# Idaho Pollutant Discharge Elimination System

Effluent Limit Development Guidance

**State of Idaho**
**Department of Environmental Quality**

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## Effluent Limit Development Guidance

**October 2017**

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# Abbreviations and Acronyms

| | |
|---|---|
| **§** | section (usually a section of federal or state rules or statutes) |
| **ACR** | acute-to-chronic ratio |
| **BAT** | best available technology economically achievable |
| **BCT** | best conventional pollutant control technology |
| **BMP** | best management practice |
| **$BOD_5$** | five-day biochemical oxygen demand |
| **BPJ** | best professional judgment |
| **BPT** | best practicable control technology currently available |
| **$cBOD_5$** | carbonaceous five-day biochemical oxygen demand |
| **CCC** | Criterion continuous concentration |
| **CFR** | code of federal regulations (refers to citations in the federal administrative rules) |
| **CMC** | Criterion maximum concentration |
| **CV** | coefficient of variation |
| **CWA** | Clean Water Act |
| **DEQ** | Idaho Department of Environmental Quality |
| **DMR** | discharge monitoring report |
| **EDU** | equivalent dwelling unit |
| **ELDG** | IPDES Effluent Limit Development Guidance |
| **ELG** | effluent limit guideline |
| **EPA** | United States Environmental Protection Agency |
| **ESA** | Endangered Species Act |
| **FDF** | fundamentally different factors |
| **HEM** | hexane extractable materials |
| **IBR** | incorporated by reference (into IDAPA 58.01.25) |
| **IC** | inhibition concentration |
| **IDAPA** | refers to citations of Idaho administrative rules |
| **IDFG** | Idaho Fish and Game Department |
| **I/I** | infiltration and inflow |
| **IP** | individual permit |
| **IPDES** | Idaho Pollutant Discharge Elimination System |
| **IU** | industrial user |
| **kg** | kilogram |
| **L** | liter |
| **$LC_{50}$** | lethal concentration 50 |
| **LOEC** | lowest observed effects concentration |
| **LTA** | long-term average |
| **MCL** | maximum contaminant level |
| **MDL** | method detection limit |
| **mg/L** | milligrams per liter |
| **mgd** | million gallons per day |
| **ML** | minimum level of quantitation |
| **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 |
| **O&M** | operations and maintenance |
| **ORW** | outstanding resource waters |
| **PCB** | polychlorinated biphenyl |
| **POTW** | publicly owned treatment works |
| **PSES** | pretreatment standards for existing sources |
| **PSNS** | Pretreatment Standards for New Sources |
| **QAPP** | quality assurance project plans |
| **QA/QC** | quality assurance/quality control |
| **RPA** | reasonable potential analysis |
| **RPTE** | reasonable potential to exceed |
| **SEP** | supplemental environmental project |
| **SHPO** | state historic preservation offices |
| **SIC** | standard industrial classification |
| **SPCC** | spill prevention, control and countermeasure |
| **SS** | suspended solids |
| **SSO** | sanitary sewer overflow |
| **SWMP** | storm water management program |
| **SWPPP** | storm water pollution prevention plan |
| **TBEL** | technology-based effluent limit |
| **TMDL** | total maximum daily load |
| **TOC** | total organic carbon |
| **TRC** | technical review criteria |
| **TSS** | total suspended solids |
| **TU** | toxic unit |
| **TWTDS** | treatment works treating domestic sewage |
| **UAA** | Use attainability analysis |
| **US** | United States |
| **USGS** | U.S. Geological Survey |
| **USACE** | United States Army Corps of Engineers |
| **USFWS** | United States Fish and Wildlife Service |
| **WER** | water effects ratio |
| **WET** | whole effluent toxicity |
| **WLA** | wasteload allocation |
| **WQBEL** | water quality-based effluent limit |
| **WQS** | Water quality standards |

# 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 the environment of the State of Idaho. Given the implications, DEQ strives to appropriately navigate these interests, while adhering to requirements of the CWA, and associated state and federal rules, regulations, and implementation policies.

IPDES permit writers consider contemporary issues from many perspectives including water quality, data collection, laboratory analysis, treatment, and other issues relevant to permitting. IPDES program implementation is an adaptive process, often facing interesting and challenging issues (e.g., toxics, temperature, nutrients), and the IPDES program adapts implementation strategies, as appropriate, to address emerging issues as they occur.

While no circumstances are identical and every permit is unique, the ELDG provides logical pathways for developing effluent limits that appropriately address the issues, not a rigid framework that defaults to generic limitations. DEQ recognizes it is critically important to document the permit process from the beginning of monitoring, data management, mathematical computations, and interpretation of data all the way through to conclusions and effluent limits. DEQ also recognizes that 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, ultimately benefitting water quality and the citizens of Idaho.

## 1.1 Purpose and Need

The purpose of this guide is to provide Idaho-specific direction for the development of effluent limits in IPDES permits by defining the requirements for permits and addressing the challenges and perspectives unique to Idaho. For example, most of Idaho's communities are small, with limited technical resources and limited funds. Because permit monitoring and implementation are challenging and expensive for permittees, permit conditions and monitoring requirements must be clear, accurate, and appropriate to be beneficial. And it is critical that a high level of skill is used in the data analyses and interpretation.

The ELDG provides direction for DEQ to recognize unique circumstances and find pathways to logical solutions that avoid previously-identified pitfalls and traps. This will occur by helping permit writers use reasonable assumptions and innovative approaches in developing 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.

This guide serves as a reference for IPDES permit writers to develop, and permittees to understand the development of, permits and effluent limits by explaining:

- 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

Because of the effluent limit development process complexity, it is impossible to completely identify each function chronologically. However, the ELDG follows and describes the process of developing effluent limits in IPDES permits (Figure 1).

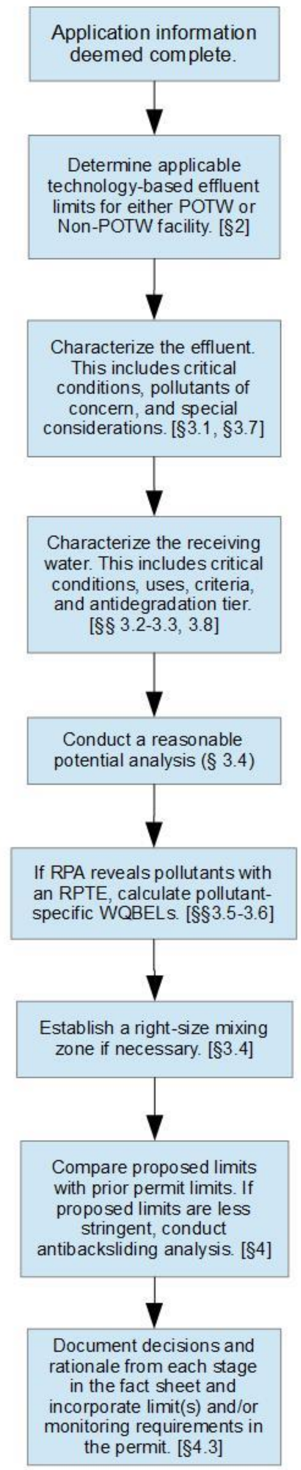



**Figure 1. The effluent limit development process for IPDES permits.**

## 1.3 Relationship to Existing Rules and Guidance

This guide is not intended to be a stand-alone document; rather, it supports implementation of the Clean Water Act (CWA), Idaho Code and administrative rules, federal regulations, and state and national policies, guidance, and standards. These include compliance 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 represent an adaptation of numerous existing state and US Environmental Protection Agency (EPA) guidance documents, including but not limited to:

- *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*
- *The 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.

### 1.3.1 Clean Water Act Background

The Federal Water Pollution Control Act, or CWA, is the primary US law addressing pollutants in receiving waters (e.g., streams, rivers, lakes, and reservoirs). The CWA was originally enacted in 1948 and was revised by significant amendments in 1972 (P.L. 92-500), and to a lesser degree in 1977 (P.L. 95-217) and in 1981 (P.L. 97-117). The most recent major amendments to the CWA were made in 1987 (P.L. 100-4). A major part of the CWA is a requirement for 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. 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 in accordance with 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 the DEQ *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 .

Additionally, permit writers should include, in IPDES permits, the information in Appendix A or similar language, clarifying how permittees should report significant figures on the DMR.

Finally, Appendix B identifies some potential approaches to consider when limiting toxic pollutants.

# 2 Determining Technology-Based Effluent Limits (TBELs)

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 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 non-water 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 deriving TBELs. The permit writer can use the federal effluent limitation guidelines (ELG) and standards, if they are applicable and appropriate, or, if no applicable ELG or standard exists, then 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 POTW or non-POTW (e.g., industrial, commercial, mining, or silvicultural). The following subsections will first address establishing TBELs for POTWs in Subsection 2.1, briefly touch upon industrial discharges to POTWs in Subsection 2.1.4, followed by Non-POTW dischargers in Subsection 2.2.

## 2.1 TBELs for Publicly Owned Treatment Works (POTWs)

The largest category of dischargers requiring individual IPDES permits is POTWs. A POTW, as defined in IDAPA 58.01.25.010.73, includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature. A POTW also includes the sewage collection system, pipes, mains, lift stations, and other conveyances that deliver wastewater to the facility. The term also means the municipality as defined in the Clean Water Act section 502(4), which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

IDAPA 58.01.25.010.55 provides a definition of municipality as:

> 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.

The EPA has established TBELs for POTWs that set minimum technology-based limits. These minimum levels are called secondary treatment and equivalent to secondary treatment standards and are codified in 40 CFR 133 (IBR). 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, then it may be eligible for equivalent to secondary treatment standards.

### 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 regulations at 40 CFR 125.3(a)(1) (IBR), state that TBELs for POTWs must be based on secondary treatment standards (which includes the “equivalent to secondary treatment standards”) specified in 40 CFR 133. The following sections will explain how to determine TBELs for the conventional pollutants $BOD_5$, TSS, and pH discharged by POTWs.

#### *2.1.1.1 Secondary Treatment Standards*

In 40 CFR 133, EPA published secondary treatment standards based on an evaluation of performance data for POTWs practicing a combination of 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) | $\geq$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

### *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 which 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. Similarly, trickling filters may experience excessive biofilm growth on the media which then sluffs off, contributing to excessive TSS. Conversely, 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. Also 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 described later in this section before these equivalent treatment standards, shown in Table 2, should be used in the permit.

