit for each IU. Direct dischargers are regulated by permits that specify limits using BPT, BAT, BCT, and NSPS. Figure 3 presents an overview of the process a permit writer follows to determine applicable ELGs and calculate final effluent limits for an IU.

2.2.2.1 Learn about the Industrial Discharger

Facility-specific information is required to properly identify applicable ELGs and derive TBELs. The following information, at a minimum, is necessary:

- Industrial processes and raw materials
- Products and services
- Amount of manufacturing production or servicing
- Number of production and nonproduction days
- Current pollution prevention practices and wastewater treatment technology
- Discharge location of the wastewater pollutants and potential compliance sampling points
- Source and characteristics of the wastewater (including flow) and pollutants that are being discharged or have the potential to be discharged from the facility

Sources of information include the facility’s permit application, current permit and fact sheet (if the facility is permitted), DMRs, site visits, site inspections (e.g., compliance evaluation inspections for an existing permit), and other information submitted by the facility.

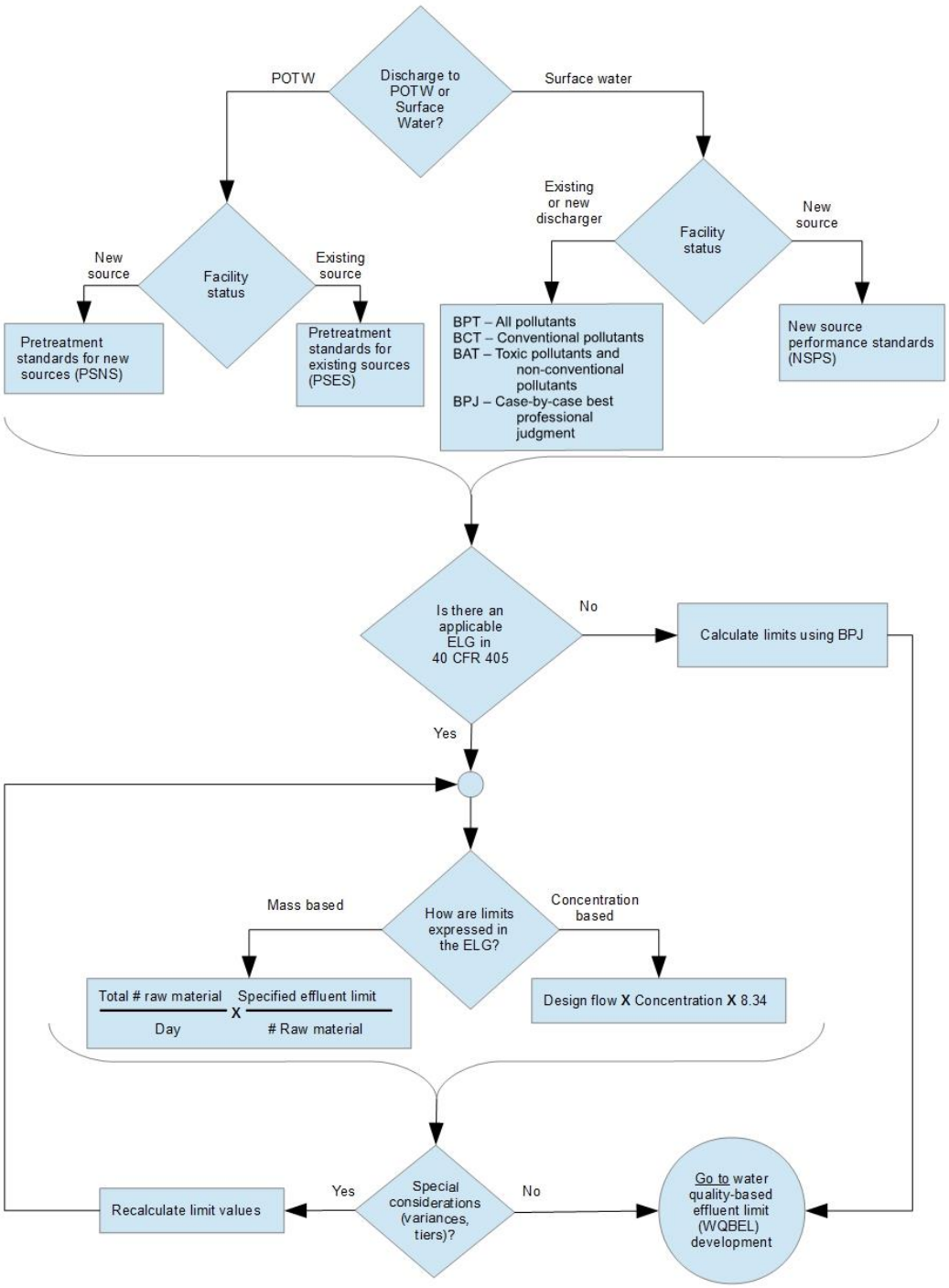


Figure 3. Overview of TBELs calculation for non-POTW (Industrial) dischargers.

2.2.2.2 Identify Applicable Effluent Limit Guideline Categories

Existing ELG regulations are organized by EPA into industry categories (Table 6) and subcategories (40 CFR 405–471). When determining subcategories, EPA considers a number of factors, including manufacturing products and processes, raw materials used, wastewater characteristics, facility size, geographic location, age of the facility and equipment, and wastewater treatability. The results are a series of subcategories that cover certain types of IUs and specify the effluent limits applicable to that industry's pollutants.

Table 6. Existing point source categories.

Industry Category	40 CFR	Industry Category	40 CFR
Aluminum Forming	467	Meat and Poultry Products	432
Asbestos Manufacturing	427	Metal Finishing	433
Battery Manufacturing	461	Metal Molding and Casting	464
Canned and Preserved Fruits and Vegetable Processing	407	Metal Products and Machinery	438
Canned and Preserved Seafood Processing	408	Mineral Mining and Processing	436
Carbon Black Manufacturing	458	Nonferrous Metals Forming and Metal Powders	471
Cement Manufacturing	411	Nonferrous Metals Manufacturing	421
Centralized Waste Treatment	437	Oil and Gas Extraction	435
Coal Mining	434	Ore Mining and Dressing	440
Coil Coating	465	Organic Chemicals, Plastics, and Synthetic Fibers	414
Concentrated Animal Feeding Operations (CAFOs)	412	Paint Formulating	446
Concentrated Aquatic Animal Production	451	Paving and Roofing Materials (Tars and Asphalt)	443
Copper Forming	468	Pesticide Chemicals	455
Dairy Products Processing	405	Petroleum Refining	419
Electrical and Electronic Components	469	Pharmaceutical Manufacturing	439
Electroplating[a]	413	Phosphate Manufacturing	422
Explosives Manufacturing	457	Photographic	459
Ferroalloy Manufacturing	424	Plastic Molding and Forming	463
Fertilizer Manufacturing	418	Porcelain Enameling	466
Glass Manufacturing	426	Pulp, Paper, and Paperboard	430
Grain Mills	406	Rubber Manufacturing	428
Gum and Wood Chemicals	454	Soaps and Detergents Manufacturing	417
Hospitals	460	Steam Electric Power Generating	423
Ink Formulating	447	Sugar Processing	409
Inorganic Chemicals	415	Textile Mills	410
Iron and Steel Manufacturing	420	Timber Products Processing	429
Landfills	445	Transportation Equipment Cleansing	442
Leather Tanning and Finishing	425	Waste Combustors	444

Industry Category	40 CFR	Industry Category	40 CFR

a. This category contains only categorical pretreatment standards and no ELGs for direct dischargers

Identifying the applicable ELGs for a facility depends on the user providing DEQ as much information as possible about its operations. DEQ will use the following sources of information in determining the appropriate 40 CFR 405–471 category and subcategory for an IU:

- **CFR titles and applicability section of the ELGs**. First, cross check the current information about the facility against Table 6. The category titles may indicate the category to which the facility belongs. In 40 CFR 405–471, each category includes an applicability section that describes the types of IUs covered under the category.
- **North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC).** If using Table 6 to find the correct category for the IU is unsuccessful, the current NAICS or former SIC codes can help determine the appropriate 400 series category. NAICS and SIC codes are federal industrial classifications by activity. The NAICS and/or SIC code are available in the IPDES permit or permit application.

  NAICS search: *https://www.naics.com/search/*

  SIC search: *https://www.osha.gov/pls/imis/sicsearch.html*

  For example, a facility reports a SIC code of 3331 in its permit application. The search results on the Occupational Safety and Health Administration's website returns "Industry Group 333: Primary Smelting and Refining of Nonferrous Metals," corresponding to 40 CFR 421 for Nonferrous Metals Manufacturing.

2.2.2.3 Identify Applicable Effluent Limit Guideline Subcategories

Regulation of an industrial category using subcategories allows each subcategory to have a uniform set of requirements that accounts for technological achievability and economic impacts unique to that subcategory. Grouping similar facilities into subcategories increases the likelihood that the regulations are practicable and diminishes the need to address variations between facilities within a category through a variance process.

Subcategories cover a wide range of industrial activities. In some cases, a facility may fall under multiple subcategories, each with different effluent limits. Each subcategory contains an applicability section that provides a detailed explanation of the types of facilities and processes covered by the subcategory. DEQ will carefully review the subcategories to ensure properly derived TBELs and will notify each user of their coverage under the 40 CFR 405–471 categories and subcategories as applicable.

2.2.2.4 Determine whether Existing or New Source Standards Apply

The type of control technology selected for each facility depends, in part, on whether the facility is a new or existing discharger or source. Table 7 defines the control technology that applies to each type of discharger (Figure 3). New and existing sources and new dischargers are defined in

IDAPA 58.01.25.010. An *existing discharger* has previously been or is currently permitted to discharge pollutants, or did not previously require authorization to discharge.

Table 7. Technology levels of control for new and existing dischargers.

Pollutants Regulated	BPT	BCT	BAT	NSPS
Existing direct discharger	✓	✓	✓	–
New direct discharger	–	–	–	✓

A *new discharger* is any building, structure, facility, or installation:

a. from which there is or may be a discharge of pollutants;

b. that did not commence the discharge of pollutants at a particular site prior to August 13, 1979;

c. which is not a new source; and

d. which has never received a finally effective NPDES or IPDES permit for discharges at that site.

Additional criteria below determine whether a discharge is a new source as defined in IDAPA 58.01.25.120:

- Constructed at a site at which no other source is located
- Totally replaces the process causing the discharge from an existing source
- Uses processes that are substantially independent of an existing source at the same site

Some 40 CFR 405–471 categories include additional criteria for making new source determinations.

New dischargers, new sources, and recommencing dischargers must install and operate all pollution control equipment required to meet the permit conditions before beginning discharge. The discharger may be granted a grace period, not to exceed 90 days, to tune the pollution control equipment, as expeditious as possible, to meet all permit conditions (40 CFR 122.29(d)(4)).

The most stringent level of control for each pollutant as specified in the facility's subcategory will be used to derive the facility's TBELs. New source dates listed by industrial point source category are provided in Appendix D.

2.2.2.5 Calculate TBELs from Effluent Limit Guidelines

IDAPA 58.01.25.303.06.a stipulates that all pollutants limited in permits must have those limits, standards, or prohibitions expressed in terms of mass except under any of the following conditions:

- For pH, temperature, radiation, or other pollutants that cannot appropriately be expressed by mass limits.
- When applicable standards or limits are expressed in terms of other units of measure (e.g., concentration [mg/L]).

- If in establishing technology-based permit limits on a case-by-case basis, limits based on mass are infeasible because the mass or pollutant cannot be related to a measure of production (e.g., discharges of TSS from certain mining operations), the permit conditions must ensure that dilution will not be used as a substitute for treatment.

The type of limit (i.e., mass, concentration, or other units) calculated for a specific pollutant at a facility depends on the pollutant type and the way limits are expressed in the applicable ELG. Generally, ELGs include both maximum daily and monthly average limits for most pollutants. Though ELGs use different terms for monthly effluent limits (e.g., monthly average, maximum for monthly average, average of daily values for 30 consecutive days), the requirements are expressed in IPDES permits as average monthly limits (AMLs) as defined in IDAPA 58.01.25.010.06.

When calculating numeric limits from ELGs, the permit writer will include all pollutants regulated by an ELG and will include both maximum daily and average monthly effluent limits expressed as mass limits unless the guideline allows or requires concentration limits.

2.2.2.5.1 Calculate Mass-Based TBELs from Production-Normalized Effluent Limit Guidelines

Production-normalized ELGs are established using the past 3 to 5 years of facility data. The production rate used in the production-normalized TBEL calculation must be as follows:

- Based upon a reasonable measure of the actual production likely to prevail during the next term of the permit (IDAPA 58.01.25.303.02.b.i)
- Account for any planned changes at the facility, such as an increase or decrease in production (IDAPA 58.01.25.303.02.b.ii).

Example:

A facility that processes raw cow milk into dried whey has applied for a permit. The permit writer has determined that the facility is a new source and falls under 40 CFR 405–Dairy Products Processing, Subpart J–Dry Milk. The facility processes approximately 3,300,000 lb of raw milk per day. Calculate the limits for BOD_5 using the raw cow milk composition and the associated conversion factors in Table 8 and Equation 2.

Table 8. Example of calculating BOD_5 limits for milk (40 CFR 405).

Standard Raw Cow Milk Composition	BOD_5 Input Conversion Factors
3.5% fat	0.890
3.2% protein	1.031
4.75% carbohydrates (as lactose)	0.691

$$C_M = M\left(\frac{lb}{day}\right) \times P_{FPC}$$

Equation 2. Macro composition calculation.

Where:

C_M = Quantity of macro component	Calculated value
P_{FPC} = Percent of fat (F), protein (P), and carbohydrates (C)	From assay in the raw milk (%)
M = Quantity of raw ingredient being processed	e.g., raw milk (lb/day)

Convert milk to BOD_5: The amount of each macro component (fat, protein, and carbohydrate) is calculated by multiplying the percent of each macro component, which needs to be analyzed and reported in the permit application, by the pounds per day of raw milk processed at the facility.

Total fat: $3{,}300{,}000\ lb/day\ \times\ 0.035 = 115{,}500\ lb/day\ fat$

Total protein: $3{,}300{,}000\ lb/day\ \times\ 0.032 = 105{,}600\ lb/day\ protein$

Total carbohydrates: $3{,}300{,}000\ lb/day\ \times\ 0.048 = 158{,}400\ lb/day\ carbohydrates$

Calculations in the 40 CFR 405 subcategories are based on BOD_5 input and calculated using the conversion factors in Table 8 and Equation 3.

$$In_x = C_M \times C_{ELG}$$

Equation 3. Constituent input calculation.

Where:

In_x = Equivalent pollutant value	Quantity in equivalent pollutant amount (e.g., percent milk fat converted to pounds BOD_5) (lb/day)
C_M = Quantity of macro component	Each constituent calculated using Equation 2
C_{ELG} = Conversion coefficient from appropriate ELG	

$$115{,}500\ lb/day\ fat\ \times\ 0.890 = 102{,}800\ BOD_5\ input/day\ from\ fat$$

$$105{,}600\ lb/day\ protein\ \times 1.031\ = 108{,}900\ BOD_5\ input/day\ from\ protein$$

$$158{,}400\ lb/day\ carbohydrates\ \times 0.691 = 109{,}500\ BOD_5\ input/day\ from\ carbohydrates$$

$$Total\ BOD_5\ input = 321{,}200\ lb/day$$

Average monthly and maximum daily limits for new dairy sources are calculated using Equation 4 and Equation 5 (Table 9).

Table 9. Performance standards for new sources (40 CFR 405.105).

Parameter	Maximum Daily Limit	Average Monthly Limit
	lb/100 lb of BOD_5 input	
BOD_5	0.036	0.018
TSS	0.450	0.225
pH	6.0 to 9.0 standard unit	

$$AML = \left(\sum In_x\right) \times PS_{AML}$$

Equation 4. Average monthly limit for new dairy sources.

Where:

AML = Average monthly limit

ΣIn_x = Summation of equivalent pollutant values — Total of equivalent macro components (lb/day)

PS_{AML} = Performance standard for AML — From applicable ELG (a conversion factor)

$$AML = (321{,}200\ lb\ BOD_5\ input\ per\ day) \times \left(\frac{0.018}{100\ lb\ BOD_5\ input}\right)$$

$$AML = 57.82\ lb/\text{day}$$

$$Max.daily\ limit = \left(\sum In_x\right) \times PS_{MaxDailyLimit}$$

Equation 5. Maximum daily limit for new dairy sources.

$$Max.daily\ limit = (321{,}200\ lb\ BOD_5\ input\ per\ day) \times \left(\frac{0.036}{100\ lb\ BOD_5\ input}\right)$$

$$Max.daily\ limit = 115.6\ lb/\text{day}$$

2.2.2.5.2 Calculate Mass-Based TBELs from Flow-Normalized Effluent Limit Guidelines

The process for calculating mass-based TBELs from flow-normalized ELGs is similar to the process used with production-normalized ELGs, but rather than using a reasonable measure of the actual daily production, the permit writer will use a reasonable measure of the actual daily flow rate as the basis for calculating the TBELs.

As with estimating production to calculate TBELs, the objective in determining a flow estimate for a facility is to develop a single estimate of the actual daily flow rate (in terms of volume of process wastewater per day), which can reasonably be expected to prevail during the next term of the permit (not the design flow rate). Using design flow rates in these calculations result in increasingly relaxed discharge requirements for facilities whose average daily flow is well below design flow rate. The permit writer may use the past 3 to 5 years of facility data to assist in developing an appropriate estimate but should account for planned changes over the next permit term. For example, the permit writer may use the highest average daily flow rate from the average daily flows of the last 3 to 5 years of facility data.

Example:

Table 10, shows the BPT factors that an organic chemical processing facility must comply with extracted from the ELGs in 40 CFR 414, Organic Chemicals, Plastics, and Synthetic Fibers. Assume that a reasonable estimate of the production flow is 16,000 gallons per day (gpd), based on the past 3 years of production history, and the facility does not anticipate any significant change from the flow rate over the next 5 years.

Table 10. BPT limits for 40 CFR 414, Subpart G (bulk organic chemicals).

Effluent Characteristic	BPT Effluent Limits	
	Maximum for any 1 day	Maximum for monthly average
	All units except pH are mg/L	
BOD5	92	34
TSS	159	49
pH	6.0–9.0	6.0–9.0

Flow conversion: $16{,}000\ gpd \times \frac{10^{-6} mgd}{gpd} = 0.016\ mgd$

Maximum Daily Limit (using Equation 1):

BOD_5: $0.016\ mgd \times 92\ \frac{mg}{L} \times 8.34 \frac{lb \times L}{mg \times MG} = 12\ lb/day$

TSS: $0.016\ mgd \times 159\ \frac{mg}{L} \times 8.34 \frac{lb \times L}{mg \times MG} = 21.2\ lb/day$

pH: Within the range of 6.0 to 9.0 standard units

Average Monthly Limit:

BOD_5: $0.016\ mgd \times 34\ \frac{mg}{L} \times 8.34 \frac{lb \times L}{mg \times MG} = 4.5\ lb/day$

TSS: $0.016\ mgd \times 49\ \frac{mg}{L} \times 8.34 \frac{lb \times L}{mg \times MG} = 6.5\ lb/day$

pH: Within the range of 6.0 to 9.0 standard units

2.2.2.5.3 Calculate Mass-Based TBELs from Concentration-Based Effluent Limit Guidelines

In some cases, the permit writer will develop mass-based TBELs for facilities with concentration-based ELGs (e.g., if a facility does not have adequate water conservation practices). Mass-based permit effluent limits encourage water conservation (e.g., minimize the potential for diluting process wastewaters by nonprocess wastewater, more efficient use of water) and pollution prevention (e.g., reduce wasteloads to wastewater treatment facilities by physically collecting solid materials before using water to clean equipment and facilities). Additionally, for facilities with on-site wastewater treatment systems, combining water-reduction technologies and practices and well-operated wastewater treatment will reduce the volume and mass of discharged wastewater pollution (i.e., after treatment). Another benefit of mass-based permit effluent limits is that it provides the permittee with more flexibility. Permittees may elect

to control their wastewater discharges through more efficient wastewater control technologies and pollution prevention practices that result in lower pollutant concentrations in the discharged wastewater, or more efficient water conservation practices that result in less wastewater volume discharged from industrial operations), or both.

Example:

As shown in Table 11 and the equation, a facility covered under 40 CFR 413, Subpart D (Anodizing) is subject to PSES limitations and discharges 8,000 gpd.

What is the mass-based calculation for the facility's lead effluent?

Table 11. PSES limitations for anodizing facilities discharging less than 38,000 liters per day.

Pollutant or Pollutant Property	Maximum for any 1 day (mg/L)	Average of Daily Values for 4 Consecutive Monitoring Days shall not exceed (mg/L)
CN, A	5.0	2.7
Pb	0.6	0.4
Cd	1.2	0.7

Flow conversion: $8{,}000\ gpd \times \frac{10^{-6} MGD}{gpd} = 0.008\ mgd$

Maximum daily limit for lead (using Equation 1): $0.6\ \left(\frac{mg}{L}\right) \times 0.008\ (mgd) \times 8.34 = \ 0.04\ \frac{lb}{day}$

2.2.2.5.4 Supplement Mass-Based TBELS with Concentration Limits

Even where ELGs require mass-based TBEL calculations, the permit writer may determine that it is beneficial to include concentration-based limits to supplement the mass-based limits. Where limits are expressed in more than one unit, the facility must comply with both. Expressing limits in terms of both concentration and mass encourages the proper operation of a treatment facility at all times.

Supplementing mass-based limits with concentration-based limits may be especially appropriate where the requirements in the ELGs are flow-normalized. The permit writer can then account for changes in a facility's discharge during low flow periods while encouraging persistent treatment efficiency throughout the discharge season.

2.2.2.5.5 Incorporate Narrative Requirements from Effluent Limit Guidelines

In some cases, DEQ may include narrative ELG controls developed by EPA(40 CFR 405–471 subcategories). When numeric effluent limits are infeasible, IDAPA 58.01.25.302.13 authorizes DEQ to include BMPs in IPDES permits to control or abate the discharge of pollutants. In some cases, *only* narrative guidelines will be provided in the applicable subcategory. For example, the ELGs for concentrated aquatic animal production facilities (40 CFR 451) consist of narrative requirements implemented through BMPs. In a monitoring and compliance example from the Metal Finishing (40 CFR 433) ELGs, a facility is allowed to implement a toxic organic management plan along with a certifying statement in reports in lieu of routine total toxic organic monitoring. The plan ensures the control authority that no toxics will be discharged by the permittee through good housekeeping and spill response measures. These narrative

requirements may include BMPs, treatment practices, and monitoring, reporting, and compliance requirements.

2.2.2.6 Account for Overlapping or Multiple Effluent Limit Guidelines Requirements

A facility may be subject to overlapping or multiple ELGs due to both new and existing sources at the facility, multiple products or services provided by the same facility, or a facility with processes subject to multiple subcategories. In such cases, the permit writer will examine the applicable ELGs to ensure that (1) one guideline does not supersede another; and (2) the ELGs are properly applied.

2.2.2.6.1 Supersede Effluent Limit Guidelines

To minimize the impact of overlapping guidelines, EPA provides exclusions in the applicability sections when developing ELGs for point source categories. The permit writer will minimize the overlap of different ELGs as much as possible by careful review of the facility's applicable subcategories.

When a facility is subject to multiple subcategories, the limits from one may be more stringent than the other, requiring the more stringent limit to be selected. EPA provides direction in the preamble of the ELG or in the applicable subparts as shown in the example below.

Example:

Several 400 series categories supersede the limits in ELG 433, Metal Finishing Point Source. When one of the following industrial categories is effective, limits from 40 CFR 433 will not apply.

- Iron and steel (40 CFR 420)
- Nonferrous metal smelting and refining (40 CFR 421)
- Battery manufacturing (40 CFR 461)
- Plastic molding and forming (40 CFR 463)
- Metal casting foundries (40 CFR 464)
- Coil coating (40 CFR 465)
- Porcelain enameling (40 CFR 466)
- Aluminum forming (40 CFR 467)
- Copper forming (40 CFR 468)
- Electrical and electronic components (40 CFR 469)
- Nonferrous forming (40 CFR 471)

2.2.2.6.2 Multiple Effluent Limit Guidelines Requirements

When a facility is subject to ELGs for two or more processes in a subcategory or two or more categories or subcategories, each of the applicable ELGs will be used individually to derive TBELs, and then combined. In applying multiple ELGs, the permit writer will use measures of production or flow that are reasonable with respect to operating multiple processes at the same time and the overall production or flow of the facility for the next term of the permit.

Usually, wastewater streams regulated by ELGs are combined during or before treatment. In such a case, the permit writer will combine the calculated allowable pollutant loadings from each set of requirements or from each set of ELGs to arrive at a single TBEL for the facility using a building block approach. In the following example, the building block approach is applied to a facility with multiple processes in the Primary Tungsten subcategory of the Primary Nonferrous Metals Manufacturing point source category (40 CFR 421, Subpart J). The same principles illustrated in this example apply to a facility with processes subject to requirements from multiple subcategories or categories that are combined before or during treatment.

Example:

A facility is subject to 40 CFR 421, Subpart J (Primary Tungsten). The facility uses a tungstic acid rinse, an acid leach wet air pollution control system, and an alkali leach wash in its manufacturing process (Table 12, Table 13, and Table 14).

The maximum daily production rate for the facility is as follows:

- 4.7 million pounds per day of tungstic acid (as W)
- 3.5 million pounds per day of sodium tungstate (as W)

What is the TBEL for lead at the facility?

BPT calculation for lead (40 CFR 421.102):

Table 12. BPT effluent limits for tungstic acid rinse, 40 CFR 421, Subpart J (Primary Tungsten).

Pollutant or Pollutant Property	Maximum for any 1 day	Maximum for Monthly Average
	mg/kg (pounds per million pounds) of tungstic acid (as W) produced	
Lead	17.230	8.205
Zinc	59.900	25.030
Ammonia (as N)	5,469.000	2,404.00
TSS	1,682.000	800.000
pH	7.0–10.0	7.0–10.0

Table 13. BPT effluent limitations for acid leach wet air pollution control, 40 CFR 421, Subpart J (Primary Tungsten)

Pollutant or Pollutant Property	Maximum for any 1 day	Maximum for Monthly Average
	mg/kg (pounds per million pounds) of tungstic acid (as W) produced	
Lead	15.040	7.162
Zinc	52.280	21.840
Ammonia (as N)	4,773.000	2,098.000
TSS	1,468.000	698.300
pH	7.0–10.0	7.0–10.0

Table 14. BPT effluent limitations for alkali leach wash, 40 CFR 421, Subpart J (Primary Tungsten)

Pollutant or Pollutant Property	Maximum for any 1 day	Maximum for Monthly Average
	mg/kg (pounds per million pounds) of sodium tungstate (as W) produced	
Lead	0.000	0.000
Zinc	0.000	0.000
Ammonia (as N)	0.000	0.000
TSS	0.000	0.000
pH	([1])	([1])

1.Within the range of 7.0 to 10.0 at all times

BPT maximum daily limit (Equation 6):

$$L_B = P_{Rate} \times C_{ELG}$$

Equation 6. Building block approach maximum daily limit calculation.

Where:

L_B = Individual component load	lb/day
P_{rate} = Production rate	Quantity of specific constituent used each day in production (lb/day)
C_{ELG} = ELG conversion factor	From applicable ELG (a conversion factor)

Tungstic acid rinse (daily maximum):
$(4.7\ million\ lb\ per\ day) \times (17.230\ lb\ per\ million\ lb) = 80.981\ lb/day$

Acid leach wet air pollution control (daily maximum):
$(4.7\ million\ lb\ per\ day) \times (15.040\ lb\ per\ million\ lb) = 70.688\ lb/day$

Alkali leach wash (daily maximum):
$(3.5\ million\ lb\ per\ day) \times (0.000\ lb\ per\ million\ lb) = 0\ lb/day$

Total allowable discharge (daily maximum):
$(80.981\ lb/day) + (70.688\ lb/day) + (0.000\ lb/day)) = 151.669\ lb/day$

The resulting daily maximum discharge under BPT is 151.669 lb/day after accounting for significant digits.

Similarly, calculations using BPT maximum monthly average values (Table 12, Table 13, and Table 14) yield an average monthly maximum value of 72.225 (rounded from 72.2249) lb/day.

BAT calculation for lead (40 CFR 421.103) (Table 15, Table 16, and Table 17):

Table 15. BAT effluent limitations for tungstic acid rinse, 40 CFR 421, Subpart J (Primary Tungsten).

Pollutant or Pollutant Property	Maximum for any 1 day	Maximum for Monthly Average
	mg/kg (pounds per million pounds) of tungstic acid (as W) produced	
Lead	11.490	5.333
Zinc	41.850	17.230
Ammonia (as N)	5,469.000	2,404.000

Table 16. BAT effluent limitations for acid leach wet air pollution control, 40 CFR 421, Subpart J (Primary Tungsten).

Pollutant or Pollutant Property	Maximum for any 1 day	Maximum for Monthly Average
	mg/kg (pounds per million pounds) of tungstic acid (as W) produced	
Lead	1.003	0.466
Zinc	3.653	1.504
Ammonia (as N)	477.400	209.900

Table 17. BAT effluent limitations for alkali leach wash, 40 CFR 21, Subpart J (Primary Tungsten).

Pollutant or Pollutant Property	Maximum for any 1 day	Maximum for Monthly Average
	mg/kg (pounds per million pounds) of sodium tungstate (as W) produced	
Lead	0.000	0.000
Zinc	0.000	0.000
Ammonia (as N)	0.000	0.000

BAT maximum daily limit (using Equation 6):

Tungstic acid rinse:
$(4.7\ million\ lb\ per\ day) \times (11.490\ lb\ per\ million\ lb) = 54.003\ lb/day$

Acid leach wet air pollution control:
$(4.7\ million\ lb\ per\ day) \times (1.003\ lb\ per\ million\ lb) = 4.714\ lb/day$

Alkali leach wash:
$(3.5\ million\ lb\ per\ day) \times (0.000\ lb\ per\ million\ lb) = 0\ lb/day$

Total allowable discharge:
$(54.003\ lb/day) + (4.714\ lb/day) + (0.000\ lb/day)) = 58.717\ lb/day$

The resulting daily maximum discharge under BAT is 58.717 lb/day after accounting for significant digits.

Therefore, the technology-based maximum daily limit for lead at the facility is the more stringent BAT limit of 58.717 lb/day.

Similarly, calculations using BAT maximum monthly average values (Table 15, Table 16, and Table 17) yield an average monthly maximum value of 27.255 (rounded from 27.2553) lb/day.

Compare the results and select the more stringent daily maximum and monthly average to include in the permit.

The permit writer may apply the building block approach in other circumstances, including:

- **Mixture of mass-based and concentration-based requirements:** The limits in ELGs for some pollutants are mass-based, production-normalized limits in some subparts and concentration-based limits in other subparts. When all the wastewater streams go to the same treatment system, the permit writer will convert the concentration-based limits to mass-based limits, combine the results with the mass-based, production-normalized limits, and apply the limit to the combined wastewater stream.
- **Mixture of different concentration-based requirements:** Some facilities could have multiple operations that are each subject to different concentration-based requirements for the same pollutant but with wastewater streams that combine before treatment. In such a case, the permit writer will establish a flow-weighted concentration-based limit as the TBEL for the combined wastewater streams. Alternatively, the permit writer may convert the concentration-based requirements to equivalent mass-based requirements using flow data and then combine the mass-based requirements into a single limit for the combined wastewater stream.
- **Mixture of regulated and unregulated wastewater streams:** In some cases, wastewater streams containing a pollutant regulated by the applicable ELGs requirements can combine with other wastewater streams that do not have ELG requirements that regulate the pollutant. In such a case, the permit writer will use BPJ to establish a TBEL for the unregulated wastewater streams and, as appropriate, calculate a final TBEL for the combined wastewater streams. For example, if one of the wastewater streams contributing to an industrial facility's discharge is sanitary wastewater, the permit writer would use BPJ to apply the treatment standards for domestic wastewater and calculate BOD_5 limits for that wastewater stream. The secondary treatment standards would be used to calculate mass-based limits for the sanitary wastewater using the concentration-based requirements and an estimate of flow rate that is expected to represent the flow rate during the proposed permit term. A final TBEL for BOD_5 could be calculated for the combined sanitary and process wastewater streams by combining the two mass limits using the building block approach.
- **Mixture of wastewater streams containing a pollutant with wastewater streams not containing the pollutant:** If a wastewater stream that does not contain a pollutant is combined with another wastewater stream that contains the pollutant (and has applicable requirements in the ELGs or requirements determined by the permit writer using BPJ), the permit writer must ensure that the nonregulated waste stream does not dilute the regulated waste stream to the point where the pollutant is not analytically detectable. If that occurs, the permit writer will establish internal outfalls, as allowed under IDAPA 58.01.25.303.08.

2.2.2.7 Apply Additional Regulatory Considerations in Calculating TBELs

Several additional factors must be considered when deriving TBELs from ELGs. Additional requirements consist of evaluating or accounting for the following:

- Expected significant increases or decreases in production during the permit term for tiered discharger limits
- Internal outfalls
- Requests for a variance from ELGs

The following sections provide an overview of these considerations.

2.2.2.7.1 Tiered Discharge Limits

If production rates are expected to change significantly during the life of the permit, the use of tiered TBELs may be included in the permit, or a reopener clause may be included, depending upon the facility and/or the receiving water conditions. If tiered TBELs are incorporated into the permit, they would apply to mass-based effluent limits and become effective when production or flow (or some other measure of production) exceed a threshold value, such as during seasonal production variations. Generally, up to 20% fluctuation in production is considered to be within the range of normal variation, while increases or decreases higher than 20% could warrant consideration of tiered limits.

Example:

Over the previous 5 years, Plant B produced approximately 40 tons per day of product during spring and summer months (i.e., March through August) and 280 tons per day during fall and winter months. Production during the fall and winter months is significantly higher than during the off-season, and the discharger has made a plausible argument that production is expected to continue at that level over the next 5 years. The ELG requirements for Pollutant Z are 0.08 lb/1,000 lb for the AML and 0.14 lb/1,000 lb for the maximum daily limit.

What are the appropriate tiered effluent limits for Plant B?

Tier I:

The first tier, or lower limit, would be based on a production rate of 40 tons per day. The limits would apply between March and August (Equation 7).

$$L_B = P_{Rate} \times C_f \times C_{ELG}$$

Equation 7. Calculation for tiered limits.

Where:

L_B = Individual component's load	lb/day
P_{rate} = Production rate	Quantity of specific constituent used each day in production (lb/day)
C_f = Conversion factor	e.g., 2,000 lb/ton, 2.2 lb/kg, 1.55 cubic feet per second (cfs)/mgd
C_{ELG} = ELG conversion factor	From applicable ELG (a conversion factor)

Monthly average limit:

$$40 \text{ tons/day} \times 2{,}000 \text{ lb/ton} \times 0.08 \text{ lb/1,000 lb} = 6 \text{ lb/day}$$

Daily maximum limit:

$$40 \text{ tons/day} \times 2{,}000 \text{ lb/ton} \times 0.14 \text{ lb/1,000 lb} = 11 \text{ lb/day}$$

Tier II:

The second tier, or higher limit, would be based on a production rate of 280 tons per day. Those limits would apply between September and February.

Using Equation 7:

Monthly average limit:

$$280\ \text{tons/day} \times 2{,}000\ \text{lb/ton} \times 0.08\ \text{lb/1{,}000 lb} = 50\ \text{lb/day}$$

Daily maximum limit:

$$280\ \text{tons/day} \times 2{,}000\ \text{lb/ton} \times 0.14\ \text{lb/1{,}000 lb} = 78\ \text{lb/day}$$

The permit writer should include tiered limits in a permit after carefully considering production data, and when a substantial increase or decrease in production is likely to occur. In the example above, the lower limits would be in effect when production was at low levels (March through August). During periods of significantly higher production (September through February), the higher limits would be in effect. In addition, a tiered or alternate set of limits might be appropriate in the case of special processes or product lines that operate during certain times.

The permit writer may also base thresholds for tiered limits on an expected increase in production during the term of the permit that will continue through the duration of the permit term. For example, if a facility plans to add a process line and significantly expand production in year 3 of the permit term, the permit could specify a higher tier of limits that go into effect when the facility reports reaching a production level specified in the permit. Alternatively, if the production increase changes the subcategory, or other considerations may need to be addressed, the permit writer may modify the permit as allowed in IDAPA 58.01.25.201.02.c.

The permit will detail thresholds and periods when each tier applies, measures of production, and special reporting requirements, which may include the following:

- A specified number of business days before, the facility notifies DEQ of the month it expects to operate at a higher level of production and the duration of this level of production.
- In the DMR, the facility reports the level of production and the limits and standards applicable to that level.

The rationale and requirements for any tiered limits will be provided in the fact sheet for the permit.

2.2.2.7.2 Internal Outfalls

IDAPA 58.01.25.303.08 authorizes DEQ to identify internal outfalls when effluent limits or standards at the point of discharge are impractical or infeasible. Limits on internal waste streams, frequency of and locations for monitoring, and analytical methods will be described in the fact sheet. Examples of circumstances include when the final discharge point is inaccessible (impacted by receiving water flow or surcharge), the wastes at the point of discharge are so diluted it makes monitoring impracticable, or the interferences among pollutants at the outfall make detection or analysis impracticable. Some ELGs may require the use of internal outfalls unless the effluent limits are adjusted based on the dilution ratio of the process wastewater to the

wastewater flow at the compliance point. Any internal outfall monitoring that might be required by the applicable ELGs will be clearly identified in the final permit. Examples of ELGs with required internal compliance points include the Metal Finishing (40 CFR 433) and Pulp, Paper, and Paperboard (40 CFR 430) ELGs.

2.2.2.7.3 Effluent Limit Guidelines Variances, Waivers, and Intake Credits

The CWA and state regulations provide limited mechanisms for variances, waivers, and intake credits from requirements in ELGs. An IPDES permit applicant must meet very specific data and application deadline requirements before a variance, waiver, or intake credit may be granted. These mechanisms provide a unique exception to particular requirements, and no expectation to receive a similar permit condition should be assumed by the permittee or applicant.

Table 18 explains the available variances, waivers, and intake credits from TBEL for dischargers.

Table 18. Available variances, waivers, and intake credits for IPDES permits.

Request Type	Eligible	CWA	Regulation	Application Deadline[a]	Granting Authority[b]
Economic	Non-POTWs	301(c)	IDAPA 58.01.25.310 40 CFR 122.21(m)	Initial request to DEQ <270 days after promulgation of ELG. A completed request by close of the draft permit comment period.	EPA[c]
Nonconventional pollutant	Non-POTWs	301(g)	IDAPA 58.01.25.310 40 CFR 122.21(m)	Initial request to DEQ <270 days after promulgation of ELG. A completed request by close of the draft permit comment period.	EPA[c]
Fundamentally different factors	Non-POTWs	301(n)	IDAPA 58.01.25.310 40 CFR 125.30–32	For BPT a request by the close of the public comment period. For BAT or BCT a request by no later than 180 days after an ELG is published in the Federal Register.	EPA[c]
Thermal discharge	All	316(a)	IDAPA 58.01.25.310 40 CFR 125.70–73	With a permit application if based on an ELG.	DEQ
Waivers	All	N/A	IDAPA 58.01.25.105 58.01.25.106 58.01.25.302.03	With a permit application.	DEQ
Intake credits	All	N/A	IDAPA 58.01.25.303.07	By close of the draft permit comment period.	DEQ

a. Permittees are advised to contact DEQ 1 year in advance if considering applying for a variance. The 180-day requirement to submit a complete application for a new permit or permit renewal may not be sufficient to also complete a variance and receive EPA approval. Dischargers must submit all requests to DEQ.
b. Any approved variance, waiver, or intake credit is effective for up to 5 years or the life of the IPDES permit. After 5 years or when the permit expires, the discharger must meet the standard or must reapply for the variance, waiver, or intake credit. To consider a reapplication, DEQ requires the discharger to demonstrate reasonable progress toward meeting the standard. DEQ's decisions may be appealed to the Board of Environmental Quality.
c. CWA §§301(c), 301(g), and 301(n) variances—If DEQ concurs with the variance request, the request must be forwarded with written concurrence to EPA for review and approval.

The options listed in Table 18 and the factors considered in a technical review are explained in the IPDES User's Guide, Volume 1, section 8 (DEQ 2016a).

2.2.2.8 Apply Additional Requirements in Effluent Limit Guidelines

Industrial storm water, specific analytical methods for measuring compliance with TBELs, and documentation and recordkeeping requirements are additional areas that need to be evaluated and incorporated into permit provisions, if necessary.

Industrial storm water sometimes falls under regulations by ELGs when an opportunity exists for unsheltered industrial operations to come into contact with and contaminate storm water. Examples of categories falling under ELG regulations are Concentrated Animal Feeding Operations (40 CFR 412), Fertilizer Manufacturing (40 CFR 418), Petroleum Refining (40 CFR 419), and Pulp, Paper, and Paperboard (40 CFR 430). Storm water commingled with process wastewater will require adjusting the ELGs to account for overlapping or multiple ELG requirements (section 2.2.2.6).

When more than one analytical method is available in 40 CFR 136 for analyzing a parameter, the permit writer may need to determine the appropriate minimum level necessary to maintain permit compliance using EPA's sufficiently sensitive test method (IPDES User's Guide Volume 1) (DEQ 2016a). When permit conditions require specific analytical methods to determine compliance with TBELs, the permit will clearly state which analytical method to use for particular pollutants.

Documentation and record keeping are mandatory components for permit compliance, and submission schedules will be included for each of the required plans (e.g., solvent management plans, BMP plans, and alternative monitoring requirements).

2.2.2.9 Document the Application of Effluent Limit Guidelines in the Fact Sheet

The IPDES permit fact sheet will document the data and information used to determine applicable ELGs, how the effluent limits were derived, and the final permit effluent limits. The fact sheet will clearly explain all considerations of applicable TBELs and variance, waiver, and intake credit requests.

2.2.3 Case-by-Case TBELs for Industrial Dischargers

Regulation 40 CFR 125.3 states that technology-based treatment requirements under CWA §301(b) represent the minimum level of control that must be imposed in an IPDES permit. Where EPA-promulgated ELGs are not applicable to a non-POTW discharge, such requirements are established on a case-by-case basis using BPJ.

2.2.3.1 Legal Authority to Establish Case-by-Case TBELs

Case-by-case TBELs are developed pursuant to CWA §402(a)(1) and IDAPA 58.01.25.302.03, which authorize the permit writer to issue a permit that (1) meets all applicable requirements developed under the authority of other CWA sections (e.g., technology-based treatment standards or water quality standards) or, before taking the necessary implementing actions related to those requirements, (2) determines the provisions needed to carry out the CWA. Further, 40 CFR 125.3(c)(3) states that technology-based treatment requirements may be imposed through one of three methods:

1. Applying EPA-promulgated effluent limits developed under CWA §304 to dischargers by category or subcategory
2. On a case-by-case basis under CWA §402, to the extent that EPA-promulgated effluent limits are inapplicable
3. Combining methods in 1 and 2

When establishing case-by-case effluent limits using BPJ, the approach selected and how the limit upholds CWA and IPDES regulations will be clearly documented in the fact sheet.

2.2.3.2 Identify Need for Case-by-Case TBELs

As noted above, case-by-case TBELs are established in situations where EPA-promulgated ELGs are inapplicable and include the following:

- When EPA has not yet promulgated ELGs for the point source category to which a facility belongs (e.g., a facility that produced distilled and blended liquors [SIC code 2085] and is part of the miscellaneous foods and beverages category, which does not have any applicable ELGs).
- When ELGs are available for the industry category, but no ELGs are available for the facility subcategory (e.g., discharges from coalbed methane wells are not now regulated by ELGs; however, EPA considers the coalbed methane industrial sector as a potential new subcategory of the existing Oil and Gas Extraction point source category [Part 435] because of the similar industrial operations performed [i.e., drilling for natural gas extraction]).
- When ELGs are available for the industry category but are not applicable to the IPDES permit applicant (e.g., facilities that do not perform the industrial operation triggering applicability of the ELGs or do not meet the production or wastewater flow cutoff applicability thresholds of the ELGs).
- When ELGs are available for the industry category, but no ELGs requirements are available for the pollutant of concern (e.g., a facility is regulated by the ELGs for Pesticide Chemicals [Part 455] but discharges a pesticide that is not regulated by these ELGs). The permit writer will ensure that the pollutant of concern is not already controlled by the ELGs and was not considered by EPA when they developed the ELGs.

Generally, case-by-case limits are appropriate when at least one of the conditions listed above applies and the pollutant is present, or expected to be present, in the discharge in amounts that can be treated or otherwise removed (e.g., implementing pollution prevention measures).

EPA periodically reviews existing and develops new ELGs. EPA's ELGs planning support documents are located at *https://www.epa.gov/eg/effluent-guidelines-plan*.