**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 ($BOD_5$ & TSS) | $\geq$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. 40 CFR 133.105(f) specifies that the equivalent to secondary treatment standards may be made more restrictive (e.g. 30-day average concentration for $BOD_5$ and/or TSS $\leq$ 37 mg/L, and/or 30-day removal efficiency $\geq$ 75%), if the permit writer determines that the facility can attain higher effluent quality through proper operation and maintenance. Additionally, if the POTW is a new facility, and the facility's design capacity, in conjunction 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: Its principal treatment process must be a trickling filter or waste stabilization pond (i.e., the largest percentage of $BOD_5$ and TSS removal is 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 set forth in Table 1. The regulation at 40 CFR 133.101(f) defines "effluent concentrations consistently achievable through proper operation and maintenance" as:

- For a given pollutant parameter, the $95^{th}$ 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 derived in the bullet above.

Some facilities might meet this criterion only for the $BOD_5$ limits or only for the TSS limits. DEQ believes that 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. The regulations at 40 CFR 133.101(k) define 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 percent removal of $BOD_5$.

Each facility should be considered 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, then data for a period that is representative of the current discharge quality may be necessary to establish limits.

Facilities that do not meet all three criteria do not qualify as equivalent to secondary treatment facilities. For such facilities, the secondary treatment standards apply. EPA noted in its December

1985 *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, then 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 are applicable to properly operated and maintained POTWs that use trickling filters or waste stabilization ponds as their primary treatment process. Additionally, the facilities must be located in a contiguous area of 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 arising 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 representative sample of facilities within the appropriate contiguous geographical area that meet the definition for facilities to be 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 approval by EPA. Idaho does not currently 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. The regulation, found at 40 CFR 133.103(c), defines "SS concentrations achievable with waste stabilization ponds" as the effluent concentration achieved 90 percent 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) (45 milligrams per liter [mg/L] as a 30-day average). This higher TSS concentration requires EPA approval. To qualify for an adjustment up to as high as 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 in order to calculate the percent removal. This section presents a protocol to establish TBELs for POTWs. A synopsis of this protocol is presented in Figure 2.

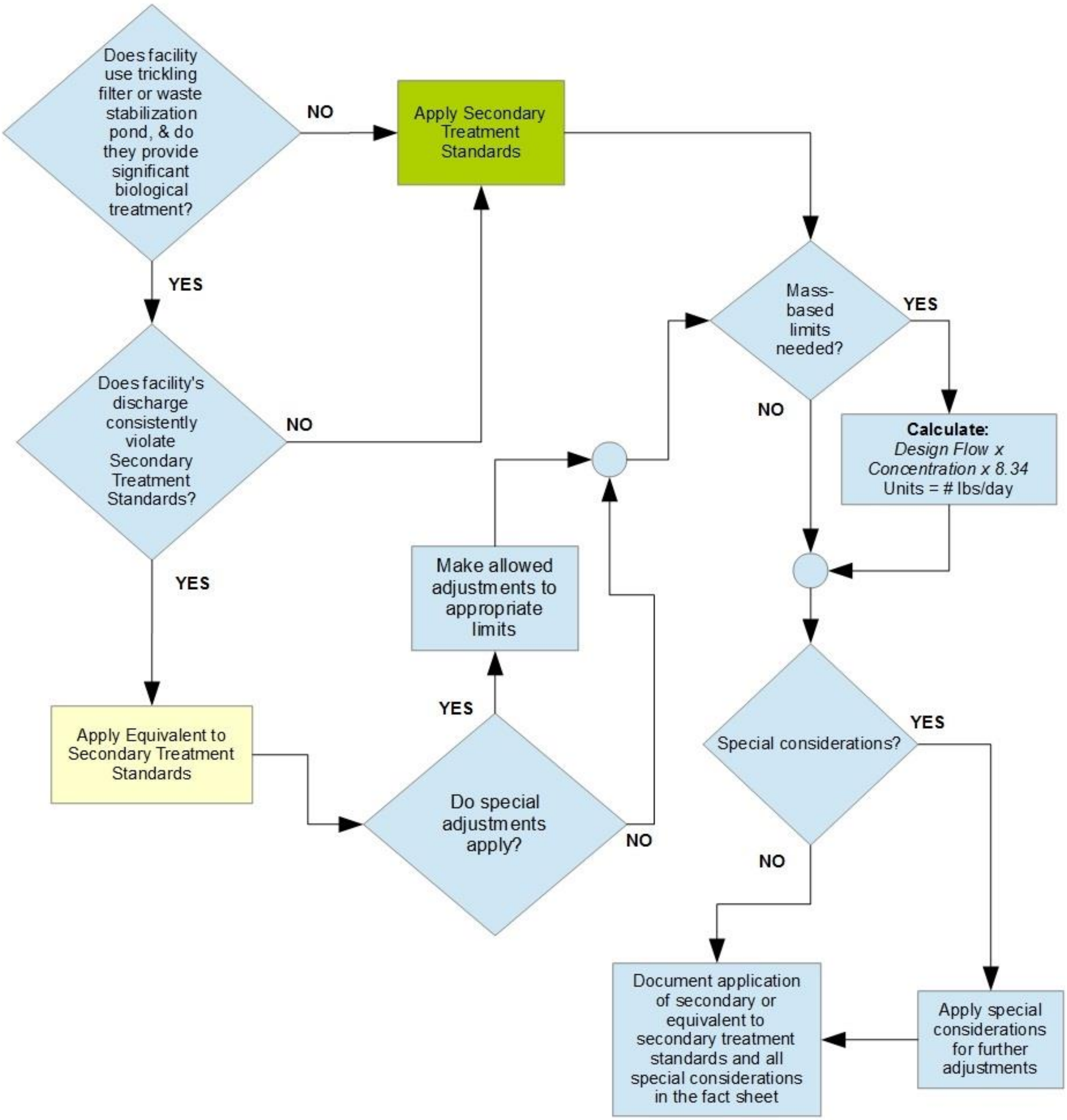



**Figure 2. Secondary and equivalent to secondary treatment standards decision tree.**

### 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 are applicable for 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 standard (secondary or equivalent to secondary) is selected, it can be used to set the permit limits. Subsection 3.1.3.2 will address the development of permit limits if secondary treatment standards are deemed appropriate. If equivalent to secondary treatment standards are deemed appropriate, then follow subsection 3.1.3.3 to address permit limit development.

### 2.1.3.2 Calculate Effluent Limits Based on Secondary Treatment

If a permit writer deems secondary treatment standards are appropriate for the POTW, then the following procedures will be used to establish concentration and mass based limits. If the secondary treatment standards do not apply, then the permit writer will move on to Section 2.1.3.3, Calculating Effluent Limits Based on Equivalent to Secondary Treatment Standards.

Application of secondary treatment standards is straightforward. If these standards apply, then 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. The 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). Consequently, it is recommended that the 30-day and 7-day average secondary treatment standards be used 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 any of 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 $BOD_5$ 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 there may be valid reasons to include mass-based limits in the permit. Including 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]) the equations and procedures presented in Equation 1 should be followed.

~~POTW design flow (mgd)~~ ~~X~~ ~~Concentration-based limits (mg/L)~~ ~~X~~ ~~Conversion factor 8.34 (lb x L/mg x millions of gallons)~~

$$L_l = Q_d \times [C] \times C_f$$

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

Where:

| | |
|---|---|
| $L_l$ = Load limit | Calculated value |
| $Q_d$ = the 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:

$$\text{Mass-based limits} = \text{POTW design flow} \times \text{Concentration-based limits} \times \text{Conversion Factor}$$

**BOD₅**

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

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

**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 above in Table 2 (not accounting for any further approved adjustments). It is important to note that the equivalent to secondary standards specify the maximum allowable discharge concentration of $BOD_5$ and TSS and a minimum percent removal requirement for qualified facilities. The regulations at 40 CFR 133.105(f) require the permit writer to include more stringent limits when the permit writer determines that the 30-day average and 7-day average $BOD_5$ and TSS concentrations are achievable through proper operation and maintenance of the treatment works. This is based on an analysis of the 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. The regulations at 40 CFR 133.101(f) define, "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 two years, excluding values attributable to upsets, bypasses, operational errors, or other unusual conditions. The 7-day average value is set equal to 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 ~~as follows~~ using Equation 1.

~~Mass-based limits = POTW design flow × Concentration-based limits × Conversion Factor~~

~~**Equation 2. Mass-based limits.**~~

**$BOD_5$**

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

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

**TSS**

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

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

If an existing facility does not have sufficient data to establish past performance, then a compliance schedule item should be included in the permit that requires monitoring and reporting to generate the necessary data. IDAPA 58.01.25.201.02 provides provisions allowing the permitting authority to reopen and, if necessary, modify the permit after reviewing the additional data submitted by the discharger (201.02.c.ii).

### *2.1.3.4 Apply Special Considerations and Adjustments*

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. The permit writer should determine whether any of the special considerations

outlined in this section apply and, as appropriate, make any further adjustments to the concentration limits or percent removal requirements. The calculated limits, after making such adjustments, are the final TBELs for the POTW.

#### 2.1.3.4.1 Substitution of $cBOD_5$ for $BOD_5$

Wastewater contains carbonaceous oxygen demanding substances and nitrogenous oxygen demanding substances. A $cBOD_5$ test measures the 5-day carbonaceous biochemical oxygen demand 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 for the use of $cBOD_5$ limits in place of $BOD_5$ limits to minimize false indications of poor facility performance as a result of nitrogenous oxygen demand.

EPA has 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 Part 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 Substitution of 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 five days). The regulations at 40 CFR 133.104(b) allow 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, then these alternate monitoring methods may be included in the permit.

### 2.1.3.4.3 Adjustments 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:

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

When making this adjustment, the 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 effluent guidelines for the industrial facility and the secondary or equivalent to secondary limits).

### 2.1.3.4.4 Adjustments to Percent Removal Requirements

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

- To encourage municipalities to remove high quantities of infiltration and inflow (I/I) from their sanitary sewer systems.
- To 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.

The regulations at 40 CFR 133.103(a), (d) and (e) provide that, under certain circumstances, less stringent limits for $BOD_5$ and TSS percent removal may be established. The specific circumstances and the 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 whether any attainable percentage removal level can be defined during wet weather and, if so, what the level should be must be evaluated on a case-by-case basis. To qualify for a less stringent percent removal requirement or substitution of 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 would otherwise be 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. The determination of whether the less concentrated wastewater results from excessive infiltration is discussed in regulations at 40 CFR 35.2005(b)(28). This regulation defines non-excessive 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.
- The regulation at 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, then 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 to have less stringent percent removal requirement or receive a mass loading limit instead of the percent removal requirement provided the treatment plant demonstrates all of the following [40 CFR 133.103(d)]:
  - 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 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 the determination of 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 non-excessive if the total flow to the POTW (i.e., wastewater plus I/I) is less than 275 gallons per capita per day.
  - The regulation at 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 transportation and treatment of the I/I. This regulation also refers to definitions of non-excessive 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 in an IPDES POTW permit fact sheet:

- The application of secondary or equivalent to secondary treatment standards

- The 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 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 one 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. Therefore, local limits are not discussed here. For additional information about the development of 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 industrial users regardless of the size or type of operation. A user may not introduce into a POTW any pollutant(s) which 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 apply to specific process wastewater discharges from particular industrial categories. These are uniform, technology-based, and applicable nationwide. Developed by the EPA, these standards apply to specific categories of IUs and limit the discharge of specified toxic and non-conventional pollutants to POTWs. Expressed as numerical limits and management standards, the categorical standards are found at 40 CFR 405 through 471. They include specific limitations for 35 industrial sectors. Appendix C of this ELDG contains a list of pollutants regulated by categorical pretreatment standards.

#### *2.1.4.3 Pretreatment Standards for Existing Sources (PSES)*

PSES are designed to prevent the discharge of pollutants that cause pass through or interference at a POTW or causes 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 BAT for non-POTWs. The general pretreatment regulations, which set forth the framework for the implementation of national pretreatment standards, are at 40 CFR 403 (see CWA §307(b)).

#### *2.1.4.4 Pretreatment Standards for New Sources (PSNS)*

Like PSES, PSNS are designed to prevent the discharges 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 have the opportunity to 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 non-conventional 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 non-conventional pollutants or to prevent interference.

**Table 3. Summary of 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 set 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 through the use of BPT for wastewater treatment, and later by improved BAT. BCT was added by EPA in 1986 to evaluate conventional pollutant control processes using a two part cost-reasonableness test. BPT, BAT, and BCT are termed “technology-based” limits, in that the discharge limits were set on the basis of 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. There are cases where a single facility may be permitted for several different effluent limits. In these cases, a building block approach is used to develop the final TBEL.

Effluent guidelines 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 the use of raw materials. Although the regulations do not require the use of 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 effluent guidelines and from which the performance data were obtained to generate the limits. Therefore, each facility has the discretion to select any technology and process necessary to meet the performance-based discharge limits and standards specified by the effluent guidelines.

If no applicable ELGs exist for a discharge or pollutant, then 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 BPJ, taking into account the same factors EPA would use in establishing a national effluent guideline 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 Guidelines and the 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, then 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. Summary of 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, *E. coli*, and oil and grease. EPA has identified 65 pollutants and classes of pollutants as *toxic pollutants*, which can be found at the link below. All other pollutants are considered *nonconventional*.

*https://www.epa.gov/eg/toxic-and-priority-pollutants-under-clean-water-act*

#### *2.2.1.1 Best Practicable Control Technology Currently Available (BPT)*

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:

- The 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
- Non-water 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 prior to applying them to an IPDES permit; however, there is currently no precisely-defined test to determine economic reasonableness and must be considered from industry to industry.

Limits for industrial facilities are stated in the 40 CFR 405-471 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). Categories and subcategories are explained in further detail in Section 2.2.2.2.

**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)*

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
- Non-water 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 reasonableness of the relationship between the costs of attaining a reduction in effluent and the effluent reduction benefits derived.
- The comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works (POTW) to the cost and level of reduction of such pollutants from a class or category of industrial sources.

This test compares the economic burden of an industrial user removing conventional pollutants beyond the limits set forth in BPT to a POTW's economic burden of removing the same pollutants beyond secondary treatment. Additional information about 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 (BAT)*

Limits for the direct discharge of non-conventional 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 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
- Non-water 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)*

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 through the application of the best available demonstrated control technology for all pollutants. Factors to consider when assessing NSPS include:

- The total cost of applying the control technology in relation to the benefits of the effluent reduction
- Non-water quality environmental impacts, including energy requirements
- Other factors as DEQ deems appropriate

### 2.2.2 Apply Effluent Guidelines

Effluent guidelines are implemented and enforced through the IPDES permit for each industrial user. Direct dischargers are regulated by permits that specify limits using BPT, BAT, BCT, and NSPS. An overview of the process a permit writer will follow to determine applicable effluent guidelines and calculate final effluent limits for an industrial user is presented in Figure 3.

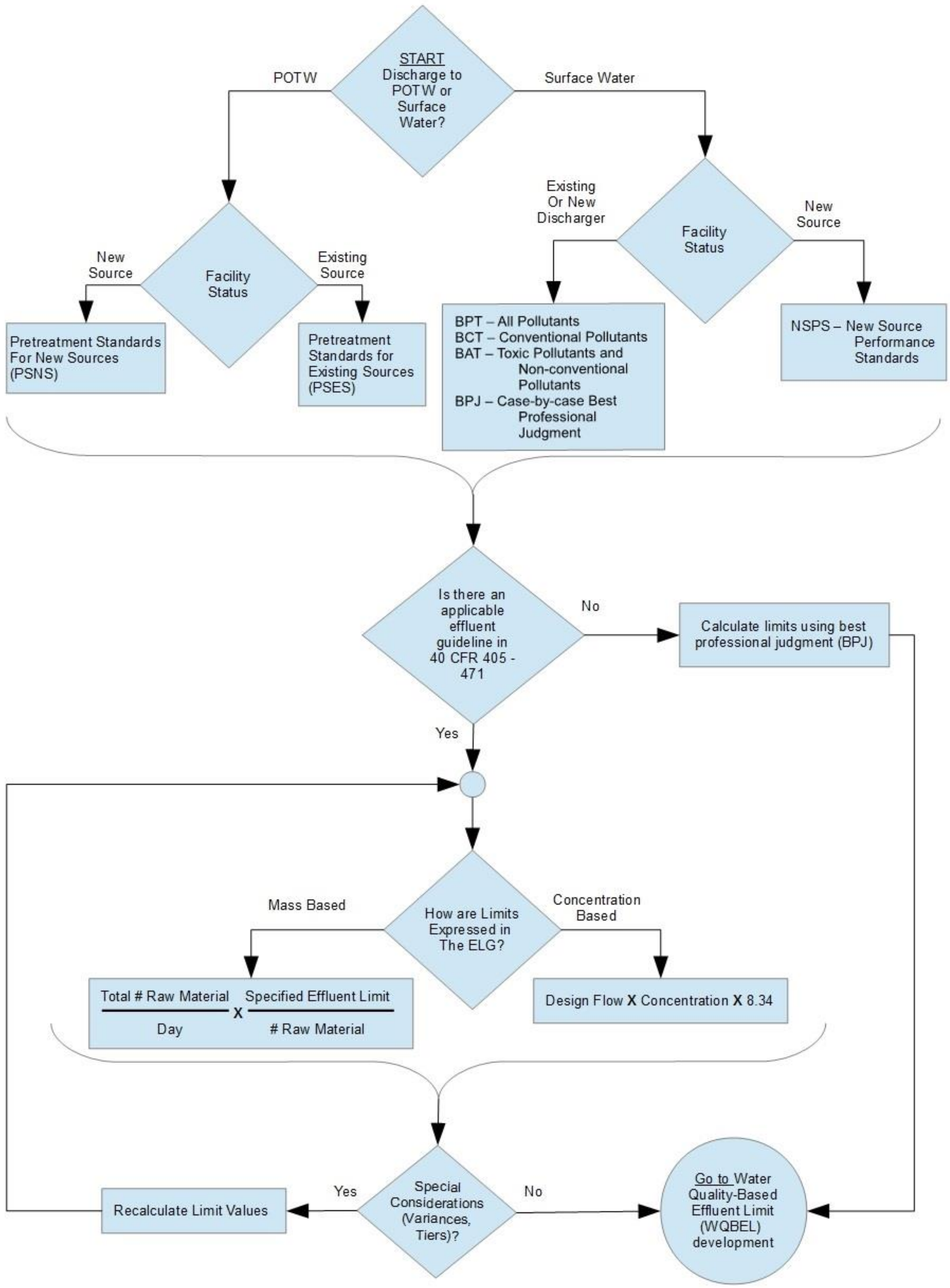



**Figure 3. Overview of TBELs calculation for non-POTW (Industrial) dischargers.**

### *2.2.2.1 Learn about the Industrial Discharger*

Facility-specific information is required to properly identify applicable effluent guidelines 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 non-production days
- Current pollution prevention practices and wastewater treatment technology
- Discharge location of the wastewater pollutants and potential compliance sampling points
- The source and characteristics of the wastewaters (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, the current permit and fact sheet (if the facility is permitted), DMRs, site visits, site inspections (such as compliance evaluation inspections for an existing permit), and other information submitted by the facility.

### *2.2.2.2 Identify the Applicable Effluent Guideline Categories*

Existing effluent guideline regulations are organized by EPA into industry categories and are found in 40 CFR 405-471 (Table 6). These are further broken down into subcategories. When determining subcategories, EPA considers a number of different 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 industrial users and specify the effluent limits applicable to that industry's pollutants.

**Table 6. Existing point source categories.**

| Industry Category | 40 CFR Part | Industry Category | 40 CFR Part |
|---|---|---|---|
| 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 | 412 | Paint Formulating | 446 |

| Industry Category | 40 CFR Part | Industry Category | 40 CFR Part |
|---|---|---|---|
| Feeding Operations (CAFOs) | | | |
| 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 |

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

Identifying the applicable effluent guidelines for a facility is dependent upon the user providing DEQ as much information as possible about its operations. DEQ will additionally use the following sources of information in determining the appropriate 40 CFR 405-471 category and subcategory for an industrial user:

- **CFR titles and applicability section of the effluent guidelines**. The first step is to cross check the current information about the facility against Table 6. The category titles may indicate to which category the facility belongs. The General Provisions section under each category includes an applicability section that describes the types of industrial users covered under the category.
- **North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC).** If finding the correct category for the industrial user using the titles in Table 6 is unsuccessful, then the current NAICS or former SIC codes could be helpful in determining the appropriate 400 series category. NAICS and SIC codes are federal industrial

classifications by activity. The NAICS and/or SIC code should be 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 OSHA website returns "Industry Group 333: Primary Smelting and Refining of Nonferrous Metals." This corresponds to 40 CFR 421 for Nonferrous Metals Manufacturing.