2.2.3.3 Factors Considered when Developing Case-by-Case TBELs

Regulation 40 CFR 125.3(c)(2) establishes the appropriate level of performance on a case-by-case basis and considers the following:

- Appropriate technology for the category or class of point sources of which the applicant is a member, based on all available information.
- Any unique factors relating to the facility.

An evaluation for case-by-case limits, conducted by the permit writer, will consider the factors specified in 40 CFR 125.3(d), based on BPT, BCT, and BAT. The most stringent technology level of control will be selected for each pollutant of concern and incorporated into the permit.

Technical criteria for BPT, BCT, and BAT:

- Age of equipment and facilities involved
- Process employed
- Engineering aspects of the application of various types of control techniques
- Process changes
- Nonwater quality environmental impact including energy requirements

Economic criteria:

- BPT—Total cost of applying the technology in relation to the effluent reduction benefits achieved from such application
- BCT—Reasonableness between the costs of attaining an effluent reduction and the benefit derived from effluent reduction. Comparison of the cost and reduction level of such pollutants from the POTW's discharge to the cost and reduction level of such pollutants from a class or category of industrial sources
- BAT—Cost of achieving such effluent reduction

Example:

POTWs treating domestic sewage:

- **Problem**: Private facility discharges to surface water. The facility is privately owned and does not qualify for POTW limits. Discharge contains pollutants (e.g., BOD_5, TSS, and pH) from domestic sources that are equivalent to influent received in a small municipal wastewater treatment facility. No ELGs exist for privately-owned treatment works treating domestic sewage.
- **Solution**: Case-by-case assessment using BPJ identifies equivalence with POTW secondary treatment standards or performance requirements derived from submitted data (IDAPA 58.01.16.455.04). To establish appropriate limits for BOD_5, TSS, and pH evaluate the facility's performance level using technical and economic criteria found above for BPT and BCT. The BPJ analysis will reasonably defend the documentation by including statutory/regulatory citation, identifying which pollutants were assessed and by what TBEL, and determining how the technical/economic criteria influenced the final permit limit, if any.

Technology-based controls in IPDES permits are performance-based measures. DEQ incorporates technology-based controls in IPDES permits that correspond to the application of an identified technology (including process changes) but does not require dischargers to install the identified technology. DEQ leaves, to each facility, the discretion to select the technology design or process changes necessary to meet the TBELs specified in the IPDES permit.

The permit may also establish a monitoring-only requirement in the current IPDES permit to identify pollutants of concern and potential case-by-case limits for the subsequent IPDES permit renewal.

2.2.3.4 Resources for Developing Case-by-Case TBELs

Numerous resources are available to identify candidates for model technologies or process changes and develop case-by-case TBELs using BPJ:

- Permit file information
  - Current and previous IPDES application forms
  - Previous permit and fact sheets
  - DMRs
  - Compliance inspection reports
- Information from existing facilities and permits
  - Individual and General Permits issued to facilities in the same region, or include case-by-case limits for the same pollutants
  - Toxicity reduction evaluations for selected industries
  - Other media permit files (e.g., Resource Conservation and Recovery Act permit applications and Spill Prevention Countermeasure and Control plans)
  - Integrated Compliance Information System-NPDES data: *https://www3.epa.gov/enviro/facts/pcs-icis/search.html*
  - Literature (e.g., technical journals and books)
- ELGs development and planning information
  - EPA's Effluent Guidelines: *https://www.epa.gov/eg*
  - EPA's Effluent Guidelines Plan: *https://www.epa.gov/eg/effluent-guidelines-plan*
  - EPA's Effluent Guidelines Program Contacts: *http://www.epa.gov/eg/forms/contact-us-about-effluent-guidelines*
- Economics guidance
  - Protocol and Workbook for Determining Economic Achievability for NPDES Permits BCT Cost Test Guidance
- Guidance for BMP-based limitations
  - Guidance Manual for Developing Best Management Practices (BMP) (EPA 1993a)
  - Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and BMPs (EPA 1992)
  - National Menu of Best Management Practices (BMPs) for Stormwater: *https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#edu*

2.2.3.5 Statistical Considerations when Establishing Case-by-Case TBELs

The quality of the effluent from a treatment facility will normally vary over time. If, for example, BOD_5 data for a typical treatment plant were plotted against time, one would observe day-to-day variations of effluent concentrations. Some of that behavior can be described by constructing a frequency-concentration plot. From the plot, one could observe that for most of the time, BOD_5 concentrations are near some average value. Any treatment system can be described using the mean concentration of the parameter of interest (i.e., the long-term average [LTA]) and the variance (or coefficient of variation) and by assuming a particular statistical distribution (usually lognormal).

When developing a case-by-case limit, the permit writer will use an approach consistent with the statistical approach in EPA's analysis for developing national standards but performed by the permit writer for a single facility. EPA's Technical Support Document (TSD) may be used to provide statistical approaches for setting maximum daily limit and AML at an appropriate performance level based on expected LTA performance. Specifically, the maximum daily limit could be calculated by multiplying the LTA achievable by implementation of the model technology or process change by a daily variability factor determined from the statistical properties of a lognormal distribution. The AML can be calculated similarly except that the variability factor corresponds to the distribution of monthly averages instead of daily concentration measurements. The daily variability factor is a statistical factor defined as the ratio of the estimated 99th percentile of a distribution of daily values divided by the mean of the distribution. Similarly, the monthly variability factor is typically defined as the estimated 95th percentile of the distribution of monthly averages divided by the mean of the distribution of monthly averages.

A modified delta-lognormal distribution could be fit to concentration data and variability factors computed for the facility distribution. The modified delta-lognormal distribution models the data as a mixture of measured values and observations recorded as values less than the detectable level. This distribution often is selected because the data for many analytes consist of such a mixture of measured values and results below the detectable level. The modified delta-lognormal distribution assumes that all nondetected results have a value equal to the detection limitations and the detected values follow a lognormal distribution.

For more details on EPA's use of statistical methods for developing ELGs, refer to: *https://www.epa.gov/eg*.

2.2.3.6 Document Case-by-Case TBELs in Fact Sheet

Case-by-case TBELs using a BPJ determination should be defensible and reasonable, and demonstrated by documentation:

- Identifying statutory and regulatory citations
- Establishing that case-by-case limits are appropriate and why ELGs do not apply
- Identifying pollutants for BPJ analysis and the performance level required by the CWA (i.e., BPT, BCT, or BAT)
- Listing each of the applicable criteria from 40 CFR125.3 and explaining how each was considered in the BPJ analysis

The information in the fact sheet will clearly state the rationale for a defensible description of how the BPJ limits comply with CWA and IPDES regulations.

3 Determining Water Quality-Based Effluent Limits

WQBELs help meet the CWA objective of restoring and maintaining the chemical, physical, and biological integrity of the state's water and provide for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water (fishable/swimmable goal). When drafting an IPDES permit, a permit writer must consider the impact of the proposed discharge on the quality of the receiving water. Water quality goals for a water body are defined by Idaho's water quality standards, which support the CWA. When analyzing the effect of a discharge on the receiving water, a permit writer may determine that TBELs alone will not prevent violations of applicable water quality standards. In such cases, 40 CFR 122.44(d) requires developing more stringent WQBELs.

> Periodically, changes are proposed to Idaho's water quality standards. These changes must be approved by the Idaho Legislature and EPA. It is critical that the permit writer understand when standards and regulations apply in composing a permit. The IPDES Program will only use standards, regulations, and other surface water criteria (e.g., TMDLs) after receiving EPA approval.

3.1 Characterize the Effluent

The permit writer typically uses information from various sources, including the permit application to identify pollutants that may be discharged by the facility and impact the receiving water. The permit writer then determines whether WQBELs are required, and if so, calculate WQBELs.

3.1.1 Identify Pollutants of Concern in Effluent

Several sources of information and methods, such as a site visit, communicating with facility staff, and reviewing monitoring history, can identify pollutants of concern for WQBEL development that might result in RPTE a water quality standard. Pollutants of concern are any pollutants or pollutant parameters that the permit writer believes are or may be discharged by the facility or could affect or alter the physical, chemical, or biological condition of the receiving water. These pollutants may not necessarily receive an effluent limit in an IPDES permit but do go through a RPA, described in section 3.4.4. Pollutants of concern are not limited to those parameters covered by technology standards. The permit writer should consider the impact of the treatment processes and operations of the facility on the nature and variability of the effluent. Determining which pollutants are pollutants of concern is an iterative process; additional pollutants of concern may be identified while reviewing the water quality standard and receiving water characterization. The following sections identify the categories of pollutants of concern for WQBEL development.

3.1.1.1 Pollutants with Applicable TBELs

One category of pollutants of concern includes those pollutants for which the permit writer has developed TBELs based on national technology standards or on a case-by-case basis using BPJ. By developing TBELs for a pollutant, the permit writer has already determined that there will be some type of final limit for that pollutant in the permit and must then determine whether more stringent limits than the applicable TBELs are needed to prevent an excursion above the water

quality standards in the receiving water. A permit writer can determine whether the TBELs are sufficiently protective by completing a RPA.

3.1.1.2 Pollutants with a Total Maximum Daily Load Wasteload Allocation

Pollutants of concern include those pollutants for which a total maximum daily load (TMDL) wasteload allocation (WLA) has been assigned to a discharger, or any discharge containing the identified pollutant erroneously omitted from the TMDL. A TMDL WLA, as applied here, refers to the portion of the receiving water body loading capacity that is allocated to one of its existing or future pollutant point sources. The TMDL WLA could be allocated through an EPA-approved TMDL or an EPA or state watershed load analysis. IDAPA 58.01.25.302.06.a.vii.2 requires that permits include effluent limits developed consistent with the assumptions and requirements of any TMDL WLA.

A TMDL is a calculation of the maximum amount of a single pollutant that a water body can receive and still meet water quality standards. The TMDL may allocate an amount of the pollutant to the various pollutant sources discharging to the water body. These portions of the TMDL assigned to point sources are WLAs, and the portions assigned to nonpoint sources and background concentrations of the pollutant are load allocations. The calculation must include a margin of safety to ensure that the water body can be used for the purposes designated in the water quality standards, to provide for the uncertainty in predicting how well pollutant reduction will result in meeting the standards, and to account for seasonal variations. A TMDL might also include a reserve capacity to accommodate expanded or new discharges in the future.

3.1.1.3 Pollutants Identified as Needing WQBELs in Previous Permit

Another category of pollutants of concern includes those pollutants identified as needing WQBELs in the discharger's previous permit. Permit writers must determine whether the conditions leading to a decision to include WQBELs for the pollutant in the previous permit continue to apply. If those conditions no longer apply, the permit writer completes an antibacksliding analysis to determine whether to make the WQBELs less stringent than the previous permit. Section 4.1 describes how antibacksliding requirements are applied to the permit development process.

3.1.1.4 Pollutants Identified as Present in Effluent through Monitoring

Pollutants of concern also include any pollutants detected in the effluent. Effluent monitoring data are reported in the discharger's IPDES permit application, DMRs, annual reports, and special studies. Whole effluent toxicity (WET) testing and expanded effluent monitoring may be required of POTWs to determine effluent toxicity or pollutants of concern. DEQ may collect data through compliance biomonitoring and/or sampling inspections or other special studies. Permit writers can match information on which pollutants are present in the effluent to the applicable water quality standard to identify parameters that are candidates for WQBELs.

3.1.1.5 Pollutants Otherwise Expected to be Present in Discharge

Another category of concern includes those pollutants not in one of the other categories but otherwise expected to be present in the discharge. Pollutants may be present for which neither

the discharger nor DEQ have monitoring data, but because of raw materials stored or used, products or by-products of the facility operation, or available data on similar facilities, the permit writer has a strong basis for expecting the pollutant to be present in the discharge. The permit writer should require the discharger to provide effluent monitoring data, or base the determination for WQBELS on other information, such as effluent characteristics of a similar discharge. Section 3.4.4.1 further discusses what to do if data are not available.

3.1.2 Identify Effluent Critical Conditions

Identifying the right effluent critical conditions is important for appropriately applying a water quality model to assess the need for WQBELs and to calculate WQBELs. The process to determine the appropriate water quality model and the variables associated with the calculation are presented in section 3.4.3.13. The effluent critical conditions used in the calculation are summarized in sections 3.1.2.1 and 3.1.2.2. Receiving water critical conditions are presented in section 3.2.

3.1.2.1 Effluent Flow

Effluent flow is a critical design condition used when modeling the discharge's impact on receiving water. A permit writer can obtain effluent flow data from DMRs or a permit application. IDAPA 58.01.25 specifies which flow measurements to use as the critical effluent flow values in various water quality-based permitting calculations (e.g., facility design flow, maximum daily flow reported on the permit application, or maximum of the monthly average flows from DMRs for the past 3 years). The calculations will use either the production flow or the design flow rate.

3.1.2.2 Effluent Pollutant Concentration

Permit writers can determine the pollutant of concern's critical effluent concentration by gathering effluent data representing the discharge. In most cases, permit writers have a limited effluent data set and no definitive way to determine that the data actually include the pollutant of concern's maximum potential effluent concentration. The TSD (EPA 1991) provides guidance on how to statistically characterize pollutant concentrations for toxic pollutants from a limited data set and appropriately account for variability.

From studies of effluent data from numerous facilities, EPA determined that daily pollutant measurements follow a lognormal distribution. The TSD procedures allow permit writers to project a critical effluent concentration from a limited dataset using statistical procedures based on the characteristics of the lognormal distribution (IPDES User's Guide Volume 1, section 12) (DEQ 2016a). These procedures use the number of effluent data points for the measured concentration of the pollutant and coefficient of variation (CV) of the data set, which is a measure of the variability of data around the average, to predict the critical pollutant concentration in the effluent.

The TSD recommends a CV of 0.6 for data sets with fewer than 10 data points. Data sets of more than 10 data points provide a sufficient level of certainty to calculate a standard deviation and mean with confidence. The resulting CV may be different from the 0.6 default recommended in the TSD (Equation 8).

$$CV = \frac{Standard\ Deviation}{Mean}$$

Equation 8. CV calculation.

The permit writer may statistically evaluate the available data for appropriate distribution, outliers, and other attributes. Statistical software available for environmental applications is addressed in the IPDES User's Guide, Volume 1, section 12.2.

3.2 Characterize Receiving Water Critical Conditions

After identifying pollutants of concern in effluent critical conditions, a permit writer should characterize the receiving water. The permit writer uses the information from those characterizations and the water quality standards in section 3.3 to determine whether WQBELs are required and, if so, to calculate WQBELs (section 3.4).

The permit writer must consider the impact of the discharge to downstream jurisdictions, including affected states and tribes. DEQ will not issue an IPDES permit for a discharge when the permit conditions cannot ensure compliance with the applicable water quality requirements of all affected states (IDAPA 58.01.25.103.03). DEQ will provide public notice of draft permits and public meetings to all affected federal and state agencies with jurisdiction over fish, shellfish, wildlife, and other natural resources, state historic preservation officers, and any affected Indian tribe (DEQ 2016b; IDAPA 58.01.25.109.01.d.i.3).

3.2.1 Receiving Water Upstream Flow

For rivers and streams, an important critical condition is the stream flow upstream of the discharge. The applicable critical flow statistic is specified in the water quality standards and reflects the duration and frequency components of the water quality criterion that is being addressed. WQBELs and mixing zones for toxic substances are based on the receiving water low-flow conditions identified in Table 19.

Table 19. Receiving water low-flow design conditions for reasonable potential analysis and effluent limit development.

Criteria Type	Use Designation	Flow Statistic	Flow Description
Acute	Aquatic life	1Q10	Lowest 1-day flow with an average recurrence frequency of once in 10 years
		1B3	Biologically-based flow indicating an allowable exceedance once every 3 years
Chronic	Aquatic life	7Q10	Lowest 7 consecutive day low flow with an average recurrence frequency of once in 10 years
		4B3	Biologically-based flow indicating an allowable exceedance for 4 consecutive days once every 3 years
Human health (carcinogens)	Contact recreation Domestic water supply	Harmonic mean flow	Long-term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows

Criteria Type	Use Designation	Flow Statistic	Flow Description
Human health (noncarcinogens)[a]	Contact recreation Domestic water supply	30Q5	Lowest 30 consecutive day low flow with an average recurrence frequency of once in 5 years
		Or	
		Harmonic mean flow	Long-term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows. (If the effects from certain noncarcinogens are manifested after a lifetime of exposure, a harmonic mean flow may be appropriate.)

a. The 30Q5 low flow is specified in IDAPA 58.01.02.210.03.b. As of October 2016, this element of Idaho's water quality standards was removed and replaced with the harmonic mean flow; this change has not been approved by EPA for CWA purposes.

For most pollutants and criteria, the critical flow in rivers and streams is some measure of the low flow of that river or stream; however, the critical condition could be different (e.g., a high flow, where wet weather sources are a major problem). If a discharge is controlled so that it does not cause water quality criteria to be exceeded in the receiving water at the critical flow condition, the discharge controls should be protective and ensure that water quality criteria and designated uses, are attained under all receiving water flow conditions. A receiving water body is considered nonflowing when it has a mean detention time longer than 15 days. DEQ will assess nonflowing water bodies on a case-by-case basis (section 3.4.3.4.2).

Several approaches can be used to obtain or estimate critical low-flow data for a receiving water. The certainty of each approach depends on the quantity of data available, and methodology ranges from direct calculation to pure estimation. These methods are discussed in detail below.

3.2.1.1 Use DFLOW

The approach with the most accurate low flows calculates low flows directly through DFLOW (part of EPA's BASINS suite of modeling tools). Calculating low flows directly requires several years of daily flow data, the quantity of which depends on the type of flow being calculated. For example, 1Q10 and 7Q10 require at least 10 years of flow data, 30Q5 requires 5 years, and 4B3 requires 3 years of daily flow data. The DFLOW model cannot run without the minimum number of years of data required for the flow type.

The primary sources for flow data are the United States Geological Survey's (USGS) National Water Information System and EPA's STORET system. The National Water Quality Monitoring Council pulls data directly from both of these sources simultaneously and provides biological and water quality data from BioData and Stewards. DEQ recommends that permit writers use the National Water Quality Monitoring Council site to easily pull data from all four sources when available.

When data are limited or unavailable, estimates must be made. Several options are available to the permit writer in these circumstances.

3.2.1.2 Move Upstream or Downstream

If the nearest gage to the discharge does not have enough data for use in DFlow, or if data are too old to be valuable, the permit writer may move farther upstream or downstream to find a sufficient gage. The permit writer should account for any significant sources of flow or diversions between the point where a critical low flow has been calculated and the point of discharge.

3.2.1.3 Correlate with a Long-Term Gage

If some stream flow data are available at or near the discharge but not enough to calculate the critical flows directly, and a long-term gage exists in the same hydrologic unit code, the permit writer can correlate the data between the two gages. The data at the long-term gage must be contemporaneous data that correlates well with the flow data for the point of discharge. The Office of Environmental Review and Assessment developed spreadsheet workbooks that correlate flow data using the Maintenance of Variance Extension (MOVE) method described by Hirsch (1982). Two MOVE methods, MOVE 1 and MOVE 2, and spreadsheet workbooks are available. DEQ recommends the permit writer try both types and use the type that produces the more accurate correlation under low-flow conditions.

3.2.1.4 Estimate Using Arithmetic and Harmonic Means

If 10 years of data are not available, the permit writer can estimate the flows based on available data using the arithmetic and harmonic means as the basis for all other calculations. The TSD defines the relationship between the harmonic mean, arithmetic mean, and 7Q10. Using this relationship, the permit writer can estimate addition flows (e.g., 1Q10 and 30Q5). At a minimum, for *every* dataset, the permit writer can calculate the harmonic and arithmetic means (Equation 9).

$$Q_{hm} = [1.194 \times (Q_{am})^{0.473}] \times [(7Q10)^{0.552}]$$

Equation 9. Harmonic mean flow calculation.

Where:

Q_{hm} = Harmonic mean
Q_{am} = Arithmetic mean

Equation 10 can be solved for the 7Q10 as follows:

$$7Q10 = \left(\frac{Q_{hm}}{1.194 \times {Q_{am}}^{0.473}}\right)^{1/0.552}$$

Equation 10. 7Q10 calculation.

The TSD also states that two-thirds of streams have harmonic mean flows that are equal to or greater than 3.5 times the 7Q10. Therefore, the 7Q10 may also be estimated as follows (Equation 11):

$$7Q10 = \frac{Q_{hm}}{3.5}$$

Equation 11. Alternative 7Q10 calculation.

The TSD (EPA 1991, Box 3-2, page 53) states that "for less than 10 items of data, the uncertainty in the (CV) is too large to calculate a standard deviation or mean with sufficient

confidence." In this procedure, the 7Q10 is estimated from the harmonic and/or arithmetic means. The uncertainty in the means (and the estimated 7Q10) will be large if less than 10 flow data points are available.

To address this uncertainty, if less than 10 flow data points are available, the 7Q10 should be estimated as the minimum of the results of Equation 10 and Equation 11. If at least 10 flow data points are available, it is likely that Equation 10 will yield a more accurate estimate of the 7Q10, and it should be used even if Equation 11 yields a lower estimate.

The TSD (EPA 1991, page 89) states "in the comparisons of flows for smaller rivers (i.e., low flow of 50 cfs), the 30Q5 flow was, on the average, only 1.1 times that of the 7Q10. For larger rivers (i.e., low flow of 600 cfs), the factor was, on the average, 1.4 times." The chapter on "Stream Design Flow For Steady-State Modeling" from the *Technical Guidance Manual for Performing Wasteload Allocation: Book VI* (EPA 1986, page 2–3) states that the average ratio of the 7Q10 to the 1Q10 is 1.3:1.

Once the 7Q10 has been estimated, the 1Q10 and 30Q5 can be estimated as follows (Equation 12–Equation 14):

$$1Q10 = \frac{7Q10}{1.3}$$

Equation 12. 1Q10 calculation.

$$30Q5 = 7Q10 \times 1.4$$

Equation 13. 30Q5 calculation (large rivers, low flow 600 cfs or more).

$$30Q5 = 7Q10 \times 1.1$$

Equation 14. 30Q5 calculation (small rivers, low flow 50 cfs or less).

In the above procedure, the 30Q5 flow rate is estimated to be at most 1.4 times the estimated 7Q10. Therefore, the 4-day average receiving water concentration of ammonia, based on the estimated 7Q10, would be at most about 1.4 times the 30-day average concentration based on the estimated 30Q5. When using this procedure to determine reasonable potential or to calculate effluent limits for ammonia in fresh water, the permit writer may assume that ensuring compliance with the 30-day average freshwater ammonia criterion at the estimated 30Q5 flow rate will also ensure compliance with the requirement that the maximum 4-day average concentration (i.e., the receiving water concentration at the estimated 7Q10 flow rate) does not exceed 2.5 times the chronic criterion.

3.2.1.5 Use StreamStats

When no data or not enough data are available to provide a confident estimate, the permit writer may use the USGS StreamStats. StreamStats allows users to estimate streamflow statistics for ungaged locations (*http://water.usgs.gov/osw/streamstats/)*. StreamStats assumes natural flow conditions at the ungaged site and can neither reliably produce estimates for any waters affected by dams nor account for diversions, returns, or withdrawals. If the permit writer cannot calculate or estimate critical low flows, surface water flow monitoring requirements may be inserted into the permit.

3.2.2 Receiving Water Upstream Pollutant Concentration

DEQ also needs the critical upstream concentration in the receiving water to ensure that any pollutant limits protect the beneficial uses and support the antidegradation policy and implementation. When available, ambient data provide the most reliable receiving water background pollutant characterization. DEQ typically uses the 90th to 95th percentile of background data to characterize receiving water quality, depending on factors such as environmental conditions, data quality, and data quantity. Sections 3.4.3.14.3 and 3.4.3.14.4 provide additional guidance on assessing background receiving water attributes. When data are not available, DEQ may include ambient monitoring requirements in the permit conditions, along with a reopener clause. When data are not available but are being collected, ambient monitoring requirements and the availability of mixing would be determined on a case-by-case basis depending on the potential risk to beneficial uses (sensitivity of uses).

3.2.3 Other Receiving Water Characteristics

Critical environmental conditions, other than flow (e.g., water level fluctuation and temperature) may apply to receiving water bodies. Depending on the pollutant of concern, the effects of biological activity and reaction chemistry might be important in assessing the impact of a discharge on the receiving water. In these situations, additional critical receiving water conditions, such as pH, temperature, hardness, or reaction rates, and the presence or absence of certain fish species or life stages of aquatic organisms, consistent with the water quality standards are used in a water quality model. Section 3.4.3.13 further discusses how critical conditions are applied in a water quality model to determine need and to calculate WQBELs.

3.3 Determine Applicable Water Quality Standards

The CWA requires states to develop and, from time to time, revise water quality standards. The Idaho Water Quality Standards Program is a joint effort between DEQ and EPA. EPA develops recommended criteria, regulations, policies, and guidance consistent with the CWA requirements. DEQ may adopt and enforce EPA's recommendations directly or modify them to fit state-specific conditions to protect beneficial uses. EPA has authority to review, approve or disapprove state standards, and promulgate federal water quality rules if it finds the state is not meeting CWA requirements.

Water quality standards define water quality goals and pollutant limits that support beneficial uses. In establishing standards, DEQ must consider the use and value of waters for public water supplies, propagation of fish and wildlife, recreation, agriculture, industry, and navigation.

DEQ's water quality standards are published in IDAPA 58.01.02. The standards designate the uses that are protected for each water body and are the basis for restrictions placed on wastewater discharge and human activities that may adversely affect public health and water quality. When developing an IPDES permit, the permit writer must identify and use EPA-approved water quality standards applicable to the receiving water body.

Water quality standards are comprised of three components:

- Beneficial uses—Ways in which humans and animals use the water

- Water quality criteria—Specify the water quality required to protect beneficial uses (numeric or narrative)
- Antidegradation—Policy designed to maintain and protect water quality

3.3.1 Beneficial Uses

Water bodies are assigned beneficial uses based on their expected or current uses. From IDAPA 58.01.02.100, beneficial uses are any of the various uses for which citizens utilize the state's waters, including, but not limited to, the following:

- Aquatic life
- Recreation (primary contact and secondary contact)
- Water supply (domestic, agricultural, and industrial)
- Wildlife habitats
- Aesthetics

The CWA also requires Idaho to recognize existing uses, which are uses attained in a water body on or after November 28, 1975, whether or not they are designated uses. While a water body may have competing beneficial uses, the CWA requires DEQ to protect the most sensitive use.

In some cases, a water body does not have designated uses. For these water bodies, DEQ applies a presumed use protection, meaning the water body will be protected for cold water aquatic life and contact recreation. DEQ must also consider and ensure the attainment and maintenance of the water quality standards of downstream waters when establishing designated uses. Designated and presumed uses apply unless a use attainability analysis (UAA) is conducted by DEQ and approved by EPA. In developing the UAA, DEQ may consider a site-specific analysis completed and presented by a discharger to assess the beneficial uses of a receiving water body. The discharger should coordinate with DEQ when collecting site-specific data so the collected data are useful for DEQ's analysis and possible rulemaking. Existing uses cannot be removed.

Permit writers should consider whether a water body is supporting its designated beneficial uses when identifying any additional pollutants of concern in the effluent. Permit writers will check the most current Integrated Report and confer with the regional office assessment coordinators to determine the beneficial use support status of the receiving water and any downstream assessment units that may be impacted by the discharge. DEQ may consider monitoring requirements to collect additional data related to the presence or absence of the impairing pollutant in a specific discharge to provide information for further analyses.

Under CWA §303(d), states are required to develop lists of impaired waters. Impaired waters are those that do not meet the water quality standards set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that those jurisdictions establish priority rankings for water on their CWA §303(d) list and develop TMDLs for those waters.

DEQ may consider any pollutant associated with an impairment (DEQ 2015) of the receiving water a pollutant of concern in permit development, regardless of whether an approved TMDL has been developed for that pollutant, a TMDL WLA has been assigned to the facility, or the permitted facility has demonstrated that the pollutant is present in its effluent.

3.3.2 Water Quality Criteria

Water quality criteria are scientifically determined parameters or pollutants that are sufficiently supportive of the water body's designated uses. These parameters can include both numeric and narrative criteria. Numeric water quality criteria are developed for specific parameters to protect wildlife, aquatic life, and human health from pollutants' deleterious effects. DEQ established narrative criteria where numeric criteria cannot be established or supplement numeric criteria. As new or revised numeric and narrative criteria are developed, the RPA and effluent limit development will comply with EPA-approved criteria. Criteria and calculations identified below are examples based on water quality standards effective in 2017. **Reference the current water quality standards to ensure the calculations use the most current criteria.**

3.3.2.1 Numeric Criteria—Aquatic Life

Numeric criteria for aquatic life use designations are designed to protect aquatic organisms, including both plants and animals. Aquatic life criteria address short-term (acute) and long-term (chronic) effects on species. Each of these criteria typically consists of three components:

- **Magnitude:** The level of pollutant or pollutant parameter, usually expressed as a concentration, that is allowable.
- **Duration:** The period (averaging period) over which the instream concentration is averaged for comparison with criteria concentrations.
- **Frequency:** How often criteria may be exceeded.

Most Idaho numeric criteria developed to support aquatic life use the 1-hour duration for criterion maximum concentrations (CMC—acute) and the 4-day duration for criterion continuous concentrations (CCC—chronic). An exception is ammonia. Ammonia criteria use 1-hour CMC and 30-day CCC durations, and the highest 4-day average within the 30-day period should not exceed 2.5 times the 30-day CCC.

Below is an example of freshwater aquatic life criteria for chlorine (IDAPA 58.01.02.210):

- CMC—The maximum instantaneous or 1-hour average concentration of total residual chlorine may not exceed 19 micrograms per liter (µg/L) more than once every 3 years.
- CCC—The 4-day average concentration of total residual chlorine may not exceed 11 µg/L more than once every 3 years.

Idaho's water quality standards include aquatic life criteria for parameters such as temperature, pH, and dissolved oxygen that differ from other chemical pollutants. Temperature criteria are expressed as both absolute temperature values (e.g., temperature may not exceed 22 °C) and restrictions on causing changes in temperature in the water body (e.g., temperatures in lakes shall have no measureable change from natural background conditions). Criteria for pH are expressed as an acceptable pH range (6.5–9.0 standard unit) in the water body. IDAPA 58.01.02.250.02.f specifies dissolved oxygen minimum concentrations, and in waters designated for salmonid spawning, percent oxygen saturation that must be maintained.

Where no specific numeric aquatic life criteria have been established for a pollutant, permit writers should address the pollutant using narrative criteria for hazardous materials and toxics from IDAPA 58.01.02.200, which includes performing an RPA for WET. WET monitoring and

developing appropriate WET effluent limits will appear in the permit, if appropriate, and documented in the fact sheet.

3.3.2.1.1 Calculate Metals and Ammonia Criteria

Several commonly monitored metals and ammonia have criteria that are expressed as equations that account for the effects of other environmental conditions on toxicity. To determine whether a criterion is met, the permit writer must not only have the results of ambient and/or effluent monitoring for the pollutant of concern but must also have access to information specific to the monitoring site and period. Criteria and calculations identified below are examples based on water quality standards effective in 2017. **Reference current water quality standards to ensure the calculations used are the most current criteria.**

Spreadsheets are available on DEQ's web page to calculate criteria values for metals and ammonia: *http://www.deq.idaho.gov/water-quality/surface-water/water-quality-criteria/*.

If concurrent hardness, pH, or temperatures are not available, the permit writer may use typical values, if known, for the water body in question for the period of interest. Whether or not typical values are used or monitoring data are used, the assumptions concerning these values must be documented in the fact sheet.

Metals

One factor impacting metal criteria is the water effects ratio (WER). The WER is the ratio of the WET test toxicity to aquatic life when solutions composed with receiving water are compared to solutions of laboratory dilution water. The WER has a value of 1 unless a site-specific criterion has been developed by DEQ and submitted to and approved by EPA. Arsenic and chromium (VI) have modifying coefficients listed in IDAPA 58.01.02.210.01.

Consider hardness-dependent metals (cadmium, chromium (III), copper, lead, nickel, silver, and zinc), which are calculated using hardness, standard coefficients, and conversion factors, and the WER. The aquatic life criteria are a function of total hardness (mg/L as calcium carbonate), the pollutants' WER (IDAPA 58.01.02.210.03.c.iii) and are multiplied by an appropriate conversion factor as defined in IDAPA 58.01.02.210.02. IDAPA 58.01.02.210.02 includes a table with coefficients and conversion factors. Hardness-dependent metals criteria are calculated using values from this table using Equation 15 and Equation 16:

$$\text{CMC} = \text{WER}\exp(mA[\ln(hardness)] + bA) \times Acute\ Conversion\ Factor$$

Equation 15. Calculation for hardness-dependent metals criteria (acute).

$$\text{CCC} = \text{WER}\exp(mc[\ln(hardness)] + bc) \times Chronic\ Conversion\ Factor$$

Equation 16. Calculation for hardness-dependent metals criteria (chronic).

Where:

WER = Water effects ratio (IDAPA 58.01.02.210.03.c.iii)

exp = Base e exponential function

mA = Slope of the acute regression line
ln hardness = Natural log of total hardness (mg/L as calcium carbonate)
bA = y-intercept of the acute regression line
Acute conversion factor = Total to dissolved conversion factor
mc = Slope of the chronic regression line
bc = y-intercept of the chronic regression line
Chronic conversion factor = Total to dissolved conversion factor

The acute and chronic conversion factors for cadmium and lead must be calculated with Equation 17–Equation 19:

$$\text{Cadmium Acute CF} = 1.136672 - [(\ln hardness)(0.041838)]$$

Equation 17. Acute conversion factor calculation for cadmium.

$$\text{Cadmium Chronic CF} = 1.101672 - [(\ln hardness)(0.041838)]$$

Equation 18. Chronic conversion factor calculation for cadmium.

$$\text{Lead (acute and chronic) CF} = 1.46203 - [(\ln hardness)(0.415712)]$$

Equation 19. Acute and chronic conversion factor calculation for lead.

Hardness-dependent metal calculation considerations are as follows:

- Hardness used for metals criteria calculation must not be less than 25 mg/L as calcium carbonate (IDAPA 58.01.02.210.03.c.i) for metals other than cadmium.
- For cadmium, hardness used for criteria calculation must not be less than 10 mg/L as calcium carbonate, except as specified in 210.03.c.ii and 210.03.c.iii (IDAPA 58.01.02.210.03.c.i).
- Maximum hardness allowed in criterion calculation equations shall not be greater than 400 mg/L as calcium carbonate, except as specified in IDAPA 58.01.02. 210.03.c.ii and iii (IDAPA 58.01.02.210.03.c.i).

Cold water aquatic life for cadmium with a receiving water hardness of 10 mg/L calcium carbonate uses Equation 15 and Equation 16, respectively:

$$\text{CMC} = \text{WER}\exp(mA[\ln hardness] + bA) \times 1.136672 - [(\ln hardness)(0.041838)] = 0.20\ \mu\text{g/L}$$

$$\text{CCC} = \text{WER}\exp(mc[\ln hardness] + bc) \times 1.101672 - [(\ln hardness)(0.041838] = 0.15\ \mu\text{g/L}$$

Hardness is typically established as the 90th to 95th percentile of background data, depending on factors such as environment conditions, data quality, and data quantity (section 3.2.2). Site-specific criteria (section 3.3.2.4) may apply to select water bodies. **The permit writer must work closely with DEQ surface water staff to ensure that applicable water quality standards criteria are used in the analysis and calculations.**

Ammonia

The magnitude of other aquatic life criteria can vary according to other conditions in the water or even based on the presence or absence of certain aquatic life. For example, Idaho's ammonia criteria address magnitude, frequency, and duration as well as variation due to pH, temperature, the presence or absence of salmonid species, and the presence or absence of early life stages of fish. The IDAPA 58.01.02.250.02.d criteria for ammonia to support cold water aquatic life with and without fish early life stages are as follows:

- CMC—The 1-hour average concentration of total ammonia nitrogen (in mg nitrogen/liter [N/L]) is not to exceed the value calculated using Equation 20 more than once every 3 years:

$$\text{CMC} = \frac{0.275}{1+10^{7.204-pH}} + \frac{39.0}{1+10^{pH-7.204}}$$

Equation 20. Calculation for ammonia criteria (acute).

Where: pH = 90th to 95th percentile of pH in the receiving water upstream from the discharge, depending on factors such as environmental conditions, data quality, and data quantity

- CCC—The 30-day average concentration of total ammonia nitrogen (in mg N/L) is not to exceed the value calculated using Equation 21 and Equation 22 more than once every 3 years:

When fish early life stages are likely present:

$$\text{CCC} = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) x\ MIN\ (2.85, 1.45x10^{0.028x(25-T)})$$

Equation 21. Calculation for ammonia criteria (chronic, early life stages present).

Where:
pH = 90th to 95th percentile of pH in the receiving water upstream from the discharge, depending on factors such as environmental conditions, data quality, and data quantity
T = 90th to 95th percentile of the ambient upstream receiving water temperature, depending on factors such as environmental conditions, data quality, and data quantity
MIN = Smallest value from the data set

When fish early life stages are likely absent:

$$\text{CCC} = \left(\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right) x\ (1.45x10^{0.028x(25-T)})$$

Equation 22. Calculation for ammonia criteria (chronic, early life stages absent).

Where:
pH = 90th to 95th percentile of pH in the receiving water upstream from the discharge, depending on factors such as environmental conditions, data quality, and data quantity
T = 90th to 95th percentile of the ambient upstream receiving water temperature, depending on factors such as environmental conditions, data quality, and data quantity

For example, using Equation 20, where pH is 7.0 and temperature is 10.0°C, the cold water aquatic life ammonia criteria are as follows:

$$\text{CMC} = \frac{0.275}{1+10^{7.204-7.0}} + \frac{39.0}{1+10^{7.0-7.204}} = 24 \text{ mg N/L}$$

Using Equation 21, when early life stages are likely present:

$$\text{CCC} = \left(\frac{0.0577}{1+10^{7.688-7.0}} + \frac{2.487}{1+10^{7.0-7.688}}\right) x\ MIN\ (2.85, 1.45x10^{0.028x(25-10)}) = 5.9 \text{ mg N/L}$$

Using Equation 22, when early life stages are likely absent:

$$\text{CCC} = \left(\frac{0.0577}{1+10^{7.688-7.0}} + \frac{2.487}{1+10^{7.0-7.688}}\right) x\ (1.45x10^{0.028x(25-10)}) = 7.9 \text{ mg N/L}$$

3.3.2.1.2 Special Considerations for Temperature Numeric Criteria

Idaho revised its "Point Source Wastewater Treatment Requirements" (IDAPA 58.01.02.401) in 2012 to remove the numeric limits on point source-induced changes in receiving water temperature unless more stringent limits are necessary to meet the applicable requirements of IDAPA 58.01.02.200–300, or unless specific exemptions are made pursuant to IDAPA 58.01.02.080.02. EPA has not yet approved or disapproved this water quality standards revision. Until EPA's final decision, apply the prior EPA-approved treatment requirements shown below (IDAPA 58.01.02.401):

01. **Temperature**. The wastewater must not affect the receiving water outside the mixing zone so that: (7-1-93)

a. The temperature of the receiving water or of downstream waters will interfere with designated beneficial uses. (7-1-93)

b. Daily and seasonal temperature cycles characteristic of the water body are not maintained. (7-1-93)

c. If the water is designated for warm water aquatic life, the induced variation is more than plus two (+2) degrees C. (3-15-02)

d. If the water is designated for cold water aquatic life, seasonal cold water aquatic life, or salmonid spawning, the induced variation is more than plus one (+1) degree C. (3-15-02)

e. If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.01.c. and 401.01.d. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C. (4-11-06)

3.3.2.2 Numeric Criteria—Human Health

Human health criteria for toxic pollutants are designed to protect people from exposure due to consumption of fish or other aquatic organisms, or from consumption of both water and aquatic organisms. Human health chronic criteria are based on lifetime exposure and express the highest concentrations of a pollutant that are not expected to pose significant long-term risk to human health. Other criteria for human health protection (e.g., bacteria criteria) consider a shorter-term exposure through water body use such as contact recreation. All Idaho human health numeric chemical criteria are not to be exceeded.

Human health criteria for toxic pollutants are derived by considering the dose of a pollutant that is ingested by humans. The criteria are based on a human health reference dose, relative source

contribution, human body weight (for adults), drinking water volume, and fish consumption rate for the target population.

Not all toxic substances have acute, chronic, and human health criteria. Many toxic substances do not have numeric criteria. Where no specific numeric human health criteria have been established for a pollutant, permit writers should address the pollutant using narrative criteria for hazardous materials and toxics from IDAPA 58.01.02.200.

3.3.2.3 Narrative Criteria

Idaho's water quality standards include narrative water quality criteria to supplement numeric criteria. Narrative criteria describe the desired water quality goal for a water body. Narrative criteria, for example, require that surface water be "free from hazardous materials in concentrations found to be of public health significance or to impair designated beneficial uses" or "free from toxic substances in concentrations that impair designated beneficial uses" ("General Surface Water Quality Criteria" [IDAPA 58.01.02.200]).

If DEQ has not established a numeric water quality criterion for a specific chemical pollutant that is present in an effluent at concentrations that will cause, have the reasonable potential to cause, or contribute to an excursion above a narrative criterion within an applicable water quality standard, DEQ must establish effluent limits using one of the options listed in IDAPA 58.01.25.302.06.a.vi.

3.3.2.3.1 Considerations for WET

WET tests are used to determine compliance with the narrative criteria for hazardous and toxic substances (IDAPA 58.01.02.200.01 and 200.02, respectively). If the facility meets at least one of the following conditions, they are required to implement WET testing:

- Facility is a POTW with a flow greater than or equal to 1 mgd.
- Facility is a POTW that receives effluent from any industry identified in 40 CFR 403.
- Facility uses, stores, produces, or transfers any hazardous substance listed in 40 CFR 302.4 with a statutory code of 1 (CWA §311(b)(2)) or 2 (CWA §307(a)).
- Facility's effluent contains any toxic pollutant listed in 40 CRF 122, Appendix D for which no water quality criteria exist for aquatic life protection listed in 40 CFR 131.36(b)(1).
- Facility belongs to an industrial category identified in 40 CFR 122, Appendix A (NPDES Primary Industry Categories).
- Facility's effluent is suspected to be toxic because of apparent detrimental impact to aquatic life in the receiving water.
- DEQ determines that the facility has the potential to discharge toxics in toxic amounts.

WET tests account for the toxicity of unknown pollutants as well as synergistic or antagonistic effects among the pollutants. These laboratory tests involve exposing representative aquatic organisms to various dilutions of effluent under specific conditions. The response of these organisms is used to quantify the toxicity of the aggregate effluent. Various responses, or endpoints, can be used to quantify toxicity, all based on the WET test dilution series. For example, the effluent dilution concentration at which 50% of the test organisms die (i.e., lethal

concentration 50 [LC_{50}]) is a commonly used endpoint for acute toxicity. Commonly used endpoints for chronic toxicity tests include the no observed effects concentration (NOEC), the lowest observed effects concentration (LOEC), and the inhibition concentration (IC_x).

If it is necessary to include WET effluent limitations or monitoring requirements in a permit, WET will be quantified using toxic units (TUs). A TU is the reciprocal of the percentage of effluent that causes a specific measured acute or chronic endpoint. Acute toxic units (TU_a) and chronic toxic units (TU_c) are calculated as follows (Equation 23 and Equation 24):

$$TU_a = 100/LC_{50}$$

Equation 23. Acute TUs.

$$TU_c = 100/NOEC$$

or

$$TU_c = 100/IC_{25}$$

or

$$TU_c = 100/LOEC$$

Equation 24. Chronic TUs.

Typically, Idaho's narrative criterion for toxics is interpreted as $TU_a = 0.3$ and $TU_c = 1$, where LC_{50} is expressed as a percentage of effluent used in the WET test, as recommended in the TSD, section 2.3.3 (EPA 1991). For example, in the case of acute testing, if a solution using 100% of the effluent causes 50% of the tested organisms to die (LC_{50}), then $TU_a = 100/100 = 1$. The numeric interpretations are used in the RPA and in developing WQBELs when necessary.

3.3.2.3.2 Considerations for Dissolved Oxygen

Narrative criteria for dissolved oxygen require that surface waters be free from oxygen demanding materials in concentrations that would result in anaerobic water conditions. The narrative criteria are addressed with numeric dissolved oxygen criteria by modeling dissolved oxygen concentrations and limiting discharges of oxygen-demanding pollutants such as BOD, COD, and nutrients (phosphorus and nitrogen).

3.3.2.3.3 Considerations for Nutrients

Idaho has not adopted numeric criteria for nutrients as part of its water quality standards. DEQ needs to determine appropriate nutrient effluent concentrations based on the assimilative capacity of the receiving water and may consider using criteria recommended by EPA or used in states with similar environmental conditions in RPA evaluations.