#### *2.2.2.3 Identify the Applicable Effluent Guideline Subcategories*

Regulation of an industrial category using subcategories allows each subcategory to have a uniform set of requirements that takes into account 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, which DEQ will carefully review to ensure properly derived TBELs. DEQ will notify each user of their coverage under 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 (see also Figure 3). New and existing sources and new dischargers are defined in IDAPA 58.01.25.010. An *existing discharger* is one that has previously 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 from which there is or may be a discharge of pollutants that did not commence the discharge of pollutants at a particular site prior to August 13, 1979, which is not a new source, and which never received a finally effective NPDES or IPDES permit.

Additional criteria for determining whether a discharge is a new source are defined in IDAPA 58.01.25.120:

- Is 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.

Note that new dischargers are required to meet the requirements of their applicable technology-based guidelines *before* they begin discharging. This is because the facility has the opportunity to install the best and newest technology prior to commencing operations.

The most stringent level of control for each pollutant as specified in the subcategory for the facility will be used to derive the facility's TBELs.

### *2.2.2.5 Calculate TBELs from the Effluent Guidelines*

IDAPA 58.01.25.303.06.a stipulates that all pollutants limited in permits must have 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)~~.~~ then the permit conditions must ensure that dilution will not be used as a substitute for treatment.

Thus, the type of limit (i.e., mass, concentration, or other units) calculated for a specific pollutant at a facility will depend on the type of pollutant and the way limits are expressed in the applicable effluent guideline. Generally, effluent guidelines include both maximum daily and monthly average limits for most pollutants. Though the effluent guidelines 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 as defined in IDAPA 58.01.25.010.06.

When calculating numeric limits from effluent guidelines, the permit writer will include all pollutants regulated by an effluent guideline 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 Calculating Mass-Based TBELs from Production-Normalized Effluent Guidelines

Production-normalized effluent guidelines are established using the past 3 to 5 years of facility data. The production rate used in the production-normalized TBEL calculation should be representative of the actual production likely to prevail during the next term of the permit and should account for any planned changes at the facility, such as an increase or decrease in production.

Consider the following example:

A facility that processes raw cow milk into ~~cheese~~ 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 ~~F~~J – ~~Natural and Processed Cheese~~Dry Milk. The facility processes approximately 3,~~8~~300,000 lbs of raw milk per day~~ and is subject to BPT controls based on information from the subcategory~~. Calculate the ~~BPT Average Monthly Limits (AMLs)~~limits for $BOD_5$ using ~~TSS, and pH~~

using the raw cow milk composition and the associated conversion factors in Table 8 and Equation 2 example equations (Equation 2 Equation 4).

**Table 8. BPT limits for 40 CFR 405 Subpart F.[a]**

| Effluent Characteristic | Effluent Limits | |
|---|---|---|
| | Maximum for any 1 day | Average of Daily Values for 30-Consecutive Days shall not exceed the values below: |
| | English units (pounds per 100 lb of $BOD_5$ input) except pH | |
| BOD5 | 0.073 | 0.029 |
| TSS | 0.109 | 0.044 |
| pH | 6.0-9.0 | 6.0-9.0 |

a. For plants processing more than 100,000 lb/day of milk equivalent (more than 10,390 lb/day of BOD5 input).

**Table 8. 40 CFR 405 example information.**

| 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 |

$$BOD_5\ Conversion\ Factor = \frac{10{,}390\,\frac{lb}{day}\,BOD_5}{100{,}000\,\frac{lb}{day}\,raw\ material\ equivalent}$$

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

Equation 2. $BOD_5$ conversion factorMacro composition calculation.

Where:

| | |
|---|---|
| $C_M$ = Quantity of Macro Component | Calculated value |
| $P_{FPC}$ = the 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) |

$$Production\ Rate \times BOD_5\ Conversion\ Factor = Milk\ to\ BOD_5\ Equivalent$$

**Equation 3. Milk to $BOD_5$ equivalent.**

Convert Milk to BOD5: 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.

$$\frac{3{,}800{,}000\ lb\ raw\ milk}{day} \times \frac{\frac{10{,}390\ lb\ BOD_5}{day}}{\frac{100{,}000\ lb\ raw\ milk}{day}} = 394{,}820\ \frac{lb\ BOD_5}{day}$$

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

$$Milk\ to\ BOD_5\ Equivalent \times Effluent\ Limit = lb/day$$

**Equation 4. Final calculation for $BOD_5$ and TSS.**

$BOD_5$: $\frac{394{,}820\ lb\ BOD_5}{day} \times \frac{0.029\ lb}{100\ lb\ BOD_5} = 110\ lb/day$

TSS: $\frac{394{,}820\ lb\ BOD_5}{day} \times \frac{0.044\ lb}{100\ lb\ BOD_5} = 170\ lb/day$

pH: Within the range of 6.0 to 9.0 standard units

Calculations in the 405 subcategories are based on $BOD_5$ input. This is 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. 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 s.u. | |

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

**Equation 4. Average monthly limit for new dairy sources.**

Where:

AML = Average Monthly Limit

$\Sigma In_x$ = 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 Calculating Mass-Based TBELs from Flow-Normalized Effluent Guidelines

The process for calculating mass-based TBELs from flow-normalized effluent guidelines is similar to the process used with production-normalized effluent guidelines, 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). Use of 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.

The example ~~and equations~~ presented in Table 10 ~~and Equation 8~~ assess an organic chemical processing facility that must comply with the effluent guidelines in 40 CFR 414, Organic Chemicals, Plastics, and Synthetic Fibers. Assume that a reasonable estimate of the production flow is 16,000 gpd, based on the past three years of production history, and the facility does not anticipate any significant change from the flow rate over the next five 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 milligrams per liter (mg/L) | |
| $BOD_5$ | 92 | 34 |
| TSS | 159 | 49 |
| pH | 6.0–9.0 | 6.0–9.0 |

$$\text{Gallons per day} \times \frac{10^{-6} mgd}{gpd} = \text{Flow Conversion to mgd}$$

Equation 8. Conversion of gallons per day (gpd) to million gallons per day (mgd

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 Calculating Mass-Based TBELs from Concentration-based Effluent Guidelines

In some cases, the permit writer will develop mass-based TBELs for facilities with concentration-based effluent guidelines (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 non-process wastewater, more efficient use of water) and pollution prevention (e.g., reduce waste loads 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, the combination of 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 they provide 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.

Consider the example and equations presented in Table 11:

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 Supplementing Mass-Based TBELS with Concentration Limits

Even where effluent guidelines 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 effluent guidelines are flow-normalized. This helps the permit writer 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 Incorporating Narrative Requirements from Effluent Guidelines

In some cases, DEQ may include narrative effluent guideline controls, which EPA has developed and included the 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 effluent guidelines for CAAP facilities (40 CFR 451) consist of narrative requirements implemented through BMPs. Another example, related to monitoring and compliance rather than effluent limits, is found in the Metal Finishing (40 CFR 433) effluent guidelines. The guideline allows a facility to implement a toxic organic management plan along with a certifying statement in reports in lieu of routine total toxic organic monitoring. The plan assures 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 Guidelines Requirements*

There are cases when a facility may be subject to overlapping or multiple effluent guidelines 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 effluent guidelines to ensure that (1) one guideline does not supersede another; and (2) the effluent guidelines are properly applied.

#### 2.2.2.6.1 Superseding Effluent Guidelines

EPA minimizes the impact of overlapping effluent guidelines as much as possible during the development of effluent guidelines for point source categories by providing exclusions in the applicability sections. The permit writer will minimize the overlap of different effluent guidelines as much as possible by careful review of the facility's applicable subcategories.

In cases where 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 has provided direction in the preamble of the ELG or provided specific direction in the affected ELG when a subcategory must comply with more than one ELG.

Consider the following example:

Several 400 series categories supersede the limits in 40 CFR 433, *Metal Finishing Point Source Category*. 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 Guidelines Requirements

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

Most commonly, wastewater streams regulated by effluent guidelines 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 effluent guidelines to arrive at a single TBEL for the facility using a building block approach. The following example presents the building block approach, as 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 would 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:

- 4.7 million pounds per day of Tungstic Acid (as W)
- 3.5 million pounds per day of Sodium Tungstate (as W)

Given the information above, what is the technology-based effluent limit for lead at the facility?

BPT calculation for lead (40 CFR 421.102):

**Table 12. BPT 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 | 17.230 | 8.205 |
| Zinc | 59.900 | 25.030 |
| Ammonia (as N) | 5,469.000 | 2,404.00 |
| Total suspended solids | 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 |
| Total suspended solids | 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 |
| Total suspended solids | 0.000 | 0.000 |
| pH | ([1]) | ([1]) |

BPT Maximum Daily Limit (Equation 6):

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

$$\text{Production Rate} \times \text{Effluent Limit Guideline} = lb/day$$

**Equation 6. Building block approach maximum daily limit calculation.**

Where:

| | |
|---|---|
| $L_B$ = Individual Component's Load | lb/day |
| $P_{rate}$ = Production Rate | Quantity of specific constituent used each day in production (lb/day) |
| $C_{ELG}$ = Effluent Limitation Guideline conversion factor | From applicable ELG (a conversion factor) |

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

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

Alkali leach wash (daily maximum):

$(3.5\ million\ lbs\ per\ day) \times (0.000\ lbs\ per\ million\ lbs) = 0\ lbs/day$

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

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

Similarly, calculations using BPT maximum monthly average values (Table 12, Table 13, and Table 14) yields an average monthly maximum value of 72.225 (rounded from 72.2249) lbs/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:
$(4.7\ million\ lbs\ per\ day) \times (11.490\ lbs\ per\ million\ lbs) = 54.003\ lbs/day$

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

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

Total allowable discharge:

$$(54.003\ lbs/day) + (4.714\ lbs/day) + (0.000\ lbs/day)) = 58.717\ lbs/day$$

The resulting daily maximum discharge under BAT is 58.717 lbs/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 lbs/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) lbs/day.

Compare the results and select the more stringent daily maximum and monthly average for inclusion in the permit.

The permit writer may apply the building block approach in other circumstances as well, such as:

- **Mixture of mass-based and concentration-based requirements:** The limits in effluent guidelines 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. This will allow the permit writer to 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 effluent guidelines requirements can combine with other wastewater streams that do not have effluent guideline requirements that regulate the pollutant. In such a case, the permit writer will use BPJ to establish a TBEL for the unregulated wastewater stream(s) 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, then 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 effluent guidelines or requirements determined by the permit writer using BPJ), then the permit writer must ensure that the non-regulated waste stream does not dilute the regulated

waste stream to the point where the pollutant is not analytically detectable. If that occurs, then 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 effluent guidelines. 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.
- Request(s) for a variance from effluent guidelines.

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, then 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, then they would apply to mass-based effluent limits and would 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.

Consider the following 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 effluent guideline requirements for Pollutant Z are 0.08 lbs/1,000 lbs for the average monthly limit and 0.14 lbs/1,000 lbs for the maximum daily limit.

What are the appropriate tiered effluent limits for Plant B?

**Tier 1:**

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).

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

$$\text{Production Rate} \times 2{,}000 \frac{lbs}{ton} \times \text{Effluent Limit Guideline} = lbs/day$$

**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. 2000 lb/ton, 2.2 lb/kg, 1.55 cfs/MGD |
| $C_{ELG}$ = Effluent Limitation Guideline conversion factor | From applicable ELG (a conversion factor) |

Monthly average limit:

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

Daily maximum limit:

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

**Tier 2:**

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:

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

Daily maximum limit:

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

The permit writer should include tiered limits in a permit after careful consideration of 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. Special reporting requirements may include the following:

- Facility notification to DEQ a specified number of business days before the month it expects to be operating at a higher level of production and the duration of this level of production.
- Facility reporting, in the DMR, the level of production and the limits and standards applicable to that level.

A detailed discussion of 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 as to make monitoring impracticable, or the interferences among pollutants at the outfall would make detection or analysis impracticable. Some effluent guidelines 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 effluent guidelines will be clearly identified in the final permit. Examples of effluent guidelines with required internal compliance points include the Metal Finishing effluent guidelines (40 CFR 433) and the Pulp, Paper, and Paperboard effluent guidelines (40 CFR 430).

#### 2.2.2.7.3 Effluent Guidelines Variances, Waivers, and Intake Credits

The CWA and state regulations provide limited mechanisms for variances, waivers, and intake credits from requirements in effluent guidelines. 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<br>40 CFR 122.21(m) | Initial request to DEQ < 270 days after promulgation of effluent limit guideline. A completed request by close of the draft permit comment period. | EPA[c] |
| Nonconventional pollutant | Non-POTWs | 301(g) | IDAPA 58.01.25.310<br>40 CFR 122.21(m) | Initial request to DEQ < 270 days after promulgation of effluent limit guideline. A completed request by close of the draft permit comment period. | EPA[c] |
| Fundamentally different factors (FDF) | Non-POTWs | 301(n) | IDAPA 58.01.25.310<br>40 CFR 125.30–32 | For BPT a request by the close of the public comment period.<br>For BAT or BCT a request by no later than 180 days after an effluent limit guideline is published in the Federal Register. | EPA[c] |
| Thermal discharge | All | 316(a) | IDAPA 58.01.25.310<br>40 CFR 125.70–73 | With a permit application if based on an effluent guideline. | DEQ |
| Waivers | All | N/A | IDAPA 58.01.25.105<br>58.01.25.106<br>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 the permit expiration, the discharger must meet the standard or must reapply for the variance, waiver, 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. CWA §§301(c), 301(g), and 301(n) variances—If DEQ concurs with the variance request, then 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 Guidelines*

Industrial storm water, specific analytical methods for measuring compliance with TBELs, and documentation and recordkeeping requirements are additional areas which need evaluation and incorporation into permit provisions, if necessary.

Industrial storm water sometimes falls under regulations by effluent guidelines when there is an opportunity for unsheltered industrial operations to come into contact with and contaminate storm water. Examples of categories which fall under effluent guideline 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 that is commingled with process wastewater will require the adjustment of the effluent guidelines to account for overlapping or multiple effluent guideline requirements, discussed in section 2.2.2.6.

When more than one analytical method is available in 40 CFR 136 for analysis of a parameter, the permit writer may need to determine the appropriate ML necessary to maintain permit compliance using EPA's sufficiently sensitive test method (*IPDES User's Guide to Permitting and Compliance 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 a particular pollutant(s).

Documentation and recordkeeping 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 Guidelines in the Fact Sheet*

The IPDES permit fact sheet will document the data and information used to determine applicable effluent guidelines, 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

40 CFR 125.3 states that technology-based treatment requirements under the CWA §301(b) represent the minimum level of control that must be imposed in an IPDES permit. Where EPA-promulgated effluent guidelines 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 authorizes the permit writer to issue a permit that will meet either all applicable requirements developed under the authority of other sections of the CWA (e.g., technology-based treatment standards or water quality standards) or, before taking the necessary implementing actions related to those requirements, that the permit writer determines are necessary to carry out the provisions of the CWA. Further, 40 CFR 125.3(c)(3) states that technology based treatment requirements may be imposed through one of the following three methods:

1. Application of 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. Through a combination of the 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 effluent guidelines are inapplicable. That includes situations such as the following:

- When EPA has not yet promulgated effluent guidelines 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 effluent guidelines).
- When effluent guidelines are available for the industry category, but no effluent guidelines are available for the facility subcategory (e.g., discharges from coalbed methane wells are not now regulated by effluent guidelines; 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 effluent guidelines 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 effluent guidelines or do not meet the production or wastewater flow cutoff applicability thresholds of the effluent guidelines).
- When effluent guidelines are available for the industry category, but no effluent guidelines requirements are available for the pollutant of concern (e.g., a facility is regulated by the effluent guidelines for Pesticide Chemicals [Part 455] but discharges a pesticide that is not regulated by these effluent guidelines). The permit writer will make sure that the pollutant of concern is not already controlled by the effluent guidelines and was not considered by EPA when they developed the effluent guidelines.

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., implementation of pollution prevention measures).

EPA periodically reviews existing and develops new effluent guidelines. EPA's effluent guidelines planning support documents are located on EPA's Effluent Guidelines Plan Website <*https://www.epa.gov/eg/effluent-guidelines-plan* >.

#### *2.2.3.3 Factors Considered when Developing Case-by-Case TBELs*

The regulations at 40 CFR 125.3(c)(2) establish the appropriate level of performance on a case-by-case basis considering:

- The 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(es) employed
- Engineering aspects of the application of various types of control techniques
- Process changes
- Non-water quality environmental impact including energy requirements

Economic criteria:

- BPT – The total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application
- BCT – The reasonableness of the relationship between the costs of attaining a reduction in effluent and the derived effluent reduction benefits, and the comparison of the cost and level of reduction of such pollutants from the discharge of POTWs to the cost and level of reduction of such pollutants from a class or category of industrial sources
- BAT – The cost of achieving such effluent reduction

**Example**

Privately-owned treatment works 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 ($BOD_5$, TSS, pH) from domestic sources that are equivalent to influent received in a small municipal wastewater treatment facility. There are no effluent guidelines 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). Establishing appropriate limits for $BOD_5$, TSS, and pH are done by evaluating the facility's performance level using technical and economic criteria found above for BPT and BCT. The BPJ analysis will reasonably defend the documentation through inclusion of statutory/regulatory citation, identification of which pollutants were assessed and by what TBEL, and how the technical/economic criteria influenced the final permit limit, if any.

As previously stated, 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. Therefore, 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*

There are numerous resources for identifying candidates for model technologies or process changes and developing case-by-case TBELs using BPJ. The following references may be used to derive such limits:

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 that 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)
- ICIS-NPDES data *https://www3.epa.gov/enviro/facts/pcs-icis/search.html*
- Literature (e.g., technical journals and books)

Effluent guidelines 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)
- Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and BMPs (EPA 1993a)
- 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 $99^{th}$ 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 non-detected results have a value equal to the detection limitations and that the detected values follow a lognormal distribution.

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

#### *2.2.3.6 Document Case-by-Case TBELs in the Fact Sheet*

The case-by-case using BPJ determination should be defensible and reasonable. The reasonableness is demonstrated by documentation that:

- Identifies statutory and regulatory citations
- Establishes that case-by-case limits are appropriate and why effluent guidelines do not apply
- Identifies pollutant(s) for BPJ analysis and the performance level required by the CWA (i.e., BPT, BCT, or BAT)
- Lists each of the applicable criteria from 40 CFR125.3 and provide an explanation of 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)

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 WQS, 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 WQS. In such cases, 40 CFR 122.44(d) requires development of more stringent WQBELs.

**Periodically, changes are proposed to Idaho's WQS. These changes must be approved by the Idaho Legislature and EPA. Therefore, it is critical that the permit writer understand when standards and regulations are applicable for use in composing a permit. The IPDES program will only use standards, regulations, and other surface water criteria (e.g., TMDLs) after they have received EPA approval.**

## 3.1 Characterize the Effluent

The permit writer uses information from 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 the Effluent

There are several sources of information and methods of identifying pollutants of concern for WQBEL development that might result in a Reasonable Potential to Exceed (RPTE) a WQS (i.e., site visit, communication with facility staff, review monitoring history). Pollutants of concern are any pollutants or pollutant parameters that the permit writer has reason to believe 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 during a review of applicable WQS and receiving water characterization. The following subsections 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 WQS 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 TMDL WLA*

Pollutants of concern include those pollutants for which a TMDL WLA has been assigned to a discharger, or any discharge containing the identified pollutant that was 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 loading analysis. The regulations at IDAPA 58.01.25.302.06.a.vii.2 require 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 called load allocations (LAs). The calculation must include a margin of safety to ensure that the water body can be used for the purposes designated in the WQS, to provide for the uncertainty in predicting how well pollutant reduction will result in meeting WQS, 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 the Previous Permit*

Another category of pollutants of concern includes those pollutants that were 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. Where those conditions no longer apply, the permit writer would need to complete an anti-backsliding analysis to determine whether to make the WQBELs less stringent than the previous permit. Section 4.1 illustrates how anti-backsliding requirements are applied to the permit development process.