3.3.2.4 Site-Specific Water Quality Criteria Implementation

DEQ's water quality criteria may not always reflect the toxicity of a pollutant in a specific water body. IDAPA 58.01.02.275 allows developing new water quality criteria or modifying existing criteria that will effectively protect designated and existing beneficial uses in certain water bodies as a result of site-specific analyses. As with all water quality criteria, site-specific criteria must be based on sound scientific principles to protect the beneficial use. Site-specific criteria are subject to EPA review and approval before use for CWA purposes, including IPDES permits.

Permit writers should review IDAPA 58.01.02.276-299 for site-specific criteria applicable to the receiving water and verify that the applicable standard has been approved by EPA. Site-specific criteria supersede IDAPA 58.01.02.210, 250, 251, 252, and 253 for water bodies and pollutants specified in these sections. Site-specific criteria in the water quality standards that are approved by EPA include dissolved oxygen standards for waters discharged from dams, reservoirs, and hydroelectric facilities, and metals, WER, ammonia, dissolved oxygen, and temperature criteria for specified water bodies in Idaho.

3.3.2.5 Variances and Intake Credits

The CWA and state regulations provide limited mechanisms for variances, waivers, and intake credits. An IPDES permit applicant must meet very specific data and application deadline requirements before a variance, waiver, or intake credit may be granted. These mechanisms provide a unique exception to particular requirements, and no expectation to receive a similar permit condition should be assumed by the permittee or applicant. Table 20 explains the available variances and intake credits for dischargers.

Table 20. Available variances and intake credits for IPDES permits.

Request Type	Eligible	CWA	Regulation	Application Deadline[a]	Granting Authority[b]
Thermal discharge	All	316(a)	IDAPA 58.01.25.310 40 CFR 125.70–73	By close of the draft permit comment period if based on a WQBEL	DEQ
Water quality standards	All	N/A	IDAPA 58.01.02.260 40 CFR 131.10(g)(1)–(6)	With a permit application (not specified in rules, necessary to ensure timely permit issuance)	DEQ[c]
Intake credits	All	N/A	IDAPA 58.01.25.303.07	By close of the draft permit comment period	DEQ

a. Permittees are advised to contact DEQ 1 year in advance if considering applying for a variance. The 180-day requirement to submit a complete application for a new permit or permit renewal may not be sufficient to also complete a variance and receive EPA approval. Dischargers must submit all requests to DEQ.
b. Any approved variance or intake credit is effective for up to 5 years or the life of the IPDES permit. After 5 years or the permit expiration, the discharger must meet the standard or must reapply for the variance or intake credit. In considering a reapplication, DEQ requires the discharger to demonstrate reasonable progress toward meeting the standard. DEQ's decisions may be appealed to the Board of Environmental Quality.
c. EPA must approve all changes to water quality standards, including variances from water quality standards.

The options listed above and the factors considered in a technical review are explained in the IPDES User's Guide, Volume 1, section 8 (DEQ 2016a).

3.3.3 Antidegradation

Maintaining water quality above the minimums set by water quality criteria is a primary objective of the CWA. Each state is required to adopt an antidegradation policy as part of its water quality standards. DEQ's antidegradation policy (IDAPA 58.01.02.051) outlines the framework used in making decisions about proposed activities that will result in changes to water quality. The antidegradation implementation procedures (IDAPA 58.01.02.052) are aimed at maintaining the existing quality of Idaho waters.

3.3.3.1 Tiers of Protection

Effluent limits included in IPDES permits must be consistent with Idaho's antidegradation policy. DEQ's antidegradation policy provides three levels of protection (i.e., tiers) from degradation of existing water quality:

- **Maintenance of Existing Uses for All Waters (Tier I Protection)—**Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected in all water bodies (IDAPA 58.01.02.051.01). An established existing use must be protected even if it is not listed in the water quality standards as a designated use. Tier I requirements apply to all surface waters.
- **High Quality Waters (Tier II Protection)—**Where the quality of the water exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected. Water quality may be lowered in Tier II waters but only after public review of the necessity for degradation based on the social and economic importance of the activity. In no case may water quality be lowered to a level that would interfere with existing or designated uses (IDAPA 58.01.02.051.02).
- **Outstanding Resource Waters (Tier III Protection)—**Where an outstanding resource water (ORW) has been designated by the legislature, that water quality shall be maintained and protected from the impacts of point and nonpoint source activities. Idaho does not currently have any designated ORWs (IDAPA 58.01.02.051.03).

If the water receiving the discharge is Tier II, proposed degradation in water quality is evaluated closely to determine if it can be minimized or avoided. If significant degradation cannot be avoided, the activity is evaluated to determine if the activity is necessary and important to the social or economic health of the affected public.

3.3.3.2 Determine Applicable Tiers of Protection

Tier I antidegradation protection applies to all jurisdictional waters, and Tier III waters are designated by statute; therefore, the only tier determination that remains are water bodies qualifying for Tier II protection. This section describes the procedure for determining if Tier II protection is applicable.

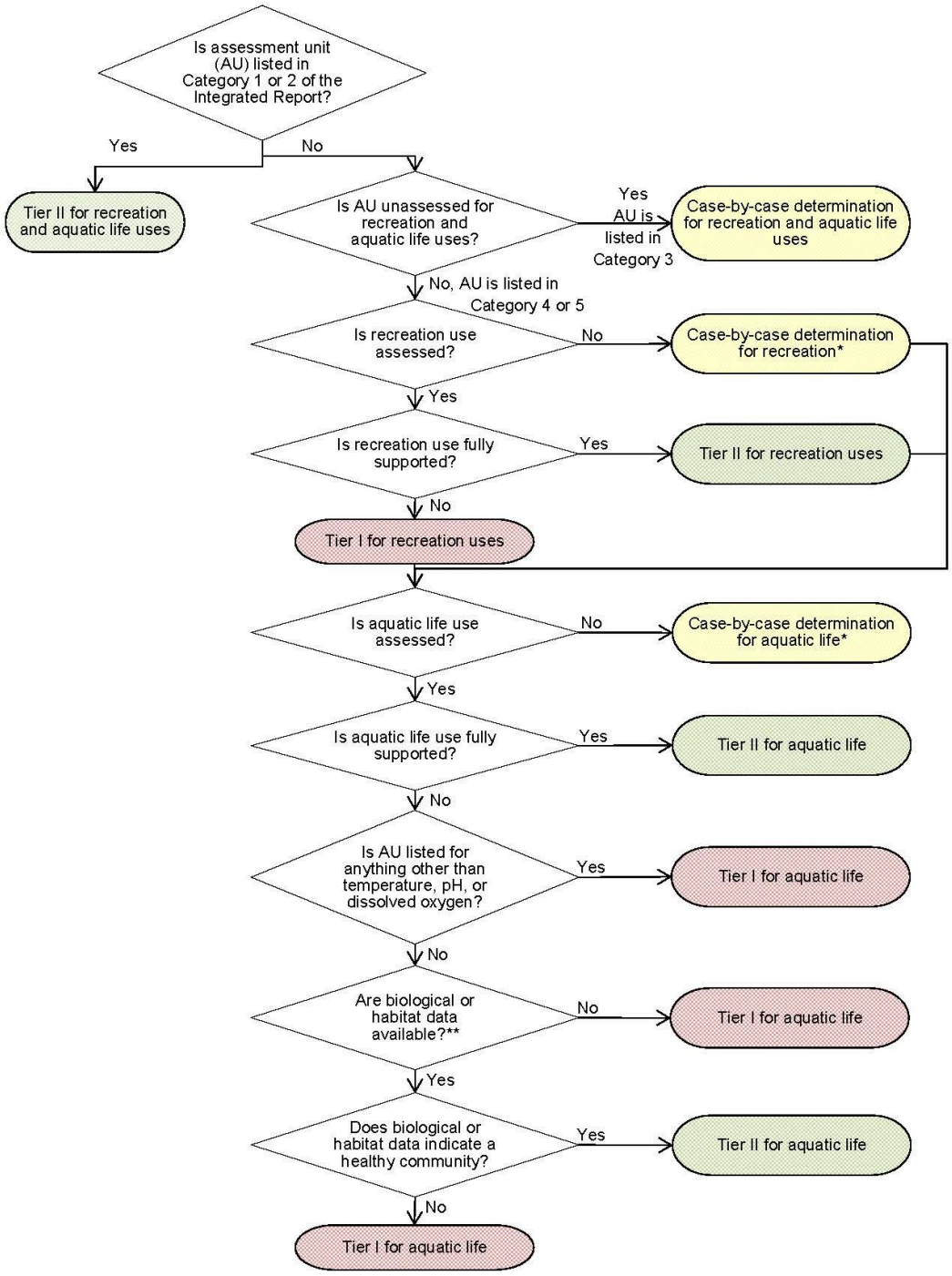
Under Idaho rule, the level of protection is determined on a water body-by-water body basis, using the most recent federally approved Integrated Report, which summarizes Idaho's assessment of water quality. The Integrated Report identifies water bodies that do not support beneficial uses or meet all water quality criteria, also known as impaired water bodies. Because the water quality criteria for aquatic life and recreational uses are distinct and different, water body tiering is split by these broad use categories. A water body can be in Tier I for recreational uses and Tier II for aquatic life uses, or vice versa.

Tier II determination is based on three factors:

- Water body's category of use support according to the most recent federally approved Integrated Report (i.e., Categories 1–5)
- Beneficial uses of the receiving water body
- Whether data indicate the water body as a whole is of high quality

Figure 4 provides a step-by-step process for determining which protection tiers apply to a water body.

More specific information on identifying the applicable protection tiers is found in the draft *Idaho Antidegradation Implementation Procedures* (DEQ 2017a).



*In this situation, DEQ will make an effort to obtain data needed to make an informed decision on support of the use that is unassessed.

**Biological or habitat data can be DEQ BURP data, BURP-compatible data, or external data (DEQ 2016). Antidegradation tiering determinations can be made with data not sufficient for water body assessments.

Figure 4. Process for determining protection tier for antidegradation purposes.

3.4 Determine the Need for WQBELs

After characterizing the effluent and receiving water, and determining the applicable water quality standards, the permit writer determines whether WQBELs are needed. When DEQ determines whether a discharge will cause, have the reasonable potential to cause, or contribute to an instream excursion above numeric or narrative criteria, the permit writer develops WQBELs. These limits account for existing controls on pollution, variability of the pollutants in the effluent, sensitivity of species to toxicity, and dilution of the effluent in the receiving water.

In developing WQBELs, permit writers should check to see if DEQ has developed guidance for the pollutants. They should also consider the appropriate tools to use for the pollutants and site-specific conditions (e.g., simple mass balance equation, Streeter-Phelps equation, a mixing zone model, or water quality model).

3.4.1 Define Reasonable Potential

IPDES regulations require permit writers to assess the impact of discharges to evaluate downstream water quality. The permit must contain effluent limits to control all pollutants that have a RPTE water quality criteria (IDAPA 58.01.25.302.06.i):

> Effluent limitations in a permit must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which the Department determines are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any water quality standard, including narrative criteria for water quality.

The regulation also specifies that the reasonable potential determination must apply not only to numeric criteria but also to narrative criteria (e.g., no toxics in toxic amounts or presence of pollutants or pollutant parameters in amounts that would result in algal blooms).

An RPA is used to determine whether a discharge, alone or combined with other sources of pollutants to a water body and under a set of conditions estimated through a series of reasonable assumptions, could lead to an excursion above applicable water quality standards. A permit writer can conduct RPA using effluent and receiving water data and modeling techniques or using a nonquantitative approach. The quantitative approach is discussed below. The nonquantitative approach is discussed in section 3.4.4.1.

RPA is the basis for determining the need for and subsequently establishing WQBELs, which protect the receiving water and prevent water quality standard violations. After completion, the RPA defines whether a pollutant will cause, have the reasonable potential to cause, or contribute to an excursion above water quality standards.

3.4.2 Assess Critical Conditions

Before performing the RPA, the permit writer must compile data reflecting critical conditions at the point of discharge, including:

- Effluent critical conditions
  - Flow
  - Concentration of pollutants of concern
- Appropriate mixing zone

- Receiving water critical conditions
  - Flow
  - Upstream pollutant concentration
  - Other receiving water characteristics as needed, including temperature, pH, or hardness
- Receiving water antidegradation tier

The effluent and receiving water critical conditions addressed in sections 3.1 and 3.2 provide the background on how to select critical condition inputs and sources of information. After identifying the critical values, they are used as inputs into the model to identify whether a RPTE exists for each of the pollutants at critical conditions.

Compounding conservative assumptions with each selection can result in critical conditions with a probability that is unlikely or impossible to ever occur. Critical conditions should be carefully defined to examine a scenario that has reasonable potential to occur.

- Consider probabilistic approaches to evaluating RPA and calculating limits if needed. The TSD (EPA 1991) notes that this is a viable and in some situations preferable approach to the steady state approach, Monte Carlo modeling is one example.
- Use appropriate tools for evaluation (e.g., biotic ligand model [BLM] for copper) and consider the differences in metals (dissolved and total) versus organics.

3.4.3 Establish an Appropriate Mixing Zone

Mixing zones may be considered when DEQ determines through the IPDES permitting process that WQBELs are necessary because a discharge does not meet water quality standards at end of pipe (IDAPA 58.01.02.010.61):

> A defined area or volume of the receiving water surrounding or adjacent to a wastewater discharge where the receiving water, as a result of the discharge, may not meet all applicable water quality criteria or standards. It is considered a place where wastewater mixes with receiving water and not as a place where effluents are treated.

A mixing zone allows pollutants originating in the discharge to become diluted by the receiving water to ensure support of the water body's beneficial uses. The RPA must demonstrate reasonable potential for a discharge to cause or contribute to an exceedance of water quality criteria for the pollutant to be eligible for a mixing zone. In addition, the receiving water must have available assimilative capacity. Mixing zone configuration and terms are presented in Figure 5.

Mixing zones in nonflowing waters must be authorized using the percentage of the receiving water body's surface area. For new discharges, the linear distance from the outfall must also be taken into account. DEQ has experience making this type of determination although the majority of discharges in Idaho are to flowing waters. Authorizing a new or expanded mixing zone in nonflowing waters will require careful consideration of the discharge, bathymetry, retention time, localized currents, receiving water beneficial uses, and other currently unidentified factors that may be uncovered.

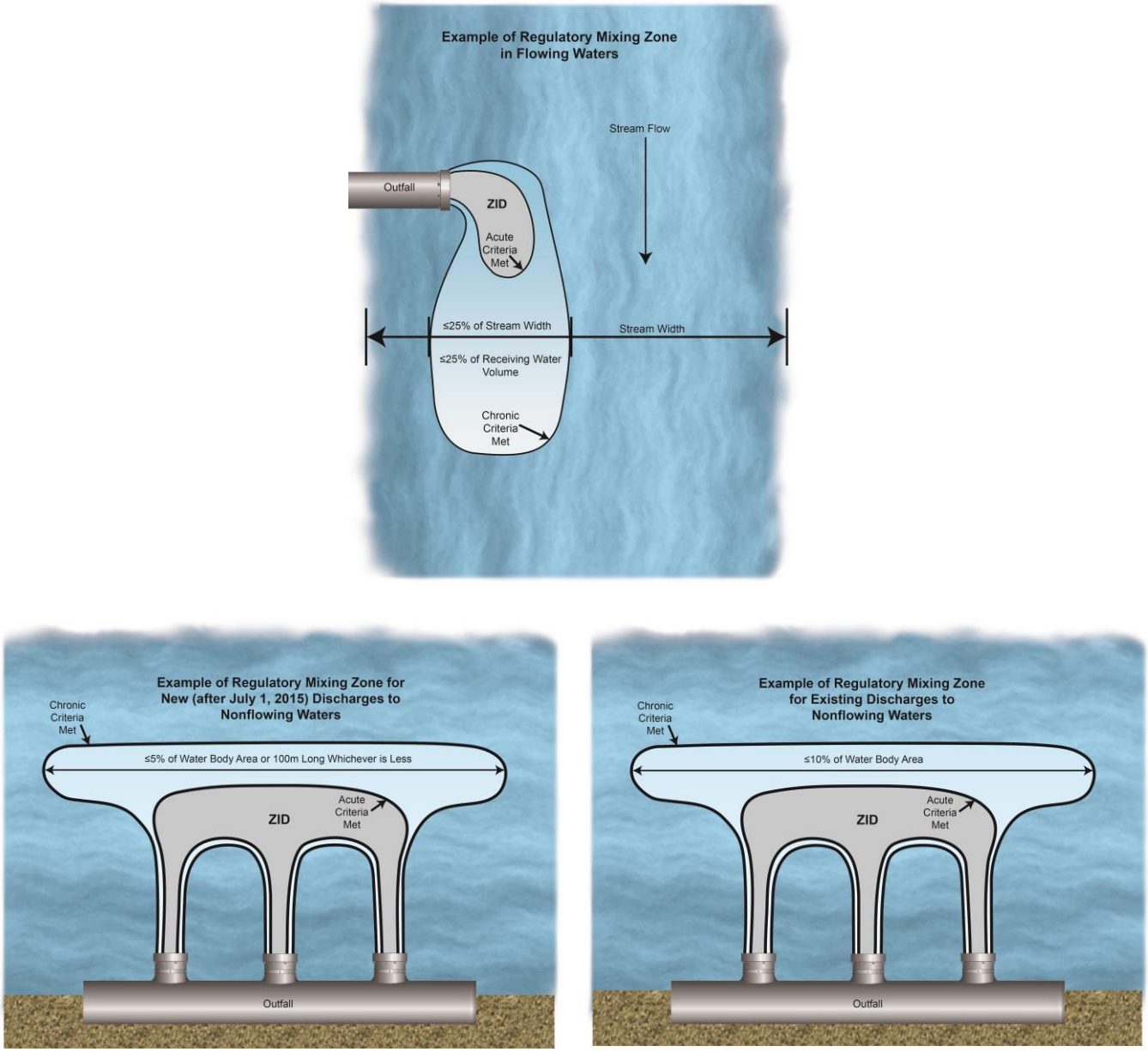


Figure 5. Examples of mixing zones in flowing (top) and nonflowing (bottom) waters. ZID indicates the zone of initial dilution.

Where DEQ proposes to reissue an IPDES permit with an existing mixing zone, the permit writer must determine whether the current mixing zone is the appropriate size. DEQ considers, at a minimum, the previous 5 years of effluent monitoring data to determine whether the existing mixing zone is still the appropriate size. The preferred approach is for DEQ to statistically evaluate facility performance data. The 95th percentile of the effluent data should be used to evaluate the appropriate mixing zone percentage. The mixing zone should be optimized to establish the minimum surface water volume and stream width or nonflowing water area, accompanied by an adjusted dilution factor. These parameters are optimized to the lowest percentage of dilution that would not result in RPTE at the edge of the mixing zone. At that point, the mixing zone may be authorized. Mixing zone percentages are rounded up to the

nearest whole number (e.g., analysis demonstrates a 9.05% mixing zone is necessary, and the percent authorized should be 10%).

A larger mixing zone may be authorized when the discharger and DEQ agree on the siting, technological, and managerial options available. These options include site-specific conditions, flexibility in treatment unit process options, other options the discharger may have, facility modification costs, and operational alternatives. Availability of funds may also be considered.

Because mixing zone modeling is typically based on a series of assumptions that are often tested and refined with water body specific data, DEQ may request the discharger provide additional information to assist in reviewing the appropriateness of the existing mixing zone. New mixing zone calculations are necessary for the following:

- Water quality criteria have been revised.
- Additional data are available for
  - Effluent quality or flow
  - Background water quality
  - Receiving water hydrodynamics

For mixing zones based on aquatic life criteria, DEQ will consider any biological data collected for the mixing zone to verify there are no adverse impacts on aquatic life outside the mixing zone. The process for new permit development is shown in Figure 6.

Federal regulations implementing the CWA and EPA guidance largely defer to the states in establishing specific requirements of mixing zone regulations. This section summarizes Idaho's mixing zone rules. Table 21 cross-references the mixing zone rules (IDAPA 58.01.02.060) and other mixing zone-related sections of Idaho's water quality standards discussed in this guidance.

To protect beneficial uses of a receiving water body, IDAPA 58.01.02.060 requires DEQ to determine on a case-by-case basis whether a mixing zone is authorized and, if applicable, a mixing zone's size, configuration, and location.

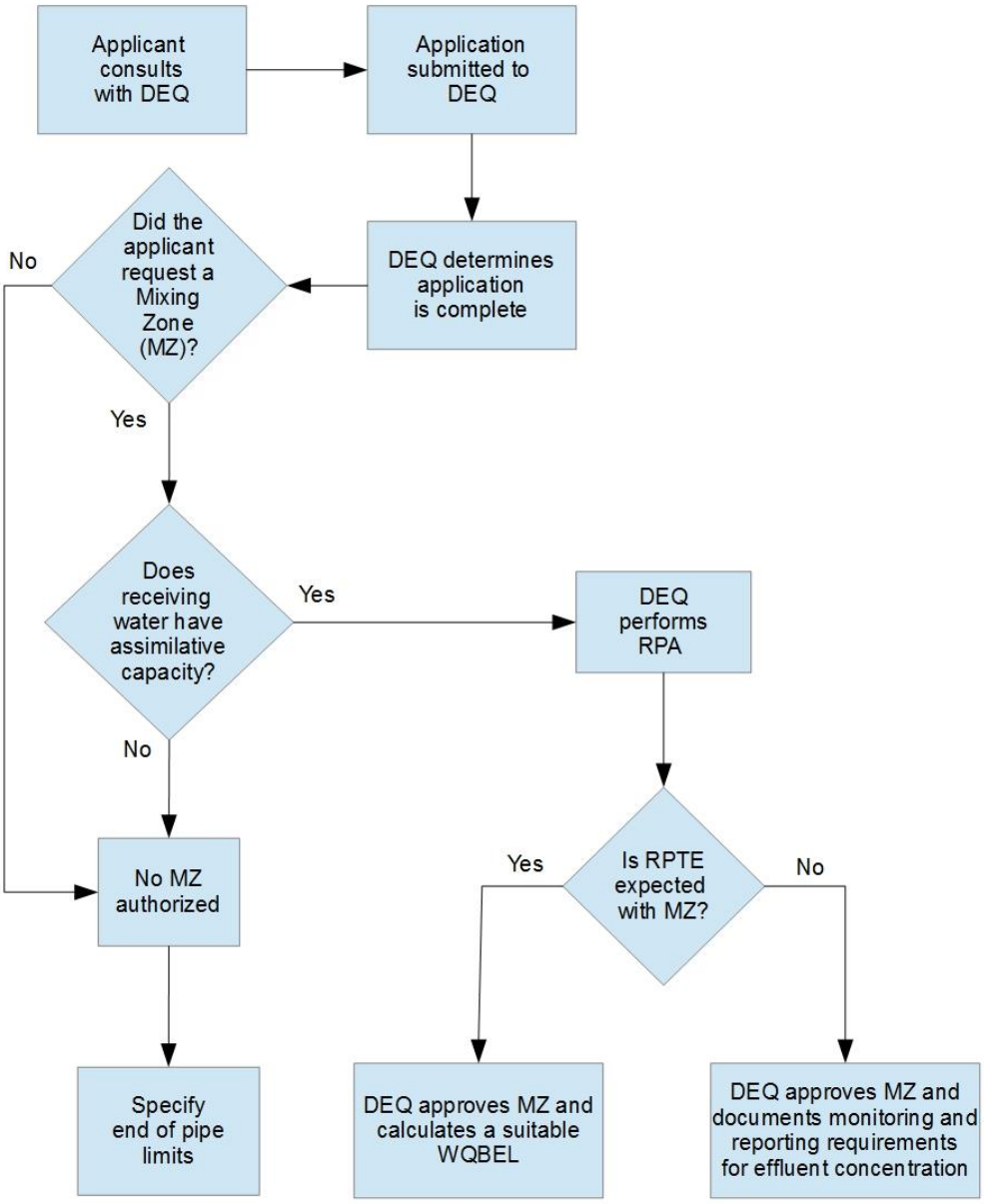


Figure 6. Mixing zone process for new or reissued permit applications.

Table 21. Cross-reference of IDAPA mixing zone rules and ELDG sections.

IDAPA Section	Regulatory Requirement	ELDG Section
58.01.02.010.61	Defines a mixing zone	3.4.3
58.01.02.060.01	Establishes that DEQ may authorize a mixing zone on a case-by-case basis when a permit is issued, renewed, or materially modified	Throughout the document, specifically 3.4.3–3.4.3.1.2
58.01.02.060.01.a	Indicates when a pollutant in a receiving water does not meet water quality criteria but may receive a mixing zone	3.4.3.7.1
58.01.02.060.01.b	Allows water quality exceedance of chronic water quality criteria for specific pollutants, and acute water quality criteria within zone of initial dilution inside the mixing zone	Throughout the document, specifically 3.4.3–3.4.3.1.2
58.01.02.060.01.c	Indicates a mixing zone is evaluated on permitted design flow and must not be larger than necessary	3.4.3.4
58.01.02.060.01.d	Establishes mixing zones must not cause unreasonable interference with or danger to beneficial uses	3.4.3–3.4.3.1.2
58.01.02.060.01.e.i	Allows multiple nested mixing zones for a single point of discharge	3.4.3.4.3
58.01.02.060.01.f	Establishes multiple mixing zones for a single activity with multiple points of discharge	3.4.3.4.3
58.01.02.060.01.g	Indicates adjacent mixing zones from independent activities shall not overlap	3.4.3.4.3
58.01.02.060.01.h.i	Indicates that the width of a mixing zone in flowing waters should not exceed 25% of the stream width or 25% of low-flow design discharge conditions	3.4.3.4.1
58.01.02.060.01.h.ii	Indicates requirements for new discharges to nonflowing waters	3.4.3.4.2
58.01.02.060.01.h.iii	Indicates requirement for existing discharges to nonflowing waters	3.4.3.4.2
58.01.02.060.01.h.iv	Defines which lakes and reservoirs are considered nonflowing waters	3.4.3.4.2
58.01.02.060.01.i	Describes when a mixing zone may vary from subsection 060.01.h	3.4.3.6
58.01.02.060.01.j	Indicates outfall design criteria	3.4.3.4
58.01.02.060.02	Establishes points of compliance as alternatives to mixing zones	3.4.3.7.3
58.01.02.210.01	Includes criteria for toxic substances for aquatic life, recreation, and domestic water supply uses	3.4.3.1, 3.4.3.2, 3.4.3.3
58.01.02.210.03.a	Indicates that criteria apply at the appropriate locations specified within or at the mixing zone boundary	3.4.3
58.01.02.210.03.b	Defines the flow values (e.g., 7Q10 and harmonic mean flow) to be used in mixing zone analyses based on the designated use and type of criteria	3.4.3.4.1,Table 24
58.01.02.250	Includes aquatic life criteria for other pollutants, including ammonia, pH, temperature, dissolved oxygen, turbidity, and dissolved gas	3.4.3.1, 3.4.3.2
58.01.02.251.01	Defines the bacteria criteria that apply for protection of recreation uses	3.4.3.3.2
58.01.02.401.01 through 401.03	Includes criteria for temperature, turbidity, and chlorine that apply to wastewater discharges	3.4.3–3.4.3.1.2

As stated previously, TBELs are the minimum level of pollutant controls for point source discharges and are based on technology and cost considerations, ELGs, BPJ, or other federal regulations and must be achieved at the end of pipe. Mixing zones do not apply to TBELs.

In determining whether a mixing zone will be authorized, DEQ considers the following:

- Quality of the effluent
- Assimilative capacity of the receiving water
- Potential impacts of the mixing zone on the beneficial uses of the receiving water body

For DEQ to authorize a mixing zone, the receiving water must possess the capacity to assimilate the discharged pollutant. Assimilative capacity exists when the quality of the receiving water is better than criteria necessary to support beneficial uses. In this evaluation, DEQ also considers upstream permitted dischargers who may not be discharging at their permitted maximum loads. Except when TMDL WLAs or other water quality plans demonstrate assimilative capacity, mixing zones shall not be considered for any pollutant when the receiving water does not meet criteria for that pollutant.

> "Whether a mixing zone is authorized, and its size, configuration, and location, is determined by the Department on a case-by-case basis. This determination is made in accordance with the provisions of Section 060 at the time a permit is issued, renewed, or materially modified and is in effect as long as the permit remains in effect. Such an authorization is required before a mixing zone can be used to determine the need for, or level of, effluent limits for a particular pollutant." (IDAPA 58.01.02.060)

Mixing zone evaluations should consider the potential impacts of the mixing zone on the beneficial uses of the receiving water, including the effects on aquatic organisms and human health. Idaho's mixing zone rules stipulate that the location of a mixing zone should not cause unreasonable interference with, or danger to, beneficial uses (IDAPA 58.01.02.060.01.d).

Unreasonable interference with, or danger to, beneficial uses includes, but is not limited to, the following:

- Impairment to the integrity of the aquatic community
- Thermal shock, lethality, or loss of cold water refugia due to heat in a discharge
- Bioaccumulation of pollutants exceeding levels protective of human health or aquatic life
- Lethality to aquatic life as a result of passage through the mixing zone
- Exceedance of maximum contaminant levels (MCLs) at drinking water intakes
- Creating conditions that impede or prohibit recreation

Table 22 summarizes the considerations to be addressed in mixing zone evaluations.

Table 22. Summary of key considerations for mixing zone evaluations.

Key Mixing Zone Considerations	Direction
Can water quality criteria be met at end of pipe?	If yes, a mixing zone is not applicable; however, Idaho's Antidegradation Policy (IDAPA 58.01.02.051) must be considered. If no, a mixing zone analysis must be performed and a mixing zone may be authorized by DEQ.
What is the assimilative capacity of the receiving water body for the pollutants of concern in the proposed discharge?	A mixing zone is not allowed where assimilative capacity does not exist (with certain exceptions per IDAPA 58.01.02.060.01.a.). The mixing zone authorization must be consistent with Idaho's Antidegradation Policy.
What are the aquatic life beneficial uses of the water body?	Describe the aquatic life uses and list the appropriate aquatic life numeric criteria for all pollutants in the effluent for which a mixing zone is proposed. If an aquatic life use is not designated, DEQ generally protects the water body for cold water aquatic life.
Is salmonid spawning a beneficial use within the proposed mixing zone area?	If yes, evaluate the proposed mixing zone potential to adversely impact salmonid spawning. An appropriate mixing zone may need to be smaller. Another option to allow mixing is relocation of the outfall.
Does effluent contain substances known to be toxic to aquatic life?	If yes, describe all potential toxic substances, predicted concentrations within the mixing zone, and the sensitivity of the aquatic community to the toxins in the vicinity of the mixing zone (especially species and/or life stages of greatest conservation need).
Are acute water quality criteria predicted to be exceeded in the mixing zone?	If yes, describe the spatial extent of such exceedances and evaluate the potential for acutely toxic conditions.
Will the mixing zone contain any pollutants known to elicit an avoidance behavior?	If yes, list these pollutants and the species that will potentially be affected. Describe the spatial and temporal extent of the mixing zone and extent of the zone of passage. If no, provide a basis for this conclusion.
Will the mixing zone contain any pollutants known to attract aquatic life?	If yes, list these pollutants and the species that will potentially be affected. Describe the spatial and temporal extent of the mixing zone. If no, provide a basis for this conclusion.
Will the effluent include pollutants known or predicted to bioaccumulate or bioconcentrate? Are fish likely to be harvested from the water body in the vicinity of the mixing zone area?	If yes, list these pollutants and describe their predicted concentration in the mixing zone and the potential impact on the food web. In addition, discuss the assimilative capacity of the receiving system and all proposed monitoring efforts for assessing the impacts of such pollutants.
What is the contact recreation beneficial use of the water body?	Describe the public access to the mixing zone area and the seasonality of public use. List the human health-based numeric criteria for consumption of organisms for all pollutants in the effluent for which a mixing zone is proposed. Note: where contact recreation is not designated, DEQ presumes the water body will support either primary or secondary contact recreation.
Is the water body designated as a domestic water supply?	If yes, list the human health-based numeric criteria for consumption of water and organisms for all pollutants in the effluent for which a mixing zone is proposed.
What is the extent of the mixing zone?	Describe the proposed mixing zone's spatial and temporal characteristics.

Key Mixing Zone Considerations	Direction
For existing dischargers, is there an established or proposed monitoring plan that will adequately characterize the physical, chemical, and biological conditions of the water body upstream and downstream from the proposed mixing zone?	If yes, describe the monitoring plan in detail, including all spatial and temporal aspects of the monitoring and quality assurance/quality control procedures.
For new dischargers, is there a proposed monitoring plan that will adequately characterize the predischarge physical, chemical, and biological condition of the water body and all postdischarge impacts from the proposed mixing zone?	If no, sufficient information should be submitted that describes why monitoring is not needed.

When establishing the appropriate size of a mixing zone, the permit writer performs an iterative series of RPAs, adjusting the mixing zone as necessary until RPTE is no longer demonstrated. Acute criteria may be exceeded in an area within the mixing zone called the zone of initial dilution (ZID) (IDAPA 58.01.02.010.118). The ZID may be no larger than necessary and the entire mixing zone should not exceed 25% of the low-flow volume of the receiving water for flowing water bodies. For nonflowing waters, the mixing zone will not exceed 10% of the total horizontal area of the water body for existing discharges and 5% of the area or 100 meters in length (whichever is smaller) for new discharges (IDAPA 58.01.02.060.01.h).

3.4.3.1 Water Quality Standards

3.4.3.1.1 Numeric Criteria

Numeric criteria are specific to beneficial uses of a receiving water body and are used to appropriately evaluate a mixing zone. The most stringent of all applicable use-specific criteria will drive the mixing zone analysis.

Acute criteria should be met at the boundary of the ZID; chronic and narrative criteria must be met at the boundary of the mixing zone (IDAPA 58.01.02.060.01.b) (Figure 5).

> Zone of initial dilution is “an area within a Department authorized mixing zone where acute criteria may be exceeded. This area shall be no larger than necessary and shall be sized to prevent lethality to swimming or drifting organisms by ensuring that organisms are not exposed to concentrations exceeding acute criteria for more than one (1) hour more than once in three (3) years. The actual size of the ZID will be determined by the Department for a discharge on a case-by-case basis, taking into consideration mixing zone modeling and associated size recommendations and any other pertinent chemical, physical, and biological data available” (IDAPA 58.01.02.010.117).

3.4.3.1.2 Narrative Criteria

Water quality standards must be met, including the narrative criteria, at the edge of the mixing zone. However, when natural background conditions exceed any water quality criteria (other than temperature, IDAPA 58.01.02.401.01.c), no lowering of water quality from natural background conditions is allowed.

Mixing zones may be authorized for numeric interpretations of narrative criteria where assimilative capacity is available and no unreasonable interference with, or danger to, beneficial uses of the water body occurs.

3.4.3.2 Effects on Aquatic Life

Mixing zones have the potential to unreasonably interfere with aquatic life (e.g., fish, benthic macroinvertebrates, and diatoms) by impairing the integrity of the aquatic community, including spawning, egg incubation, rearing, or passage; adding heat that causes thermal shock, lethality, or loss of cold water refugia; bioaccumulation of pollutants; and, lethality to aquatic life passing through the mixing zone (IDAPA 58.01.02.60.01.d). As a result, mixing zones are authorized based on a case-by-case analysis to ensure sufficient stream area and volume for protecting aquatic life beneficial uses.

Evaluation of an existing or proposed mixing zone must consider the following:

- Composition of the aquatic community, including any ecologically or economically important species
- Seasonal dynamics of the water body (both physical dynamics such as snowmelt runoff and ecological dynamics such as migrating fish)
- Physical impacts the discharge may cause
- Concentrations and nature of pollutants that may interfere with the beneficial aquatic life uses of that water body

In general, the risk of any mixing zone to aquatic life increases with the magnitude, duration, and frequency of pollutant exposure and the extent of the mixing zone. It is critical to determine the concentration of a pollutant in the mixing zone and all expected physical and chemical habitat changes that would be associated with it. Also, evaluate how frequently and how long the aquatic community will be exposed to the discharge.

The biological community should be characterized before a mixing zone is authorized. Mixing zone requests for discharges to receiving waters that support sensitive species near the discharge will be reviewed with a higher degree of scrutiny. The seasonal sensitivity of an aquatic community (e.g., during spawning runs or when vulnerable life stages are present) should also be evaluated regarding the potential impacts from the discharge on spawning.

Information about the aquatic communities expected to be present in Idaho waters is available in the Idaho Department of Fish and Game's (IDFG's) current *Fisheries Management Plan* (IDFG 2013) and *Idaho Comprehensive Wildlife Conservation Strategy* (IDFG 2005). These plans, including lists of Idaho species of greatest conservation need (e.g., Bull Trout, Snake River physa) and critical habitat designations (section 3.4.3.2.6), should be consulted early in the mixing zone evaluation process.

Critical habitat is identified for salmon and steelhead in the Federal Register (2005). Bull Trout recovery plans, critical habitat, and other information are available from the United States Fish and Wildlife Service (USFWS). Coordinating with USFWS (for threatened species such as Bull Trout) and the National Marine Fisheries Service (NMFS) (for anadromous fish such as Chinook Salmon) is advised when species of greatest conservation need may occur in the area of the proposed mixing zone. Additional information on the location of these species' critical habitat is

found on EPA, USFWS, and NMFS websites (*http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm*). DEQ will also coordinate with the Idaho Office of Species Conservation when appropriate and refer to Idaho's Bull Trout Conservation Plan (Batt 1996).

The beneficial use of a water body (e.g., cold water aquatic life) may be a significant factor in determining the type of biological community present (including species of greatest conservation need) and whether a mixing zone is appropriate. While state water quality criteria for toxics do not vary for the aquatic life beneficial use, dissolved oxygen, temperature, and ammonia numeric criteria do. Thus, beneficial uses of a water body play an important role when evaluating and establishing such criteria in a mixing zone.

While protecting beneficial uses is imperative, aquatic life protection includes paying attention to individual species that make up an aquatic community. The loss of individual species in certain circumstances may significantly impact the aquatic community as a whole, including species of ecological or economic importance and species more sensitive to depressed populations.

3.4.3.2.1 Toxicity to Aquatic Organisms

Idaho water quality standards include narrative water quality criteria (IDAPA 58.01.02.200) and numeric water quality criteria (IDAPA 58.01.02.210) that address the effects of toxic pollutants on aquatic life. Further toxicity data are found in EPA's ECOTOX databases. Using these resources and information provided by the discharger, DEQ must determine if acutely toxic conditions will not occur outside the ZID and if chronic water quality criteria will be met at the boundary of the proposed mixing zone (Figure 5).

Acutely toxic conditions are those conditions that cause lethality after short-term exposure (e.g., 1 hour or less). These conditions can be avoided by limiting the magnitude of pollutant concentrations as well as ensuring the frequency and duration of exposure to elevated concentrations is limited. Acute lethality is generally not expected when an organism, drifting through the mixing zone along the path of maximum exposure, would not be exposed to concentrations exceeding the acute criteria when averaged over a 1-hour period. It can also be assumed that no lethality to passing organisms will occur in the following scenarios (EPA 1991):

1. Acute criteria are met at end of pipe.
2. Discharge is of high velocity ($\geq$3 meters/second), and the ZID is less than 50 times the discharge length scale in any direction.
3. Discharge is of low velocity (<3 meters/second), and the most restrictive of the following conditions is met:
    a. Acute criterion will be met within 10% of the distance from the edge of the outfall to the boundary of the mixing zone (when the acute-to-chronic ratio [ACR] is equal to 10 or more) in any spatial direction.
    b. ZID will be less than 50 times the discharge length scale in any spatial direction (this requirement must be met for each port in a multiport diffuser).

> The **Discharge Length Scale** is the square root of the cross-sectional areas of the discharge pipe (or port) at its outlet.

c. Acute criterion will be met within a distance of 5 times the local water depth in any horizontal direction from the outfall.

4. When traveling through the path of maximum exposure, a drifting organism would pass through the acute mixing zone within 15 minutes.

3.4.3.2.2 Whole Effluent Toxicity

Mixing zones can be authorized for both acute and chronic WET effluent limitations. When authorized, the acute and chronic WET limits should be based on the instream concentration of effluent at the boundary of the ZID (acute) or boundary of the mixing zone (chronic). It is preferable that acute WET limits (e.g., no significant difference between the control and 100% effluent using hypothesis testing) be met at the end of the discharge pipe; however, DEQ may allow numeric interpretations of narrative toxics criterion for WET to be met at the edge of the ZID, as long as lethality does not occur to organisms passing through the ZID.

3.4.3.2.3 Zone of Passage

The extent of the mixing zone may be restricted to ensure sufficient stream area and volume for a zone of passage for aquatic life. Many salmonids migrate downstream as juveniles then upstream to spawn as adults; therefore, adequate zones of passage are necessary to maintain the biological integrity of the water body. Any authorized mixing zone for waters with established aquatic life beneficial uses must provide an adequate zone of passage to satisfy the requirement that the mixing zone will not unreasonably interfere with, or endanger, established beneficial uses.

Of primary concern in evaluating the zone of passage are concentrations of various pollutants known to elicit an avoidance behavior and the location of the mixing zone relative to suitable stream velocities and depths for aquatic life passage. Because aquatic life have been shown to have their upstream passage blocked when encountering elevated concentrations of pollutants, any permitted mixing zone must provide a sufficient zone of passage so the allowable mixing zone does not unreasonably interfere or endanger movement of aquatic life.

A comprehensive review of the scientific literature on fish avoidance was conducted by DEQ (2000). This review included fish avoidance thresholds for cadmium, copper, chromium, nickel, lead, mercury, and zinc (Table 23). Newer literature suggests that many of the threshold concentrations listed in Table 23 are still accurate, with a few exceptions. Copper toxicity and avoidance response may occur at lower concentrations than the listed 3 µg/L; avoidance has been observed at concentrations approaching 1 µg/L. Sublethal effects of copper can be less in waters with greater concentrations of dissolved organic carbon; pH may also influence copper toxicity. Literature published since 2000 includes observations of avoidance response of cadmium at levels lower than 8 µg/L; avoidance has been observed at concentrations as low as 0.5 µg/L. Alternative avoidance threshold values, supported by adequate and appropriate scientific literature or based upon site-specific information, may be presented by the permit applicant.

Table 23. Threshold concentrations observed to elicit avoidance responses in salmonids (DEQ 2000).

Selected Avoidance Thresholds	Cadmium	Copper	Chromium	Nickel	Lead	Mercury	Zinc
	(micrograms per liter)						
Lab	8	3	10	24	14	0.2	14
Field	***16***	***3***	***20***	***48***	***28***	***0.4***	***28***

Note: Except for copper, lab avoidance thresholds from the studies reviewed were calculated by multiplying the lowest lab-to-field response ratio by two to obtain field avoidance thresholds. Because of ambiguity with the threshold avoidance response of juvenile Chinook Salmon to copper, the recommended avoidance threshold is 3 µg/L, without multiplication by the lab-to-field response ratio.

From a physical perspective, the mixing zone size limitations as described in section 3.4.3.4 have historically been presumed to provide an adequate zone of passage. To ensure that the mixing zone "shall not cause unreasonable interference with, or danger to, existing beneficial uses" (IDAPA 58.01.02.060.01.d), site-specific considerations of both channel morphology and species of greatest conservation need should be considered, especially for discharges with small dilution factors. A dilution factor represents the ratio of the receiving water body low flow (i.e., low-flow design discharge conditions) and the effluent discharge (section 3.4.3.9.1). Channel morphology could be evaluated with the modeling efforts, as these efforts may involve a detailed description of the receiving water.

Of particular concern are instances in which a mixing zone is proposed for stream channels that contain a limited percentage of stream width with characteristics (e.g., depth or flow volume) capable of supporting aquatic life passage. For example, it is not unusual for limited areas of some streams to contain areas with a well-defined thalweg adjacent to a comparatively large gravel bar over which only shallow, diffuse flow travels. In such situations, a mixing zone could occupy less than 25% of the stream width, or even less than 25% of the streamflow but close to 100% of the useable area of the stream for fish passage. In such cases, a site-specific determination of the appropriate physical extent of a mixing zone must be made. The requirements of species of greatest conservation need must be considered (e.g., migrating Chinook Salmon or sessile aquatic invertebrates).

3.4.3.2.4 Attraction

Discharges that attract free-swimming organisms have the potential to adversely affect aquatic life because free-swimming organisms may remain within the mixing zone area for longer periods of time extending the organisms' exposure to pollutants. DEQ may consider restricting or denying mixing zones for discharges that attract free-swimming organisms. According to the *Water Quality Standards Handbook* (EPA 2014), most toxicants elicit a neutral or avoidance response; in some situations, aquatic life are attracted to a toxic discharge (*http://www2.epa.gov/wqs-tech/water-quality-standards-handbook-chapters*). For example, the temperature of or organic matter (as a food source) in a toxic effluent may be an attractive force to aquatic organisms. Innate behavior such as migration may also counter an avoidance response; in this instance, passage of aquatic life should be evaluated. Reviewing scientific literature (EPA 1991) or other peer-reviewed documentation may be necessary where attraction is a concern.

3.4.3.2.5 Spawning

In Idaho there is particular concern with protecting the spawning activities of salmonids (trout and salmon). *Oncorhynchus* spp. spawn by depositing eggs and sperm in a depression (i.e., a redd) cut into the stream bottom of shallow, silt-free riffle/run habitats from large rivers to headwater streams. In general, salmon and trout typically choose to spawn in streams that are shallow, clear, and cold with a strong upwelling of water through the gravel. Discharges containing elevated suspended solids, for example, may clog these critical gravel beds. Sockeye Salmon spawning occurs almost exclusively in lakes or streams that connect to lakes. The female Sockeye salmon most often selects a redd site in an area of the stream with fine gravels. Chinook Salmon, steelhead, and Bull Trout spawning preferences and habitat needs by life stage are described at *http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead.html*. Information on Sockeye Salmon habitat requirements can be obtained from IDFG at *http://fishandgame.idaho.gov/public/fish/?getPage=36*. Any discharge that significantly alters habitat, lowers dissolved oxygen, or increases the temperature of a water body has the potential to impact spawning activities.

To adequately protect vulnerable fish communities, mixing zones may be prohibited during certain times of the year or within areas of the receiving water body that provide spawning and rearing habitat. The spawning periods for salmonids occur in seasonal blocks. During late winter and spring, Cutthroat Trout, Rainbow Trout, and steelhead move into spawning habitats. Anadromous and landlocked salmon (Coho, Chinook, Sockeye, and Kokanee) spawn during late summer and fall. Brown Trout, Brook Trout, and Bull Trout will typically spawn in the fall and early winter. For a mixing zone to be allowed in any spawning area, the applicant must demonstrate that the discharge will not unreasonably interfere with the capability of the receiving water body to support ongoing and future spawning, incubation, and rearing activities. Whether or not the mixing zone will be authorized during fish spawning seasons should be carefully evaluated. Specifically, discharges with a thermal mixing zone should not cause unreasonable interference, danger to, or the impairment of the integrity of the aquatic community (e.g., impairing cold water refugia by overlapping the confluence of a smaller stream).

When a discharge is located near spawning areas, the applicant for a mixing zone should provide documentation that the pollutants discharged do not have the potential to unreasonably interfere with present or future salmonid spawning, incubation, or rearing activities in the water body. Further discussions with NMFS, USFWS, and IDFG may be necessary to determine potential impacts on spawning areas of sensitive species.

3.4.3.2.6 Species of Greatest Conservation Need

Of particular concern in evaluating potential and existing mixing zones are a small group of aquatic species designated by the state as *species of greatest conservation need* because of their limited range in Idaho, low or declining populations, or threats to their existence. These species for Idaho's fisheries are of particular ecological, social, and economic importance and are all native fish. Other aquatic organisms of greatest conservation need include several species of snails found in tributaries and the main stem of the Snake River. A species list may be reviewed at *https://idfg.idaho.gov/species/taxa/list*.

A mixing zone will not be granted if the mixing zone impairs the integrity of the aquatic community. When species of greatest conservation need exist, the impact of a mixing zone to the integrity of the aquatic community may be significant due to, for example, the depressed population of a species. Mixing zone evaluations should include an analysis of the potential for impacts to habitat used for spawning by endangered or threatened species or species of greatest conservation need. To adequately protect vulnerable aquatic communities, mixing zones for Idaho's streams and rivers may not be allowed within areas during any time of the year that the area provides necessary habitat for any life stage.

3.4.3.2.7 Bioaccumulation

Bioaccumulation is the elevation in concentration of substances in an organism relative to the concentration in the environment (e.g., food, water, and sediment). The process involves uptake of the substance and an inability to break it down or excrete it, which leads to the organism having a higher internal concentration of the substance than its surrounding environment. Though similar to bioaccumulation, bioconcentration involves uptake from water only. In general, substances that are more lipid soluble and less water soluble are more likely to bioaccumulate. A general discussion of these properties is available through the USGS Toxic Substances Hydrology Program at *http://toxics.usgs.gov*. Examples of bioaccumulative pollutants are found at *https://www.epa.gov/toxics-release-inventory-tri-program/persistent-bioaccumulative-toxic-pbt-chemicals-covered-tri*

Idaho's water quality standards specifically state that mixing zones shall not cause unreasonable interference, or danger to, beneficial uses. The bioaccumulation of pollutants (IDAPA 58.01.02.010) resulting in tissue levels in aquatic organisms that exceed levels protective of human health or aquatic life would constitute such interference or danger. DEQ will closely evaluate mixing zones for pollutants with a high potential to bioaccumulate to ensure such mixing zones will not lead to harmful tissue concentrations in fish, benthic macroinvertebrates, or other organisms. Examples of pollutants with a moderate-to-high potential to bioaccumulate that are currently present in some discharges throughout Idaho include selenium, arsenic, polychlorinated biphenyls (PCBs), and methylmercury. Of the 121 toxic substances included in the water quality standards (96 have criteria), 36 are currently defined as bioaccumulative. Substances are considered bioaccumulative if they have a bioaccumulation factor or bioconcentration factor exceeding 1,000 liters per kilogram (L/kg)[1]. This value is a threshold for high risk of harm through bioaccumulation.

Bioaccumulation intensity varies with site-specific conditions; therefore, a discharger requesting a mixing zone for bioaccumulative pollutants may be required to provide information (e.g., expected fate and transport of the substance) about the potential for such substances to bioaccumulate or bioconcentrate in organisms residing in the receiving water body. The discharger may be required to conduct upstream and downstream monitoring of the tissue, sediment, and/or water column concentrations for the bioaccumulative substance before (where possible) and after establishing the discharge. This monitoring will provide insight into the

[1] The 1,000 L/kg threshold is used by EPA to determine if a chemical is bioaccumulative under the 1986 Emergency Planning and Community Right-to-Know Act. The value 1,000 L/kg is based on a combination of science and policy and does not imply that chemicals with lower bioaccumulation factor values do not bioaccumulate or are incapable of causing harm to beneficial uses.

potential impacts of the discharge on species present in the receiving water body and may be included as a requirement in an IPDES permit.

In IDAPA 58.01.02.060.01.d.iii, mixing zones are prohibited from causing bioaccumulation of pollutants that results "in tissue levels in aquatic organisms that exceed levels protective of human health or aquatic life."

3.4.3.3 Effects on Human Health

In determining whether to allow a mixing zone or the best manner in which to monitor a mixing zone, the impacts of that mixing zone on human health must be considered. Specifically, mixing zones are not to cause unreasonable interference with beneficial uses (IDAPA 58.01.02.60.01.d), including bioaccumulation of pollutants (IDAPA 58.01.02.010) that result in tissue levels in aquatic organisms exceeding levels protective of human health or aquatic life; concentrations of pollutants that exceed MCLs at drinking water intake structures; and conditions impeding or prohibiting recreation in or on the water body. Potential impacts can be evaluated through water quality criteria associated with ingesting water (domestic water supply uses) and consuming fish (recreational uses). In determining whether human health-based criteria should be considered, the beneficial uses of the water body in question must be known. IDAPA 58.01.02.100–160 identify the designated beneficial uses of Idaho's water bodies.

The following sections address water quality criteria developed to protect domestic water supply, contact recreation, and fish consumption.

For more information on bioaccumulation:

- DEQ List of Bioaccumulative Pollutants

www.deq.idaho.gov/media/60160659/bioaccumulative-pollutants.pdf

- EPA Water Data and Tools

www.epa.gov/waterscience/gli/mixingzones

- EPA Bioaccumulative Toxic (BPT) Chemicals Covered by the TRI Program

https://www.epa.gov/toxics-release-inventory-tri-program/persistent-bioaccumulative-toxic-pbt-chemicals-covered-tri

3.4.3.3.1 Domestic Water Supply

Those water bodies designated for domestic water supply (IDAPA 58.01.02.100.03.a) should have water quality available for use as drinking water. Any mixing zone must not interfere with this beneficial use.

Water quality criteria designed to protect human health can be more restrictive (i.e., allowable concentrations are lower) than corresponding water quality criteria designed to protect aquatic life. An example is the organochlorine pesticide, Aldrin, for which the human health-based criterion is 0.0000025 µg/L, while the aquatic life-based CMC is 3 µg/L. IDAPA 58.01.02.210 provides information about applicable human health- and aquatic life-based water quality criteria.

When evaluating any proposed mixing zone, its proximity to existing and/or proposed domestic water intakes will be considered. DEQ will not authorize a mixing zone that will cause concentrations above a drinking water MCL at a surface water supply intake. Dilution models should be used to determine the potential proximity of the intake and mixing zone under various flow conditions (e.g., low, 7Q10 and high, maximum monthly average flow). The discharger should work with DEQ in determining the most appropriate flow regimes to use in the mixing

zone model. Using these data, BPJ should be used in determining whether the mixing zone has the potential to interfere with the domestic water supply beneficial use.

3.4.3.3.2 Primary and Secondary Contact Recreation

Most waters in the state are presumed to support primary or secondary contact recreation uses. Any mixing zone must generally protect these uses. Idaho's water quality standards prohibit authorizing a mixing zone for *E. coli* and any condition that impedes or prohibits recreation in and on the water body (IDAPA 58.01.02.060.01.d.vi).

When considering whether to authorize a mixing zone in an area designated or presumed for contact recreation uses, specific information is needed about the ability of the public to access the area affected and seasonality of use (e.g., swimming during late summer or whitewater rafting or kayaking during spring high flows). The permit writer will request more information from the discharger about these uses when evaluating potential impacts of mixing zones.

3.4.3.3.3 Consumption of Aquatic Organisms

Although consumption of aquatic organisms (e.g., fish, mussels, and crawdads) is not a distinct beneficial use in Idaho, it is considered part of recreation use through fishing in Idaho waters. Consumption of fish and other aquatic organisms is an important exposure pathway that is incorporated into the human health criteria applied to waters protected for either domestic water supply or recreational uses. Applying these criteria is based on the opportunity for exposure, not the actual occurrence of exposure. Evaluating existing or proposed mixing zones to determine whether there is unreasonable interference with the recreational beneficial use should consider the following:

1. Whether the discharge contains bioaccumulative pollutants
2. Whether the harvest and consumption of aquatic organisms will be impeded by the mixing zone
3. Frequency with which organisms are harvested in the vicinity of the mixing zone

The evaluation will consider the potential for harvest and consumption of exposed aquatic organisms within the mixing zone and downstream. The discharger may be required to submit information about the frequency of such activities or access points for such activities in the vicinity of the mixing zone. Using this and other information, DEQ staff will use BPJ in determining the appropriateness of a mixing zone for the pollutants of concern.

3.4.3.4 General Size and Location Requirements to Consider

Mixing zones must be sized and located to protect beneficial uses in the water body as a whole. Idaho's mixing zone policy lists specific requirements for the size and location of a mixing zone. DEQ has the discretion to depart from these requirements in certain circumstances. The following sections discuss each of the size and location requirements for flowing and nonflowing waters.

3.4.3.4.1 Flowing Waters

Flow Requirement

As described in IDAPA 58.01.02.060.01.h, the size of a mixing zone should not exceed 25% of streamflow volume of the low-flow design discharge conditions (Table 24). DEQ permit writers use 25% of low-flow design discharge conditions to establish a dilution factor when conducting an RPA, and evaluate whether a mixing zone will be authorized consistent with water quality standards by adjusting the percentage of low flow down from 25% until RPTE is demonstrated. The percentage is then raised to the next whole number at which RPTE is not demonstrated to occur.

This size determination is accomplished through RPA and WQBEL back-calculations. Historical effluent data demonstrating a smaller mixing zone is achievable should be considered when lowering the mixing percentage. For example, if a discharge has no RPTE with a criterion using 10% mixing, DEQ may authorize a mixing zone using 10% of the receiving water low-flow condition for that parameter. Section 3.4.3 provides further guidance on establishing an appropriate mixing zone percentage.

DEQ may authorize a mixing zone that includes more than 25% of the receiving water low-flow condition, provided the discharger demonstrates this larger mixing zone is needed and submits sufficient information illustrating the increased mixing zone size will not unreasonably interfere with, or cause danger to, the beneficial uses of the receiving water body (section 3.4.3.6). Table 24 lists the receiving water low-flow criteria that apply to mixing zones (IDAPA 58.01.02.210.03).

Table 24. Low-flow design discharge conditions to use in mixing zone evaluations.

Criteria	Low-Flow Design Condition	Explanation
Aquatic Life—Toxics		
Acute toxic criteria (CMC)[a]	1Q10 or 1B3	1Q10: lowest 1-day flow with an average recurrence frequency of 10 years 1B3: biologically-based low flow that indicates an allowable exceedance of once every 3 years
Chronic toxic criteria (CCC)[b]	7Q10 or 4B3	7Q10: lowest 7-day average flow with an average recurrence frequency of 10 years 4B3: biologically-based low flow that indicates an allowable exceedance for 4 consecutive days once every 3 years
Aquatic Life—Nonconventionals[c]		
Temperature[d]	7Q10 or 4B3	7Q10: lowest 7-day average flow with an average recurrence frequency of 10 years 4B3: biologically-based low flow that indicates an allowable exceedance for 4 consecutive days once every 3 years
Ammonia—acute criterion (CMC)[a]	1Q10 or 1B3	1Q10: lowest 1-day flow with an average recurrence frequency of 10 years 1B3: biologically-based low flow that indicates an allowable exceedance of once every 3 years

Criteria	Low-Flow Design Condition	Explanation
Ammonia—chronic criterion (CCC)[b]	7Q10 or 4B3	7Q10: lowest 7-day average flow with an average recurrence frequency of 10 years 4B3: biologically-based low flow that indicates an allowable exceedance for 4 consecutive days once every 3 years
Nutrients[e]		
Human health—carcinogen	Harmonic mean flow	Harmonic mean flow: long-term mean flow value calculated by dividing the number of daily flows by the sum of the reciprocals of those daily flows
Human health—noncarcinogen[f]	Harmonic mean flow or 30Q5	Harmonic mean flow: long-term mean flow value calculated by dividing the number of daily flows by the sum of the reciprocals of those daily flows (if the effects from certain noncarcinogens are manifested after a lifetime of exposure, then a harmonic mean flow may be appropriate) Lowest 30 consecutive day low flow with an average recurrence frequency of once in 5 years.

a. CMC: criterion maximum concentration
b. CCC: criterion continuous concentration
c. These low flows are not specified in Idaho's water quality standards, and DEQ may use alternative flows as appropriate.
d. Low flows for the salmonid spawning beneficial use should be determined for the time period during which spawning and egg incubation occurs.
e. DEQ will evaluate low flows for nutrients on a case-by-case basis. In TMDLs, DEQ has used various estimates of low flows, including a seasonal average flow representative of the growing season (i.e., May to September) or an annual average flow.
f. The 30Q5 low flow is specified in IDAPA 58.01.02.210.03.b. However as of October 2016, this element of Idaho's water quality standards was removed and replaced with the harmonic mean flow, this change has not been approved by EPA for CWA purposes.

Low stream flows are determined based on hydrologic records, often USGS flow records at a nearby gaging station. Other methods to estimate low flow at ungauged locations may be used, such as USGS StreamStats: *http://water.usgs.gov/osw/streamstats/*. More information on flow estimates is available in section 3.2.1.

In some instances a discharger may request DEQ consider alternative streamflow estimates in calculating the RPTE and any associated mixing zone authorization. DEQ would consider these requests in cases where it is clear that differing sets of circumstances exist that should be considered when developing effluent limits (e.g., different effluent flows, receiving water flows, or hydrologic or climatic conditions). These requests must contain information sufficient to show that using these alternatives do not impact beneficial uses of the water body. Sufficient information would likely include an extensive flow record and monitoring data of both the receiving water body and effluent.

One possible approach to using alternative streamflow estimates includes calculating effluent limits and mixing zone size based on seasonal flows. This approach provides for tiered effluent limits based on an empirical data record for the receiving water body and effluent discharge. The use of seasonal limits in calculating has been sanctioned and employed in EPA permits over the years. However, this tiered approach would require dynamic modeling of the receiving water

body and the effluent discharge to ensure that duration and frequency components of an associated criterion continue to be met. It would also require an extensive data record to model seasonal flows in the receiving water body.

Idaho's water quality standards allow for the flexibility of incorporating seasonal or tiered effluent limits in discharge permits. Authorizing multiple mixing zones associated with these seasonal or tiered effluent limits requires the same calculations using the appropriate seasonal flows. For example, dilution ratios for tiers may be calculated and analyzed to determine critical periods in a case where high seasonal flows associated with run-off cause significant variability both in the receiving water body and effluent flow. Critical dilution ratios may be calculated as the highest ratio expected to occur in a 4-day period once every 3 years corresponding to the biologically-based water quality critical flows (4B3). These critical dilution ratios would then be incorporated into the effluent limit calculation to ensure compliance with duration and frequency components of the water quality criteria.

Width Requirement

A mixing zone should be sized so the concentration of the pollutant discharged does not exceed the applicable chronic criteria at greater than 25% of the stream width (IDAPA 58.01.02.060.01.h.i). A higher level of analysis should be used where this is a concern (section 3.4.3.9). The relevant width of the stream is the wetted width of the water flowing in the channel. Wetted width is a dynamic parameter that varies with flow. At any given streamflow, channel widths and wetted widths naturally change based on upstream or downstream location. As channel gradients become steeper, flow often becomes more constricted and velocities increase. Likewise, channels tend to spread out and widen with decreasing gradients and lower flow velocities.

It is important to define the flow regime (i.e., the water level) and the channel cross-section downstream where pollutant concentrations meet the chronic criteria. At any given streamflow, channel widths and wetted widths naturally vary upstream and downstream of an outfall. Open channel hydraulics models such as the Hydrologic Engineering Centers River Analysis System may be used to define the wetted width and shoreline of the 7Q10 low flow. Mixing zone models, such as CORMIX, can be used to compare different levels of flow, width and length of the effluent plume, and appropriate cross-section where the low-flow wetted width would be established as a compliance point. Where aquatic life toxics criteria are considered, DEQ generally uses the 7Q10 to define the low-flow wetted-width and the location of the compliance cross-section. This value ensures the mixing of effluent plumes meets chronic criteria before becoming wider than 25% of the stream width at all flow conditions.

In some instances, streamflow and velocity increases may cause the effluent plume to travel greater distances before sufficient mixing occurs to meet criteria. Wider plumes may be observed at higher flows. Where the required mixing zone to meet chronic criteria approaches 25% of the stream width, additional studies and modeling may be necessary to predict the length, width, and amount of mixing at higher flow conditions.

Shore-Hugging Plumes

DEQ understands EPA's position that shore-hugging plumes should be avoided, but Idaho's water quality standards do not specifically prohibit shore-hugging plumes in flowing waters. In some cases, DEQ may significantly limit or even prohibit mixing zones to prevent adverse impacts to the environment and human health consistent with IDAPA 58.01.01.060.01.b. and 060.01.d. IDAPA 58.01.02.060.01.j.ii instructs outfall design to consider avoiding shore-hugging plumes where the littoral zone is a major supply of food and cover for migrating or rearing fish and other aquatic life or where recreational activities are impacted by the plume's contact with the shore.

Outfalls constructed on the bank generally result in shore-hugging plumes; most dischargers in Idaho have outfall structures located on the bank, perpendicular to streamflow. DEQ encourages, but does not require, diffusers for discharges to flowing waters. While DEQ recognizes that installing a diffuser may result in more harm than good, or does not result in any added environmental benefit, diffusers generally result in more rapid mixing, decreasing the area containing elevated concentrations and minimizing effects on beneficial uses. Mixing zone models such as CORMIX may be used to determine the likelihood of a mixing zone hugging a shoreline (e.g., where beneficial uses like a domestic water supply intake structure or primary contact recreational area has the potential to encounter a proposed mixing zone).

3.4.3.4.2 Nonflowing Waters

Water bodies with a mean detention time of 15 days or greater are considered nonflowing. Detention time is calculated by dividing the mean annual storage volume by the mean annual flow rate out of the impoundment for the same time period. Nonflowing waters like lakes and reservoirs offer less mixing potential than streams or rivers and are at greater risk for some pollutants to interfere with the beneficial uses of a water body, including bioaccumulative pollutants and nutrients. DEQ will review mixing zones within nonflowing waters with respect to effluent attributes (e.g., flow volume, velocity, and buoyancy), mixing conditions, and bioaccumulative pollutants.

Horizontal Area Requirement

For existing discharges to nonflowing waters authorized before July 1, 2015, the size of the mixing zone is not to exceed 10% of the nonflowing water body's surface area (IDAPA 58.01.02.060.01.h.iii). For all new discharges to nonflowing waters authorized after July 1, 2015, the size of the mixing zone is not to exceed 5% of the total surface area of the water body or 100 meters from the point of discharge, whichever is smaller (IDAPA 58.01.02.060.01.h.ii).

The discharger should provide an estimate of a nonflowing water body's minimum surface area during low-pool conditions (maximum drawdown). The horizontal (surface) area of the water body may be estimated by interpolating low-pool elevations with USGS topographic maps and/or other maps that delineate the water body's boundaries.

Additional Requirements for New Dischargers to Nonflowing Waters

New dischargers to nonflowing waters are required to use diffusers and design the outfall so the plume is not shore-hugging (IDAPA 58.01.02.060.01.h.ii.2).

3.4.3.4.3 Multiple Mixing Zones

IDAPA 58.01.02.060.01.e states multiple nested mixing zones may be established for a single discharge (a single outfall), each being specific for one or more pollutants contained within the discharge. For example, DEQ may authorize a mixing zone for zinc that uses 25% of the low-flow design discharge conditions and for the same outfall authorize a mixing zone for copper that uses 15% of the low-flow design discharge conditions.

When multiple points of discharge for a single activity (discharge facility) are evaluated, DEQ will consider the treatment processes, concentrations of the pollutants of concern, and locations of the outfalls. Where these individual mixing zones overlap or merge, the sum of the (multiple) mixing zones from those discharge points must not exceed the area and volume that would be allowed for a single point of discharge (IDAPA 58.01.02.060.01.f).

When these individual mixing zones do not overlap or merge, DEQ may authorize individual mixing zones. The cumulative impact of these discharges should not cause unreasonable interference with the beneficial uses of the receiving water body. Additionally, adjacent mixing zones from independent activities are not permitted to overlap (IDAPA 58.01.02.060.01.g).

The mixing zone area and volume are generally determined through modeling, as discussed in section 3.4.3.11.

3.4.3.5 Requirements for Submerged Discharges

Idaho's water quality standards do not require a submerged discharge point for new or existing discharges into flowing waters. A submerged discharge is preferable because it enhances hydrodynamic mixing. For new discharges into nonflowing waters, diffusers are required (IDAPA 58.01.02.060.01.h.ii.3). A description of the discharge location and depth should be provided by the applicant when mixing zones are being considered.

3.4.3.6 Varied Mixing Zone Sizes

IDAPA 58.01.02.060.01.i allows mixing zones to vary from the limits of IDAPA 58.01.02.060.01.h. A smaller mixing zone may be needed to avoid an unreasonable interference with, or danger to, a beneficial use. Conversely, a larger mixing zone that does not interfere with beneficial uses and meets the other requirements of IDAPA 58.01.02.060 may be authorized when the discharger provides an analysis that demonstrates a need given siting, technological, and managerial options.

Siting options include the location point of discharge, which receiving water body as well as where in the receiving water body. While this is typically an option for new discharges, it may be a consideration during facility upgrades. For example, a discharger may choose to use diffusers or a longer pipe to discharge to a larger receiving water body rather than discharge to the water body adjacent to the treatment facility.

Technological considerations include treatment types and process alternatives that would improve effluent quality. For example, a treatment option may be switching from chlorination to ultraviolet (UV) disinfection, and a process alternative may be using a less toxic chemical.

Managerial options typically involve water management so that effluent discharge is reduced, treatment levels are enhanced, or process efficiency is improved, so that less waste is generated per unit of production.

3.4.3.7 Other Considerations

3.4.3.7.1 Assimilative Capacity

Mixing zones will not be authorized for pollutants for which a water body is considered impaired unless WLAs (e.g., specifically allocated for a discharger or included in a reserve for growth) are available in an approved TMDL or other applicable plans or analyses (e.g., Integrated Report Category 4b implementation plans, watershed loading analyses, or facility-specific water quality pollutant management plans) that demonstrate available assimilative capacity. Use the most current EPA-approved Integrated Report to determine the beneficial use support status of the receiving water body (*www.deq.idaho.gov/integrated-report*).

In assessing assimilative capacity, consider upstream permitted discharges, which may not yet be discharging at their permitted maximum loads. If not yet discharging, basing assimilative capacity on what is presently or recently observed is likely to result in overshooting assimilative capacity when all discharges in a watershed reach their permit limits. This broader look at assimilative capacity is known as a watershed-based approach to permitting and its application can avoid future impairment, the need to develop a TMDL, and future cut backs in permitted effluent limits.

One example of a watershed-based approach to permitting was a metals analysis included in an NPDES fact sheet for several wastewater discharges to the Spokane River. EPA performed a separate analysis to determine if combined zinc discharges from the City of Coeur d'Alene, City of Post Falls, and Hayden Area Regional Sewer Board will cause, have the reasonable potential to cause, or contribute to excursions above Washington's water quality criteria for zinc at the state line.

Zinc excursions would still exist at the state line even if the Idaho dischargers ceased discharging entirely, or discharged no zinc. However, the water quality criteria for zinc become less stringent with increasing hardness. Because the effluents from the three point sources to the Spokane River in Idaho are harder than the receiving water, the Idaho dischargers create loading capacity for zinc (by raising the hardness and in turn the water quality criteria) at the state line. Using available information and conservative assumptions, EPA determined that, by discharging relatively hard water, the three Idaho point sources reduce the magnitude of excursions above zinc water quality standards at the state line. In other words, the Idaho point sources' discharges of relatively hard water to the Spokane River create more zinc loading capacity than they use by discharging zinc. Therefore, the Idaho dischargers will not cause, do not have the reasonable potential to cause, or contribute to excursions above Washington's water quality standards for zinc at the state line, and it is not necessary to impose zinc effluent limits on the Idaho point

sources that are more stringent than those necessary to meet Idaho water quality standards at the end of pipe.

3.4.3.7.2 Temperature

When evaluating thermal plumes, DEQ will consider whether the heat in the discharge will cause unreasonable interference with, or danger to, beneficial uses as well as, the limitations expressed in *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards* (EPA 2003a). Thermal plumes should not cause (1) impairment to the integrity of the aquatic community, including interfering with successful spawning, egg incubation, rearing, or passage of aquatic life, and (2) thermal shock, lethality, or loss of cold water refugia (IDAPA 58.01.02.060.01.d). To minimize or avoid these types of unreasonable interference, the following will be considered when conducting a mixing zone analysis (EPA 2003a):

- Within 2 seconds of plume travel from the point of discharge, maximum temperatures should not exceed 32 ºC.
- The cross-sectional area of the receiving water body exceeding 25 ºC should be limited to less than 5%.
- The cross-sectional area of the receiving water body exceeding 21 ºC should be limited to less than 25%, or if upstream temperatures exceed 21 ºC, then at least 75% of the receiving water body should not have temperature increases of more than 0.3 ºC.
- In spawning and egg incubation areas, the maximum weekly maximum stream temperatures should not exceed 13 ºC, or the temperatures should not be increased by more than 0.3 ºC above ambient stream temperatures during times when spawning and incubation occur.

3.4.3.7.3 Points of Compliance as Alternatives to Mixing Zones

DEQ may establish points for monitoring compliance with ambient water quality criteria when the nature of the discharges precludes a mixing zone analysis, such as with storm water discharges that are intermittent and diffuse. For these types of discharges, a point of compliance may be established at a reasonable distance from the discharge.

For flowing waters, a down current point of compliance should be less than or approximately equivalent to the width of the receiving water body. For nonflowing waters, a point of compliance should ensure no unreasonable interference, or danger to, the beneficial uses of the receiving water body; it should be established at a site-specific radial distance from the activity and based on the magnitude, frequency, and duration of the discharge.

3.4.3.7.4 Effluent-Dominated Waters

In some cases, the volume of discharge may provide a benefit (e.g., flow augmentation) to the beneficial uses of the receiving water body, and this benefit would be lost if the discharge were to cease. In these instances, DEQ may authorize mixing zones that use more than 25% of the stream volume at low flow as long as the mixing zone does not unreasonably interfere with the beneficial uses of the receiving water body.

3.4.3.8 Mixing Zone Assessment Process

The process below will be followed when determining whether to authorize a regulatory mixing zone for pollutants in IPDES permits:

1. DEQ determines that the effluent will have end-of-pipe concentrations constituting a RPTE water quality standards unless a mixing zone is authorized (i.e., C_e > WQ criterion).
2. DEQ performs an RPA using 25% of the low-flow receiving water volume for dilution (i.e., a 25% mixing zone). The low-flow statistic used can vary but is usually a 1Q10 for the CMC and a 7Q10 for the CCC.
3. When assessing the appropriate mixing zone size in nonflowing waters the volume of the receiving water body must be determined-based on the allowed surface area of the water body and the depth at the point of discharge. The receiving water body's bathymetry must be assessed to calculate the volume of water available for dilution. A dilution factor can also be assessed through modeling.
4. DEQ adjusts the size of the regulatory mixing zone so that it is no larger than necessary considering siting, technological, and managerial options available to the discharger. The mixing zone size may be reduced if a smaller mixing zone is shown to not yield an RPTE.
5. Additionally, DEQ performs a mixing zone analysis to determine the size of the plume and its effects on the receiving water body.
6. Once acceptable regulatory mixing zones are defined, DEQ drafts the permit using these mixing zone sizes for dilution.

In the fact sheet, the permit writer will document the end-of-pipe pollutant concentration and low-flow criteria used in the RPA. This pollutant will have monitoring and reporting conditions included in the permit. Permittees will be required to report these pollutant concentrations in the annual report, or as part of a renewal application.

When the discharger needs a mixing zone that is larger than 25% or the maximum area allowed for a nonflowing receiving water, the process will evaluate the siting, technological, and managerial options provided by the discharger. The assessment will weigh the impact of increasing the volume of water used to dilute pollutants versus the ability to reduce the quantity of pollutants discharged.

Conversely, if the percentage of upstream critical flow required to meet a water quality criterion is small (e.g. less than 5%), DEQ and the discharger should investigate the feasibility of treatment upgrades at the facility to achieve better effluent quality. Adding a negotiated compliance schedule item addressing facility upgrades and documenting an appropriate timeline may be necessary.

3.4.3.9 Mixing Zone Analysis Level of Effort

DEQ recognizes that not all discharges merit the same level of concern. Some discharges will demand an extensive mixing zone analysis to evaluate the potential for chemical, physical, and biological impacts. Furthermore, not all discharges require complex modeling to determine the size, configuration, and location of the mixing zone. The intent of Idaho's mixing zone policy

can be met through various levels of effort depending on the nature of the discharge and the characteristics of the receiving water, which are described in section 3.4.3.9.1. DEQ identified three levels of analysis involved in mixing zone analysis:

- Level 1—Simple
- Level 2—Moderate
- Level 3—Complex

Figure 7 depicts the process for determining the appropriate level of analysis. The data requirements for each level of analysis are presented in Table 25. DEQ retains discretion in departing from these guidelines.

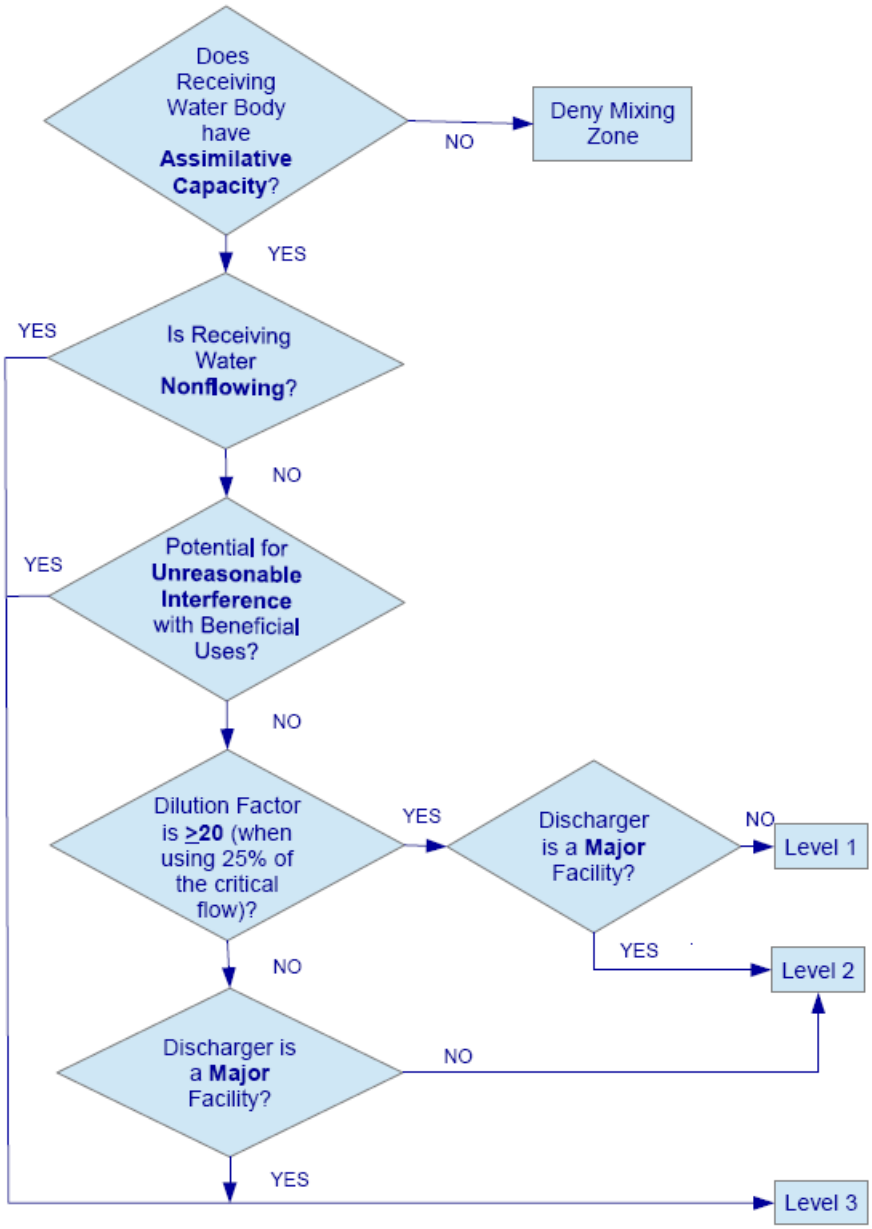


Figure 7. Decision flow chart for determining level of analysis.

Table 25. Mixing zone level of analysis data inputs.

Data Description	Analysis Level[a]		
Outfall Information	**1**	**2**	**3**
Outfall location (estimate from 1:24K topographic map or measure with a Global Positioning System receiver. When measured, provide the datum.)	E	M	M
Map	P	P	P
Photographs of the outfall and the vicinity of the outfall	O	O	P
Distance from nearest bank to discharge (m)	O	E	M
Height of outfall above stream bottom (m)	O	E	M
Diameter of port (m)	O	M	M
Discharge horizontal angle (σ)	O	M	M
Diffuser:			
Length of diffuser (m)		M	M
Distance from nearest bank to first port (m)		M	M
Distance from nearest bank to last port (m)		M	M
Total number of ports		M	M
Distance between ports (m)		M	M
Port vertical angle (θ)		M	M
Angle between diffuser line and ambient current (γ)		M	M
Angle between port centerline projection and diffuser axis (β)		M	M
Effluent Information			
Flow rate (mgd) and/or velocity (m/s)	E	E	M
Pollutant concentrations	P	P	P
Receiving Water Body Information			
Low flow (cfs) or velocity (f/s)	E	E	M
Channel depth (m)		E	M
Channel width (m)		E	M
Channel slope (degrees)		E	M
Manning's roughness coefficient		E	E
Ambient concentrations for pollutants in mixing zone		M	M
Model Information			
Model used		P	P
Basis for model selection		P	P
Mixing zone configuration/location		P	P
Model results table		P	P

a. P = provide; E = estimate; M = measure (field or engineering plans); O = optional

3.4.3.9.1 Determine Level of Analysis

The level of analysis is determined by looking at the potential for unreasonable interference with, or danger to, beneficial uses, the dilution factor, and the type of discharge facility.

Unreasonable Interference with, or Danger to, Beneficial Uses

Situations may exist where a discharge has the potential for unreasonable interference with, or danger to, the beneficial uses of a water body, including:

1. Areas used for spawning when those areas are considered to be necessary for the overall success of the population in that water body
2. Pollutants significant to human health with the potential to impinge on a drinking water intake
3. Areas heavily used for contact recreation purposes (e.g., public swimming beaches) where discharges occur during the recreation season
4. Areas supporting species of greatest conservation need
5. Priority persistent bioaccumulative pollutants (section 3.4.3.2.7 and *www.deq.idaho.gov/media/60160659/bioaccumulative-pollutants.pdf*)
6. When dilution is severely limited (e.g., a dilution ratio <1)

Situations with a potential for unreasonable interference or danger to beneficial uses necessitate a level 3 mixing zone analysis.

Dilution Factor

A dilution factor represents the ratio of the receiving water body low flow percentage (i.e., the low-flow design discharge conditions) to the effluent discharge volume (Equation 25).

$$Dilution\ Factor = D_f = \frac{(Q_S \times P + Q_e)}{Q_e} = \frac{(Q_s \times P)}{Q_e} + 1$$

Equation 25. Dilution factor calculation.

Where:

Q_s = Receiving water low-flow design conditions (in cubic feet per second)
P = Mixing zone percentage (25% may be used initially to determine the level of analysis required)
Q_e = Discharge flow (in cubic feet per second)

If the dilution factor is equal to or greater than 20, a level 2 or 3 mixing zone analysis may not be required (depending on other site-specific factors), and the appropriate percentage of the low flow may be automatically used in the permitting process.

The dilution factor calculated using 25% of the low-flow design will only be used to determine the appropriate level of effort that should be conducted. If a level 1 analysis is sufficient, the appropriate proportion of streamflow according to the flow requirement discussion in section

3.4.3.4.1 must be used to evaluate RPTE and subsequently calculate WQBELs. However, if a level 2 or 3 analysis is appropriate, the dilution factor that is modeled at the edge of the mixing zone must be used in the RPA and, when appropriate, in calculating WQBELs.

Type of Facility

DEQ classifies facilities as major or minor. Facility design flow is the primary consideration in this classification scheme for POTWs. If the design flow is greater than or equal to 1 mgd, or poses a potential or actual threat to human health or the environment, the POTW is a major facility. Industrial facilities are classified as major or minor based on a scoring system that considers a variety of factors including standard industrial classification code, type of effluent pollutants (e.g., toxics), and available dilution. DEQ uses the IPDES Permit Rating Worksheet for IUs.

3.4.3.9.2 Level 1—Simple

The mass balance equation approach represents the simplest form of calculating an appropriate dilution factor for the RPA and WQBEL calculations and is appropriate when the following conditions are met:

- No known potential exists for unreasonable interference with, or danger to, beneficial uses or lowering of water quality.
- Discharger is considered minor.
- Dilution factor is greater than or equal to 20.

Limited data are needed for this analysis, and no modeling is required. In most situations, predischarge biological data will not be required, and although ambient water quality data are desirable, DEQ recognizes that they may not be available and may require ambient monitoring during the permit cycle.

For minor dischargers with a dilution factor greater than 20, the mixing zone percentage may be adjusted to no larger than necessary by back calculating downwards from the value of 25.

3.4.3.9.3 Level 2—Moderate

The moderate mixing zone analysis may be used when there is a low level of risk to the public and aquatic environment. This level of analysis is used when there is no known potential for unreasonable interference with beneficial uses and one of the following conditions are met:

- Dilution factor is greater than or equal to 20, and discharger is considered major.
- Dilution factor is less than 20, and discharger is considered minor.

Although level 2 analysis is more extensive than the level 1 analysis, this level has relatively minimal data needs. Modeling is necessary to understand the location and configuration of the mixing zone, but some of the modeling inputs can be estimated rather than measured (Table 25). Similar to level 1, biological data and ambient water quality data may not be required.

3.4.3.9.4 Level 3—Complex

This level of analysis is appropriate when there is a moderate or high level of risk to the public and aquatic environment and is used when one of the following conditions is met:

- Potential exists for unreasonable interference with beneficial uses (e.g., a water body that is effluent dominated).
- No known potential exists for unreasonable interference with beneficial uses, dilution ratio is less than 20, and discharger is considered major.

This level of analysis requires more of the model inputs to be measured rather than estimated (Table 25). Some flexibility does exist, depending on the situation and reliability of estimates. Some estimates may be based on a facility type (e.g., modeling for a new POTW with a pretreatment program), while other inputs may be specific to a facility and require measurement. For example, a receiving water body may become highly channelized during critical low flows, requiring the modeler to obtain numerous downstream bathymetric cross-sections. Predischarge (or upstream/downstream) biological and chemical data for the receiving stream will be required before authorizing a mixing zone for new discharges.

3.4.3.10 Mixing Zone Review and Approval

When mixing zones are proposed, DEQ staff will verify mixing zone percentages used in the dilution factor and/or modeling. After the mixing zone has been verified or calculated, staff will apply the appropriate dilution factor to the RPA and, if necessary, calculate WQBELs.

The fact sheet will include DEQ's mixing zone decision. At a minimum, the fact sheet should include the dilution factor used; the size, configuration, and location of the mixing zone; and, where appropriate, calculations showing an analysis on the size considerations in IDAPA 58.01.02.060.01.h when a level 2 or 3 analysis is conducted. A three-dimensional representation overlaying the mixing zone with the receiving water may also be provided. Multiple mixing zones and ZIDs should be displayed, where appropriate.

The public will have an opportunity to comment on the authorized mixing zone during the public comment period for the draft IPDES permit and its associated fact sheet. DEQ will address comments related to the authorized mixing zone before issuing the final permit.

3.4.3.11 Mixing Zone Determinations

Mixing zone determinations, especially those requiring more complex levels of analysis, can be aided by using models and/or dye studies. Available models and associated inputs are discussed below.

3.4.3.12 Background on Mixing Zone Modeling

The hydrodynamics of mixing when two streams of water come together can be complex. How well waters mix largely depends on the forces governing water movement. An effluent discharged from a pipe or side channel will have jet forces associated with it created by the volume of water, size of the pipe or channel opening, angle or direction of flow, and water's

buoyancy (relative density). The receiving water also has its own forces: velocity and volume, gradient, and channel dimensions and characteristics.

Hydrodynamic models have been developed to characterize these forces and predict how the two water bodies will mix, rate at which they will mix, and size of the resulting plume in the receiving water (length, width, and depth). Models help determine how fast pollutants dilute to specific levels and when and where certain concentrations exist. Models are divided into two basic categories: (1) those that predict the results of immediate mixing (near-field mixing) where jet forces are at work and (2) far-field mixing where more passive diffusion or ambient mixing occurs. Pollutants added to a receiving water through discharge may already exist as background concentrations in that receiving water. Once the discharge is completely mixed, there will be a new equilibrium or new concentration for the pollutants moving downstream.

The distinction between near-field and far-field is made purely on hydrodynamic grounds and is unrelated to any regulatory mixing zone definitions that address prescribed water quality criteria. In many practical cases, the regulatory mixing zone may include only near-field hydrodynamic mixing processes. However, in some instances, the mixing zone may extend into the far-field. For example, a small source in a strong cross flow may rapidly enter the far-field region well before the edge of a regulatory mixing zone. The entire gamut of mixing processes—ranging from the near-field to the far-field—should be considered for individual mixing zone analyses.

3.4.3.12.1 Near-Field Mixing

The first stage of mixing is achieved from the discharge's momentum and buoyancy. This stage is particularly important in lakes, impoundments, and slow-moving water bodies because mixing in those systems relies upon the effluent's momentum, buoyancy, and eventually simple diffusion. In the absence of receiving water turbulence, horizontal or nearly horizontal discharges will create a clearly defined jet in the water column. When the discharge flow encounters a boundary such as the surface, the bottom, or an internal ambient density stratification layer, the near-field region ends and the transition to the far-field begins. The near-field region is typically the region controlled by the characteristics of the discharge itself (e.g., discharge flow rate and momentum).

3.4.3.12.2 Far-Field Mixing

Beyond the near-field, mixing is controlled by passive diffusion and ambient turbulence (i.e., spatial variations in the water body's velocity field). If little discharge-induced mixing is associated with the jet action of the discharge, continued mixing must be accomplished by ambient forces, which can result in much larger mixing zones. This situation is typical in nonflowing waters (lakes and reservoirs). Once the discharge interacts with a boundary such as the banks, the surface, or the bottom of the stream, the mixing processes are primarily a function of turbulence. The discharge in the far-field (Figure 8) loses its *memory* of its initial conditions, and mixing is mainly a function of the ambient conditions (e.g., ambient velocity and density field, channel roughness, and meanders).