#### *3.1.1.4 Pollutants Identified as Present in the 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. Additionally, 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 WQS to identify parameters that are candidates for WQBELs.

#### *3.1.1.5 Pollutants Otherwise Expected to be Present in the Discharge*

Another category of concern includes those pollutants that are not in one of the other categories but are otherwise expected to be present in the discharge. There might be pollutants 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. Further detail on what to do if data are not available is discussed in Section 3.4.4.1.

### 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, which will be 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 0.

#### *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 measurement(s) to use as the critical effluent flow value(s) in various water quality-based permitting calculations (e.g., the facility design flow, the maximum daily flow reported on the permit application, or the 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 representative of 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. EPA's TSD 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 (see the 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 to Permitting and Compliance – 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 WQS in Section 3.3 to determine whether WQBELs are required and, if so, to calculate WQBELs (Section 3.4).

### 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 WQS 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 one-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 seven 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<br>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 |
| Human Health (noncarcinogens)[a] | Contact Recreation<br>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, then a harmonic mean flow may be appropriate.) |

a. 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 Clean Water Act 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 (for example, 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, then the discharge controls should be protective and ensure that water quality criteria, and thus designated uses, are attained under all receiving water flow conditions. A receiving water body is considered non-flowing when it has a mean detention time longer than 15 days. DEQ will assess non-flowing water bodies on a case-by-case basis.

There are several approaches for obtaining or estimating critical low flow data for a receiving water. The certainty of each approach varies depending 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 that yields the most accurate low flows is calculating 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, the 1Q10 and 7Q10 require at least 10 years of ~~continuous~~ flow data while the 30Q5 requires 5 years. The DFLOW model cannot run without the minimum number of years of data required for the flow type.

The primary sources for ~~continuous~~ flow data are the 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, while also providing biological and water quality data from BioData and Stewards. It is recommended 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. There are several options 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, then the permit writer may move farther upstream or downstream to find a sufficient gage provided there are no diversions that significantly impact the stream flow. The permit writer should also account for any additional sources of flow or diversions between the point where a critical low flow has been calculated and the point of discharge. If significant diversions exist between the gage and the discharge, then they must be accounted for in the final flow estimate.

#### 3.2.1.3 Correlate with a Long-Term Gage

If there are some stream flow data available at or near the discharge, but not enough to calculate the critical flows directly, and there is a long-term gage in the same HUC, then 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 has developed spreadsheet workbooks that correlate flow data using the Maintenance of Variance Extension (MOVE) method described by Hirsch (1982). There are two "types" of the MOVE method, MOVE 1 and MOVE 2, and spreadsheet workbooks are available. It is recommended that 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, then 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 the 7Q10. By using this relationship, the permit writer can estimate addition flows (1Q10, 30Q5, etc.). 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 estimates as follows (Equation 11):

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

**Equation 11. Alternative 7Q10 calculation.**

In Box 3-2, on Page 53, the TSD states that, “for less than 10 items of data, the uncertainty in the (coefficient of variation) is too large to calculate a standard deviation or mean with sufficient confidence.” In this procedure, the 7Q10 is being estimated from the harmonic and/or arithmetic means. The uncertainty in the means (and therefore the estimated 7Q10) will be large if there are less than 10 flow data points available.

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

The TSD states that “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” (Page 89). The chapter on “Stream Design Flow For Steady-State Modeling” from the *Technical Guidance Manual for Performing Wasteload Allocation: Book VI* (EPA 1986) states that the average ratio of the 7Q10 to the 1Q10 is 1.3:1 (Page 2-3).

Thus, 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. Thus, 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/)*. However, StreamStats assumes natural flow conditions at the ungaged site and thus can neither reliably produce estimates for any waters affected by dams nor account for diversions, returns, or withdrawals. If the permit writer cannot ultimately calculate or estimate critical low flows, then 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. 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 dependent on the potential risk to beneficial uses (sensitivity of uses).

### 3.2.3 Other Receiving Water Characteristics

For water bodies other than free-flowing rivers and streams, there might be critical environmental conditions that apply rather than flow (e.g., water level fluctuation, temperature). In addition, 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 such situations, additional critical receiving water conditions consistent with WQS are used in a water quality model including conditions such as pH, temperature, hardness, or reaction rates, and the presence or absence of certain fish species or life stages of aquatic organisms. Section 3.4.3.13 provides further discussion of how critical conditions are applied in a water quality model to determine the need for and calculate WQBELs.

## 3.3 Determine Applicable Water Quality Standards (WQS)

The CWA requires states to develop and, from time to time, revise WQS. 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 requirements of the CWA. 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, and approve or disapprove state standards, and to promulgate federal water quality rules if it finds the state is not meeting the requirements of the CWA.

WQS define water quality goals and pollutant limits that support propagation of fish, shellfish and wildlife, and recreation in and on the water. 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 WQS are published in IDAPA 58.01.02. The WQS designate the uses that are protected for each water body. These standards are the basis for restrictions placed on the discharge of wastewater and on 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 WQS applicable to the receiving water body.

WQS 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—a policy designed to maintain and protect water quality

These components are described in the sections that follow.

### 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:

- Aquatic life
- Recreation (primary contact, 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 the development of 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 in the collection of site specific data in order for the collected data to be useful for DEQ 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 section 303(d), states are required to develop lists of impaired waters. Impaired waters are those that do not meet the WQS 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 section 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 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 has established narrative criteria where numeric criteria cannot be established or to 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 WQS effective in 2017. **Please reference current WQS to ensure calculations are using 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 both 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 in-stream 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.

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

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

Idaho WQS also 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 degrees Celsius [°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 s.u.) in the water body. DEQ's dissolved oxygen WQS include both minimum concentrations and 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. This includes performing an RPA for whole effluent toxicity (WET). Subsequently, WET monitoring and development of appropriate WET effluent limits will appear in the permit, if appropriate, and be documented in the fact sheet.

#### 3.3.2.1.1 Calculating Metals and Ammonia Criteria

Several commonly monitored metals and ammonia have criteria that are expressed as equations which 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 WQS effective in 2017. **Please reference current WQS to ensure calculations are using the most current criteria.**

Calculation spreadsheets are available on the DEQ 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, then 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 which impacts metal criteria is known as 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 the table at IDAPA 58.01.02.210.01.

Also 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. The WQS (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 need to 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.**

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:

- 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 210.03.c.ii and 210.03.c.iii (IDAPA 58.01.02.210.03.c.i).

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

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

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

There may also be site-specific criteria (see section 3.3.2.4) that apply to select water bodies. **The permit writer needs to work closely with the WQS staff to make sure that applicable criteria are being 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. Below are the IDAPA 58.01.02.250.02.d criteria for ammonia to support cold water aquatic life with and without fish early life stages present:

- CMC—The one (1) hour average concentration of total ammonia nitrogen (in mg N/L) is not to exceed the value calculated using Equation 20 more than once every three (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 = 95$^{th}$ percentile of pH in the receiving water upstream from the discharge.

- CCC—The thirty (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 three (3) years:

  When fish early life stages are likely present:

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

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

Where:

pH = 95th percentile of pH in the receiving water upstream from the discharge
T = 95th Percentile of the ambient upstream receiving water temperature
MIN = the smallest value from the data set

When fish early life stages are likely absent:

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

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

Where:

pH = 95th percentile of pH in the receiving water upstream from the discharge
T = 95th Percentile of the ambient upstream receiving water temperature

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

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

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

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

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

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

### 3.3.2.1.2 Special Considerations for Temperature Numeric Criteria

Idaho revised its WQS 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 through 300, or unless specific exemptions are made pursuant to IDAPA 58.01.02.080.02. EPA has not yet approved or disapproved this WQS revision. Until EPA’s final decision, prior EPA-approved treatment requirements apply.

Water Quality Standards. 2011. 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 based on an annual harmonic mean and 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; a relative source contribution; a human body weight (BW) (for adults); a drinking water volume of 2.4 L/day; and a fish consumption rate for the target population.

Not all toxic substances have acute, chronic, and human health criteria. Furthermore, 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*

DEQ WQS also include narrative water quality criteria to supplement numeric criteria. Narrative criteria are statements that 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." DEQ's narrative criteria are outlined in 58.01.02.200 – General Surface Water Quality Criteria.

#### 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, then they are required to implement WET testing:

- The facility is a POTW with a flow greater than or equal to 1 mgd;

- The facility is a POTW that receives effluent from any industry identified in 40 CFR 403;
- The 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));
- The facility's effluent contains any toxic pollutant listed in Appendix D of 40 CFR Part 122 for which there are no water quality criteria for aquatic life protection listed in 40 CFR 131.36(b)(1);
- The facility belongs to an industrial category identified in 40 CFR 122, Appendix A (NPDES Primary Industry Categories);
- ~~The facility exceeded acute or chronic WET triggers within the last 5 years;~~
- The facility's effluent is suspected to be toxic because of apparent detrimental impact to aquatic life in the receiving water; or
- 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 (Section 3.6.1.1). For example, the effluent dilution concentration at which 50% of the test organisms die, known as lethal concentration 50, or $LC_{50}$, 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, then WET will be quantified using toxic units. A toxic unit (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 ($TU_c$) can be calculated as follows:

**Equation 23. Acute Toxic Units**

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

**Equation 24. Chronic Toxic Units**

$$TU_c = 100/NOEC$$

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

$$TU_c = 100/LOEC$$

Typically, Idaho's narrative criterion for toxics is interpreted to mean $TU_a = 0.3$ and $TU_c = 1$, where $LC_{50}$ is expressed as a percentage of effluent used in the WET test. For example, in the case of acute testing, if a solution using 100% of the effluent causes half (or 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 in unison 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

DEQ has not adopted numeric criteria for nutrients as part of its WQS. Therefore, DEQ needs to determine appropriate nutrient effluent concentrations based on the assimilative capacity of the receiving water and may consider use of 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. Therefore, IDAPA 58.01.02.275 allows development of new water quality criteria or modification of 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 prior to use for CWA purposes, including IPDES permits.