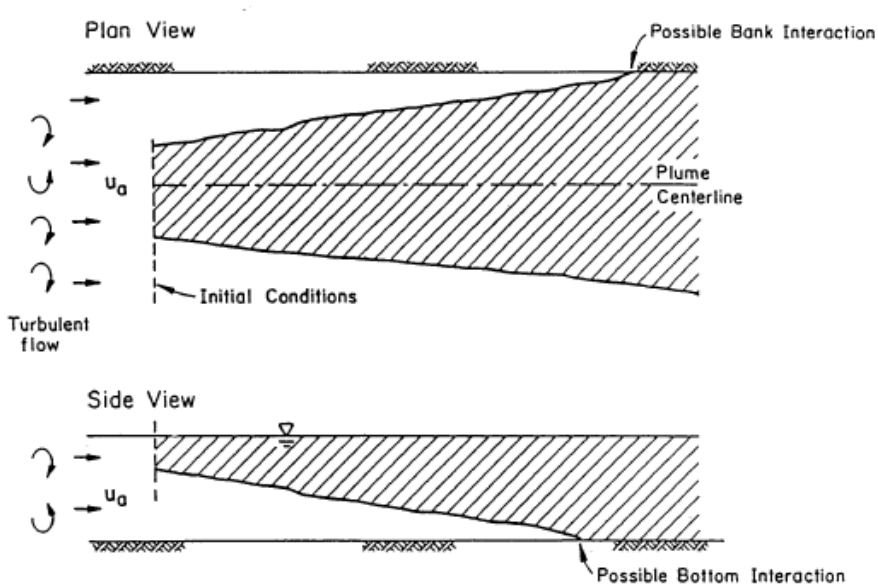


Figure 8. Far-field plume, passive ambient diffusion processes (Jirka et al. 1996).

3.4.3.13 Available Models

A wide variety of mixing zone models exists for evaluating the mixing behavior and plume dynamics of a point source discharge. No single model is appropriate for every discharge situation. Each model has its own set of strengths and weaknesses. It may be appropriate to use more than one model to evaluate mixing and dilution if more than one is available to the modeler. DEQ prefers EPA-supported models such as CORMIX; however, DEQ may consider other models (e.g., Visual Plumes) if they are more suitable for the site-specific conditions. If the applicant wants to use a model not discussed in this manual, it is highly recommended that the applicant discuss this with DEQ before modeling the discharge.

3.4.3.13.1 Near-Field Dilution Models

Buoyant jet models, such as those in CORMIX, predict dilution by stringing together a series of semiempirical entrainment formulations. The region of applicability of the entrainment formulations is determined by various length scales including the buoyancy and momentum length scales. The entrainment formulations are referred to as semiempirical because their general functional dependencies are derived theoretically, but various coefficients must be determined from observations. A length scale is a scaling estimate based on dimensional analysis arguments that identify the region of influence of a particular physical process. Each length scale is a distance along the trajectory where one parameter predominates (i.e., controls the flow). Once strung together by this analysis, the length scales should describe the relative importance of all parameters—discharge volume flux, momentum flux, buoyancy flux, ambient cross flow, and density stratification—throughout the trajectory. For example, the solution for a pure jet can be applied as an approximate solution to that portion of a buoyant jet in a cross flow where jet momentum dominates the flow. Likewise, the results for a pure plume can be applied to the buoyancy dominated regions for the buoyant jet. The length scales are linked by appropriate transition conditions to create a path for the trajectory through the completion of initial dilution.

CORMIX is a commercially available mixing zone model and decision support system for environmental impact assessment of regulatory mixing zones resulting from continuous point source discharges. CORMIX emphasizes the role of boundary interaction to predict steady-state mixing behavior and plume geometry. The CORMIX methodology contains systems to model single-port and multiport diffuser discharges, as well as surface discharges of conventional or toxic pollutants. Effluents considered may be conservative, nonconservative, heated, or contain suspended sediments.

CORMIX uses a data-driven approach to simulation model selection. It is comprised of about 50 flow modules, each with their own formulae or algorithms, and more than 100 possible distinct flow classifications. Based on the input data the user enters to describe the discharge and ambient environment, the system selects the proper choice of model to represent the physical mixing processes likely to occur within the mixing zone. The model selection procedure is both automated and fully documented by a rule-based system that screens the input data for internal consistency and compliance with model formulation assumptions. The system contains logic to reject cases where no reliable model exists for the given discharge situation and will warn the user in cases where the simulation occurs but results may be unreliable. The internal model selection procedure is fully documented by extensive, published, peer-reviewed scientific research. Statistical tools are readily available to evaluate model performance with available laboratory and field data on mixing predictions.

> CORMIX is available for free testing and evaluation from Mixzon, Inc., at *http://www.mixzon.com/*.

Visual Plumes (EPA 2003b) is another initial dilution model available for analyzing mixing zones (*www2.epa.gov/exposure-assessment-models/visual-plumes)*. Visual Plumes lists salinity, temperature, and current variations at different depths; simulates single and merging submerged plumes in arbitrarily stratified ambient flow and buoyant surface discharges; and addresses model consistency in a unique way, including other models in its suite of models. Visual Plumes promotes the idea that in the future, modeling consistency will be achieved by recommending particular models in selected flow categories. Visual Plumes includes:

- Davis, Kannberg, and Hirst model for Windows (DKHW) based on the universal Davis, Kannberg, and Hirst density model (UDKHDEN)
- Prych, Davis, and Shirazi surface discharge model (PDS)
- Three-dimensional updated merge model (UM3) based on the updated merge model (UM)
- Near-field model (NRFIELD) based on the Roberts, Snyder, and Baumgartner length scale model (RSB)

3.4.3.13.2 Far-Field Modeling Frameworks

The far-field models are designed to track the contaminant concentration along the plume of the discharge in areas of the receiving water where mixing is dominated by ambient fluid turbulence. Where far-field mixing is a concern, cumulative discharge centerline (defining cumulative changes in water quality) may need to be established. The CORMIX model is recommended as a primary modeling framework for near-field analysis and far-field simulation since it has the capability of performing both near- and far-field mixing zone calculations (*http://www.mixzon.com/docs/UserManuals/FFL_UM/FFL_UserManual/*).

3.4.3.14 Data and Information to Support Mixing Zone Analysis

The reliability of the predictions from any of the modeling techniques depends on the accuracy of the data used in the analysis. The minimum data required for model input include receiving water characteristics (flow, channel morphology, and background concentrations); effluent characteristics (flow and concentrations); and outfall design information. Table 25 lists the type of information needed for each level of analysis.

The discharger or DEQ may gather the necessary data, conduct the modeling, and prepare a summary of the modeling results. Where the discharger conducts the modeling, the discharger should include a map of the facility and its discharge point. At a minimum, the map should include other discharges within 0.5 mile, public access points, known spawning locations, drinking water intakes within 0.5 mile, and diversions. DEQ encourages gathering information from outside the 0.5 mile region if the modeled mixing zone extends further that 0.5 mile or contains a bioaccumulative pollutant. DEQ will review the information provided by the discharger and determine whether the resulting mixing zone complies with Idaho's water quality standards. DEQ encourages the discharger to consult with staff early in the process to ensure that DEQ concurs with the modeling approach.

3.4.3.14.1 Analytical Methodologies

Where possible, analytical methods listed in 40 CFR 136 should be used to measure pollutants in the effluent and receiving water body. The detection limits and reporting limits should be sufficiently low to ensure that concentrations of concern can be reliably measured. Of particular concern are chemicals with very low water quality criteria values such as cadmium. EPA's Office of Science and Technology is a good source for information regarding analytical methods and their detection limits.

3.4.3.14.2 Receiving Water Morphology/Hydrology

Receiving water data would ideally include the following:

- Bathymetry in the vicinity of the discharge site
- Seasonal water temperature ranges or vertical temperature profile information for deeper lakes and reservoirs
- Ambient low flows
- Current information from direct measurements or inferred from water body ambient discharge and cross-sectional area

Existing ambient water data may be very limited. In some cases, estimated values for the data may be acceptable (e.g., measures of discharge and channel geometry could be used to estimate currents). If data are limited, DEQ may require field sampling to gather the necessary data for either conducting or verifying the mixing zone modeling analysis. The sampling work described below may be required to gather stream geometry and hydraulic data.

Channel Geometry

Channel geometry data are used to define the stream configurations, regardless of the particular model being used. The basic types of channel geometry data include the following:

1. Variation of channel width and cross-sectional area with depth
2. Bottom slope (or bed elevations)
3. Variation of wetted perimeter or hydraulic radius with depth
4. Bottom roughness coefficient (Manning's n)

Variation of water depth with flow is discussed in the next section. The four parameters listed above may be assumed constant for the section of the river being modeled (i.e., the river is modeled as a rectangular box). However, these parameter values should be defined when low-flow conditions drastically change the receiving water body's channel geometry and its ability to assimilate the effluent. Length and average slope over long distances can be determined from topographic maps, while the other variables usually require field surveys. The level of detail required in describing the stream geometry depends on the amount of variability in the system and whether the mixing zone is expected to extend into the (hydrodynamic) far-field.

For more information on flows:

- DFLOW
  https://www.epa.gov/waterdata/dflow
- SWSTAT Instructions
  http://water.usgs.gov/software/swstat.html
- USGS Gage Information
  http://waterdata.usgs.gov/nwis/sw
- StreamStats (USGS)
  http://water.usgs.gov/osw/streamstats

For streams with uniform slopes and cross-sections over the study area, only a few transects will be necessary. In areas where the channel geometry varies widely, the stream should be divided into a series of representative reaches, and sufficient transects should be measured along each reach to adequately characterize the geometry. Three to five cross-sections could be measured along each reach, and the results could be averaged to define the reach characteristics for the channel. At a minimum, one representative cross-section should be measured in each reach. Some pool and riffle streams may require dye studies and measuring as many cross-sections as possible to obtain adequate stream geometry. Where modeling (e.g., CORMIX) demonstrates the mixing zone will extend into the far-field, a cumulative discharge centerline may need to be established.

Channel Hydrology

Hydraulic data are needed to define the velocities, flows, and water depths for mass transport calculations. As indicated in section 3.4.3.4.1, mixing zone evaluations must consider low flows of the receiving water body. To determine low-flow values where an extended record of flow data at or near the discharge point is available, the EPA Office of Research and Development's DFLOW program (free download) may be used. The USGS SWSTAT or Idaho StreamStats may also be used. Other statistical methods can be proposed by dischargers after consulting DEQ.

Both DFLOW and SWSTAT rely on the availability of long-term flow data. These models require at least 3 years, and preferably 10 years, of flow data to provide reliable statistical results. Such data may be independently collected by the discharger or another party within the watershed. Alternatively (as well as to verify discharger data), long-term flow data may be available if a nearby USGS stream gage is available.

3.4.3.14.3 Receiving Water Quality

Background water quality information is desired to thoroughly evaluate mixing zones. Depending on the quantity and quality of available background data, DEQ will generally use a conservative estimate (90th to 95th percentile) of background pollutant concentrations when assessing mixing zones.

Some criteria depend on other water quality parameters (chemical or physical). For example, the ammonia criteria depend on temperature and pH. Criteria for seven metals (cadmium, chromium (III), copper, lead, nickel, silver, and zinc) depend on water hardness. The hardness, pH, and temperature of water bodies will vary seasonally, and conservative values must be used for these parameters to ensure criteria are only rarely exceeded, after allowing for mixing. Critical temperatures, pH, or hardness may not correspond in time with critical low flows, and a more sophisticated evaluation may be called for than simply using independently derived conservative values for each parameter. For example, in the preferred approach, create a time series of criteria values overlaying a time series of receiving stream flows to evaluate when assimilative capacity is at its minimum.

Section 3.4.3.4.1 discusses low-flow design discharge conditions for toxics criteria as specified in IDAPA 58.01.02.210.03.b. The conditions are based on the frequency component of the toxics criteria. Idaho's water quality standards do not specify conservative estimates that should be used for hardness, pH, and temperature when evaluating the potential impact of a discharge on the receiving water body.

When evaluating mixing zones for criteria depending on hardness, pH, or temperature, DEQ believes a conservative estimate of background concentrations of these three parameters should be used to calculate an applicable edge of mixing zone pollutant concentration as described below.

For effluent with greater or lower hardness, pH, or temperature than the receiving water body, use an estimate of the fully mixed conditions to calculate the applicable edge of mixing zone concentration. General practice uses the 90th to 95th percentile of ambient pH and temperature data and the 5th percentile of ambient hardness data (section 3.4.3.14.4) as conservative estimates of background concentrations in the mixing zone evaluation. This approach is appropriate for pH and temperature; however, it may not always be appropriate for hardness. The following section discusses methods that can be used to select a conservative value of background hardness.

To calculate the criteria applicable at the edge of the mixing zone, the minimum hardness concentration for metals other than cadmium that may be used is 25 mg/L; the maximum is 400 mg/L. For cadmium, the minimum hardness concentration that may be used is 10 mg/L (IDAPA 58.01.02.210.03.c.i).

3.4.3.14.4 Background Hardness

If data are available, DEQ permit writers will examine the relation between flow and hardness if hardness-influenced pollutants are present or may be present in the effluent.

- If the evaluation indicates that flow has a marked impact on hardness-dependent pollutants in the effluent, the permit writer may include flow-based or seasonal limits for impacted pollutants.
- If hardness-influenced pollutants are present in the effluent, but hardness data are not available, the permit should contain flow and stream quality monitoring requirements to collect data and assess the relationship between flow and hardness for the receiving water.
- If the data justify reopening the permit after the data have been evaluated, the permit may be modified as allowed in IDAPA 58.01.25.201.02.c.ii.
- If hardness data do not exist and a hardness-dependent metal criteria must be included in the permit before obtaining data identifying hardness response to stream flow rates, the permit writer may be required to search for upstream or downstream data to assist in selecting a hardness value that could be used to establish the metal criterion until the permittee can supply the receiving water specific data. Upon receiving the hardness data, the permit may be modified as allowed in IDAPA 58.01.25.201.02.c.ii.

DEQ plotted flow versus hardness data from 21 USGS gage sites and found most sites have an inverse relation between hardness and flow. Six examples are given in Figure 9. The relationship between hardness and flow can be nonexistent (Figure 9-a), intermediate (Figure 9-d), strong (Figure 9-c), and very strong (Figure 9-b).

An inverse relation between hardness and flow is problematic as it confounds conservative assumptions—low hardness and low flows do not co-occur. Taking a 5th-percentile hardness value irrespective of flow and applying it at low flows could be overly conservative in many cases (Figure 9-b). If there is little relation between flow and hardness (Figure 9-a), a 5th percentile of all hardness data will represent all flows, including low flows. But if an inverse relation exists, even if weak (Figure 9-d), using all hardness data will not represent low-flow hardness.

Idaho's water quality standards state the following:

> The hardness values used for calculating aquatic life criteria for metals at design discharge conditions shall be representative of the ambient hardness for receiving water that occur at the [low-flow] design discharge conditions given in Subsection 210.03.b. (IDAPA 58.01.02.210.03.c.ii.)

The hardness data must represent low flows; however, DEQ recognizes that availability of hardness data during low flows (or during a restricted range of flows representative of low flows) is typically limited. For example, using or obtaining hardness data only at 7Q10 flow is impracticable as this flow is a rare occurrence and is usually not known until after the fact. A wider window of flows is likely to provide more data, and more data will give better statistical estimates of hardness values such as the 5th percentile. When a relation between hardness and flow exists, which is most often the case, DEQ suggests the maximum window of flows acceptable for obtaining hardness data that represents low design flow is the 3 months that typically have the lowest flows in a year. Narrower windows are better, especially if the relation between hardness and flow is steep (Figure 9-b). Data from a broader window of flows are acceptable but will likely result in an overly conservative estimate of low-flow hardness.

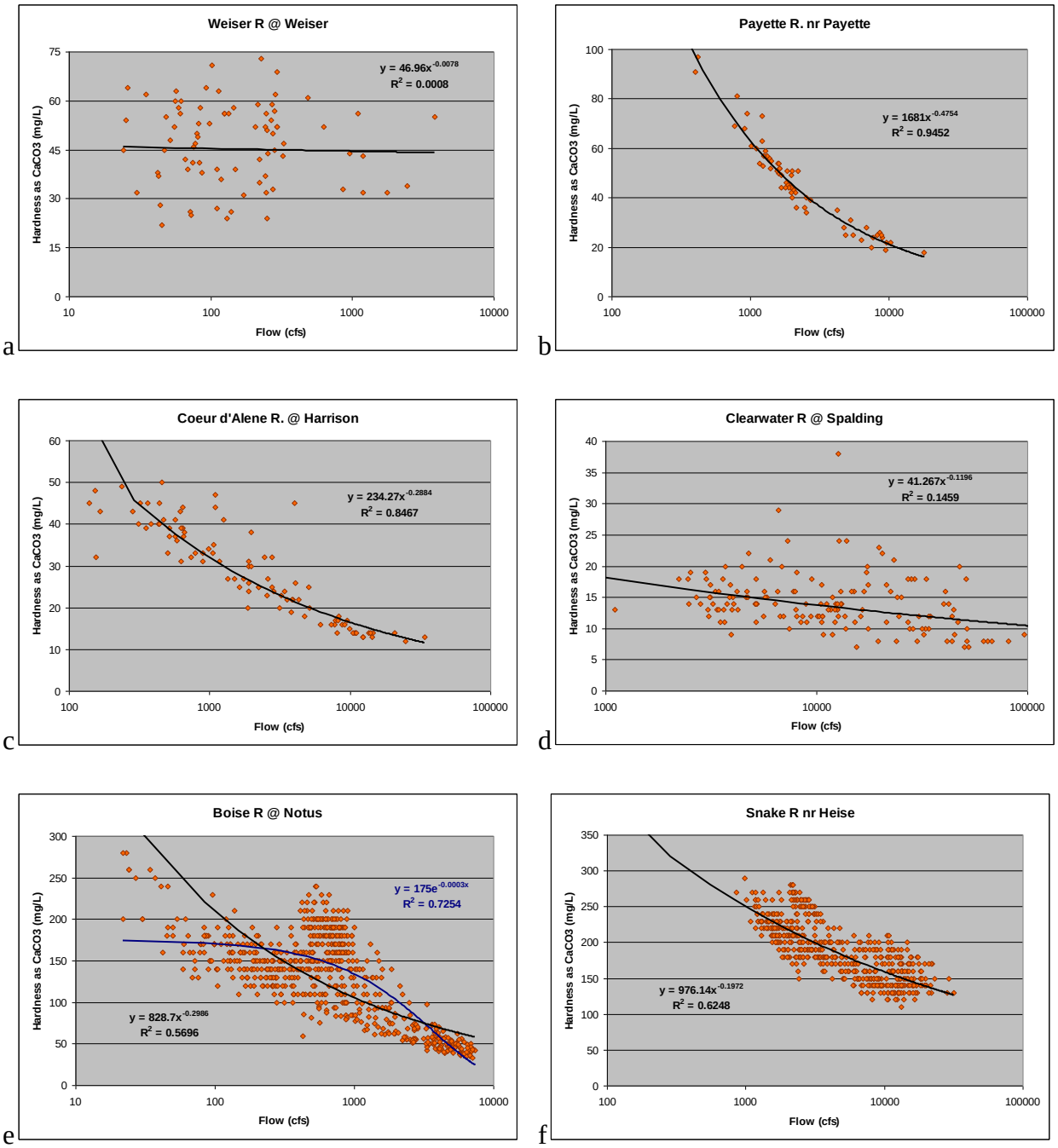


Figure 9. Example plots of water hardness versus flow.

In many situations, the hardness versus flow relation may be unknown. DEQ suggests that 30 samples are adequate to plot a relation between hardness and flow and recommends a minimum of 12 samples during the low-flow period as a basis for estimating the 5th percentile or other low exceedance probability hardness value. The narrower the window of flows sampled and the higher the number of samples, the more likely the estimate of the 5th-percentile hardness at design flow will be accurate and not overly protective.

If sufficient data are available, an alternative would be to use the statistical relation (nonlinear regression) between hardness and flow to estimate the hardness at the design flow. DEQ recommends using at least 30 paired samples of flow and hardness over a range of flows, and the lower 95th-prediction limit on the regression estimate be used. Another option to approach the hardness versus flow relation and refine effluent limits accordingly is to employ flow-tiered effluent limits (section 3.4.3.4.1).

3.4.3.14.5 Effluent Characteristics

Both effluent quantity and quality information are needed to evaluate mixing zones. For POTWs, the facility design flow is used in the mixing zone analysis. For other types of dischargers (e.g., industrial), the maximum recorded flow during the previous 5-year permit term is typically used; facilities anticipating expansion may choose to use projected design flows. An exception would be where facility changes have occurred such that the maximum flow is highly unlikely to be reached in the future (e.g., permanent shutdown of a portion of an industrial facility). In such cases, the maximum flow observed (or anticipated) under the current or planned future operating conditions would be used.

When characterizing the quality of the effluent, DEQ follows the methodology described in the TSD (EPA 1991) to project the maximum possible effluent concentration from the maximum observed effluent concentration. For a new discharge, obtain the pollutant concentration data from the IPDES permit application. For a reissued permit, the maximum observed concentration is the highest level observed during the previous 5-year permit term.

To comply with IDAPA 58.01.02.060.01, the permit writer will assess the receiving water; perform any mixing zone analyses; establish the mixing zone’s size, configuration, and location if a mixing zone is applicable; and authorize all mixing zones on a case-by-case basis. The permit writer should run the mixing zone model using the maximum projected effluent concentration and the appropriate low-flow condition associated with the each pollutant assessed. The discharger may run a series of mixing zone analyses and submit that to DEQ for consideration.

3.4.3.14.6 Outfall and Diffuser Information

Required information for single-port discharges and multiport discharges (diffusers) includes the following:

1. Height of outfall or port above stream bottom
2. Port diameters
3. Type of port mouth such as bell-mouthed or sharp-edged
4. Horizontal and vertical orientation of the port centerline for single-port discharge

5. Horizontal and vertical orientations and spacing of ports for multiport diffusers
6. Distance from shoreline to port or first and last port of a multiport diffuser
7. For side channel discharges, the channel's width, depth, bottom slope, and orientations
8. Photographs of the outfall structure or design plans for new discharges
9. Photographs of the receiving stream

3.4.3.15 Dye Studies

Field dilution measurement using dye or other tracers can be useful in a mixing zone analysis. Measuring tracer concentration in the mixing zone and the effluent discharge allows for directly determining dilution under the specific conditions of the measurements. If the measurements are taken under critical conditions corresponding to a specified low ambient flow and maximum permitted effluent discharge, and the dye or tracer has reached steady state concentration, the field results could be used as an alternative to modeling. If conditions during the field study do not correspond to critical conditions, the results of the tracer or dye measurements can provide important data to validate a model. Preliminary modeling to design a dye or tracer study is highly recommended to ensure adequate dye or tracer mass for detectable concentrations and to select spatial sampling locations. EPA's TSD (EPA 1991, Chapter 4) provides a detailed discussion of dye studies.

3.4.4 Conduct a Reasonable Potential Analysis

When determining the need for a WQBEL, a permit writer uses any available effluent and receiving water data as well as other information pertaining to the discharge and receiving water (e.g., type of industry, existing TBELs, compliance history, and stream surveys), as the basis for a decision, including:

- Data available from previous monitoring
- Working with the permittee to collect data before public notice
- Data collection and reporting as a condition of the new permit

Whenever possible, DEQ will encourage new dischargers to collect monitoring data before effluent limit development. Monitoring should be conducted long before permit development to allow sufficient time to conduct chemical analyses. When monitoring is required as a condition of the permit for future RPA or mixing zone analyses, permittees must adhere to monitoring and reporting conditions in the permit. DEQ will use collected data in a RPA and mixing zone analysis as appropriate. The permit may then be modified if a mixing zone is appropriate, or a WQBEL is required.

To calculate the receiving water concentration downstream of the effluent discharge (Equation 26) (Figure 10):

$$C_d = \frac{(C_e Q_e) + \lfloor C_u (Q_u \times \%MZ) \rfloor}{Q_e + (Q_u \times \%MZ)}$$

Equation 26. Simple mass-balance equation.

Where:

C_d = downstream receiving water concentration	Calculated value
Q_e = critical effluent flow	From discharge flow data (design flow for POTW)
Q_u = critical upstream flow (1Q10 acute criterion, 7Q10 chronic, or harmonic mean)	From water quality standards
%MZ = percent of critical low flow provided by mixing zone	From mixing zone analysis
C_u = critical upstream pollutant concentration (90th to 95th percentile)	From receiving water data
C_e = critical effluent pollutant concentration	Calculated value using Equation 28

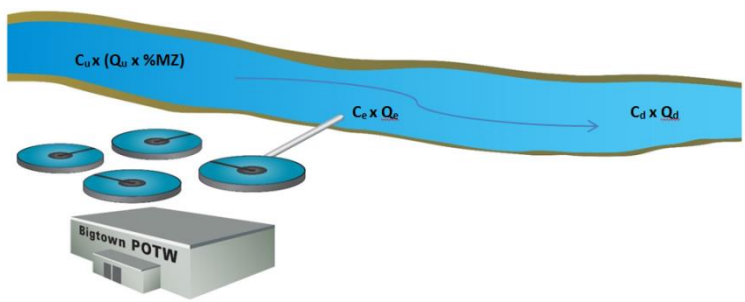


Figure 10. Graphic illustration of the simple mass balance equation.

Use Equation 27 to calculate the resulting receiving water body pollutant concentration when a dilution factor is available. This equation is suitable for use in nonflowing water bodies.

$$C_f = \frac{C_e - C_r}{D_f} + C_r$$

Equation 27. Simple mass-balance equation using dilution factor.

Where:

C_f = Water quality concentration	
C_e = Effluent concentration	
D_f = Dilution factor	Calculated from Equation 25 or via modeling
C_r = Receiving water pollutant concentration	

The permit writer will analyze the previous effluent samples to determine the maximum observed effluent concentration (MOEC) value. First, the permit writer will locate the sample with the MOEC and use the processes provided in the TSD to convert this value to a critical effluent concentration (Ce) that accounts for day-to-day variability in effluent quality. Identify the number of samples reported in the permit application, calculate the CV (Equation 8), and select a reasonable potential multiplying factor (RPMF) from Table 26 (95th-percentile RPMF), or Table 27 (99th-percentile RPMF).

Table 26. Reasonable potential multiplying factors: 95% confidence level and 95% probability basis.

Number of	Coefficient of Variation																			
Samples	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
1	1.4	1.9	2.6	3.6	4.7	6.2	8.0	10.1	12.6	15.5	18.7	22.3	26.4	30.8	35.6	40.7	46.2	52.1	58.4	64.9
2	1.3	1.6	2.0	2.5	3.1	3.8	4.6	5.4	6.4	7.4	8.5	9.7	10.9	12.2	13.6	15.0	16.4	17.9	19.5	21.1
3	1.2	1.5	1.8	2.1	2.5	3.0	3.5	4.0	4.6	5.2	5.8	6.5	7.2	7.9	8.6	9.3	10.0	10.8	11.5	12.3
4	1.2	1.4	1.7	1.9	2.2	2.6	2.9	3.3	3.7	4.2	4.6	5.0	5.5	6.0	6.4	6.9	7.4	7.8	8.3	8.8
5	1.2	1.4	1.6	1.8	2.1	2.3	2.6	2.9	3.2	3.6	3.9	4.2	4.5	4.9	5.2	5.6	5.9	6.2	6.6	6.9
6	1.1	1.3	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.1	3.4	3.7	3.9	4.2	4.5	4.7	5.0	5.2	5.5	5.7
7	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.9
8	1.1	1.3	1.4	1.6	1.7	1.9	2.1	2.3	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9	4.0	4.2	4.3
9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.2	3.4	3.5	3.6	3.8	3.9
10	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.4	2.6	2.7	2.8	3.0	3.1	3.2	3.3	3.4	3.6
11	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.0	3.1	3.2	3.3
12	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.0
13	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.5	2.6	2.7	2.8	2.9
14	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.6	2.7
15	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5
16	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.3	2.4	2.4
17	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.3
18	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2
19	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.9	1.9	2.0	2.0	2.0	2.1	2.1
20	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.0

Table 27. Reasonable potential multiplying factors: 99% confidence level and 99% probability basis.

Number of	Coefficient of Variation																			
Samples	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
1	1.6	2.5	3.9	6.0	9.0	13.2	18.9	26.5	36.2	48.3	63.3	81.4	102.8	128.0	157.1	190.3	227.8	269.9	316.7	368.3
2	1.4	2.0	2.9	4.0	5.5	7.4	9.8	12.7	16.1	20.2	24.9	30.3	36.3	43.0	50.4	58.4	67.2	76.6	86.7	97.5
3	1.4	1.9	2.5	3.3	4.4	5.6	7.2	8.9	11.0	13.4	16.0	19.0	22.2	25.7	29.4	33.5	37.7	42.3	47.0	52.0
4	1.3	1.7	2.3	2.9	3.8	4.7	5.9	7.2	8.7	10.3	12.2	14.2	16.3	18.6	21.0	23.6	26.3	29.1	32.1	35.1
5	1.3	1.7	2.1	2.7	3.4	4.2	5.1	6.2	7.3	8.6	10.0	11.5	13.1	14.8	16.6	18.4	20.4	22.4	24.5	26.6
6	1.3	1.6	2.0	2.5	3.1	3.8	4.6	5.5	6.4	7.5	8.6	9.8	11.1	12.4	13.8	15.3	16.8	18.3	19.9	21.5
7	1.3	1.6	2.0	2.4	2.9	3.6	4.2	5.0	5.8	6.7	7.7	8.7	9.7	10.8	12.0	13.1	14.4	15.6	16.9	18.2
8	1.2	1.5	1.9	2.3	2.8	3.3	3.9	4.6	5.3	6.1	6.9	7.8	8.7	9.6	10.6	11.6	12.6	13.6	14.7	15.8
9	1.2	1.5	1.8	2.2	2.7	3.2	3.7	4.3	5.0	5.7	6.4	7.1	7.9	8.7	9.6	10.4	11.3	12.2	13.1	14.0
10	1.2	1.5	1.8	2.2	2.6	3.0	3.5	4.1	4.7	5.3	5.9	6.6	7.3	8.0	8.8	9.5	10.3	11.0	11.8	12.6
11	1.2	1.5	1.8	2.1	2.5	2.9	3.4	3.9	4.4	5.0	5.6	6.2	6.8	7.4	8.1	8.8	9.4	10.1	10.8	11.5
12	1.2	1.4	1.7	2.0	2.4	2.8	3.2	3.7	4.2	4.7	5.2	5.8	6.4	7.0	7.5	8.1	8.8	9.4	10.0	10.6
13	1.2	1.4	1.7	2.0	2.3	2.7	3.1	3.6	4.0	4.5	5.0	5.5	6.0	6.5	7.1	7.6	8.2	8.7	9.3	9.9
14	1.2	1.4	1.7	2.0	2.3	2.6	3.0	3.4	3.9	4.3	4.8	5.2	5.7	6.2	6.7	7.2	7.7	8.2	8.7	9.2
15	1.2	1.4	1.6	1.9	2.2	2.6	2.9	3.3	3.7	4.1	4.6	5.0	5.4	5.9	6.4	6.8	7.3	7.7	8.2	8.7
16	1.2	1.4	1.6	1.9	2.2	2.5	2.9	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.1	6.5	6.9	7.3	7.8	8.2
17	1.2	1.4	1.6	1.9	2.1	2.5	2.8	3.1	3.5	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8
18	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.4	3.7	4.1	4.4	4.8	5.2	5.6	5.9	6.3	6.7	7.0	7.4
19	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.3	4.6	5.0	5.3	5.7	6.0	6.4	6.7	7.1
20	1.2	1.3	1.6	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.2	4.5	4.8	5.2	5.5	5.8	6.1	6.5	6.8

The permit writer will use the number of samples evaluated in determining the MOEC to select the appropriate row from either Table 26or Table 27. The same data should be used to calculate the CV. EPA recommends a CV of 0.6 for N < 10 (where N is the number of samples). For N > 10, the CV can be calculated using Equation 8:

The critical effluent pollutant concentration (C_e) can now be calculated (Equation 28):

$$C_e = MOEC\ x\ RPMF$$

Equation 28. Calculation of critical effluent pollutant concentration.

An acceptable alternative method to determining the critical effluent concentration (C_e) uses the number of samples (N) collected, the CV, Equation 29 to calculate the probability corresponding to the number of samples collected, and Equation 30, which yields the RPMF. The first step is to calculate the percentile representing the MOEC using Equation 29:

$$p_n = (1 - Confidence\ Level)^{1/N}$$

Equation 29. Highest concentration reported percentile.

Where:

P_n = Percentile corresponding to the highest reported pollutant concentration	Calculated value
N = Number of samples	
Confidence Level = 99%	Use decimal equivalent (0.99)

Once the corresponding percentile is determined from Equation 29, select the associated z-score from Table 28:

Table 28. Percentile to z-score conversion table.

Percentile	Z-Score	Percentile	Z-Score	Percentile	Z-Score
1	-2.326	34	-0.412	67	0.440
2	-2.054	35	-0.385	68	0.468
3	-1.881	36	-0.358	69	0.496
4	-1.751	37	-0.332	70	0.524
5	-1.645	38	-0.305	71	0.553
6	-1.555	39	-0.279	72	0.583
7	-1.476	40	-0.253	73	0.613
8	-1.405	41	-0.228	74	0.643
9	-1.341	42	-0.202	75	0.674
10	-1.282	43	-0.176	76	0.706
11	-1.227	44	-0.151	77	0.739
12	-1.175	45	-0.126	78	0.772
13	-1.126	46	-0.100	79	0.806
14	-1.080	47	-0.075	80	0.842
15	-1.036	48	-0.050	81	0.878
16	-0.994	49	-0.025	82	0.915
17	-0.954	50	0.000	83	0.954
18	-0.915	51	0.025	84	0.994
19	-0.878	52	0.050	85	1.036
20	-0.842	53	0.075	86	1.080
21	-0.806	54	0.100	87	1.126
22	-0.772	55	0.126	88	1.175
23	-0.739	56	0.151	89	1.227
24	-0.706	57	0.176	90	1.282
25	-0.674	58	0.202	91	1.341
26	-0.643	59	0.228	92	1.405
27	-0.613	60	0.253	93	1.476
28	-0.583	61	0.279	94	1.555
29	-0.553	62	0.305	95	1.645
30	-0.524	63	0.332	96	1.751
31	-0.496	64	0.358	97	1.881
32	-0.468	65	0.385	98	2.054
33	-0.440	66	0.412	99	2.326

Next, a reasonable potential multiplication factor can be calculated from Equation 30:

$$RPMF = \frac{C_{99}}{C_{p_n}} = \frac{e^{(z_{99} \times \sigma - 0.5 \times \sigma^2)}}{e^{(z_{p_n} \times \sigma - 0.5 \times \sigma^2)}}$$

Equation 30. RPMF calculation using z-scores.

Where:

RPMF = Reasonable potential multiplication factor	
e = Base of natural log	Approximately 2.718
Z_{99} = z score of the 99th percentile of the normal distribution	2.326
Z_{pn} = z score of the normal distribution corresponding to the "N" samples	From Equation 29 and Table 28
σ = Square root of σ^2	
$\sigma^2 = Ln(CV^2+1)$	Ln is the natural log of base e
CV = Coefficient of variation	Equation 8

The RPMF calculated from Equation 30 can be used in Equation 28 to convert the MOEC from the data set into the critical effluent concentration (C_e).

When the projected pollutant concentration in the receiving water exceeds the applicable water quality criterion, reasonable potential exists, and the permit writer must calculate WQBELs. (Note that for dissolved oxygen, reasonable potential would occur if the water quality model indicates that the projected effluent concentration of the oxygen-demanding pollutants would result in depleting dissolved oxygen below acceptable values in the receiving water).

If C_e is equal to or less than the applicable criterion, reasonable potential does not exist and WQBELs do not need to be calculated.

In situations where mixing is incomplete, the permit writer projects the concentration of the pollutant of concern at the edge of the mixing zone after accounting for available dilution allowance. The projected concentration can be compared to the applicable water quality criterion.

For water bodies needing Tier II antidegradation protection (section 3.3.3), if the projected pollutant concentration does not exceed the applicable water quality criterion, the permit writer should determine if degradation occurs. If significant (>10% loss of assimilative capacity) degradation occurs, the permit writer will follow the antidegradation implementation procedures to evaluate alternatives to discharge, socioeconomic justifications, and ensure all other source controls are achieved.

RPA must be completed for all pollutants of concern and their applicable criteria.

3.4.4.1 What to do if Data are not Available

In some cases (e.g., new or modifications to an existing permit), effluent data may not be available to input into a steady-state model, and the permit writer determine RPA using a

qualitative approach. The permit writer will rely on the methods outlined in the TSD (EPA 1991, section 3.2), which includes the following:

- Effluent variability information, such as history of compliance problems and toxic impacts
- Point and nonpoint source controls such as existing treatment technology, type of industry, POTW treatment system, or BMPs in place
- Species sensitivity data including instream data, adopted water quality criteria, or designated uses
- Dilution information, such as critical receiving water flows or mixing zones
- Engineering reports provided with a New Source/Discharger application
- Effluent data from similar operations either provided in the application or through research

After evaluating all available information, the permit writer may determine that monitoring is required to gather additional data. The permit writer can work with the permittee to obtain data before public notice, if sufficient time exists. The permit will include effluent and receiving water monitoring and reporting requirements that allow DEQ to complete an RPA and evaluate any appropriate mixing zones.

3.4.4.2 Document RPA in Fact Sheet

Permit writers will document the details of the RPA in the IPDES permit fact sheet, including:

- Statutory or regulatory citation
- Applicable site-specific water quality standards considered
- Process used to determine the water quality model, critical conditions, and dilution allowance
- Process used to conduct the RPA including formulas and calculations

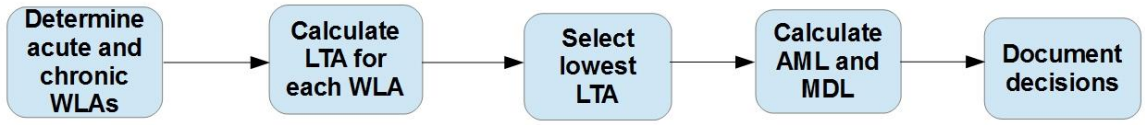
3.5 Calculate Pollutant-Specific WQBELs

If a permit writer has determined that a pollutant or pollutant parameter is discharged at a level that will cause, have reasonable potential to cause, or contribute to an excursion above any state water quality standards at the edge of the mixing zone, the permit writer must develop WQBELs for that pollutant parameter. Calculating WQBELs for toxic pollutants and a number of conventional or nonconventional pollutants with effluent concentrations that tend to follow lognormal distribution have a similar procedure. When pollutants with effluent concentrations that do not follow lognormal distributions are encountered, the methodology used may be either a Monte Carlo simulation or current/relevant methods documented in DEQ's or another agency's guidance.

3.5.1 Calculate Pollutant-Specific WQBELs from Aquatic Life Criteria

Once an RPA has been performed that indicates an RPTE, the permit writer calculates WQBELs. The process for developing pollutant-specific WQBELs for each pollutant involves several steps (Figure 11):

A.



B.

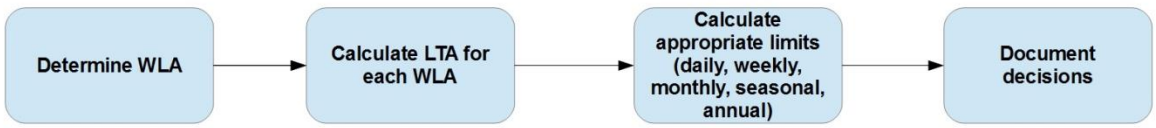


Figure 11. Process for developing chemical specific WQBELs; A—Toxics, B—Nonconventional.

DEQ will follow the TSD's (EPA1991) process for calculating WQBELs from aquatic life criteria using the five steps in Figure 11A and described in the following sections. Pollutants or pollution that does not have acute and chronic criteria will follow the four-step process presented in Figure 11B.

3.5.1.1 Determine Acute and Chronic WLAs

The first step in calculating a pollutant-specific WQBEL from aquatic life criteria is to determine the appropriate WLA. A TMDL WLA must be used if present; otherwise, a WLA can be calculated for a facility on a case-by-case basis if no TMDL exists.

3.5.1.1.1 Flowing Receiving Waters

If a TMDL is not available, the simple mass-balance equation used in Equation 26 can be rearranged to solve for the critical effluent pollutant concentration (C_e), which will be equivalent to the WLA (Equation 31). C_e must be calculated for both acute and chronic criteria. The downstream receiving water concentration, C_d, will be replaced with the water quality criterion, acute or chronic, for the pollutant under consideration.

$$C_e = WLA_{(a\ or\ c)} = \frac{WQC_{(a\ or\ c)}[Q_e + (Q_u \times \%MZ)] - [C_u \times (Q_u \times \%MZ)]}{Q_e}$$

Equation 31. Simple mass-balance equation for calculating WLA for flowing water.

Where:

$WQC_{(a\ or\ c)}$ = Pollutant water quality criterion (acute or chronic)	Calculated value
Q_e = Critical effluent flow	From discharge flow data (design flow for POTW)

Q_u = Critical upstream flow (1Q10 acute criterion or 7Q10 chronic)	From water quality standards
%MZ = Percent of critical low flow provided by mixing zone	From mixing zone analysis
C_u = Critical upstream pollutant concentration (90th to 95th percentile)	From receiving water data
C_e = $WLA_{(a\ or\ c)}$ = wasteload allocation (acute or chronic)	

Equation 31 must be applied to both the acute and chronic water quality criterion for each pollutant under investigation present in the effluent. Each of these values will be used to determine the acute and chronic long-term averages ($LTA_{(a\ or\ c)}$), presented in section 3.5.1.2.

3.5.1.1.2 Nonflowing Receiving Waters

To determine the WLA for nonflowing waters, the receiving water volume surrounding the discharge point must be determined. Nonflowing water are defined in IDAPA 58.01.02.060.h.iv:

> Lakes and reservoirs with a mean detention time of fifteen (15) days or greater shall be considered nonflowing waters for this purpose. Detention time will be calculated as the mean annual storage volume divided by the mean annual flow rate out of the reservoir for the same time period.

For discharges that commenced after July 1, 2015, the volume is the column of water at the discharge point whose surface area is either ≤ 5% of the receiving water's surface area or 100 meters from the point of discharge, whichever is smaller. For discharges that existed before July 1, 2015, the receiving water volume is the column of water ≤10% of the receiving water's surface area.

The WLA equation for nonflowing waters is presented in Equation 32:

$$WLA_{(a\ or\ c)} = WQC_{(a\ or\ c)}\left(D_f + 1\right) - D \times C_r$$

Equation 32. Simple mass-balance equation for calculating WLA for nonflowing water.

Where:

$WLA_{(a\ or\ c)}$ = Wasteload allocation (acute or chronic)	Calculated value
$WQC_{(a\ or\ c)}$ = Pollutant water quality criterion (acute or chronic)	
D = Dilution ratio	Calculated from Equation 33 or through modeling
C_r = Critical receiving water pollutant concentration (acute and chronic; 90th to 95th percentile)	

The dilution ratio (D) used in Equation 32 may be a simple ratio of the effluent volume and the receiving water volume. The dilution ratio can either be determined through modeling or using Equation 33:

$$D = \frac{V_r}{Q_e \times t}$$

Equation 33. Nonflowing water dilution ratio.

Where:

D = Dilution ratio	Calculated (unitless)
V_r = Nonflowing receiving water volume	Millions of gallons (MG)
Q_e = Effluent flow rate	Millions of gallons per day (mgd)
t = Receiving water body residence time	Days

The pollutant specific WLA discharging to nonflowing waters will need to be calculated for both acute and chronic values using Equation 32.

3.5.1.2 Calculate Long-Term Average Concentration for each WLA

The second step in calculating WQBELs is to calculate LTA values for both acute and chronic WLAs. DEQ selected the TSD's procedures for calculating LTAs. Acute and chronic WLA multipliers that can be used to convert WLAs to LTA values are provided in Table 29. The permit writer should use the 99th-percentile confidence level (CL) whenever calculating an LTA, acute or chronic from the associated WLA; the 95th-percentile CL may be used for nutrients and temperature.

Table 29. Acute and chronic WLA multipliers.

CV	Acute		Chronic	
	95th percentile	99th percentile	95th percentile	99th percentile
0.10	0.853	0.797	0.922	0.891
0.20	0.736	0.643	0.853	0.797
0.30	0.644	0.527	0.791	0.715
0.40	0.571	0.440	0.736	0.643
0.50	0.514	0.373	0.687	0.581
0.60	0.468	0.321	0.644	0.527
0.70	0.432	0.281	0.606	0.481
0.80	0.403	0.249	0.571	0.440
0.90	0.379	0.224	0.541	0.404
1.00	0.360	0.204	0.514	0.373
1.10	0.344	0.187	0.490	0.345
1.20	0.330	0.174	0.468	0.321
1.30	0.319	0.162	0.449	0.300
1.40	0.310	0.153	0.432	0.281
1.50	0.302	0.144	0.417	0.264
1.60	0.296	0.137	0.403	0.249
1.70	0.290	0.131	0.390	0.236
1.80	0.285	0.126	0.379	0.224
1.90	0.281	0.121	0.369	0.214
2.00	0.277	0.117	0.360	0.204

Note:TSD (EPA 1991, page 102)

LTA_a can also be calculated using Equation 34.

$$LTA_a = WLA_a \times e^{(0.5\sigma^2 - z_{99}\sigma)}$$

Equation 34. Acute LTA for toxics.

Where:

LTA_a = Acute long-term average	Calculated value
WLA_a = Acute wasteload allocation	Calculated value. See Equation 31 and Equation 32.
e = Base of natural log	Approximately 2.718
σ = Square root of σ^2	
$\sigma^2 = Ln(CV^2+1)$	Ln is the natural log
CV = Coefficient of variation	Calculated using field data. If 10 or less samples available, use default value of 0.6. See Equation 8
Z_{99} = z score of the 99th percentile of the normal distribution	2.326

LTA_c can also be calculated using Equation 35.

$$LTA_c = WLA_c \times e^{(0.5\sigma_n^2 - z_{99}\sigma_n)}$$

Equation 35. Chronic LTA average for toxics.

Where:

LTA_c = Chronic long-term average	Calculated value
WLA_c = Chronic wasteload allocation	Calculated value. See Equation 31 and Equation 32.
e = Base of natural log	Approximately 2.718
σ_n = Square root of σ_n^2	
$\sigma_n^2 = Ln[(CV^2)/n + 1)]$	Ln is the natural log
CV = Coefficient of variation	Calculated using field data. If 10 or less, samples available use default value of 0.6. See Equation 8
Z_{99} = z score of the 99th percentile of the normal distribution	2.326
n = Averaging period for the chronic water quality criterion (typically 4 days)	Varies

3.5.1.3 Select Lowest LTA as Performance Basis for Permitted Discharger

To calculate the maximum daily limit and the AML for each pollutant, select the lowest (minimum value) LTA (LTA_m) calculated using the acute and chronic WLAs. Using the smallest LTA ensures that both WLAs are met, attaining both acute and chronic criteria, and sets one basis for facility performance.

3.5.1.4 Calculate Average Monthly and Maximum Daily Limits

DEQ selected EPA's recommendation of applying the 99th-percentile value to calculate the maximum daily limit while applying the 95th-percentile value to calculate the AML. LTA multipliers for calculating the maximum daily limit are presented in Table 30, and LTA multipliers for calculating the AML are presented in Table 31.

To use these tables, calculate the CV using Equation 8, (round the CV to the nearest tenth [0.1]). Using the 99th-percentile column in Table 30, and the calculated CV, identify the appropriate *LTA multiplier*, which will be used to calculate the maximum daily limit from the LTA.

Table 30. LTA multipliers to calculate maximum daily limits.

CV	Percentiles	
	95th	99th
0.10	1.17	1.25
0.20	1.36	1.55
0.30	1.55	1.90
0.40	1.75	2.27
0.50	1.95	2.68
0.60	2.13	3.11
0.70	2.31	3.56
0.80	2.48	4.01
0.90	2.64	4.46
1.00	2.78	4.90
1.10	2.91	5.34
1.20	3.03	5.76
1.30	3.13	6.17
1.40	3.23	6.56
1.50	3.31	6.93
1.60	3.38	7.29
1.70	3.45	7.63
1.80	3.51	7.95
1.90	3.56	8.26
2.00	3.60	8.55

If the calculated CV value exceeds 2.0, use Equation 36 to calculate the maximum daily limit.

$$Maximum\ Daily\ Limit = LTA_m \times e^{(z_{99}\sigma - 0.5\sigma^2)}$$

Equation 36. Maximum daily limit for toxics.

Where:

LTA_m = Minimum long-term average value	Lesser value of Equation 34 and Equation 35.
e = Base of natural log	Approximately 2.718
σ = Square root of σ^2	
$\sigma^2 = Ln(CV^2+1)$	Ln is the natural log of base e
Z_{99} = z score of the 99th percentile of the normal distribution	2.326
CV = Coefficient of variation	Equation 8

Calculating the AML requires that the permit writer identify how many samples (n) the permittee will be required to collect and analyze each month to verify compliance with the AML. This is not the number of samples that were used to assess RPTE. The AML will be evaluated at the 95th-percentile CL. Calculate the CV, using Equation 8, (round the CV to the nearest tenth [(0.1]). If the permit writer selects any of the following sample quantities (n = 1, 2, 4, 10, or 30), and the CV value is 2.0 or less, the appropriate 95th-percentile columns in Table 31 should be used to identify the *LTA multiplier*.

Table 31. LTA multipliers to calculate AML.

CV	95th Percentile					99th Percentile				
	n = 1	n = 2	n = 4	n = 10	n = 30	n = 1	n = 2	n = 4	n = 10	n = 30
0.10	1.17	1.12	1.08	1.05	1.03	1.25	1.18	1.12	1.08	1.04
0.20	1.36	1.25	1.17	1.11	1.06	1.55	1.37	1.25	1.16	1.09
0.30	1.55	1.38	1.26	1.16	1.09	1.90	1.59	1.40	1.24	1.13
0.40	1.75	1.52	1.36	1.22	1.12	2.27	1.83	1.55	1.33	1.18
0.50	1.95	1.66	1.45	1.28	1.16	2.68	2.09	1.72	1.42	1.23
0.60	2.13	1.80	1.55	1.34	1.19	3.11	2.37	1.90	1.52	1.28
0.70	2.31	1.94	1.65	1.40	1.22	3.56	2.66	2.08	1.62	1.33
0.80	2.48	2.07	1.75	1.46	1.26	4.01	2.96	2.27	1.73	1.39
0.90	2.64	2.20	1.85	1.52	1.29	4.46	3.28	2.48	1.84	1.44
1.00	2.78	2.33	1.95	1.58	1.33	4.90	3.59	2.68	1.96	1.50
1.10	2.91	2.45	2.04	1.65	1.36	5.34	3.91	2.90	2.07	1.56
1.20	3.03	2.56	2.13	1.71	1.39	5.76	4.23	3.11	2.19	1.62
1.30	3.13	2.67	2.23	1.77	1.43	6.17	4.55	3.34	2.32	1.68
1.40	3.23	2.77	2.31	1.83	1.47	6.56	4.86	3.56	2.45	1.74
1.50	3.31	2.86	2.40	1.90	1.50	6.93	5.17	3.78	2.58	1.80
1.60	3.38	2.95	2.48	1.96	1.54	7.29	5.47	4.01	2.71	1.87
1.70	3.45	3.03	2.56	2.02	1.57	7.63	5.77	4.23	2.84	1.93
1.80	3.51	3.10	2.64	2.08	1.61	7.95	6.06	4.46	2.98	2.00
1.90	3.56	3.17	2.71	2.14	1.64	8.26	6.34	4.68	3.12	2.07
2.00	3.60	3.24	2.78	2.19	1.68	8.55	6.61	4.90	3.26	2.14

If the calculated CV value exceeds 2.0, or the samples required differ from the number specified (n = 1, 2, 4, 10, or 30), use Equation 37 to calculate the AML.

$$AML = LTA_m \times e^{\left(z_{95}\sigma_n - 0.5\sigma_n^2\right)}$$

Equation 37. Average monthly limit for toxics.

Where:

LTA_m = Minimum long-term average	Lesser value of Equation 34 and Equation 35.
AML = Average monthly limit	Calculated value
e = Base of natural log	Approximately 2.718
σ_n = Square root of σ_n^2	
$\sigma_n^2 = Ln[(CV^2)/n + 1]$	Ln is the natural log of base e
Z_{95} = z score of the 95th percentile of the normal distribution	1.645
n = Number of sample specified in the permit to be analyzed each month	Typically n = 1, 2, 4, 10, or 30.
CV = Coefficient of variation	Equation 8

3.5.1.5 Document Calculation of WQBELs in Fact Sheet

The rationale and calculations for the WQBELs must be included in the permit's fact sheet, which should include, at a minimum:

- Statutory and regulatory citations
- Process for determining the applicable WLA, including:
  - Selected water quality model
  - Critical conditions
  - Dilution allowance or mixing zone
- Process used to calculate water quality-based effluent limitations (including calculations)
- Number of samples (n) the permittee will be required to collect and analyze each month
- Antidegradation analysis or antibacksliding analysis conducted and the basis for resulting decisions

3.5.2 Calculate Chemical-Specific WQBELs Based on Human Health Criteria for Toxic Pollutants

Criteria for toxic pollutants are divided into multiple categories in Idaho's water quality standards: aquatic life (chronic), aquatic life (acute), consumption of water and fish, and consumption of fish only (IDAPA 58.01.02.210). When a pollutant has criteria in the water quality standards for both human health and aquatic life, the permit writer will calculate the downstream concentrations for each set of standards separately. The resulting downstream concentrations are compared, and the most stringent chosen. The permit writer will then proceed through the remaining calculations as normal.

Developing WQBELs for toxic pollutants affecting human health is somewhat different from calculating WQBELs for other pollutants because (1) the exposure period of concern is generally longer (e.g., often a lifetime exposure) and (2) usually the average exposure, rather than the maximum exposure, is of concern. EPA's recommended approach for setting WQBELs for toxic pollutants for human health protection is to set the AML equal to the WLA determined from the human health criterion. The C_e calculation (Equation 28) for human health pollutants uses the 50th percentile effluent concentration instead of the MOEC. The maximum daily limit should then be calculated from the AML using either the maximum daily limit from AML multiplication factors listed in Table 32, or using Equation 38 when the number of samples per month are other than n = 1, 2, 4, 8, or 30, or the CV > 2.0.

$$Maximum\ Daily\ Limit = AML \times \frac{e^{(2.326\sigma - 0.5\sigma^2)}}{e^{(z_a\sigma_n - 0.5\sigma_n^2)}}$$

Equation 38. Human health maximum daily limit from AML.

Where:

AML = Set equal to the WLA	Set equal to the WLA.
e = Base of natural log	Approximately 2.718
σ = Square root of σ^2	
$\sigma^2 = Ln[CV^2 + 1]$	Variance; where Ln is the natural log of base e
σ_n = Square root of σ_n^2	
$\sigma_n^2 = Ln[(CV^2)/n + 1]$	Variance; where Ln is the natural log of base e
Z_a = Percentile exceedance probability for the AML	1.645 at 95th percentile; 2.326 at 99th percentile

n = Number of samples specified in the permit to be analyzed each month	Typically n = 1, 2, 4, 10, or 30.
CV = Coefficient of variation	Equation 8

Table 32. Ratio between maximum daily and average monthly permit limits.

	Maximum = 99th percentile Average = 95th percentile					Maximum = 99th percentile Average = 99th percentile				
	n					n				
CV	**1**	**2**	**4**	**8**	**30**	**1**	**2**	**4**	**8**	**30**
0.1	1.07	1.12	1.16	1.18	1.22	1.00	1.07	1.12	1.16	1.20
0.2	1.14	1.25	1.33	1.39	1.46	1.00	1.13	1.24	1.32	1.43
0.3	1.22	1.37	1.50	1.60	1.74	1.00	1.19	1.36	1.49	1.67
0.4	1.30	1.50	1.67	1.82	2.02	1.00	1.24	1.46	1.66	1.92
0.5	1.38	1.62	1.84	2.04	2.32	1.00	1.28	1.56	1.81	2.18
0.6	1.46	1.73	2.01	2.25	2.62	1.00	1.31	1.64	1.95	2.43
0.7	1.54	1.84	2.16	2.45	2.91	1.00	1.34	1.71	2.08	2.67
0.8	1.61	1.94	2.29	2.64	3.19	1.00	1.35	1.76	2.19	2.89
0.9	1.69	2.03	2.41	2.81	3.45	1.00	1.36	1.80	2.27	3.09
1.0	1.76	2.11	2.52	2.96	3.70	1.00	1.37	1.83	2.34	3.27
1.1	1.83	2.18	2.62	3.09	3.93	1.00	1.37	1.84	2.39	3.43
1.2	1.90	2.25	2.70	3.20	4.13	1.00	1.36	1.85	2.43	3.56
1.3	1.97	2.31	2.77	3.30	4.31	1.00	1.36	1.85	2.45	3.68
1.4	2.03	2.37	2.83	3.39	4.47	1.00	1.35	1.84	2.46	3.77
1.5	2.09	2.42	2.89	3.46	4.62	1.00	1.34	1.83	2.46	3.84
1.6	2.15	2.47	2.93	3.52	4.74	1.00	1.33	1.82	2.46	3.90
1.7	2.21	2.52	2.98	3.57	4.85	1.00	1.32	1.80	2.45	3.94
1.8	2.27	2.56	3.01	3.61	4.94	1.00	1.31	1.78	2.43	3.97
1.9	2.32	2.60	3.05	3.65	5.02	1.00	1.30	1.76	2.41	3.99
2.0	2.37	2.64	3.07	3.67	5.09	1.00	1.29	1.74	2.38	4.00

If the permit writer calculates chemical-specific WQBELs from human health criteria, these WQBELs should be compared to any other WQBELs (e.g., WQBELs based on aquatic life criteria) and TBELS, and apply antidegradation and antibacksliding requirements to determine the final limitations that meet all technology and water quality standards. Selecting the criterion that yields the smallest limit guarantees that all designated uses are protected by ensuring the protection of the most sensitive use. As discussed above, all processes should be documented in the permit's fact sheet.

3.5.3 Calculate Pollutant-Specific WQBELs using Probabilistic Methods

In instances where adequate data exist to develop receiving water and discharging facility attributes versus frequency curves, probabilistic methods may be used to predict whether criteria may be exceeded more frequently than desired. Monte Carlo simulation combines probabilistic and deterministic analyses because it uses a fate and transport mathematical model with statistically described inputs. The probabilistic distributions of effluent flow, effluent

concentration, and other required model inputs must be definable in durations that match the associated criteria, (e.g., 1-day average for CMC, or 4-day average for CCC). Values from these parameters' probability distributions are randomly selected for the deterministic (fate and transport) model. Each time the deterministic model is run a new set of randomly selected parameter values are used. The permit writer may have the model run hundreds or thousands of repetitions. Each run of the simulation yields a result that is independent of the previous iterations. The results, a data set of receiving water concentrations, can be sequenced by magnitude, yielding a magnitude versus frequency distribution curve.

In contrast to the standard mass balance steady-state equation that assesses the worst-case concentration based on critical conditions that are highly improbable of happening concurrently, a Monte Carlo model may provide the full range of environmental responses if sufficient model iterations are performed. The advantages to performing Monte Carlo simulations are as follows:

- Predict the frequency and duration of toxicant concentrations in a receiving water.
- Use with steady-state or continuous simulation models that include fate processes for specific pollutants.
- Use with steady-state or continuous simulation models that include transport processes for rivers, or lakes.
- Use with steady-state or continuous simulation models that are designed for single or multiple pollutant source analyses.
- Does not require time series data.
- Does not require model input data to follow a specific statistical distribution or function.
- Incorporate the cross-correlation and interaction of time-varying pH, flow, temperature, pollutant discharges, and other parameters if the analysis is developed separately for each season and the results are combined.

The primary disadvantages of Monte Carlo simulation are as follows:

- Requires more input, calibration, and verification data than do steady-state models.
- Model results need manipulation to calculate the effluent LTA concentration and CV to develop effluent limits.

Probabilistic models require significant amounts of data. Years of continuous data may be required to have a dataset sufficiently large to run the model to obtain sufficiently reliable results to use in the permit. While significant, these restrictions are not prohibitive when using Monte Carlo simulations to establish permit limits.

An example of a Monte Carlo simulation using a mass balance model to calculate downstream concentrations of a toxic substance (e.g., zinc) and a parameter that affects toxicity (e.g., hardness) is based on randomly simulated inputs per each repetitive calculation. Each variable (effluent and river flow, effluent and river hardness, and zinc concentrations) was simulated on a daily basis by randomly generating data based on the mean and standard deviation of each parameter using a lognormal distribution using the program @Risk (Palisades Corporation) (Table 33). The mean and standard deviation of each parameter were selected to approximate the same hypothetical data set used for the steady-state analyses. This random simulation for each parameter for each day was done for a 21-year period (7,665 daily values).

The process was repeated using successively different LTA effluent zinc concentrations until the model showed compliance with the water quality criteria for zinc for the allowed violation frequency. This process is repeated for both acute and chronic criteria. The allowable frequency of excursion above the standard was once in 3 years (1 per 1,095 days) as recommended in the TSD and included in Idaho's water quality standards. The effluent LTA needed to protect the acute and chronic toxicity (LTA_a and LTA_c) obtained from the model outputs are used to calculate the acute and chronic maximum daily limits and the acute and chronic AMLs using the TSD method. Note that the iterated LTA_a and LTA_c turned out to be 13.2 and 14.0 µg/L, respectively, for this Monte Carlo simulation, and about a 9% reduction in the LTA compared to the originally simulated effluent dataset. Table 34 summarizes the outcome of the Monte Carlo simulation compared to a steady-state method.

Table 33. Example summary of statistical characteristics of the Monte Carlo simulated data—values used as inputs to steady-state method.

Parameter	1Q10	7Q10	Mean	Standard Deviation	5th Percentile	95th Percentile	Geometric Mean
River flow (cfs)	138	258	NA	NA	NA	NA	NA
River zinc (µg/L)	NA	NA	NA	NA	NA	5.3	2.2
River hardness (mg/L)	NA	NA	NA	NA	41	NA	59
Effluent flow (mgd)	NA	NA	20 design 14.5 daily 13.8 weekly	NA	NA	NA	NA
Effluent zinc (µg/L)	NA	NA	15.8	6.9	NA	28.8	NA
Effluent hardness (mg/L)	NA	NA	111	NA	87	NA	111

Note: NA = Not Applicable

Table 34. Comparison of Monte Carlo and steady-state methods.

Effluent Limitations	Monte Carlo Method		Steady-State Method	
	Once per Month Sampling Frequency	Four times per Month Sampling Frequency	Once per Month Sampling Frequency	Four times per Month Sampling Frequency
Maximum daily limit (µg/L)	36	36	17	17
Average monthly Limit (µg/L)	33	24	13	10

Note: Steady-state method assumed 95th-percentile zinc and 5th-percentile hardness concentrations in the upstream receiving water.

3.6 Calculate RPA and WQBELs for Whole Effluent Toxicity

WET tests measure the degree of response of exposed aquatic test organisms to an effluent sample or a sample mixture of some proportion of effluent with dilution water (e.g., laboratory water, nontoxic receiving water). Idaho's water quality standards do not have numeric criteria for WET. The number of test results for a given permittee is often less than other commonly evaluated pollutants. For example, semiannual acute and chronic testing, which is generally

required for major facilities, will yield 10 tests over the 5-year permit cycle. Less frequent testing is generally required for minor facilities.

The RPTE is based on toxicity data submitted by the discharger. For an RPA, data should be available for acute and/or chronic testing with select aquatic test species listed in section 3.6.2.1. The permit writer can evaluate the need for WQBELs using a calculated numeric criterion that will attain and maintain the applicable narrative criterion. Typically, Idaho's narrative criterion for toxics is interpreted to mean $TU_a = 0.3$ and $TU_c = 1$, as defined in section 3.3.2.3. Using these values, the permit writer uses WET test results to project acute or chronic toxicity in the receiving water after accounting for the applicable dilution allowance or mixing zone. If the projected toxicity exceeds the calculated criterion, the permit writer has demonstrated RPTE and must calculate WET limits.

3.6.1 Express WET Limits or Test Results

Two options are available for expressing WET limits or test results: directly in terms of endpoints or indirectly in terms of TUs.

Toxicity in terms of endpoints is typically expressed in one of the following ways:

- NOEC, the highest concentration of effluent (i.e., highest percent effluent) at which no adverse effects are observed on the aquatic test organisms
- LOEC, the lowest concentration of effluent that causes observable adverse effects in exposed test organisms
- LC_{50}, a point estimate of the effluent concentration that would kill 50% of the test animals
- IC_x, a point estimate of the effluent concentration that would cause a given percent reduction (x%) in a biological measurement of the test organisms
- Effect concentration, a point estimate of the effluent concentration that would cause an observable adverse effect in a given percentage of test organisms

The acute test results (LC_{50}) and chronic test results (IC_{25}) can be converted to TUs by dividing 100 by the test result percentage (Equation 23 and Equation 24). For example, if the IC_{25} for a chronic test is 60%:

$$\frac{100}{60} = 1.7\ chronic\ toxic\ units\ (TU_c)$$

However, 1.0 $TU_a \neq 1.0\ TU_c$ because they represent toxicity at different endpoints. A permit may require monitoring both acute and chronic toxicity. When at least 10 sets of paired acute and chronic WET test data are available, the permit writer may develop an ACR, to equate TU_a and TU_c. For fewer than 10 paired sets of data, EPA recommends a default ACR of 10. The ACR will be used to convert acute data to chronic or chronic data to acute. If chronic data are not available, the acute data are converted to chronic data by multiplying each acute toxicity TU_a by the TSD default ACR of 10. The reciprocal mathematical operation is used to convert each chronic TU_c to a TU_a using the ACR. The ACR used is the average of these 10 individual ratios.

The ACR is expressed as (Equation 39):

$$ACR = \frac{Acute\ Endpoint}{Chronic\ Endpoint} = \frac{LC_{50}}{IC_{25}}$$

Equation 39. ACR expression.

A TU is the inverse of the sample fraction, as expressed in Equation 23, acute TUs, and Equation 24, chronic TUs, repeated below:

$$TU_a = \frac{100}{LC_{50}}$$

Acute TU.

$$TU_c = \frac{100}{IC_{25}}$$

Chronic TU.

Consequently, toxicity as percent sample, may be expressed by rearranging the acute and chronic TU equations as indicated below:

$$LC_{50} = \frac{100}{TU_a} \text{ and } IC_{25} = \frac{100}{TU_c}$$

Substituting into Equation 39, we can rearrange to obtain Equation 40:

$$ACR = \frac{LC_{50}}{IC_{25}} = \frac{\frac{100}{TU_a}}{\frac{100}{TU_c}} = \frac{TU_c}{TU_a}$$

Equation 40. ACR in terms of TU.

Example 1:

Given LC_{50} = 28%, IC_{25} = 10%

Using Equation 40, $ACR = \frac{28\%}{10\%} = 2.8$

Example 2:

Given TU_a = 3.6, TU_c = 10.0

Using Equation 40, $ACR = \frac{TU_c}{TU_a} = \frac{10.0}{3.6} = 2.8$

Example 3:

Given the toxicity data for a facility's effluent for *C. dubia* (Table 35) and using Equation 40 to calculate the ACR in column 3:

Table 35. Example WET data.

LC_{50} (% effluent)	IC_{25} (% effluent)	ACR
62	10	6.2
18	10	1.8
68	25	2.7
61	10	6.1
63	25	2.5
70	25	2.8
17	5	3.4
35	10	3.5
35	10	3.5
35	25	1.4
47	10	4.7
		Mean = 3.5

Example 4:

Given TU_a = 1.8, ACR = 3.5

Using Equation 40 and rearranging to solve for TU_c, $TU_c = ACR \times TU_a = 3.5 \times 1.8 = 6.3$

3.6.2 WET WLA and RPA

Performing an RPA for WET is similar to executing a RPA for other pollutants. The permit writer must begin by assessing the data, determining the CV and RPMF, and comparing the calculated downstream concentration to the appropriate numeric WET interpretation of the narrative criterion (e.g., 1.0 TU_c or 0.3 TU_a). The WLA for WET is then calculated using a simple mass balance equation (section 3.6.2.2).

3.6.2.1 Data Quantity and Quality Considerations

An RPA is based on toxicity data submitted by the discharger. For an RPA, data should be available for acute and/or chronic testing with a selection of the species identified in Table 36. The selection should include the most sensitive vertebrate, invertebrate, and an algae if warranted. As an alternative when there is a lack of acute or chronic testing data, the ACR may be used to convert acute data to chronic or chronic data to acute.

Table 36. Freshwater organisms used in WET.

Organism Class and Common Name	Species	Test Type
Vertebrate—Fathead Minnow	*Pimephales promelas*	Acute, chronic
Vertebrate—Bannerfin Shiner	*Cyprinella leedsi*	Acute
Vertebrate—Rainbow Trout	*Oncorhynchus mykiss*	Acute
Vertebrate—Brook Trout	*Salvelinus fontinalis*	Acute
Invertebrate—water flea	*Ceriodaphnia dubia*	Acute, chronic
Invertebrate—water flea	or *Daphnia pulex*	Acute, chronic
Plant—algae	*Pseudokirchneriella subcapitata*	Chronic

Note: While any of these species may be used, the fathead minnow and Ceriodaphnia water flea are most common.

If less than 10 acute or chronic data points are available, or in cases where no effluent data are available, an RPA may still be performed (section 3.4.4.1). This case should instigate additional monitoring. For major facilities, acute and chronic monitoring should be at a minimum on a semiannual basis so that 10 valid data points are available by the end of the permit cycle. Regardless of the amount of data available to assess a WET RPA, the procedures must account for the following, as specified in IDAPA 58.01.25.302.06.a.ii:

- Existing controls on point and nonpoint sources of pollution
- Variability of the pollutant or pollutant parameter in the effluent
- Sensitivity of the species to toxicity testing
- Dilution of the effluent in the receiving water (where appropriate)

3.6.2.2 RPA Assessment

Ideally, the RPTE is assessed if at least 10 valid WET test results for acute, chronic, or both (whichever is applicable) are available and the following:

- Maximum probable effluent TU_a at the 99% CL of the 99% probability level is greater than the WET WLA_a.
- Maximum probable effluent TU_c at the 99% CL of the 99% probability level is greater than the WET WLA_c.

The RPTE may also be assessed when less than 10 test results are available or in cases where no effluent data are available using the procedure in section 3.4.4.1.

Select the appropriate RPMF from Table 27 based on the CV and number of tests performed.

These analyses will result in four possible maximum probable concentrations (MPC), an acute and a chronic value for each of the two species used in the WET tests. The MPC is calculated by multiplying the maximum TU_a for each species and the maximum TU_c for each species by the RPMF from Table 27. If the MPC for a species for a given test type (acute or chronic) is less than the appropriate WET WLA, no RPTE exists, and no WET WQBELs need be generated. If RPTE is indicated, WET limits may need to be calculated for WET WLA_a, WET WLA_c, or both. WET WLAs can be calculated using Equation 31 or Equation 32, depending on whether the receiving water body is flowing or not.

3.6.3 Determine WET Triggers and Limits

If there is no RPTE, the permit writer should determine a trigger value. If a WET monitoring result exceeds the trigger value, the permittee must conduct accelerated testing. Accelerated test results that corroborate the trigger exceedance may identify the need for a WET limit in future permits.

3.6.3.1 Calculate a WET Trigger

To calculate an appropriate trigger, a simple mass balance will be performed by rearranging the simple mass balance equation (Equation 26) to solve for the effective effluent concentration (C_e) (Equation 41). To calculate WET triggers for discharges to nonflowing water bodies use Equation 32 and an appropriate dilution factor.

$$C_e = \frac{C_d \times \left(Q_e + (Q_u \times \%MZ)\right) - \left(C_u \times (Q_u \times \%MZ)\right)}{Q_e}$$

Equation 41. WET trigger calculation.

Where:

C_e = Chronic WET trigger effluent concentration	Value > chronic WET criterion (1.0 TU_c)
Q_e = Critical effluent flow	From discharge flow data (design flow for POTW)
Q_u = critical upstream flow (7Q10 chronic)	From water quality standards
%MZ = Percent of critical low flow provided by mixing zone	From mixing zone analysis
C_u = Critical upstream pollutant concentration	Upstream chronic WET concentration = 0.0 TU_c
C_d = Critical effluent pollutant concentration	Chronic WET criterion = 1.0 TU_c

Example:

A discharger is granted a mixing zone (%MZ) using 10% of the critical low flow (Q_u = 7Q10) of 15 cfs. The POTW's design flow (Q_e) is 0.25 mgd (0.39 cfs). The downstream (C_d) chronic WET criterion is 1.0 TU_c, and the upstream (C_u) chronic WET concentration is 0.0 TU_c. Calculate the appropriate chronic WET trigger.

$$C_e = \frac{\left(C_d\left((Q_u \times \%MZ) + Q_e\right) - C_u \times (Q_u \times \%MZ)\right)}{Q_e}$$

$$C_e = \frac{\left(1.0TU_c \times \left((15 \times 0.10) + 0.39\right) - \left(0TU_c \times (15 \times 0.10)\right)\right)}{0.39}$$

$$C_e = 4.8TU_c$$

Typically, only chronic WET triggers are developed because a dilution factor exceeding 1,000:1 is very uncommon in Idaho. In the instances where acute WET triggers are required, the ACR can be used to convert the acute WET trigger into an equivalent chronic WET trigger, which will

work as a surrogate for the acute WET trigger. If an ACR is not available, use the EPA recommended default value of 10 to obtain the equivalent value in chronic TUs (0.3 TU_a * 10 = 3.0 TU_c).

3.6.3.2 Calculate Acute WET Limit

Using the WET WLA_a, calculate the LTA_a at the 99% CL with Equation 42.

$$LTA_a = WLA_a \times e^{(0.5\sigma^2 - z_{99}\sigma)}$$

Equation 42. WET acute LTA.

Where:

LTA_a = Acute long-term average	Calculated value
WLA_a = Acute wasteload allocation	Calculated value. See Equation 31.
e = Base of natural log	Approximately 2.718
σ = Square root of σ^2	
$\sigma^2 = Ln(CV^2+1)$	Ln is the natural log.
Z_{99} = z score of the 99th percentile of the normal distribution	2.326

Calculate the maximum daily and average monthly permit limits using the LTA_a. Use Equation 43 to calculate the maximum daily limit, using 99th-percentile z-score, and use Equation 44 to calculate the AML, using the 95th-percentile z-score.

$$Maximum\ Daily\ Limit_a = LTA_a \times e^{(z_{99}\sigma - 0.5\sigma^2)}$$

Equation 43. Acute WET maximum daily limit.

$$AML_a = LTA_a \times e^{(z_{95}\sigma_n - 0.5\sigma_n^2)}$$

Equation 44. Acute WET average monthly limit.

Where:

LTA_a = Acute long-term average	Calculated value. See Equation 42.
AML_a = Acute average monthly limit	Calculated value
e = Base of natural log	Approximately 2.718
σ = Square root of σ^2	
σ_n = Square root of σ_n^2	
$\sigma^2 = Ln(CV^2+1)$	Ln is the natural log of base e.
$\sigma_n^2 = Ln[(CV^2/n) + 1]$	Ln is the natural log of base e.
Z_{95} = z score of the 95th percentile of the normal distribution	1.645
Z_{99} = z score of the 99th percentile of the normal distribution	2.326
n = Number of samples specified in the permit to be analyzed each month	Default = 4 (assumed when monitoring frequency is less than or equal to once per month)
CV = Coefficient of variation	Equation 8

3.6.3.3 Calculate Chronic WET Limit

Using the WET WLA_c, calculate the LTA_c at the 99% CL with Equation 45.

$$LTA_c = WLA_c \times e^{(0.5\sigma_4^2 - z_{99}\sigma_4)}$$

Equation 45. Chronic WET long-term average.

Where:

LTA_c = Chronic long-term average	Calculated value
WLA_c = Chronic wasteload allocation	Calculated value. See Equation 31.
e = Base of natural log	Approximately 2.718
σ_4 = Square root of σ_4^2	
$\sigma_4^2 = Ln[(CV^2/4) + 1]$	Ln is the natural log of base e.
Z_{99} = z score of the 99th percentile of the normal distribution	2.326

Calculate the maximum daily and average monthly permit limits using the LTA_c. Use Equation 46 to calculate the maximum daily limit, using 99th-percentile z-score, and use Equation 47 to calculate the AML, using the 95th-percentile z-score.

$$Maximum\ Daily\ Limit_c = LTA_c \times e^{(z_{99}\sigma - 0.5\sigma^2)}$$

Equation 46. Chronic WET maximum daily limit.

$$AML_c = LTA_c \times e^{(z_{95}\sigma_n - 0.5\sigma_n^2)}$$

Equation 47. Chronic WET average monthly limit.

Where:

LTA_c = Chronic long-term average	Calculated value. See Equation 45.
AML_c = Chronic average monthly limit	Calculated value
e = Base of natural log	Approximately 2.718
σ = Square root of σ^2	
σ_n = Square root of σ_n^2	
$\sigma^2 = Ln(CV^2+1)$	Ln is the natural log of base e.
$\sigma_n^2 = Ln[(CV^2/n) + 1]$	Ln is the natural log of base e.
Z_{95} = z score of the 95th percentile of the normal distribution	1.645
Z_{99} = z score of the 99th percentile of the normal distribution	2.326
n = Number of sample specified in the permit to be analyzed each month	Default = 4 (assumed when monitoring frequency is less than or equal to once per month)
CV = Coefficient of variation	Equation 8

3.6.3.4 Report Chronic and Acute WET Limits

The permit requires the permittee to report the maximum acute or chronic WET result for that calendar month as the maximum daily limit result on the DMR. For the AML, the permittee reports the average of the acute or chronic WET tests performed during that calendar month.

3.6.4 Document RPA and WQBEL Calculations for WET in Fact Sheet

The permit writer will record all rationale, regulatory justification, and decisions regarding RPA and WQBEL calculations for WET in the permit's fact sheet, including:

- Statutory and regulatory citations.
- Monitoring frequency—required WET monitoring frequency.
- RP determinations—calculations for deriving or revising WET limits or WET triggers and the associated RPA workbook.
- WET triggers and limits—decision-making process and calculations for establishing the permittee's WET triggers or limits.
- Justification for including or omitting valid WET data—how generated WET test data are used or not used in reasonable potential determinations and IPDES permit compliance. If data generated over the course of a previous permit cycle are not used, the reasons for not using certain data or using other data must be clearly explained.

3.7 Special Considerations

The special considerations are topics DEQ believes may impact effluent limits and are beyond the scope of straightforward calculations. Each section discusses the nuances of each topic and how permit writers will work to address the topic and incorporate relevant limits, if necessary, in the permit. While specific frameworks have not been developed for all topics, established guidance documents will be consulted when available. These considerations may warrant special conditions in a permit through requirements for additional monitoring or special studies, BMPs, or compliance schedules.

3.7.1 Nutrients

The macronutrients that have the greatest impact on surface water quality are nitrogen and phosphorus. These macronutrients are ubiquitous in the environment and find their way into surface water from agricultural runoff, urban irrigation, storm water, and other nonpoint and point source discharges.

Excessive nitrogen and phosphorus loading to surface waters impact water quality by stimulating the growth of algae and aquatic plants that may result in shifts in pH, high levels of dissolved and suspended organic matter, increased turbidity, depletion of dissolved oxygen, impairment of drinking water sources, and in some cases, harmful algal blooms. Eutrophication is the process of stimulating aquatic plant growth resulting in a reduction in water quality. Typically, eutrophication is a far-field effect because it relies upon aquatic plants' rates of growth, death, and decay. Nutrients discharged to surface waters may travel great distances in flowing streams or settle in sediment in nonflowing surface water before the aquatic impact is realized. Nutrients, excluding ammonia, do not behave in a similar fashion as toxics.

IDAPA 58.01.25 requires DEQ to evaluate whether a discharger will cause, have the reasonable potential to cause, or contribute to an excursion of numeric or narrative water quality criteria. If reasonable potential is identified, the permit must contain a limit addressing the specific pollutant. While this concept was primarily developed for toxic pollutants, it is equally applicable to nutrient discharges that detrimentally impact the receiving water body. IPDES

permit limits control the negative impact of excess nitrogen and phosphorus on surface waters through appropriate limits on point source discharges. Understanding the differing impacts these macronutrients have on the receiving water is necessary to develop appropriate limits for point source discharges.

Section 3.7.1.1 discusses special considerations a permit writer should evaluate when the discharge being permitted contains nutrients.

3.7.1.1 Nutrient Speciation

Nitrogen and phosphorus are elements present in the environment in many different chemicals. Some of these chemicals are classified as inorganic and others as organic. Each has its own reactivity or bioavailability. Unless a specific chemical is identified in the water quality standards as a toxic, the permit writer will aggregate the chemicals bearing nitrogen as total nitrogen and phosphorus as total phosphorus.

3.7.1.1.1 Nitrogen

In wastewater, nitrogen is generally found in chemicals such as ammonia, nitrates, urea, and amino acids. Wastewater treatment processes reduce the urea, amino acids, and other large organic and bioavailable inorganic nitrogen-bearing chemicals to ammonia, nitrates, and nitrogen gas. The nitrogen gas escapes to the atmosphere, removing nitrogen from the wastewater, if the facility's processes are designed to accommodate nitrification-denitrification.

Residual ammonia and nitrate are the chemicals of immediate concern in the wastewater discharge; both of these chemicals are toxic to freshwater aquatic life. Consequently, ammonia is initially addressed in the assessment of toxic chemicals, and limits are developed for the facility if there is RPTE. Ammonia has both acute and chronic toxic criteria, which are influenced by temperature and pH (IDAPA 58.01.02).

Nitrate is regulated in Idaho's water quality standards under the narrative criteria as a toxic (IDAPA 58.01.02.200.02) and nutrient (IDAPA 58.01.02.200.06). IDAPA 58.01.25.302.06.a.vi(2) allows limits to be established on a case-by-case basis using the CWA §304(a) criteria. Nitrate in high concentrations may adversely impact public drinking water systems and is regulated under IDAPA 58.01.08 for those systems that obtain their water from surface water. Nitrate has a MCL of 10 mg-N/L, above which children under 6 months of age are susceptible to nitrate-induced methemoglobinemia. Methemoglobinemia occurs in young children when the nitrate oxidizes the ferrous iron in hemoglobin to the ferric form, which has a higher affinity for oxygen, inhibiting the release of oxygen resulting in tissue hypoxia. Severe methemoglobinemia may be fatal in young children. Nitrate is a component of total inorganic nitrogen and total nitrogen when specified in pollutant monitoring.

3.7.1.1.2 Phosphorus

Phosphorus, unlike nitrogen, is a solid at standard temperature and pressure. Consequently, wastewater treatment processes cannot discharge phosphorus to the atmosphere as is possible with nitrogen. Phosphorus is reported in the technical literature in multiple ways, depending on the phosphorus bearing chemical that is under investigation.

3.7.1.2 Receiving Water Quality

IDAPA 58.01.02.200.06 states, "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses." In addition to nutrient concentrations, several factors determine the impact of nutrients on receiving water quality (e.g., extent of algal growth) including, but not limited to, the following:

- Light penetration
- Stream velocity
- Stream turbulence
- Substrate stability
- Frequency of flood events
- Intensity of flood events
- Land usage of abutting terrain
- Temperature

Due to each stream's unique nature, DEQ will assess-nutrient impacts for each point source discharge on a case-by-case basis.

Following the procedures outlined at sections 3.2 and 3.3, the permit writer should identify the water body's beneficial uses, applicable nutrient criteria, antidegradation protection, and support status. Depending on the designated and existing uses for the receiving water, it may be necessary to determine seasonal or annual nutrient limits.

3.7.1.2.1 Impaired Waters with TMDLs

In receiving waters that have WLAs established in a TMDL, the permit writer will use the assigned TMDL WLA as the permit limits (section 3.5).

3.7.1.2.2 Impaired Waters without TMDLs

When a permittee proposes to discharge to a receiving water body that has been assessed as nutrient impaired but does not currently have an approved TMDL, the permit writer will evaluate the nutrient limit requirements under the water quality standards narrative criteria (section 3.3.2.3). In these cases, because the receiving water body exceeds an allowable concentration of nutrients, any discharge of additional nutrients would clearly contribute to the RPTE for nutrients.

Alternatively, the permit writer may do the following:

- Investigate the applicability of EPA recommended §*304(a) criteria*.
- Investigate how the discharge being considered may be limited to prevent contributing to a downstream exceedance of criteria for nutrients, pH, or dissolved oxygen.
- Investigate water bodies with similar characteristics for nutrient impairment and a TMDL. These TMDLs may provide important insight.
- Work with the Surface Water Program staff to establish a nutrient target that can be used to establish limits.

3.7.1.2.3 Nonimpaired Waters

When a permittee proposes to discharge to a receiving water body that has been assessed and found to not be water quality limited due to nutrients, the permit writer will complete an RPA and incorporate monitoring and reporting requirements for both the effluent and receiving water as appropriate. If the RPA indicates that the discharge is likely to violate the narrative water quality standards, the permit writer will conduct the following:

- Investigate the applicability of EPA recommended §*304(a) criteria*.
- Investigate how the discharge being considered may be limited to prevent contributing to a downstream exceedance of criteria for nutrients, pH, or dissolved oxygen.
- Investigate water bodies with similar characteristics for nutrient impairment and a TMDL. These TMDLs may provide important insight.
- Work with the Surface Water Program to establish a nutrient target that can be used to calculate appropriate limits.

3.7.1.3 Averaging Period

Nutrients in excessive amounts have a detrimental impact on receiving waters, yet most are not by themselves acutely or chronically toxic. The few exceptions (ammonia and nitrate) have been identified and have appropriate toxic criteria established in the water quality standards or the drinking water rules, where they are appropriately addressed as toxic chemicals. The TSD establishes a 1-hour averaging period for acute toxicity (CMC) and a 4-day averaging period for chronic toxicity (CCC) (EPA 1991). Nutrients do not have the same impacts, and these averaging periods are not appropriate. An appropriate averaging period for nutrient wasteloads should reflect the receiving water body's environmental response.

Nutrient impacts result from transport and biological uptake processes that occur in as little as a few weeks for some water bodies, or as long as a year for others. EPA (1983) noted the following when developing WLAs for lakes and reservoirs:

> The time scale over which mass loading estimates should be developed is determined by the retention time of the lake. Generally, annual loading estimates are required (for lakes and reservoirs). For small lakes or lakes having short detention times, the annual load may have to be subdivided seasonally.

Flowing streams exhibit highly variable responses to nutrients. Consequently, EPA's Permit Writers Manual (EPA 2010a) recommends "…states may adopt seasonal or annual averaging periods for nutrient criteria instead of the 1-hour, 24-hour, or 4-day average durations typical of aquatic life criteria for toxic pollutants."

3.7.1.4 Critical Conditions, Frequency of Excursion, and Mixing Zones

The environment responds differently to nutrient stimulation than to toxics so it may not be appropriate to align nutrient averaging periods and the receiving water critical flows used for toxic chemicals (NACWA 2014). For example, a 1Q10 or 7Q10 stream flow, representing the minimum 1-day or 7-day average flow reoccurring in a 10-year period, is not applicable to use with a nutrient load that has a seasonal or annual environmental response. It is appropriate to align the stream flow averaging duration and the nutrient averaging period. If the receiving water body's response to nutrients is best represented on a seasonal or annual basis, the corresponding

receiving water duration should be aligned. This alignment requires that receiving waters with seasonal nutrient loads use corresponding seasonal flows (section 3.7.1.6).

The receiving water body's size may also impact the average flow selected. For example, a small water body may exhibit the highest potential for algal growth during warm, low-flow conditions. Low flows could provide sunlight to access the stream bottom, and with corresponding flows not providing adequate scour, attached algal growth may increase when stimulated by excess nutrients. Similarly, low-flow conditions may represent critical receiving water flows for large rivers and reservoirs due to the low flushing rates. For long-retention time systems, large flows may result in greater nutrient response. The larger flows may increase the nutrient contribution from nonpoint sources triggering algal blooms, and the increase in flows may suspend the accumulated nutrients found in the sediment in the river bed, reservoir, or lake.

Typically, effluent limits are written for toxic pollutants to ensure that the concentration in the receiving water is not exceeded more than once in a 3-year period. When seasonal averaging is applied to nutrients, the resulting combination of critical flow conditions with nutrient averaging periods is a conservative approach to setting effluent limits. For example, the critical flow condition for a monthly nutrient average may be defined as the lowest 30-day (i.e., monthly) average flow occurring once in 3 years (30Q3). Because aquatic life is typically more resilient to fluctuations in nutrient concentrations than to toxics, increasing the averaging period from 1 hour (acute) or 4 days (chronic) to 30 days is an acceptable approach for setting nutrient effluent limits. This approach aligns the critical flow condition (30Q3) with the nutrient averaging period (30-day) to produce an effluent limit that ensures nutrient concentrations in the receiving water are not exceeded more than once in a 3-year period. Other options would include evaluating seasonal nutrient averaging periods (60 or 90 day during growing periods) with seasonal flow conditions that return with a frequency of once in 3 years. If an annual averaging period is appropriate for the receiving water, the harmonic mean flow should be used with the annual average nutrient load.