A permit writer 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 WQS 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 from requirements. 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<br>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<br>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. Variance from water quality standards—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 WQS. DEQ's antidegradation policy is defined at IDAPA 58.01.02.051 and outlines the framework to be used in making decisions about proposed activities that will result in changes to water quality. The Antidegradation Implementation Procedures (IDAPA 58.01.052) 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 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). Where an existing use is established, it must be protected even if it is not listed in the WQS 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 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 outstanding resource waters. (IDAPA 58.01.02.051.03).

If the water receiving the discharge is Tier II, then proposed degradation in water quality is evaluated closely to determine if it can be minimized or avoided. If significant degradation cannot be avoided, then 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 Determining Applicable Tiers of Protection*

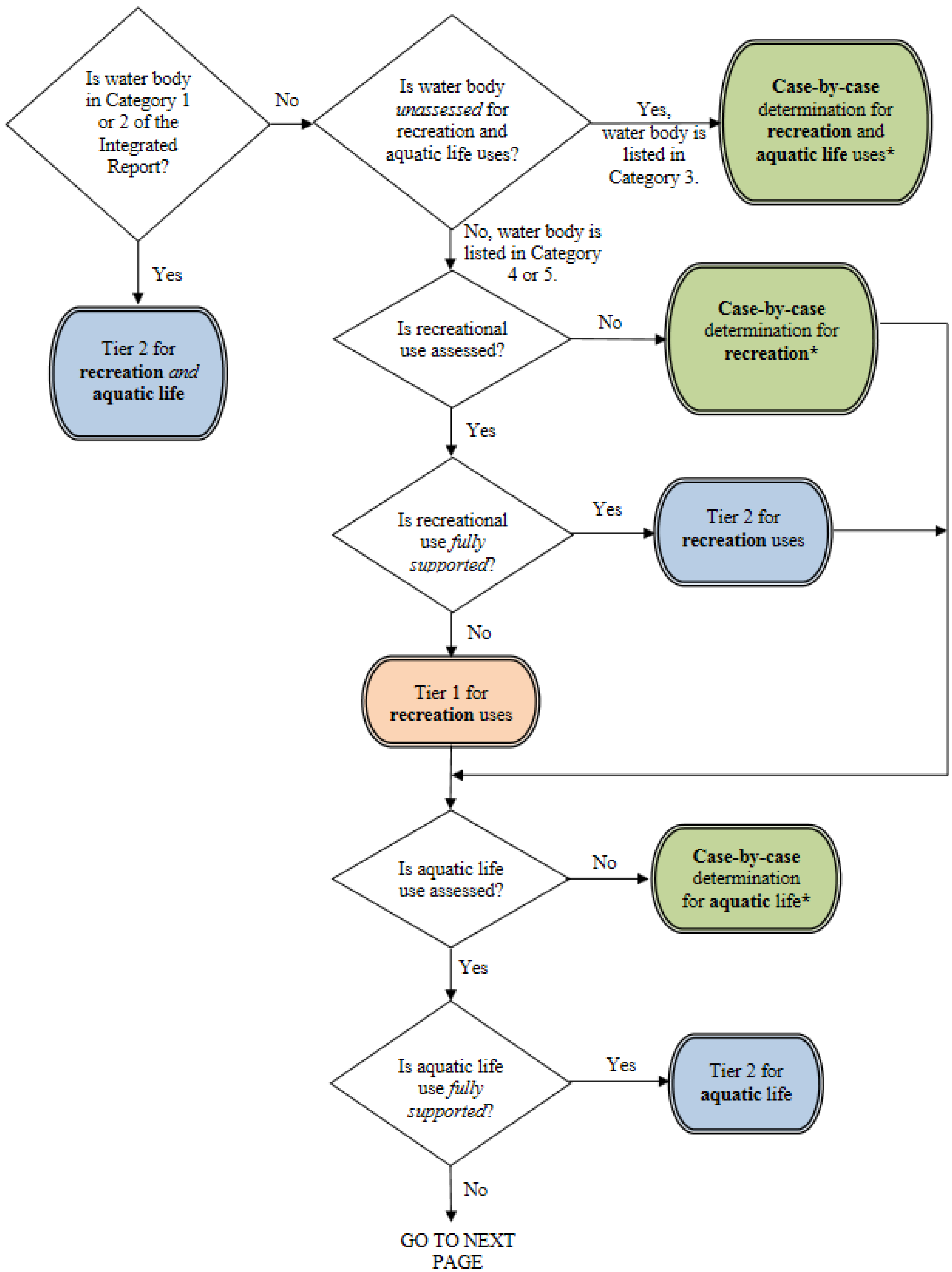
Tier 1 antidegradation protection applies to all jurisdictional waters, and Tier 3 waters are designated by statute; therefore, the only tier determination that remains are water bodies qualifying for Tier 2 protection. This section describes the procedure for determining if Tier 2 protection is applicable.

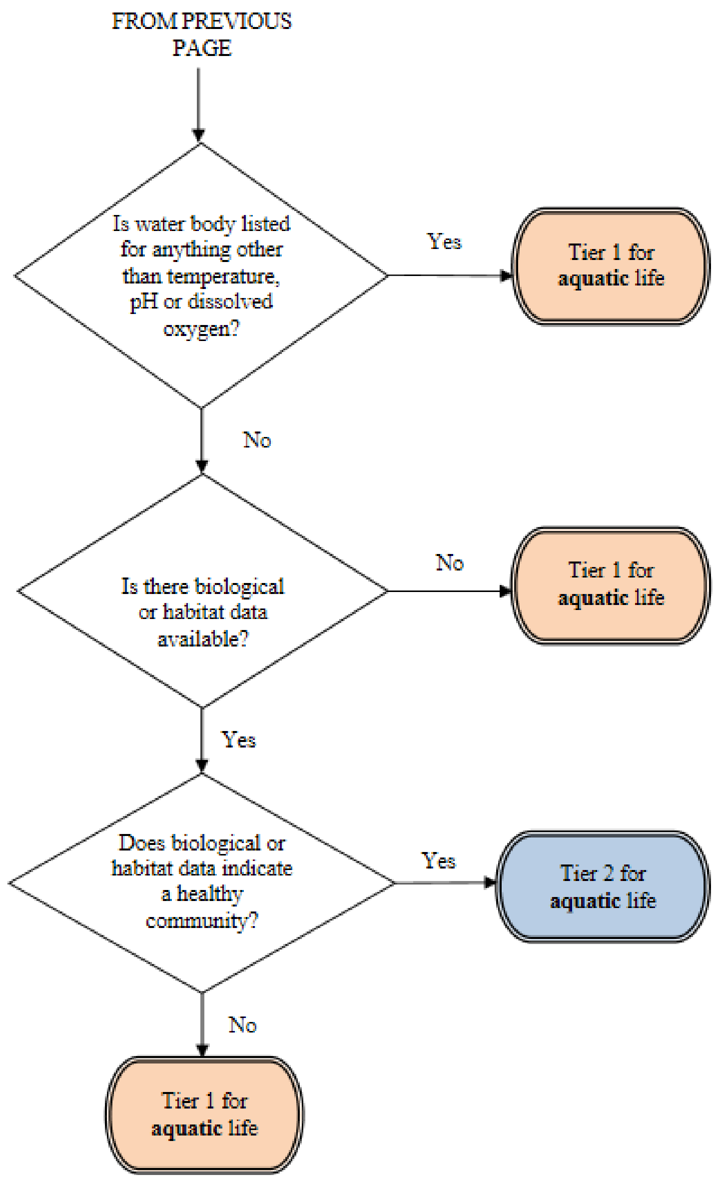
Under Idaho rule, the level of protection (i.e., tier) is determined on a water body by water body basis, using the most recent federally approved Integrated Report, which summarizes Idaho's assessment of water quality. The Integrated Report identifies water bodies that do not support beneficial uses 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. Thus a water body can be in Tier 1 for recreational uses and Tier 2 for aquatic life uses, or vice versa.

Tier 2 determination is based on the following three factors:

- The water body's category of use support according to the most recent federally approved IR (i.e., Categories 1–5)
- The 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 tiers of protections to apply to a water body.


Is water body in Category 1 or 2 of the Integrated Report?
No
Yes
Tier 2 for recreation and aquatic life
Is water body unassessed for recreation and aquatic life uses?
Yes, water body is listed in Category 3.
Case-by-case determination for recreation and aquatic life uses*
No, water body is listed in Category 4 or 5.
Is recreational use assessed?
No
Case-by-case determination for recreation*
Yes
Is recreational use fully supported?
Yes
Tier 2 for recreation uses
No
Tier 1 for recreation uses
Is aquatic life use assessed?
No
Case-by-case determination for aquatic life*
Yes
Is aquatic life use fully supported?
Yes
Tier 2 for aquatic life
No
GO TO NEXT PAGE




*In this situation DEQ will make an effort to obtain data needed in order to make an informed decision on support of the use that is unassessed.
**In this situation, DEQ will make an effort to obtain biological or habitat data in order to make an informed decision on the aquatic life use support.

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

More specific information on identifying the applicable tiers of protection can be found in the Idaho Antidegradation Implementation Procedures guidance (draft DEQ 2017a).

## 3.4 Determine the Need for WQBELs

After characterizing the effluent and receiving water and determining the applicable WQS, the permit writer determines whether WQBELs are needed. When DEQ determines whether a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above WQS criteria (numeric or narrative), the permit writer develops WQBELs. These limits account for existing controls on pollution, the variability of the pollutants in the effluent, the sensitivity of species to toxicity, and the 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, water quality model, etc.).

### 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 in order to control all pollutants that have a reasonable potential to exceed water quality criteria. IDAPA 58.01.25.302.06.i states:

> 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, 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 in combination 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 WQS. A permit writer can conduct RPA using effluent and receiving water data and modeling techniques, or using a non-quantitative approach. The quantitative approach is discussed in the sections below. The non-quantitative 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 violations of WQS. After completion, the RPA defines whether a pollutant has 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 that reflects the critical conditions at the point of discharge. These include:

- Effluent critical conditions
  - Flow
  - Concentration of pollutant(s) 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 0 provide the background on how to select critical condition inputs and sources of information. After identifying the critical values, they will be 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 it 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., 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 WQS at end of pipe. Idaho WQS define a mixing zone as (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 non-flowing 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 non-flowing 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.