When discharged to flowing streams, nutrients have time to travel a significant distance downstream before yielding a far-field environmental response. When evaluating mixing zones for nutrients, the percentage of stream flow allocated for nutrient mixing may not be expanded to be larger than necessary and may not exceed 25% unless justification is provided by the permittee considering siting, technological, and managerial options available to the discharger as required in the water quality standards mixing zone policy. Additionally, because nutrients pose no threat of lethality to passing or drifting organisms, the maximum allowable mixing zone width may not be an applicable restriction on mixing zone size.

3.7.1.5 Reasonable Potential Analysis for Nutrients

For receiving water bodies not impaired for nutrients, the permit writer will follow the procedures in section 3.4 to determine if reasonable potential exists to exceed the narrative nutrient criteria for the water body. DEQ will typically determine RPTE using the 90th to 95th percentile of background for nutrients (total nitrogen and total phosphorus), the effluent concentration from the 95th percentile of monthly daily maximum effluent based on daily maximum DMR data, instead of the MOEC, multiplied by the RPMF (calculated using Table 26), and the simple mass balance equation (Equation 26). To assess the resulting nutrient critical

effluent concentration and nutrient load with respect to an RPTE, consult with the Surface Water Program on a case-by-case basis for dischargers lacking a TMDL WLA.

3.7.1.6 Nutrient Limits in Permits

DEQ proposes two different methods for determining nutrient limits in permits. The method selected will be influenced by the site conditions, quantity and quality of effluent data, receiving water body data, and other factors pertinent to the permit development. The alternatives (NAWCA 2014) include the following:

- Setting the WQBELs equal to the TMDL WLA
- Using empirical distribution functions.

3.7.1.6.1 Use WLAs as WQBELs

If the discharger has a nutrient WLA from a TMDL, DEQ will set the WQBELs equal to the WLAs (NACWA 2014). The TSD's focus on toxics and human health and aquatic life impacts strongly discourages this practice because it is perceived as insufficiently conservative. This assumption is appropriate when addressing pollutants that exhibit acute and chronic toxic affects; nutrients do not impact aquatic life and human health in this manner. EPA is appropriately concerned with toxics because of the disparity between the criterion averaging period (4 days for chronic toxins) and the limit averaging period (30 days). The disparity between the averaging periods allows exceedances of the chronic (4-day) criterion and still yield compliance with the monthly average (30-day) limit. This situation is not typical when addressing nutrients. It is more probable that the nutrient criteria and WLA have averaging periods of the same duration as the limits. For WLAs with longer averaging periods (seasonal or annual), the WLA's use as a WQBEL is as conservative, if not more conservative, than the TSD approach, as stated in a review of EPA methods (NACWA 2014):

> …limits for any averaging period can be higher or lower than the WLA, depending on the CV, sampling frequency, and probability bases. As the averaging period of the WLA increases to 30-days and longer, the AML will usually be higher than the WLA. Hence, setting monthly, seasonal, or annual WQBELs to the WLA tends to be a conservative approach. In addition, as the averaging period of the WLA and sample number increase, the LTA becomes closer to the WLA, such that there is little difference between the TSD approach and simply setting the WQBEL to the WLA.

Other factors that support the using WLAs as WQBELs are based on the conservative nature of WLA models, conservative nature of water quality criteria, and requirement for a margin of safety in TMDLs. Steady-state WLA models assume that the receiving water body's low-flow conditions are synchronized with the maximum discharge flow and loads. These assumptions yield WLAs that are sufficiently conservative to be used as WQBELs for nutrients that do not exhibit neither acute nor chronic toxic effects on aquatic life or human health. An example and Table 37 illustrate this situation (NACWA 2014):

Example:

"The Sandy Shoals WWTP has been assigned a WLA based on 8.0 mg/L total nitrogen as an annual average. The CV is 0.3 and the sampling frequency is weekly. The LTA is calculated using a 95% probability basis, and the average annual limit is calculated using a 99th-percentile basis. Interpreting the WLA as an annual average, the resulting LTA is 7.8 mg/L, and the annual

average limit is 8.6 mg/L. At this long averaging period, the TSD approach gives a similar but slightly less conservative average annual limit than simply setting the average annual limit at the WLA of 8.0 mg/L."

Table 37. LTA at 95% probability basis; averaged limit at 99th-probability basis.

Statistic	Units	Value
Z95	—	1.645
Z99	—	2.326
WLA	mg/L	8.0
CV	—	0.3
σ2	—	0.0862
σ	—	0.2936
n-day average for WLA	Days	365
σ2n-day avg	—	0.00025
σn-day avg	—	0.01570
LTAc	mg/L	7.80
n	Sample/year	52
σ2n-sample	—	0.00173
σn-sample	—	0.04158
Average annual limit	mg/L	8.58

Nutrients do not have numeric criteria in IDAPA 58.01.02, and the assignment of a WLA is applicable for receiving waters that are impaired and not impaired. If the receiving water is impaired, the existence of a TMDL WLA makes the task of developing a limit much easier. If a TMDL has yet to be created, the permit writer, with the surface water staff, can still develop an appropriate WLA limit.

3.7.1.6.2 Empirical Distribution Functions

The TSD methodology relies upon theoretical probability distribution functions, in particular the lognormal distribution, related parameters, and application of appropriate averaging periods. An alternative to this approach is to use probability distributions based upon the facility's discharge data. Using the facility's own data allows the discharge probability distributions to be assessed for each pollutant that has sufficient quantity and quality of data, which can be displayed as a concentration probability plot. Figure 12 provides an example of a probability distribution plot showing the probability of BOD exceeding a selected value. Probability distribution plots can be generated from the data for any averaging period (e.g., weekly, monthly, and seasonally).

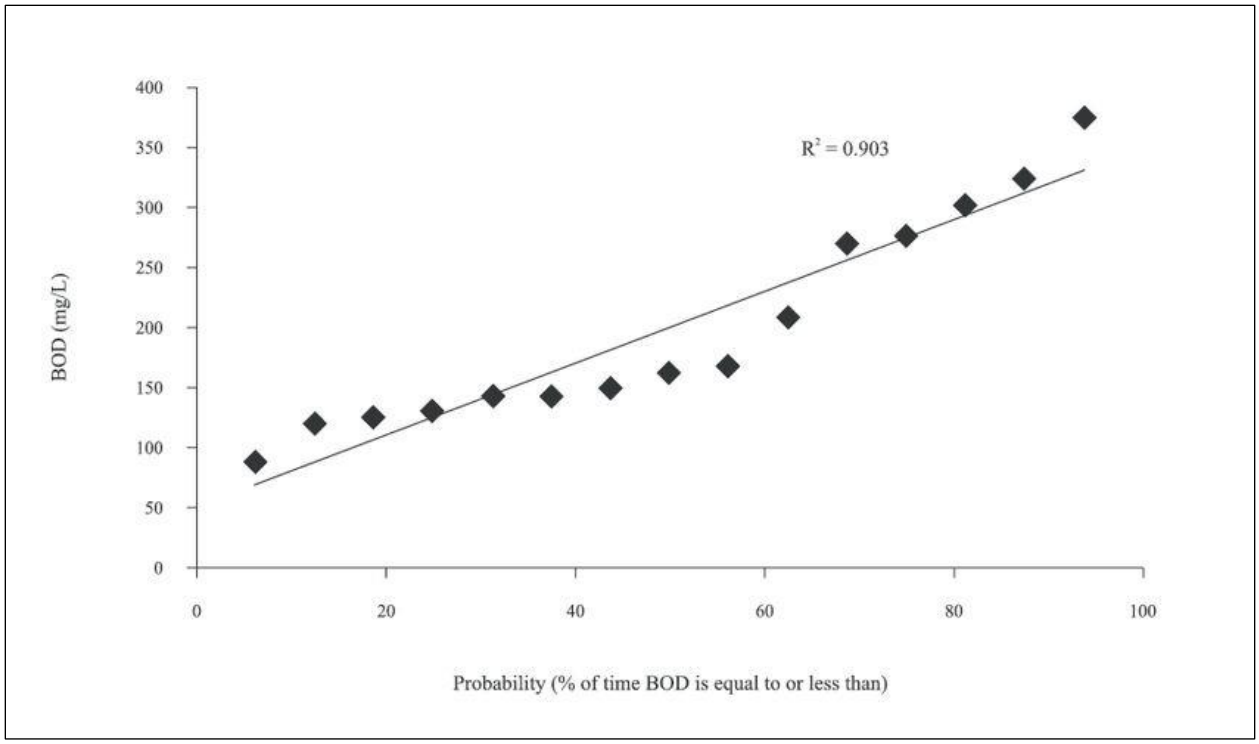


Figure 12. BOD probability distribution plot.

Unless WQBELs are based on the data obtained from the existing facility conditions, the observed empirical distribution function would have to be shifted, most probably, downward on the concentration-probability plot to achieve the WLA. A simple assumption that may be required is the ratio of percentiles is constant (i.e., ratio of the 90% to the 50% percentiles). Under this assumption, the regression line would translate and remain parallel to the regression line for the original data. Specific steps for deriving WQBEL from a concentration-probability plot include the following (NACWA 2014):

1. Express the WLA as a target concentration at the appropriate design flow, with an averaging period appropriate to the receiving water body and manner in which the WLA was derived.
2. Develop the concentration-probability plot based on observed data averaged using the appropriate averaging period. The Weibull probability associated with each concentration can be calculated as (Equation 48):

$$P = \left(\frac{rank}{n+1}\right)$$

Equation 48. Concentration probability.

   Where P is the probability, n is the number of data points in the set, and rank is the rank of the concentration in the data set.
3. Choose a probability basis that corresponds to a low rate of exceedance of the WLA. Generally, this should be in the 90th to 99th percentile range, and can be lower for longer averaging periods.

4. Reduce or increase the unaveraged (daily) observed concentration values by a constant percentage until the concentration probability plot (of averaged values) is shifted such that the target WLA corresponds to the selected probability basis.
5. The shifted daily values represent the *target* distribution. They can be used to calculate concentration-probability plots for any appropriate averaging period, and WQBELs can be set based on the upper bounds (e.g., 95th to 99th percentile) of the probability plots.

This procedure can be implemented in a spreadsheet to ensure consistency and accuracy. The results must be checked against the ability of technological processes to achieve the identified limits. If system improvements to attain a lower discharge concentration express a reducing efficacy as it is ramped up, the assumed consistent ratio of percentiles may not be applicable.

3.7.2 Temperature

Similar to nutrients, temperature as a source of pollution has its own unique challenges for permitting. Thermal energy is not necessarily *in* the water in the same sense as other pollutants (e.g., copper and ammonia). Thermal energy is absorbed by the water and manifested as temperature, a physical property of the water (Washington DOE 2010).

Nonconservative pollutants and pollution, such as temperature, are defined as those mitigated by natural biodegradation or other environmental decay or removal processes in the receiving water after mixing and dilution have occurred. Temperature from effluent is cooled as a result of the transfer of thermal energy from the effluent when mixed with the receiving water. The rate at which temperature from the effluent comes to equilibrium with the receiving water depends on many factors, such as dew point, radiant energy from the sun, receiving water surface temperature, and flow (Washington DOE 2010).

As with other pollutants, the permit writer will need to identify the various critical conditions that go into calculating the final effluent limit. The following sections will help the permit writer identify conditions that are unique to calculating temperature limits.

A permittee may submit a request to DEQ, supported by suitable evidence, to consider a §316(a) thermal variance. The variance application should accompany an application for permit renewal and must comply with IDAPA 58.01.25.310 and 40 CFR 125.70–73 requirements. For more information on variances see the IPDES User's Guide, Volume 1, section 8.2.1.

3.7.2.1 Effluent Temperature Considerations

Effluent temperatures, especially for municipal POTWs, may vary over the course of the year in relation to seasonal water temperatures in wastewater coming into the facility, process operations, and solar radiation. When characterizing the thermal loading of the effluent, the permit writer will consider the following:

- Effluent flow rate (design or production)
- Frequency (continuous or intermittent) of discharge
- Distribution of effluent temperature data
- Magnitude of thermal loading (maximum temperature)

Determining the critical conditions for the effluent should take into consideration the points above. Evaluating seasonal temperature distributions will help the permit writer identify when the effluent temperature is at a maximum value as well as various statistical distribution points that may be used in calculating RPTE.

3.7.2.2 Receiving Water Temperature Considerations

Idaho's water quality standards for temperature are specific to the beneficial use of the water body (IDAPA 58.01.02.250) (Table 38). Additional temperature requirements are found at IDAPA 58.01.02.401 regarding point source wastewater treatment requirements. IDAPA 58.01.02.276-299 documents site-specific water quality criteria (section 3.3.2.4).

Table 38. Summary of freshwater temperature water quality criteria.

IDAPA 58.01.02 250	Beneficial Use	Temperature Criterion (°C)	Maximum Daily Average (°C)
02.b	Cold water	≤22.0	≤19.0
02.f.	Salmonid spawning	≤13.0	≤9.0
03.a.	Seasonal cold	≤26.0	≤23.0
04.a.	Warm water	≤33.0	≤29.0

Following the procedures outlined in sections 3.2 and 3.3, the permit writer will identify the water body's beneficial uses, applicable temperature criteria, antidegradation protection, and support status. Depending on the designated and existing uses for the receiving water, it may be necessary to determine seasonal temperature limits. For example, salmonid spawning uses only apply during those times of the year when spawning and incubation occur.

Section 3.4.3.14.3 details the approach for identifying the background temperature of the receiving water body.

3.7.2.3 Reasonable Potential Analysis

For receiving water bodies not impaired for temperature, the permit writer will follow the procedures identified in section 3.4 to determine if reasonable potential exists to exceed the temperature criteria for the water body. DEQ typically determines RPTE using the 90th to 95th percentile receiving water temperature (calculated from permittee data or based on USGS data), 95th percentile of monthly daily max effluent based on daily maximum DMR data, appropriate dilution factor (calculated using Equation 25 for flowing water and Equation 33 for nonflowing water), and simple mass balance equation (Equation 49).

For mixing zones and temperature, the permit writer should refer to section 3.4.3.7.2, which discusses thermal plumes.

IDAPA 58.01.02.401.01 outlines additional rules about temperature for point source wastewater treatment sources. These rules specify that the effluent must not affect the receiving water outside the mixing zone in a manner that interferes with designated beneficial uses or that does not maintain daily and seasonal temperature cycles. If the receiving water exceeds the temperature criteria for the designated beneficial use due to natural conditions, the effluent must

not raise the receiving water temperature by more than the amount specified at IDAPA 58.01.02.401.01.

3.7.2.4 Calculating Effluent Limits

For receiving water bodies not impaired for temperature, the permit writer will calculate temperature effluent limits using the procedures identified below. These procedures should allow development of daily maximum temperature and daily average temperature limits.

IDAPA 58.01.02.010.19 defines the *daily mean* as "…the average of at least two (2) appropriately spaced measurements… calculated over a period of one (1) day," and explains for ambient monitoring of temperature, "…the daily mean should be calculated from equally spaced measurements, at intervals such that the difference between any two (2) consecutive measurements does not exceed one point zero (1.0) degree C."

The permit writer will calculate effluent limits for temperature using an appropriately sized mixing zone and the monthly 7Q10 flow for the receiving water body. Equation 49 will be used to establish the instantaneous maximum temperature limit or the maximum daily average temperature limit, where in each case the downstream temperature (T_d) is set equal to the temperature criterion.

$$T_e = D_x \times (T_d - T_r) + T_r$$

Equation 49. Temperature limit calculation.

Where:

T_e = Effluent temperature (°C)
D_x = D_f = Dilution factor (Equation 25) or D = Dilution ratio (Equation 33)
T_d = Water quality criterion (°C)
T_r = Receiving water body temperature (°C)

Other temperature permitting options include the following:

- If the receiving water body has an approved TMDL, the permit writer will use the TMDL WLA established for the discharger to calculate appropriate limits. If the discharger cannot immediately achieve this limit, the permit writer may explore other options, including an extended mixing zone, establishing performance-based limits, removing or reducing effluent discharge to receiving water during critical periods, or pollutant trading. Any selected alternatives based on performance will be accompanied by a compliance schedule.
- If a TMDL for the water body does not currently exist but is under development, the permit writer may include interim performance-based limits and BMPs to hold effluent to current temperature until the TMDL is complete. Once the TMDL is completed and approved, the permit writer may have justification to modify the permit to incorporate the permittee's assigned TMDL WLA. If the limit is not immediately attainable by the permittee, the permit writer may explore the options outlined above.
- CWA §316(a), state, and federal regulations provide for variances from thermal effluent limits in NPDES permits (EPA 2008; IDAPA 58.01.25.310; 40 CFR 125.70–73). Alternative thermal effluent limits may be included in permits if the discharger demonstrates that effluent limits are more stringent than necessary to ensure the

protection and propagation of a balanced, indigenous community of shellfish, fish and wildlife in and on the water body into which the discharge is made. The cumulative impact of its thermal discharge must be considered with all other significant impacts on the species affected. For more information on §316(a) variances, see the IPDES User's Guide, Volume 1, section 8.2.1.

3.7.2.5 Antidegradation

In identifying the tier of protection for the receiving water body, temperature has some unique considerations that must be applied. For receiving water bodies that are listed in either Category 4 or 5 of the Integrated Report, the permit writer will evaluate the causes for listing before making a Tier I decision. If the causes of impairment for the aquatic life use of a receiving water body do not include a pollutant other than temperature, pH, or dissolved oxygen, the permit writer must evaluate the biological community of the receiving water. If the biological community shows that the aquatic life use is fully supporting, Tier II protections will apply to the receiving water.

Applying Tier II protections to a receiving water body means that the permit writer must identify the thermal load assimilative capacity and any change in thermal load resulting from the new permit conditions. If the change in the receiving water temperature causes more than 10% of the assimilative capacity to be used, an alternatives analysis and socioeconomic justification must be done (section 3.8).

3.7.3 Water Quality Trading

Pollutant trading is recognized in IDAPA 58.01.02.055.06 and the *Water Quality Trading Guidance* (DEQ 2016c). Currently, DEQ policy is to allow pollutant trading as a means of restoring water quality limited water bodies to compliance with the standards. DEQ considers nutrients and temperature appropriate pollutants for trading—specifically, TP, TN, and thermal loading. Sediment or suspended solids trading to address sedimentation may be considered, particularly where dissolved oxygen impacts occur. DEQ supports trades where adequate information exists to establish and correlate water quality improvements from implementing BMPs or technological measures.

3.7.4 Emerging Contaminants of Concern

3.7.4.1 PCBs

PCBs are human-made chemicals used historically as insulation in transformers, lighting ballast, transmission fluids, and building materials. Although the direct manufacture of PCBs was banned in 1979, creating PCBs as a manufacturing by-product is allowed. Many commercially available items contain small amounts of PCBs including the following:

- Inks, dyes, and pigments (yellow, green, and blue colors) that are used in paints, clothing, and newspaper printing
- Caulk
- Motor oil
- Plastics
- Food packaging

Today, PCBs can still be released into the environment from the following:

- Poorly maintained hazardous waste sites that contain PCBs
- Illegal or improper dumping of PCB wastes
- Leaks or releases from electrical transformers containing PCBs
- Disposal of PCB-containing consumer products into municipal or other landfills not designed to handle hazardous waste
- Burning some wastes in municipal and industrial incinerators

PCBs do not readily break down once in the environment. They can remain for long periods cycling between air, water, and soil. PCBs can be carried long distances and are found in snow and sea water in areas far from where they were released into the environment; consequently, they are found all over the world. In general, the lighter the form of PCB, the further it can be transported from the source of contamination.

IDAPA 58.01.02.201specifies numeric criteria for PCBs. As previously mentioned, the permit writer needs to verify that the criteria published under IDAPA 58.01.02 are current for CWA purposes, and if not, work with the water quality standards group to ensure the correct criteria are used. EPA has not approved these criteria, so permit writers will conduct an RPA using the last EPA-approved criteria and follow the chemical-specific approach outlined in section 3.5 to develop effluent limits. Additional monitoring requirements or BMPs may be included as appropriate.

3.7.4.2 Phthalates

Phthalates are produced in high volume—over 470 million pounds per year. Manufacturers use them in numerous industrial and consumer products, primarily as plasticizers in polyvinyl chloride products. Many phthalates can potentially lead to high exposure, both individually and together with other phthalates. They can often substitute for each other in products, are used in medical applications, and have been detected in food. A number of phthalates appear in biomonitoring surveys of human tissues, evidencing widespread human exposure. Exposure to phthalates can produce a variety of effects in laboratory animals, but for certain phthalates, adverse health effects on the development of the male reproductive system are the most serious. Several studies have shown associations between phthalate exposures and human health (although no causal link has been established). Recent scientific attention is focusing on evaluating the cumulative effects of mixtures of phthalates in an exposed organism.

IDAPA 58.01.02.210 specifies criteria for the following phthalates:

- Bis(2-Ethylhexyl) Phthalate
- Butylbenzyl Phthalate
- Diethyl Phthalate
- Dimethyl Phthalate
- Di-n-Butyl Phthalate
- Di-n-Octyl Phthalate

Permit writers will follow the chemical-specific approach outlined in section 3.5 to develop WQBELs for these pollutants.

3.7.5 Watershed Permitting

Watershed permitting is a process that evaluates and emphasizes looking at all activities and stressors occurring within a defined watershed area to determine the impacts on the water body. Watershed permitting allows for flexibility in defining approaches to meet water quality standards. This approach allows the permit writer to consider the overall goals in the watershed and work with dischargers to find ways to meet those goals.

Watershed permitting allows DEQ to focus on watershed goals and consider multiple pollutant sources and stressors. The most common form reissues permits according to a 5-year rotating basin schedule, although other forms of permitting are available.

More information on this type of permitting is provided at EPA's Watershed Permitting website: *www.epa.gov/npdes/watershed-based-permitting.*

3.7.6 Metal Translators

EPA currently requires effluent measurement to be total recoverable (TR) metals data (40 CFR 122.45(c)). Conversion factors and translators are used to convert to dissolved criteria when necessary because most facilities in Idaho provide TR data. Translators are the fraction of TR metal in downstream water that is dissolved; that is, the dissolved metal concentration divided by the TR metal concentration. The translator may take one of three forms.

- It may be assumed to be equivalent to the criteria conversion factors.
- It may be developed directly as the ratio of dissolved to TR metal.
- It may be developed by using a partition coefficient that is functionally related to the number of metal binding sites on the adsorbent in the water column (i.e., concentrations of TSS, TOC, or humic substances).

The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From A Dissolved Criterion (EPA 1996) and *Guidance Document on Dynamic Modeling and Translators* (EPA 1993b) provide methods to develop metal translators.

Site-specific metal translators may be developed for a receiving water by completing a translator study of the downstream reach (downgradient of the mixing zone) to support developing water quality-based effluent limits and to complete the RPA.

3.7.7 Implementing Fish Tissue Criteria

While implementing a criterion that is expressed as a concentration of a pollutant in water has certain challenges, a criterion that is expressed as a concentration of pollutant in fish tissue is even more challenging. With an increased emphasis on the accumulation of pollutants in sediment and fish tissue, it is likely that more future criteria will either be strictly fish tissue based, or will have some component dependent on the amount of the pollutant in fish tissue.

DEQ developed implementation guidance for mercury criteria that the permit writer should consult when evaluating methylmercury fish tissue (DEQ 2005). Other fish tissue criteria guidance may be forthcoming for other pollutants such as selenium. EPA also provided a guidance document on implementing methylmercury fish tissue guidance (EPA 2010b).

The following sections were adapted from DEQ's and EPA's guidance on developing effluent limits for mercury in fish tissue and may be used, with modification, for other pollutants that have fish tissue criteria. This section provides the permit writer with specific information, references, and direction in developing effluent limits based on tissue criteria.

3.7.7.1 Effluent Characterization

The permit writer should determine if there is a quantifiable amount of the pollutant in the discharge that has been analyzed using a sufficiently sensitive method. If data show there is not a quantifiable amount of the pollutant in the discharge, or the facility is not expected to discharge the pollutant, the permit writer may reasonably conclude the discharge does not have reasonable potential and a WQBEL is not necessary (DEQ 2005). If data show a quantifiable amount of the pollutant, the permit writer should continue to the receiving water characterization.

3.7.7.2 Receiving Water Characterization

The permit writer should first determine if there is a TMDL for the pollutant on the receiving water. If there is a TMDL and it assigns a WLA to the discharge, the permit should include permit limits for that discharger as described in section 3.7.7.4.

Characterizing the receiving water body will likely require fish tissue samples to be collected. The general procedure for characterizing the receiving water is to evaluate the pollutant concentration in the fish tissue. This may mean looking at certain types of fish (mercury requires collecting sport fish), certain sizes (the smallest fish collected for sampling must be within 75% of the length of the largest fish), or certain parts of the fish (whole fish versus filet). In some instances, prescribed methods are available for gathering these samples such as for mercury (IDAPA 58.01.02.210.03.c.iv). For mercury, fish tissue concentrations should be measured in the skinless fillets of sport fish using techniques capable of detecting tissue concentrations down to 0.05 mg/kg.

If reliable data are not available, the permit should include fish tissue monitoring requirements for the facility if the facility is expected to discharge the pollutant but does not have a TMDL WLA assigned to it.

3.7.7.3 Reasonable Potential Analysis for Fish Tissue

Where fish tissue data are available, the permit writer will evaluate the pollutant concentration in the fish tissue relative to the applicable criterion. If fish tissue pollutant concentrations are below criteria values, the permit writer may conclude that the discharge does not have an RPTE criteria (DEQ 2005). The permit writer should evaluate if the water body is Tier II and what antidegradation protections apply.

If the fish tissue concentration is at or above the applicable criterion, the permit writer should consider that the discharger will cause, has a reasonable potential to cause, or contribute to a water quality criteria exceedance.

When no fish tissue data for the receiving water are available, but water column data exist, the permit writer should consult the water quality standards and associated guidance applicable to

the receiving water to determine if there is a water column translator or criterion to evaluate reasonable potential.

As stated previously, if a TMDL has been developed for the receiving water body and the pollutant of concern, the permit writer should conclude that reasonable potential exists to exceed the criterion and develop effluent limits.

3.7.7.4 Calculating Effluent Limits

Where a TMDL has been developed for the receiving water body, the permit writer should use the WLA established for the facility to develop effluent limits.

If a TMDL has not been developed, or the facility was not assigned a WLA, the following methods may be used to establish appropriate WQBELs:

- Water column translator of the fish tissue criterion—permit writer may use this method to develop an effluent limit.
- Water column translation of the fish tissue criterion is not available—the permit writer may:
  - Require the permittee to implement a minimization plan tailored to the facility's potential to discharge the pollutant. Depending on the particular facts, the permit writer may include in the minimization plan:
    - Trigger level
    - Reduction goal
    - Enforceable numeric level (e.g., existing effluent quality) to further manage discharges
  - Require effluent monitoring using a sufficiently sensitive EPA-approved method to evaluate the effectiveness and implementation of the minimization plan
  - Require the permittee to develop a site-specific water column translation of fish tissue criterion for the receiving water.

A pollutant minimization plan with BMPs may provide a mechanism for point source dischargers to effectively minimize mercury discharges and attain water quality standards. In addition, source control measures may result in effective mercury reductions without applying control technologies. Effective source control programs may be implemented, often without significant capital expenditures for the facility, and provide an alternative to costly, end-of-pipe treatments. The permit writer should consider these alternatives to numeric end-of-pipe effluent limits when considering the requirements of a minimization plan.

3.7.8 Biotic Ligand Model

In some instances, such as for specific metals, the water quality criterion is not a defined number but a calculation based on other chemical and physical characteristics of the receiving water body. Copper is one such parameter that uses an equation to derive the final numeric value for the criterion. Idaho is using EPA's biotic ligand model BLM to derive copper criteria. This model predicts the toxicity of copper by estimating how much of the metal is available to bind to a biological receptor (e.g., gill surface).

Unlike the hardness-based criteria, which only consider cationic binding, the BLM accounts for metal speciation and complexation with dissolved organic carbon and available inorganic ligands. The BLM results in criteria values that more accurately represent the aquatic life toxicity of copper in the receiving water, depending on the following input parameters:

- Temperature
- Calcium
- Potassium
- Alkalinity
- pH
- Magnesium
- Sulfate
- Sulfide
- Dissolved organic carbon
- Sodium
- Chloride
- Humic acid

The major challenge for a permit writer when dealing with copper will be determining what the criteria are at critical conditions. Once a value for the criterion is calculated, the permit writer can use that in developing the permit's effluent limits following the normal procedures for WQBELs.

Additional details on Idaho's BLM implementation is found in the draft *Implementation Guidance for the Idaho Copper Criteria for Aquatic Life: Using the Biotic Ligand Model (BLM)* (DEQ 2016d).

3.7.8.1 Calculating Criteria

Copper criteria and effluent limit calculations should be done after all other effluent calculations. This will reduce the overall workload and number of calculations necessary, as some of the input parameters will have already been reviewed for RPTE and possibly have effluent limits placed on them. The permit writer should work with water quality standards staff to ensure that the copper criterion calculation is correct.

3.7.8.2 Reasonable Potential Analysis

The permit writer can use these conservative criteria estimates to perform RPA to determine if there is an RPTE copper criteria. If the resulting RPA does not indicate RPTE, no further analysis is necessary. If the RPA indicates RPTE, the permit writer would use the conservative estimate of criteria to develop WQBELs following procedures outlined in section 3.5. Additionally, the discharger should initiate monitoring of BLM input parameters to confirm or refine applicable criteria once sufficient (e.g., 24 monthly) data are collected.

Users may propose alternative methods for estimating protective criteria. The proposed estimates must be based on scientifically sound methods and must be demonstrated to be protective of aquatic life. Analysis similar to DEQ (2017b) may be considered sufficient to demonstrate protectiveness.

3.8 Antidegradation Implementation

One objective of the CWA is to maintain water quality, and federal regulations require antidegradation policies and procedures to be part of the water quality standards. Antidegradation should be considered in the permit development process when determining the applicable receiving water's water quality standards. The permit writer should have determined

what tiers of protection should be assigned to the proposed receiving water for the pollutants of concern (section 3.3.3).

The following sections provide methods permit writers will consider for implementing, through the WQBEL development process, the three levels of protection found in IDAPA 58.01.02.051. Idaho's antidegradation implementation procedures are found at IDAPA 58.01.02.052, and additional guidance is found in the draft *Idaho Antidegradation Implementation Procedures* (DEQ 2017a).

3.8.1 Tier I Review

All water bodies receive Tier I protection to ensure that existing uses and the water quality necessary to protect those existing uses is maintained and protected. The process of evaluating RPTE water quality criteria is one step in protecting existing uses and ensuring the discharge does not cause or contribute to a water quality criteria violation. This step identifies the water quality criteria associated with the specific uses for the receiving water (designated uses if applicable, existing uses, or Idaho's presumed use protections) and ensures that the water quality necessary to protect those uses is maintained.

In situations where a water body is impaired for a pollutant that would be present in the proposed discharge, the permit writer should identify and consult any relevant TMDLs to determine what quantity of pollutant (if any) is appropriate. Tier I protections in this case would be to use the WLAs from relevant TMDLs to develop effluent limits and help the receiving water body return to a condition supporting the relevant uses.

Section 3.3 describes the process for the permit writer to use when determining the appropriate beneficial uses and associated water quality criteria.

3.8.2 Tier II Analysis

This analysis applies to those water bodies identified as requiring Tier II protection. For new or increased discharges that could potentially lower water quality in high-quality waters, Tier II protection provides a framework for deciding the degree of degradation allowed for activities determined to be necessary and important for the social or economic health of the community. Depending on the outcome of the review, the permit may be written to maintain the existing high water quality or to allow some degradation.

The main components of a Tier II analysis include the following:

- Determine if resulting degradation is significant.
- Assure other point and nonpoint source controls are achieved.
- Identify nondegrading and least degrading alternatives.
- Determine if resulting degradation is necessary and important to the social or economic health of the community.

Not all permitted activities will degrade water quality. For an existing discharge, if a reissued permit or license maintains allowable discharge, and the activity does not otherwise change in character, the activity will most likely be nondegrading. Under Idaho rule, degradation is forward-looking. In general, an activity must be new or cause an increase in pollutant discharge

from an existing activity, through greater volume or concentration of pollutants, to degrade water quality.

Idaho's antidegradation rule provides requirements for determining the significance of the change in water quality due to an activity or discharge. For discharge to waters receiving Tier II protection, a degrading activity that would cause no more than a cumulative 10% loss of assimilative capacity from conditions as of July 1, 2011, may be considered an insignificant degradation of water quality after considering the size and character of the activity or discharge and the magnitude of its effect on the receiving stream. During the RPA, the permit writer should evaluate the potential for significant degradation if the water body was identified as needing Tier II protection. Insignificant degradation of water quality is permitted without investigating other source controls, analyzing other alternatives, or needing social or economic justification.

One of the conditions for allowing significant degradation of high-quality water is that the highest statutory and regulatory requirements for all new and existing point sources and cost effective and reasonable BMPs for all nonpoint sources shall be achieved in the watershed. When evaluating proposals to significantly degrade high-quality waters (i.e., Tier II waters), the permit writer should look at whether nonpoint sources in the watershed will be controlled through cost-effective and reasonable BMPs.

The other major condition that must be met to allow significant degradation of high-quality water is that the activity must be shown to be "necessary to accommodate important economic or social development" (IDAPA 58.01.02.051.02). This condition has been broken down into two parts: (1) assessing the necessity of degradation by finding ways to reduce or avoid increases in discharge of pollutants or lessen their impact on water quality and (2) demonstrating an important social or economic justification for degradation that cannot be reasonably avoided.

A new or proposed increase in pollutant discharge could be rejected either because the degree of degradation is unnecessary or because the activity is not justified as socially or economically important. If reasonable steps to minimize degradation are taken, the analysis will depend on showing a social or economic reason to accept the proposed degradation.

If significant degradation of a Tier II (high quality) water body is proposed, the permit writer will work with the applicant to evaluate alternatives to reduce degradation and determine if degradation that cannot be reasonably avoided is socially or economically justified. If, after completing the review process and DEQ makes a determination to allow a new or increased discharge that would lower water quality, the permit writer will include such limitations in the IPDES permit for that discharge provided the limits meet all other applicable TBELs and water quality standards.

In the fact sheet, the permit writer must include all relevant information regarding the Tier II analysis.

3.8.3 Tier III Designation

High-quality water bodies considered to be of exceptional recreation or ecological significance (e.g., waters in national or state parks, wild and scenic rivers, or wildlife refuges) may be nominated for designation as ORWs. These waters may not necessarily have high water quality. Only water bodies designated by the state legislature as ORWs are given the Tier III level of

protection and are protected from the impacts of point and nonpoint source activities under antidegradation regulations. This means that water quality in these waters will be maintained and no person shall conduct a new or substantially modify an existing activity if that activity is expected to lower or degrade water quality. The only allowed exception is for those activities that are short-term or temporary and do not alter the essential character or special uses of a segment, allocation of water rights, or operation of water diversions or impoundments (IDAPA 58.01.02.052.09.f.i.).

However, point source discharges that may cause degradation to an ORW may be allowed if the proposed degradation is offset by reductions in pollution from other sources that are tied to the proposed point source activity or discharge as described in IDAPA 58.01.02.052.09.g. These offsets must occur before the beginning of the activity or discharge and upstream of the degradation that the activity or discharge may cause.

Point source activities that discharge to tributaries of ORWs are not subject to the same limitations as those that discharge directly to ORWs. However, these activities are subject to the antidegradation protections for the waterbody they discharge to, provided that water quality of the ORW (below the appropriate or designated mixing zone) is not lowered and that antidegradation requirements for the tributary (i.e., Tier II or III) are addressed.

Nonpoint source activities on ORWs are restricted per IDAPA 58.01.02.052.09.f. Once a stream segment has been designated as an ORW, no person shall conduct a new or substantially modify an existing nonpoint source activity that can reasonably be expected to lower the water quality of that ORW, except for conducting short-term or temporary nonpoint source activities that do not alter the essential character or special uses of a segment, allocation of water rights, or operation of water diversions or impoundments.

Tributaries to ORWs are not subject to restrictions of nonpoint source activities in the same manner as ORWs. As with point sources, a person or organization may conduct a new or substantially modify an existing nonpoint source activity that may lower or degrade water quality in the tributary to an ORW provided that water quality of the ORW is not lowered and that antidegradation requirements for the tributary are addressed.

Nonpoint source activities that took place before designating the water as an ORW may continue and shall be conducted in a manner that protects and maintains the current water quality of the ORW. These existing nonpoint source activities may not be substantially modified in a way that may be reasonably expected to lower or degrade the quality of water once the water has been designated as an ORW.

4 Final Effluent Limits and Antibacksliding

When determining the final effluent limits, the permit writer must ensure that all applicable statutory and regulatory requirements are fully implemented. This includes the calculation for TBELs or WQBELs that will ensure applicable CWA standards are met. For reissued permits, if any of the limits are less stringent than limits on the same pollutant in the previous permit, the permit writer then conducts an antibacksliding analysis and, if necessary, revises the limits accordingly.

4.1 Applying Antibacksliding Requirements

Antibacksliding refers to provisions prohibiting the relaxation of effluent limits, standards, and conditions in reissued permits under the CWA, 40 CFR 122.44(l), and IDAPA 58.01.25.200. In general, antibacksliding refers to statutory and regulatory provisions that prohibit the renewal, reissuance, or modification of an existing NDPES permit that contains effluent limits, permit conditions, or standards less stringent than those established in the previous permit. Exemptions to the prohibition are available and determining the applicability requires familiarity with provisions and exceptions existing in regulation.

4.1.1 Antibacksliding Provisions

Permit writers will review two provisions when evaluating antibacksliding in a permit. The first relates to statutory provision of the CWA. The second is regulatory provisions found in the CFR and IDAPA.

First, CWA antibacksliding provisions address two specific situations where backsliding is prohibited:

- Relaxing a TBEL based on using case-by-case BPJ when less stringent ELGs are promulgated, OR
- Relaxing limits based on state water quality standards unless the change is consistent with §303(d)(4).

NPDES and IPDES regulations found at 40 CFR 122.44(l)(1) and IDAPA 58.01.25.200.01 prevent backsliding unless the follow occurs:

- Circumstances upon which the previous permit was based have materially and substantially changed since the time the permit was issued.
- Changes would constitute a cause for permit modification or revocation and reissuance under 40 CFR 122.62 and IDAPA 58.01.25.201.02.

4.1.2 Antibacksliding Exceptions

The exceptions to effluent limits under the CWA are for TBELs developed using BPJ on a case-by-case basis, limits based on state standards, and the safety clause. The following highlights the specific nature of each type of exception.

1. CWA §402(o)(2) outlines six specific exceptions for TBEL case-by-case limits. The provision provides that relaxed limits may be allowed where:
    a. Substantial alterations or additions to the permitted facility have occurred.
    b. New information exists that was not available at the time of permit issuance.
    c. Technical mistakes or misinterpretations of the law were made in permit issuance.
    d. Good cause exists because of events beyond the permittee’s control (e.g., natural disasters), and no reasonable available remedy exists.
    e. The permit has been modified under one of several CWA sections [§301(c), 301(g), 301(i), 301(k), 301(n), or 316(a)].
    f. The permittee is unable to meet the permit limits after properly operating and maintaining required treatment facilities.

2. CWA §402(o)(1) allows relaxing WQBELs and effluent limits based on state standards if the relaxation is consistent with the provisions of CWA §303(d)(4) or if one of the of the six exceptions above is met. The two provisions stated here constitute independent exceptions and if either is met, relaxation is permissible. CWA §303(d)(4) has two parts: (1) waters attaining standards and (2) waters not attaining standards. For waters attaining standards, a less stringent limit is acceptable if the revision is subject to and consistent with state antidegradation policy (sections 3.3.3 and 3.8). For waters not attaining standards, less stringent limits based on a TMDL or WLA are acceptable if the cumulative effect of all limits ensure attainment of water quality standards or the designated use that is not being attained is removed according to the water quality standards.
3. CWA §402(o)(3) is a safety clause that provides an absolute limit on backsliding. Regardless of any exceptions that are met, backsliding is prohibited if the less stringent limit violates either an applicable ELG or water quality standards, including antidegradation requirements.

Figure 13 outlines the antibacksliding process (DEQ 2016a).

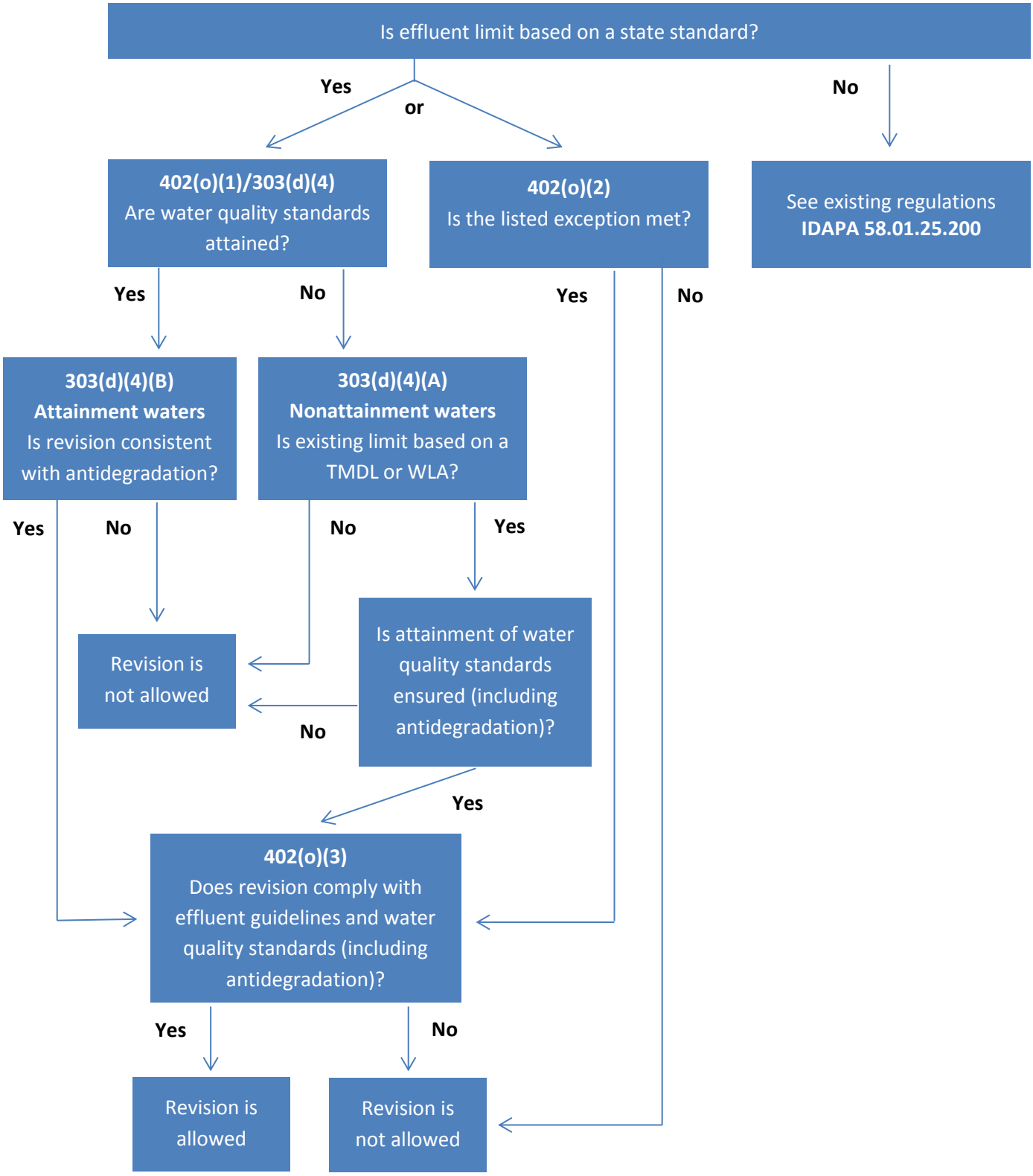


Figure 13. Application of antibacksliding requirements.

4.2 Document Final Effluent Limit Rationale in Fact Sheet

The permit writer will clearly explain in the fact sheet how the final limits in the permit were determined and how those limits meet both technology and water quality standards (including antidegradation) and, where appropriate, how an antibacksliding analysis was applied to the final effluent limits.

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Key Terms

Citations for key terms used in this guide are provided below. Each term is defined in the rule.

Term	IDAPA, CFR, or CWA Citation
Antibacksliding	Clean Water Act section 402(o)
Application	IDAPA 58.01.25.010.03
Background	IDAPA 58.01.25.010.08
Balanced, Indigenous, Community (or Population)	40 CFR 125.71(c)
Best Management Practices (BMPs)	IDAPA 58.01.25.010.09
Biochemical Oxygen Demand (BOD)	IDAPA 58.01.25.010.10
Compliance Schedule or Schedule of Compliance	IDAPA 58.01.25.010.17
Direct discharge	IDAPA 58.01.25.010.24
Discharge	IDAPA 58.01.25.010.27
Discharge Monitoring Report (DMR)	IDAPA 58.01.25.010.26
Discharge of a Pollutant	IDAPA 58.01.25.010.28
Draft Permit	IDAPA 58.01.25.010.29
Effluent	IDAPA 58.01.25.010.30
Effluent Data	40 CFR 2.302(a)(2)(i)–(ii)
Effluent Limitation	IDAPA 58.01.25.010.31
Effluent Limit Guidelines (ELG)	IDAPA 58.01.25.010.32
Existing Discharger	IDAPA 58.01.02.010.37
Facility or Activity	IDAPA 58.01.25.010.38
Fundamentally Different Factors	IDAPA 58.01.02.010.39
General Permit	IDAPA 58.01.02.010.40
Hydrologically-Based Design Flow	IDAPA 58.01.02.010.50 1Q10 (IDAPA 58.01.02.210.03.b.i) 1B3 (IDAPA 58.01.02.210.03.b.ii) 7Q10 (IDAPA 58.01.02.210.03.b.iii) 4B3 (IDAPA 58.01.02.210.03.b.iv) Harmonic Mean Flow (IDAPA 58.01.02.210.03.b.v)
Idaho Pollutant Discharge Elimination System (IPDES)	IDAPA 58.01.25.010.42
Indirect Discharger	IDAPA 58.01.25.010.45
Intake Pollutant	IDAPA 58.01.25.303.07.a.i
Interference	40 CFR 403.3(k)
Load Allocation (LA)	IDAPA 58.01.25.010.50

Term	IDAPA, CFR, or CWA Citation
Major Facility	IDAPA 58.01.25.010.51
Method Detection Limit (MDL)	40 CFR 136, Appendix B
Minimum Level (ML)	40 CFR 136, Table 2
Mixing Zone	IDAPA 58.01.25.010.54
Municipality	IDAPA 58.01.25.010.55
National Pollutant Discharge Elimination System (NPDES)	IDAPA 58.01.25.010.56
New Discharger	IDAPA 58.01.25.010.57
New Source	IDAPA 58.01.25.010.58.a
Owner or Operator	IDAPA 58.01.25.010.62
Pass Through	40 CFR 403.3(p)
Permit	IDAPA 58.01.25.010.63
Person	IDAPA 58.01.25.010.64
Point source	IDAPA 58.01.25.010.65
Pollutant	IDAPA 58.01.25.010.66
Pretreatment	IDAPA 58.01.25.010.68
Process Wastewater	IDAPA 58.01.25.010.71
Publicly Owned Treatment Works (POTW)	IDAPA 58.01.25.010.73
Reasonable Potential Analysis (RPA)	58.01.25.302.06.a.ii–vi
Reasonable Potential to Exceed (RPTE)	58.01.25.302.06.a.ii–vi
Recommencing Discharger	IDAPA 58.01.25.010.75
Secondary Treatment	IDAPA 58.01.25.010.78
Sewage Sludge	IDAPA 58.01.25.010.84
Source	IDAPA 58.01.25.010.90
Storm Water	IDAPA 58.01.25.010.94
Technology-Based Effluent Limit (TBEL)	IDAPA 58.01.25.010.95
Total Maximum Daily Load (TMDL)	IDAPA 58.01.02.010.100
Treatment Works Treating Domestic Sewage (TWTDS)	IDAPA 58.01.25.010.100
Variance	IDAPA 58.01.25.103
Wasteload Allocation (WLA)	IDAPA 58.01.25.010.104
Water Body (Unit)	IDAPA 58.01.02.010.110
Water Quality-Based Effluent Limit (WQBEL)	IDAPA 58.01.25.010.107
Waters of the United States	IDAPA 58.01.25.003.aa
Whole Effluent Toxicity	IDAPA 58.01.25.010.110

Appendix A. Significant Figures and Precision for Permit Limits and Reporting

Permit writers should include in IPDES permits, the following or similar language, clarifying how permittees should report significant figures on the DMR:

> The permittee must report the same number of significant figures or precision as the permit limit for a given pollutant or pollutant parameter. Regardless of the rounding conventions used by the permittee, the permittee must use the conventions consistently, and must ensure that consulting laboratories employed by the permittee use the same conventions.

Pollutant	Typical Permit Limit Range	Standard Laboratory Technique	Concentration Value = Minimum Number of Significant Figures	DMR Reporting Precision
Conventional Pollutants				
BOD	5.0 to 50 mg/L	DO Probe	<10 mg/L = 2 sig figs >10 mg/L = 2 sig figs	Report to 0.1 mg/L Report whole numbers
CBOD	2.0 to 45 mg/L	DO Probe	<10 mg/L = 2 sig figs >10 mg/L = 2 sig figs	Report to 0.1 mg/L Report whole numbers
TSS	5.0 to 80.0 mg/L	Filtration/ Gravimetric	<10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.1 mg/L
Temperature	77°F as a maximum	Various	Various	Report + 0.1 degrees F or C
Bacteria (fecal, *E. coli*, etc.)	126/ 235/ 406/ 576 for *E. coli*	Various	<10 = 1 sig fig >10 <100 = 2 sig figs >100 = 3 sig figs	Report whole numbers only
DO	8.0 to 10.0 mg/L	DO Probe	<10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.1 mg/L
Total chlorine residual (method dependent)	0.02 to 1.0 mg/L 0.1 to 1.0 mg/L	Amperometric Titr. DPD – colorimetric	<0.1 mg/L = 1 sig fig >0.1 <10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.01 mg/L Report to 0.1 mg/L Report to 0.1 mg/L
Minimum UV dose	35 millijoules			
pH	6.0 to 9.0	pH Probe	<10 = 2 sig figs >10 = 3 sig figs	Report to 0.1 pH unit
Nutrients				
TKN	5.0 to 20.0 mg/L	Digest w/ ISE or Colorimetric	<10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.1 mg/L
Total Ammonia as N	1.0 to 30.0 mg/L	Distill w/ ISE or Colorimetric IC	<10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.1 mg/L
Nitrate and Nitrite	1.0 to 20.0 mg/L	Colorimetric or IC	<10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.1 mg/L
Total Phosphorus	0.01 to 3.0 mg/L	Colorimetric	<0.1 mg/L = 1 sig fig >0.1 <10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.01 mg/L Report to 0.1 mg/L Report to 0.1 mg/L
Dissolved Orthophosphate as P	0.01 to 3.0 mg/L	Colorimetric	<0.1 mg/L = 1 sig fig >0.1 <10 mg/L = 2 sig figs >10 mg/L = 3 sig figs	Report to 0.01 mg/L Report to 0.1 mg/L Report to 0.1 mg/L
Toxics				
In Permit	In Permit	In Permit	In Permit	In Permit

Appendix B. Potential Approaches for Limiting Toxic Pollutants

Toxics are a broad group of chemicals that can have a detrimental effect on living organisms. The Clean Water Act §307(a) *priority* pollutants are a subset of this group of pollutants. The Technical Support Document (EPA 1991) provides a foundation for evaluating toxics; however, IPDES permit writers should be aware of currently evolving issues regarding toxics:

- Appropriate protocols and methods must be followed while collecting data for toxic pollutants or samples could easily be contaminated. If collection methods contaminate a sample, the data should be blank corrected or censored, and the data should be collected using appropriate methods with results appropriately handled (e.g., blank adjusted where needed).
- The various laboratory methods available for analyzing toxics may have different detection levels. Permit writers should use caution when assessing a dataset when the results are based on different methods and different detection levels.
- Depending on the data distribution, permit writers may consider using a geometric mean for background of toxic pollutants. While the TSD does not provide guidance, other states and programs may have more recent and comprehensive methods for determining background concentrations.

Table B-1 provides a matrix overview of toxics and topics to consider during the effluent limit development process.

Table B-1. Matrix overview of topics and considerations in effluent development for toxic pollutants.

Effluent Limit Development Step	Ammonia	Copper	Metals Cd, Pb, Zn, Arsenic	Hg	HHC, PCBs, Phthalates, and Others
Characterize effluent	- Toxic and dissolved oxygen impacts - MPEC 95th	- BLM	- Cause of background - Metal Translator	- MPEC - Geometric mean	- Blank correction
Characterize receiving water	- Little or no ambient	- DEQ guidance	- Geometric mean	- Geometric mean	- Geometric mean - Blank correction
Determine applicable water quality standards	- Appropriate frequency and duration	- Updates to criteria	- WER recalculation - §304(a) criteria	- Fish tissue	- Probabilistic approach - Variances
Determine the need for WQBELs (RPA)	- Monte Carlo - Mixed pH - Mixing zone	- Monte Carlo - Mixing zone	- TSD - Mixing Zone	- DEQ guidance	- Mixing zone - Congener-specific approach[a]
Interim and final WQBELs	- Monte Carlo	- Monte Carlo	- Monte Carlo - Intake variance	- Dental BMPs - Mercury minimization plans	- Toxic management plans - Congener-specific approach[a]

Notes: BLM = Biotic Ligand Model; MPEC = Maximum Possible Effluent Concentration
a. PCB congeners may be used to support the total PCB limit required by water quality standards.

Appendix C. Pollutants Regulated by Categorical Pretreatment Standards

	1,1,1-Trichloroethane	1,1,2,2-Tetra-chloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	1,2,4-Trichloro- benzene	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,2-Diphenyl- hydrazine	1,2-trans- Dichloroethylene	1,3-Dichloro- benzene	1,3-Dichloro- propene	1,4-Dichloro- benzene	2,3,4,6-Tetra-chlorophenol	2,3-Dichloro- aniline	2,4,5-Trichloro- phenol	2,4,6-Trichloro- phenol	2,4-Dichlorophenol	2,4-Dimethyl- phenol	2,4-Dinitro- toluene	2,4-Dinitrophenol	2,6-Dinitro- toluene	2-Chloro- naphthalene	2-Chloroethyl vinyl ether (mixed)	2-Chlorophenol	2-Nitrophenol	3,3-Dichloro- benzidine	3,4,5-Trichloro- catechol	3,4,5-Trichloro- guaiacol	3,4,6-Trichloro- catechol	3,4,6-Trichloro- guaiacol	4,4-DDD	4,4-DDE
Aluminum Forming										X											X					X								
Battery Manufacturing																																		
Carbon Black Manufacturing																																		
Centralized Waste Treatment																X		X																
Coil Coating	X	X		X	X																													
Copper Forming	X																						X											
Electrical and Electronic Components	X		X		X	X	X	X		X		X		X				X	X							X	X							
Electroplating	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X		X	X	X					X	X
Feedlots																									X									
Fertilizer Manufacturing																																		
Glass Manufacturing																																		
Grain Mills																																		
Ink Formulating																																		
Inorganic Chemicals Manufacturing																																		
Iron and Steel Manufacturing																																		
Leather Tanning and Finishing																																		
Metal Finishing	X	X	X	X	X		X	X	X	X	X																						X	X
Metal Molding and Casting	X					X						X	X	X				X	X	X	X	X	X	X		X	X	X						
Nonferrous Metals Form./Metal Powders																									X									
Nonferrous Metals Manufacturing																		X	X	X						X								
Oil and Gas																																		
Organic Chems., Plastics, and Syn. Fibers	X		X	X	X		X	X	X		X																							
Paint Formulating																																		
Paving and Roofing Materials						X						X	X	X													X							
Pesticide Chemicals	X				X		X	X	X		X																							
Petroleum Refining																																		
Pharmaceutical Manufacturing							X	X					X	X																				
Porcelain Enameling																																		
Pulp, Paper, and Paperboard																																		
Rubber Manufacturing																																		
Soap and Detergent Manufacturing															X		X	X											X	X	X	X		
Steam Electric Power Generating	X	X	X	X	X		X	X	X	X	X																						X	X
Timber Products Processing																																		
Transportation Equip. Cleaning						X						X	X	X				X	X	X	X	X	X	X		X	X	X						
Waste Combustors																									X									

	4,4-DDT	4,5,6-Trichloro- quaiacol	4,6-Dinitro-o- cresol	4-Bromophenyl phenyl ether	4-Chlorophenyl phenyl ether	4-Nitrophenol	Acenaphthene	Acenaphthylene	Acetone	Acrolein	Acrylonitrile	Aldrin	Alpha- endosulfan	Alpha-BHC	Ammonia (as N)	Anthracene	Benzene	Benzidine	Benzo (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (ghi) perylene	Benzo (k) fluoranthene	Beta-BHC	Beta-endosulfan	Bis (2-chloro- ethoxy) methane	Bis (2-chloro- ethyl) ether	Bis (2-chloro- isopropyl) ether	Bis (2-ethyl- hexyl) phthalate	BOD	Bromoform	Butyl benzyl phthalate	Carbazole	Carbon tetrachloride
Aluminum Forming							X	X								X				X	X	X							X					
Battery Manufacturing																																		
Carbon Black Manufacturing																																		
Centralized Waste Treatment																													X				X	
Coil Coating																											X		X			X		
Copper Forming																X	X																	
Electrical and Electronic Components						X										X													X			X		X
Electroplating	X		X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X
Feedlots																																		
Fertilizer Manufacturing															X																			
Glass Manufacturing																																		
Grain Mills																														X				
Ink Formulating																																		
Inorganic Chemicals Manufacturing																																		
Iron and Steel Manufacturing															X																			
Leather Tanning and Finishing																																		
Metal Finishing	X		X		X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			
Metal Molding and Casting				X		X	X	X								X	X		X	X	X		X						X			X		X
Nonferrous Metals Form./Metal Powders															X																			
Nonferrous Metals Manufacturing															X					X												X		
Oil and Gas																																		
Organic Chems., Plastics, and Syn. Fibers			X			X	X									X	X												X					
Paint Formulating																																		
Paving and Roofing Materials																																		X
Pesticide Chemicals																	X														X			
Petroleum Refining															X																			
Pharmaceutical Manufacturing									X						X		X																	X
Porcelain Enameling																																		
Pulp, Paper, and Paperboard		X																																
Rubber Manufacturing																																		
Soap and Detergent Manufacturing																																		
Steam Electric Power Generating	X		X		X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			
Timber Products Processing																																		
Transportation Equip. Cleaning				X																												X		X
Waste Combustors																																		

	Chlordane (tech. mix. & metabolites)	Chlorobenzene	Chlorodibromo- methane	Chloroethane	Chloroform	Chrysene	COD	Cresol	Delta-BHC	Dibenzo (a,h) anthracene	Dichlorobromo- methane	Dieldrin	Diethyl phthalate	Diethylamine	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Endosulfan sulfate	Endrin	Endrin aldehyde	Ethyl acetate	Ethylbenzene	Flow Restrictions Only	Fluoranthene	Fluorene	Fluoride	Gamma-BHC	Heptachlor	Heptachlor epoxide	Hexachloro- benzene	Hexachloro- ethane	Hexachlorobuta- diene	Hexachlorocyclo pentadiene	Indeno (1,2,3- cd)pyrene
Aluminum Forming						X				X			X			X		X	X	X		X		X	X									X
Battery Manufacturing																																		
Carbon Black Manufacturing																																		
Centralized Waste Treatment								X																X										
Coil Coating					X											X										X								
Copper Forming					X																	X												
Electrical and Electronic Components					X						X					X						X				X								
Electroplating		X	X	X	X	X			X	X	X	X	X		X	X	X	X	X	X		X		X	X		X	X	X	X	X	X	X	X
Feedlots	X																						X											
Fertilizer Manufacturing																																		
Glass Manufacturing																										X								
Grain Mills																																		
Ink Formulating																							X											
Inorganic Chemicals Manufacturing							X																			X								
Iron and Steel Manufacturing																																		
Leather Tanning and Finishing																																		
Metal Finishing																														X	X	X	X	X
Metal Molding and Casting		X	X	X	X	X			X	X	X	X	X		X	X	X	X	X	X		X		X	X		X	X	X					
Nonferrous Metals Form./Metal Powders	X																									X								
Nonferrous Metals Manufacturing		X			X	X							X		X	X								X	X	X				X				
Oil and Gas																							X											
Organic Chems., Plastics, and Syn. Fibers																														X	X		X	
Paint Formulating																							X											
Paving and Roofing Materials		X		X	X								X		X							X		X	X									
Pesticide Chemicals																																		
Petroleum Refining																																		
Pharmaceutical Manufacturing		X	X		X						X											X												
Porcelain Enameling																																		
Pulp, Paper, and Paperboard		X			X									X							X													
Rubber Manufacturing							X																											
Soap and Detergent Manufacturing					X																		X											
Steam Electric Power Generating																														X	X	X	X	X
Timber Products Processing																																		
Transportation Equip. Cleaning		X	X	X	X	X			X	X	X	X	X		X	X	X	X	X	X		X		X	X		X	X	X					
Waste Combustors	X																																	

	Isobutylaldehyde	Isophorone	Isopropyl acetate	Isopropyl ether	Methyl bromide	Methyl cellosolve	Methyl chloride	Methyl formate	Methyl Isobutyl Ketone	Methylene chloride	n-Amyl acetate	Naphthalene	n-Butyl acetate	n-Decane	n-Heptane	n-Hexane	Nitrate (as N)	Nitrobenzene	N-nitrosodi- methylamine	N-nitrosodi- phenylamine	N-nitrosodi-n- propylamine	n-Octadecane	Nonpolar material (SGT-HEM)	Oil (mineral)	Oil and Grease	Organic Nitrogen (as N)	Parachloro- metacresol	PCB–1016	pH	Phenols	Phosphorus	Sulfide	TSS
Aluminum Forming		X										X								X					X		X	X					
Battery Manufacturing																																	
Carbon Black Manufacturing																									X								
Centralized Waste Treatment														X								X											
Coil Coating										X															X						X		
Copper Forming										X		X								X					X								
Electrical and Electronic Components		X								X		X																					
Electroplating		X			X		X			X		X						X	X	X	X						X	X					
Feedlots																																	
Fertilizer Manufacturing																	X									X			X		X		
Glass Manufacturing																								X									
Grain Mills																																	X
Ink Formulating																																	
Inorganic Chemicals Manufacturing																													X				
Iron and Steel Manufacturing												X																		X			
Leather Tanning and Finishing																													X			X	
Metal Finishing		X			X		X			X		X						X	X	X	X						X	X					
Metal Molding and Casting										X		X													X		X			X			
Nonferrous Metals Form./Metal Powders																			X	X	X												
Nonferrous Metals Manufacturing																														X			
Oil and Gas																																	
Organic Chems., Plastics, and Syn. Fibers							X			X		X						X															
Paint Formulating																																	
Paving and Roofing Materials																									X								
Pesticide Chemicals					X		X			X		X																					
Petroleum Refining																									X								
Pharmaceutical Manufacturing	X		X	X		X		X	X	X	X		X		X	X																	
Porcelain Enameling																																	
Pulp, Paper, and Paperboard																					X												
Rubber Manufacturing																									X								
Soap and Detergent Manufacturing																																	
Steam Electric Power Generating		X			X		X			X		X						X	X	X	X						X	X					
Timber Products Processing																									X								
Transportation Equip. Cleaning																																	
Waste Combustors																							X										X

Appendix D. New Source Dates by Effluent Category

40 CFR	Category	New Source Date for Direct Dischargers		New Source Date for Indirect Dischargers	
467	Aluminum Forming	Subparts A-F:	10/24/83	Subparts A-F:	11/22/82
427	Asbestos Manufacturing	Subparts A-K:	10/30/73[1]	Not Applicable	
461	Battery Manufacturing	Subparts A-G:	03/09/84	Subparts A-G	11/10/82
407	Canned and Preserved Fruits and Vegetables Processing	Subparts A-H:	03/21/74	Not Applicable	
408	Canned and Preserved Seafood Processing	Subparts A-J, N: Subparts O-AG:	06/26/74 12/01/75	Not Applicable	
458	Carbon Black Manufacturing	Subparts A-D:	01/09/78	Subparts A-D:	05/18/76
411	Cement Manufacturing	Subparts A-C:	02/20/74	Not Applicable	
437	Centralized Waste Treatment (CWT)	Subparts A-D:	01/05/01	Subparts A-D:	01/13/99
434	Coal Mining	Subparts B-E, H: Subpart G:	05/04/84[2] 02/22/02[3]	Not Applicable	
465	Coil Coating	Subparts A-C: Subpart D:	12/01/82 11/17/83	Subparts A-C: Subpart D:	01/12/81 02/10/83
412	Concentrated Animal Feeding Operations (CAFO)	Subparts A-B: Subparts C-D:	02/14/74 04/14/03[4]	Subpart B:	09/07/73
451	Concentrated Aquatic Animal Production	Subparts A-B:	09/07/04	Not Applicable	
468	Copper Forming	Subpart A:	08/15/83	Subpart A:	11/12/82
405	Dairy Products Processing	Subparts A-L:	05/28/74	Not Applicable	
469	Electrical and Electronic Components	Subparts A-B: Subparts C-D:	04/08/83 12/14/83	Subparts A-B: Subparts C-D:	08/24/82 03/09/83
413	Electroplating	Not Applicable[5]		See Metal Finishing[6]	
457	Explosives Manufacturing	Not Applicable		Not Applicable	
424	Ferroalloy Manufacturing	Subparts A-C:	02/22/74	Not Applicable	
418	Fertilizer Manufacturing	Subparts A-D: Subpart E: Subparts F-G:	04/08/74 01/16/76 10/07/74[7]	Subparts A-D[8]: Subpart E: Subparts F-G:	12/07/73 01/16/76 10/07/74
426	Glass Manufacturing	Subpart A: Subparts B-D: Subparts E-G: Subparts H, J-M:	01/22/74 02/14/74 02/14/74 01/16/75	Subparts H, K-M:	08/21/74
406	Grain Mills	Subparts A-J:	12/04/73[9]	Subpart A:	12/04/73
454	Gum and Wood Chemicals	Not Applicable		Not Applicable	
460	Hospitals	Not Applicable		Not Applicable	
447	Ink Formulating	Subpart A:	07/28/75	Subpart A:	02/26/75
415	Inorganic Chemicals	Subparts B-F, H, K-N, P, Q, T, V, W, AJ [$CuSO_4$ manufacturing], AH, AP, AU [$NiSO_4$ manufacturing], BB: Subparts AJ [except	06/29/82	Subparts B-F, H, K-N, P, Q, V, AH, AJ [$CuSO_4$ manufacturing], AP, AU [$NiSO_4$ manufacturing], BB: Subparts T, AA, AC, AE, AI, AJ [except $CuSO_4$	07/24/80

40 CFR	Category	New Source Date for Direct Dischargers	New Source Date for Indirect Dischargers
		$CuSO_4$ manufacturing], AU [except $NiSO_4$ manufacturing], BL - BO: 08/22/84	manufacturing], AL, AN, AQ, AR, AU [except $NiSO_4$ manufacturing], AX, BC, BH, BK-BO: 10/25/83
420	Iron and Steel Manufacturing	Subparts A-B: 11/18/02[10] Subpart C: 05/27/82 Subpart D, Semi-Wet: 10/31/02 Subpart D, Other: 05/27/82 Subparts E-L: Subpart M: 05/27/82 10/31/02	Subparts A-B: 11/18/02 Subpart C: 01/07/81[11] Subpart D, Semi-Wet: 12/27/00 Subpart D, Other: Subparts 01/07/81 E-F, H-J,L: Subpart M: 01/07/81 12/27/00
445	Landfills	Subparts A-B: 02/02/00	Not Applicable
425	Leather Tanning and Finishing	Subparts A, B, D-I: 11/23/82 Subpart C: 04/04/88	Subpart A, B, D-I: 07/02/79 Subpart C: 01/21/87
432	Meat and Poultry Products	Subparts A-D, Small Facilities: 02/28/74[12] Subparts A-D, Other: 09/22/04 Subparts E-I, Small Facilities: 01/03/75[13] Subparts E-I, Other: 09/22/04 Subpart J-L: 09/22/04	Not Applicable
433	Metal Finishing	Subpart A: 07/15/83	Subpart A: 08/31/82
464	Metal Molding and Casting	Subparts A-D: 11/13/85	Subparts A-D: 11/15/82
438	Metal Products and Machinery	Subpart A: 06/12/03[14]	Not Applicable
436	Mineral Mining and Processing	Not Applicable	Not Applicable
471	Nonferrous Metals Forming and Metal Powders	Subparts A-J: 09/06/85	Subparts A-J: 03/05/84
421	Nonferrous Metal Manufacturing	Subparts B-I (except molybdenum acid plants), K-M: 03/08/84 Subparts N-AE, molybdenum acid plants in subpart I: 10/04/85 Subpart J: 02/04/88	Subparts B-I (except molybdenum acid plants), K-M: 02/17/83 Subparts N-AE, molybdenum acid plants in subpart I: 06/27/84 Subpart J: 01/22/87
435	Oil and Gas Extraction[15]	Subparts C (Onshore), D (Coastal), and E (Agriculture & Wildlife): 03/04/93 Subparts A and D (Synthetic-Based Drilling Fluids): 02/05/01	Subpart D: 02/17/95
440	Ore Mining and Dressing	Subparts A-F, J, M: 12/03/82	Not Applicable
414	Organic Chemicals, Plastics, and Synthetic Fibers	Subparts B-H: 11/19/87	Subparts B-H: 03/21/83
446	Paint Formulating	Subpart A: 07/28/75	Subpart A: 02/26/75
443	Paving and Roofing Materials (Tars and Asphalt)	Subparts A-D: 07/28/75	Subparts A-D: 01/10/75
455	Pesticide Chemicals	Subparts A-B: 10/12/93 Subparts C, E: 11/20/96	Subparts A-B: 04/10/92 Subparts C, E: 04/14/94

40 CFR	Category	New Source Date for Direct Dischargers	New Source Date for Indirect Dischargers
419	Petroleum Refining	Subparts A-E: 10/18/82	Subparts A-E: 12/21/79
439	Pharmaceutical Manufacturing	Subparts A-D: 11/20/98[16]	Subparts A-D: 05/02/95
422	Phosphate Manufacturing	Subparts D-F: 06/23/76	Not Applicable
459	Photographic	Not Applicable	Not Applicable
463	Plastics Molding and Forming	Subparts A-C: 12/17/84	Not Applicable
466	Porcelain Enameling	Subparts A-D: 11/24/82	Subparts A-D: 01/27/81
430	Pulp, Paper, and Paperboard	Subparts B, E: 06/15/98[17] Subparts A, C, D, F, G, I-L: 11/18/82	Subparts B, E: 12/17/93 Subparts A, C, D, F, G, I-L: 01/06/81
428	Rubber Manufacturing	Subparts A-D: 02/21/74 Subparts E-J: 01/10/75	Subparts E-K: 08/23/74
417	Soap and Detergents Manufacturing	Subparts A-S: 4/12/74	Subpart Q: 12/26/73 Subparts O, P, R: 02/20/75
423	Steam Electric Power Generation	11/19/82[18]	10/14/80
409	Sugar Processing	Subpart A: 1/31/74 Subparts B, C: 12/07/73[19]	Not Applicable

[1] Rule was finalized within 120 days of October 30, 1973, proposal (38 FR 22606).

[2] New Source date is specified in 40 CFR 434.11(j)(1).

[3] New Source date is specified in 40 CFR 434.11(j)(1).

[4] New Source date derived from the 10-year protection period (40 CFR 412.35(d) and 412.43(d)).

[5] Direct dischargers formerly regulated under Part 413 are now regulated under Part 433 (metal finishing).

[6] Pretreatment categorical standards in Part 413 currently apply only to job shop electroplaters and independent printed circuit board manufacturers that were in existence before the New Source date for Part 433 (metal finishing). Job shop electroplaters and independent printed circuit board manufacturers that are "New Sources" must comply with PSNS in Part 433. Except for these "existing" job shop electroplaters and independent printed circuit board manufacturers, all other operations formerly subject to Part 413 are now subject to Part 433.

[7] Rule was finalized within 120 days of October 7, 1974, proposal.

[8] Section 41 8.46 (PSNS under Subpart D) was suspended until further notice, at 40 FR 26275, June 23, 1975, effective July 20, 1975.

[9] Rule was finalized within 120 days of December 4, 1973, proposal (38 FR 33438).

[10] Date specified in 40 CFR 420.14(a)(2), 420.16(a)(2), 420.24(b), and 420.26(a)(2).

[11] See previous footnote.

[12] The 2004 Amendment did not revise NSPSs for small meat products facilities in Subparts A–I, so the 2004 New Source date does not affect these facilities.

[13] See previous footnote.

[14] Date specified in 40 CFR 438.15.

[15] See promulgated standards at 40 CFR 58 FR 12505 and 66 FR 6850 for complete information on the applicability of New Source standards.

[16] New Source date derived from the 10-year protection period (40 CFR 439.15(c), 439.35(c), and 439.45(b)).

[17] Date specified in 40 CFR 430.25(b) and 430.55(b). Refer to these sections for additional information regarding the applicability of NSPSs.

[18] NSPS promulgated were not removed via the 1982 regulation; therefore, wastewaters generated by Part 423-applicable sources that were New Sources under the 1974 regulations are subject to the 1974 NSPS. The New Source date for the 1974 regulations was 10/8/1974.

[19] Rule was finalized within 120 days of December 7, 1973, proposal (38 FR 33846).

Appendix E. Equations

Equation #	Description	Equation	Variables
1	Mass-based limit calculations	$\boldsymbol{L_l = Q_d \times [C] \times C_f}$	L_l = POTW design flow in MGD Concentration limit in mg/L Conversion factor = 8.34 (lb*L)/(mg*MG)
2	Macro composition calculation	$C_M = M\left(\frac{lb}{day}\right) \times P_{FPC}$	C_M = Macro component (lb/day) is the amount of Fat (F), Protein (P), or Carbohydrate (C) in the milk M = Raw milk is the amount processed each day (lb/day) PFPC = Percentage of F, P, and C in the raw milk
3	Constituent input	$In_x = C_M \times C_{ELG}$	In_x = Equivalent pollutant value C_M = Quantity of Macro Component C_{ELG} = Conversion coefficient from appropriate ELG
4	AML for new dairy sources	$AML = \left(\sum In_x\right) \times PS_{AML}$	AML = Average Monthly Limit ΣIn_x = Summation of equivalent pollutant values PS_{AML} = Performance Standard for AML
5	Maximum daily limit for new dairy sources	$Max.Daily\ Limit = \left(\sum In_x\right) \times PS_{MaxDailyLimit}$	ΣIn_x = Summation of equivalent pollutant values $PS_{MaxDailyLimit}$ = Performance Standard for Max Daily Limit
6	Building block approach maximum daily limit calculation	$L_B = P_{Rate} \times C_{ELG}$	L_B = Individual Component's Load P_{rate} = Production Rate C_{ELG} = Effluent Limit Guideline conversion factor
7	Tiered limit calculation	$L_B = P_{Rate} \times C_f \times C_{ELG}$	L_B = Individual Component's Load P_{rate} = Production Rate C_{ELG} = Effluent Limit Guideline conversion factor C_f = Conversion Factor
8	Coefficient of variation (CV)	$CV = \frac{Standard\ Deviation}{Mean}$	CV = Coefficient of Variation Standard Deviation = Calculated value that indicates the extent of deviation for a group as a whole Mean = Calculated central value of a set of numbers

Equation #	Description	Equation	Variables
9	Harmonic mean flow	$Q_{hm} = [1.194X(Q_{am})^{0.473}]X[(7Q10)^{0.552}]$	Q_{hm} = Harmonic mean flow Q_{am} = Arithmetic mean flow
10	7Q10 calculation	$7Q10 = [Q_{hm}/(1.194XQ_{am}^{0.473})]^{1/0.552}$	7Q10 = Low 7-day average flow with a return frequency of once every 10 years
11	Alternative 7Q10 calculation	$7Q10 = Q_{hm}/3.5$	
12	1Q10 calculation	1Q10 = 7Q10/1.3	1Q10 = Low 1-day average flow with a return frequency of once every 10 years
13	30Q5 calculation for flow >600 cfs	30Q5 = 7Q10 X 1.4	30Q5 = Low 30-day average flow with a return frequency of once every 5 years
14	30Q5 calculation for flows <50 cfs	30Q5 = 7Q10 X 1.1	
15	Acute hardness-dependent metals criteria	CMC = WER X exp(mA[ln(hardness)]+bA) X Acute Conversion Factor	CMC = Maximum instantaneous or 1-hour average concentration WER = Water effects ratio exp = Base e exponential function (2.71828) mA = Slope of the acute regression line ln hardness = Natural log of total hardness bA = y-intercept of the acute regression line Acute Conversion Factor = Total to dissolved conversion factor
16	Chronic hardness-dependent metals criteria	CCC = WER X exp(mc[ln(hardness)]+bc) X Chronic Conversion Factor	CCC = 4-day average concentration WER = Water effects ratio exp = Base e exponential function (2.71828) mc = Slope of the chronic regression line ln hardness = Natural log of total hardness bc = y-intercept of the chronic regression line Chronic Conversion Factor = Total to dissolved conversion factor
17	Cadmium acute conversion factor	Cd Acute CF = 1.136672 – [(ln hardness) X (0.041838)]	Cd Acute CF = Cadmium Acute Conversion Factor ln hardness = Natural log of total hardness
18	Cadmium chronic conversion factor	Cd Chronic CF = 1.101672 – [(ln hardness) X (0.041838)]	Cd Chronic CF = Cadmium Chronic Conversion Factor ln hardness = Natural log of total hardness

Equation #	Description	Equation	Variables
19	Lead acute and chronic conversion factor	$Pb_{(acute\&chronic)}$ CF = 1.46203 – [(ln hardness) X(0.415712)]	$Pb_{(acute\&chronic)}$ CF = Lead Acute and Chronic Conversion Factor ln hardness = Natural log of total hardness
20	Acute ammonia criteria	$CMC = [0.275/(1+10^{(7.204-pH)}] + [39.0/(1+10^{pH-7.204})]$	CMC = 1-hour average concentration of total ammonia nitrogen (in mg-N/L) pH = 90th to 95th percentile of pH in the receiving water body upstream from the discharge
21	Chronic, early life stages present, ammonia criteria	$CCC = [0.0577/(1+10^{(7.688-pH)}) + 2.487/(1.10^{(pH-7.688)})] \times MIN[2.85, 1.45 \times 10^{(0.028 \times (25-T)}]$	CCC = 30-day average concentration of total ammonia nitrogen (in mg-N/L) pH = 90th to 95th percentile of pH in the receiving water body upstream from the discharge T = 90th to 95th percentile of the ambient upstream receiving water body temperature MIN = Smallest value from the data set
22	Chronic, early life stages absent, ammonia criteria	$CCC = [0.0577/(1+10^{(7.688-pH)}) + 2.487/(1.10^{(pH-7.688)})] \times [1.45 \times 10^{(0.028 \times (25-T)}]$	CCC = 30-day average concentration of total ammonia nitrogen (in mg-N/L) pH = 90th to 95th percentile of pH in the receiving water body upstream from the discharge T = 90th to 95th percentile of the ambient upstream receiving water body temperature
23	Acute toxic units	$TU_a = 100/LC_{50}$	TU_a = Acute toxic unit LC_{50} = Lethal concentration at 50% survival rate
24	Chronic toxic units	$TU_c = 100/NOEC$ $TU_c = 100/IC_{25}$ $TU_c = 100/LOEC$	TU_c = Chronic toxic unit NOEC = No observable effects concentration IC_{25} = Inhibition concentration at which 25% of test subject suffer effects LOEC = Lowest Observable Effect Concentration
25	Dilution factor calculation	$D = (Q_s \times P + Q_e)/Q_e$ Or, an alternate form $D = [(Q_s \times P)/Q_e] + 1$	D = Dilution factor Q_s = Receiving water low-flow condition (cfs) P = Mixing zone percentage Q_e = Effluent discharge flow (cfs)
26	Simple mass-balance equation	$C_d = [C_eQ_e+(C_u(Q_u \times \%MZ))] / [Q_e + (Q_u \times \%MZ)]$	C_d = Downstream receiving water concentration Q_e = Critical effluent flow Q_u = Critical upstream flow (1Q10 acute criterion, 7Q10 chronic, or harmonic mean) %MZ = Percent of critical low flow provided by mixing

Equation #	Description	Equation	Variables
			zone C_e = Critical effluent pollutant concentration C_u = Critical upstream pollutant concentration (90th to 95th percentile)
27	Simple mass balance using dilution factor	$C_f = \frac{C_e - C_r}{D_f} + C_r$	Cf = Water quality concentration Ce = Effluent concentration Df = Dilution factor Cr = Receiving water pollutant concentration (90th to 95th percentile)
28	Critical effluent pollutant concentration calculation	C_e = MOEC X RPMF	C_e = Critical effluent pollutant concentration MOEC = Maximum observed effluent concentration RPMF = Reasonable Potential Multiplication Factor
29	Highest concentration reported percentile	$P_n = (1 - \text{Confidence Level})^{1/N}$	P_n = Percentile corresponding to the highest reported pollutant concentration N = Number of samples Confidence Level = 99th
30	RPMF calculation using z-scores	$RPMF = \frac{e^{(z_{99} \times \sigma - 0.5 \times \sigma^2)}}{e^{(z_{p_n} \times \sigma - 0.5 \times \sigma^2)}}$	RPMF = Reasonable Potential Multiplication Factor e = Base of natural log (2.71828) z_{99} = z score of the 99th-percentile normal distribution (2.326) z_{pn} = z score of the normal distribution corresponding to the “N” samples calculated using Equation 29 and Table 28 σ = Square root of σ^2 $\sigma^2 = \ln(CV^2 + 1)$ CV = Coefficient of variation use Equation 8
31	WLA for flowing water from simple mass balance equation	$C_e = WLA_{(a\ or\ c)} = \frac{WQC_{(a\ or\ c)}[Q_e + (Q_u \times \%MZ)] - [C_u \times (Q_u \times \%MZ)]}{Q_e}$	$WQC_{(a\ or\ c)}$ = Pollutant water quality criterion (acute or chronic) Q_e = Critical effluent flow Q_u = Critical upstream flow (1Q10 acute criterion or 7Q10 chronic) %MZ = Percent of critical low flow provided by mixing zone C_u = Critical upstream pollutant concentration (90th percentile) $C_e = WLA_{(a\ or\ c)}$ = Wasteload allocation (acute or chronic)

Equation #	Description	Equation	Variables
32	WLA for nonflowing water from simple mass balance equation	$WLA_{(a\ or\ c)} = WQC_{(a\ or\ c)}(D+1) - D \times C_r$	$WLA_{(a\ or\ c)}$ = Wasteload allocation (acute or chronic) $WQC_{(a\ or\ c)}$ = Pollutant water quality criterion (acute or chronic) D = Dilution ratio C_r = Critical receiving water pollutant concentration (acute and chronic)
33	Dilution factor for nonflowing water	$D = \frac{V_r}{Q_e \times t}$	D = Dilution ratio V_r = Nonflowing receiving water volume (MG) Q_e = Effluent flow rate (MGD) t = Receiving water body residence time (days)
34	Acute long-term average for toxics	$LTA_a = WLA_a \times e^{(0.5\sigma^2 - z_{99}\sigma)}$	LTA_a = Acute long-term average WLA_a = Acute wasteload allocation e = Base of natural log σ = Square root of σ^2 $\sigma^2 = Ln(CV^2+1)$ CV = Coefficient of Variation (default = 0.6) Z_{99} = z score of the 99th percentile of the normal distribution
35	Chronic long-term average for toxics	$LTA_c = WLA_c \times e^{(0.5\sigma_n^2 - z_{99}\sigma_n)}$	LTA_c = Chronic long-term average WLA_c = Chronic wasteload allocation e = Base of natural log σ_n = Square root of σ_n^2 $\sigma_n^2 = Ln[(CV^2)/n + 1)]$ CV = Coefficient of Variation (default = 0.6) Z_{99} = z score of the 99th percentile of the normal distribution n = Averaging period for the chronic water quality criterion (4 days)
36	Maximum daily limit for toxics	$Maximum\ Daily\ Limit = LTA_m \times e^{(z_{99}\sigma - 0.5\sigma^2)}$	LTA_m = Minimum long-term average value e = Base of natural log σ = Square root of σ^2 $\sigma^2 = Ln(CV^2+1)$ CV = Coefficient of variation (default = 0.6) Z_{99} = z score of the 99th percentile of the normal distribution

Equation #	Description	Equation	Variables
37	Average monthly limit for toxics	$AML = LTA_m \times e^{(z_{95}\sigma_n - 0.5\sigma_n^2)}$	LTA_m = Minimum long-term average AML = Average monthly limit e = Base of natural log σ_n = Square root of σ_n^2 σ_n^2 = Ln[(CV^2)/n + 1] Z_{95} = z score of the 95th percentile of the normal distribution n = Number of sample specified in the permit to be analyzed each month CV = Coefficient of variation
38	Human health maximum daily limit from AML	$Maximum\ Daily\ Limit = AML \times \frac{e^{(2.326\sigma - 0.5\sigma^2)}}{e^{(z_a\sigma_n - 0.5\sigma_n^2)}}$	AML = Set equal to the WLA e = Base of natural log σ = Square root of σ^2 σ^2 = Ln[CV^2 + 1] σ_n = Square root of σ_n^2 σ_n^2 = Ln[(CV^2)/n + 1] Z_a = Percentile exceedance probability for the AML n = Number of samples specified in the permit to be analyzed each month CV = Coefficient of variation
39	WET test acute to chronic ratio	$ACR = \frac{Acute\ Endpoint}{Chronic\ Endpoint} = \frac{LC_{50}}{IC_{25}}$	LC_{50} = Lethal concentration at 50% survival rate IC_{25} = Inhibition concentration at which 25% of test subject suffer effects
40	Alternate acute to chronic ratio	$ACR = \frac{LC_{50}}{IC_{25}} = \frac{\frac{100}{TU_a}}{\frac{100}{TU_c}} = \frac{TU_c}{TU_a}$	
41	WET trigger calculation	$C_e = \frac{\left(C_d \times \left(Q_e + (\%MZ \times Q_u)\right) - \left(C_u \times (\%MZ \times Q_u)\right)\right)}{Q_e}$	C_e = Chronic WET trigger effluent concentration (value > Chronic WET criterion) Q_e = Critical effluent flow Q_u = Critical upstream flow (7Q10 chronic) %MZ = Percent of critical low flow provided by mixing zone C_u = Critical upstream pollutant concentration (upstream chronic WET concentration = 0.0 TU_c)

Equation #	Description	Equation	Variables
			C_d = Critical effluent pollutant concentration (1.0 TU_c)
42	WET acute LTA	$LTA_a = WLA_a \times e^{(0.5\sigma^2 - z_{99}\sigma)}$	LTA_a = Acute long-term average WLA_a = Acute wasteload allocation e = Base of natural log σ = Square root of σ^2 $\sigma^2 = Ln(CV^2+1)$ Z_{99} = z score of the 99th percentile of the normal distribution
43	Acute WET maximum daily limit	$MDL\ Max\ Daily\ Limit_a = LTA_a \times e^{(z_{99}\sigma - 0.5\sigma^2)}$	LTA_a = Acute long-term average e = Base of natural log σ = Square root of σ^2 $\sigma^2 = Ln(CV^2+1)$ Z_{99} = z score of the 99th percentile of the normal distribution
44	Acute WET average monthly limit	$AML_a = LTA_a \times e^{(z_{95}\sigma_n - 0.5\sigma_n^2)}$	AML_a = Acute average monthly limit LTA_a = Acute long-term average e = Base of natural log σ_n = Square root of σ_n^2 $\sigma_n^2 = Ln[(CV^2/n) + 1]$ Z_{95} = z score of the 95th percentile of the normal distribution

Equation #	Description	Equation	Variables
45	Chronic WET long-term average	$LTA_c = WLA_c \times e^{(0.5\sigma_4^2 - z_{99}\sigma_4)}$	LTA_c = Chronic long-term average WLA_c = Chronic wasteload allocation e = Base of natural log σ_4 = Square root of σ_4^2 σ_4^2 = Ln[(CV^2/4) + 1] Z_{99} = z score of the 99th percentile of the normal distribution
46	Chronic WET maximum daily limit	$Max\ Daily\ Limit_c = LTA_c \times e^{(z_{99}\sigma - 0.5\sigma^2)}$	LTA_c = Chronic long-term average e = Base of natural log σ = Square root of σ^2 σ^2 = Ln(CV^2+1) Z_{99} = z score of the 99th percentile of the normal distribution
47	Chronic WET average monthly limit	$AML_c = LTA_c \times e^{(z_{95}\sigma_n - 0.5\sigma_n^2)}$	AML_c = Chronic average monthly limit LTA_c = Chronic long-term average e = Base of natural log σ_n = Square root of σ_n^2 σ_n^2 = Ln[(CV^2/n) + 1] Z_{95} = z score of the 95th percentile of the normal distribution
48	Concentration probability	$P = \left(\frac{rank}{n+1}\right)$	P = Probability n = Number of data points in the set Rank is the rank of the concentration in the data set
49	Temperature limit calculation	$T_e = D \times (T_d - T_u) + T_u$	T_e = Effluent temperature (°C) D = Dilution factor (Equation 25) T_d = Water quality criterion (°C) T_u = Upstream receiving water temperature (°C)