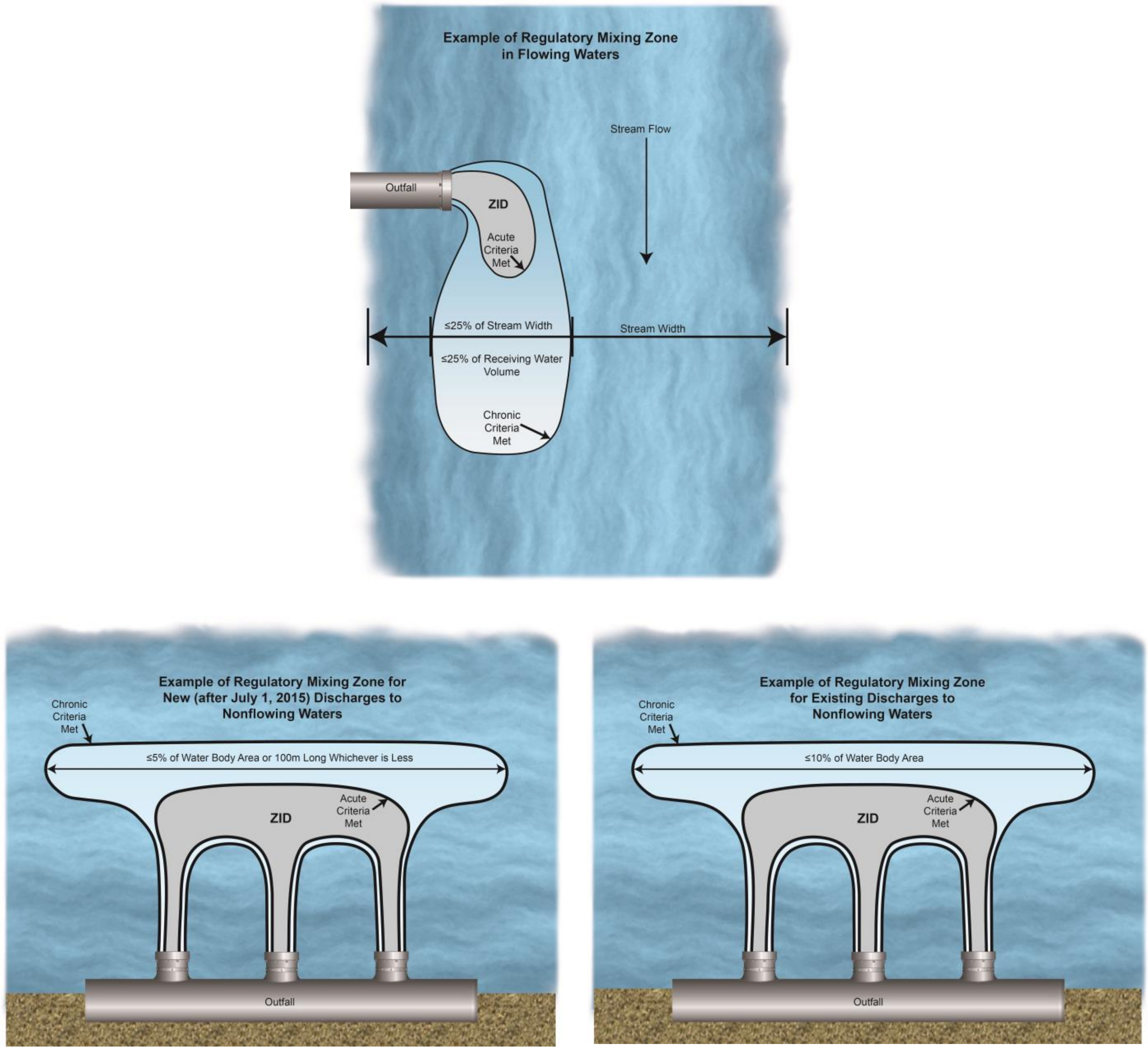



**Figure 5. Examples of mixing zones in flowing (top) and non-flowing (bottom) waters. ZID indicates the zone of initial dilution.**

Where DEQ proposes to re-issue 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 95$^{th}$ 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 non-flowing 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, the percent authorized should be 10%).

A larger mixing zone may be authorized where the discharger and DEQ agree after careful consideration of 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 if:

- 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.

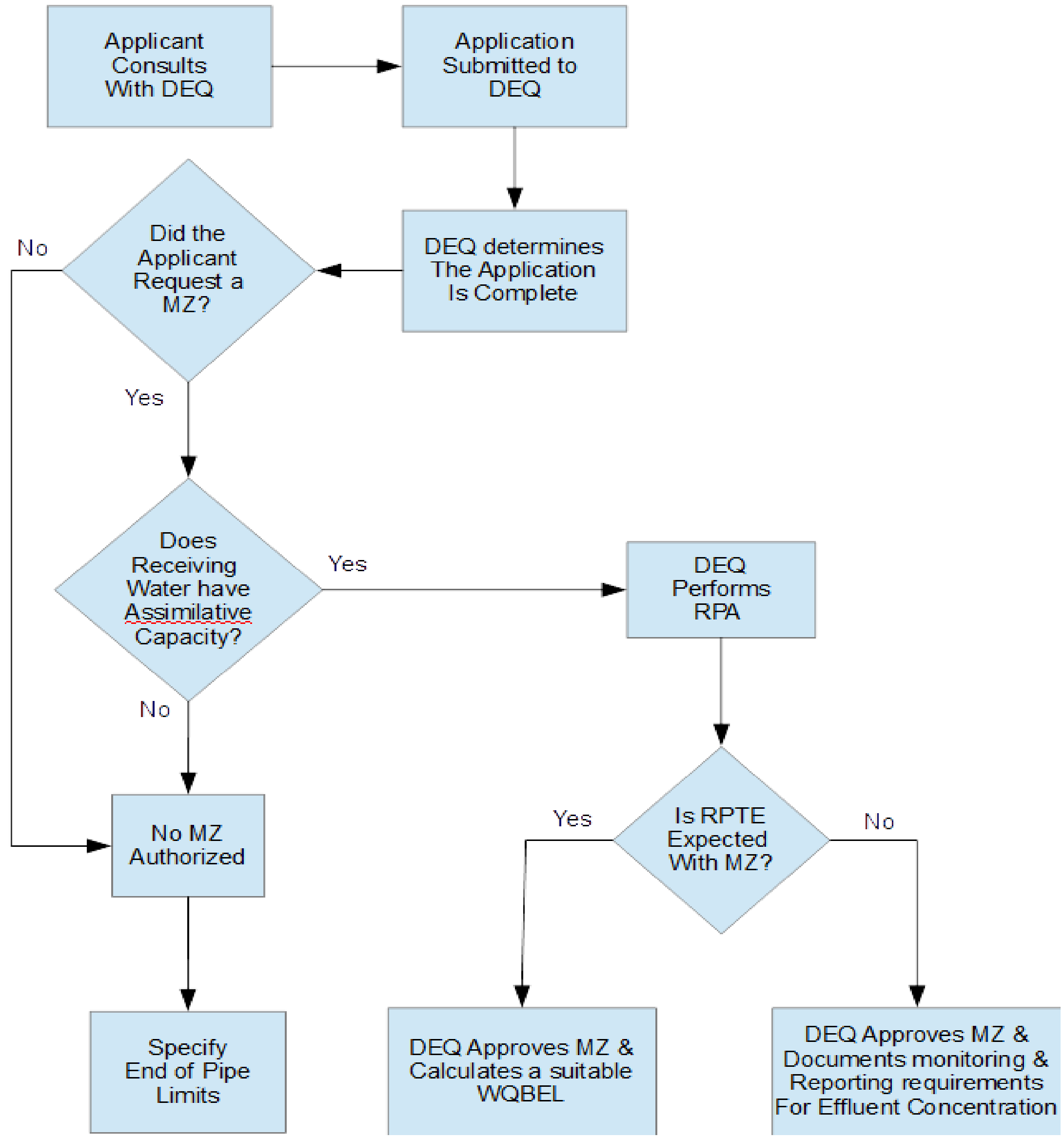



**Figure 6. Mixing zone process for new or reissued permit applications.**

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 is a cross-reference of where the mixing zone rules (IDAPA 58.01.02.060) and other mixing zone related sections of Idaho's WQS are discussed in this guidance. Please see IDAPA 58.01.02.060 for mixing zone rule language.

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.

**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 within zone of initial dilution | 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, effluent limitation guidelines, best professional judgment, or other federal regulations and must be achieved at the end-of-pipe. Therefore, mixing zones do not apply to TBELs.

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

- Quality of the effluent
- The 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 there is 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 an evaluation of 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 at drinking water intakes; or
- Creating conditions that impede or prohibit recreation.

Table 22 includes a summary of 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, then a mixing zone is not applicable; however, Idaho's Antidegradation Policy (IDAPA 58.01.02.051) must be considered.<br>If not, then 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 is the aquatic life beneficial use(s) of the water body? | Describe the aquatic life use(s) 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, then 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, then 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, then 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, then 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, then 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.<br>If no, then provide a basis for this conclusion. |
| Will the mixing zone contain any pollutants known to attract aquatic life? | If yes, then list these pollutants and the species that will potentially be affected. Describe the spatial and temporal extent of the mixing zone.<br>If no, then provide a basis for this conclusion. |
| Will the effluent include pollutants known or predicted to bioaccumulate or bioconcentrate?<br>Are fish likely to be harvested from the water body in the vicinity of the mixing zone area? | If yes, then 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. Also 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, then 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, then describe the monitoring plan in detail, including all spatial and temporal aspects of the monitoring and quality assurance/quality control (QA/QC) procedures.<br>If no, then sufficient information should be submitted that describes why monitoring is not needed. |
| For new dischargers, is there a proposed monitoring plan that will adequately characterize the pre-discharge physical, chemical, and biological condition of the water body and all post-discharge impacts from the proposed mixing zone? | |

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 ~~requires that the mixing zone~~ may be no larger than necessary~~, and will~~ and should not exceed 25% of the low-flow volume of the receiving water for flowing water bodies. For non-flowing 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 an area within the mixing zone known as the ~~zone of initial dilution (~~ZID~~)~~; chronic and narrative criteria must be met at the boundary of the mixing zone (IDAPA 58.01.02.060.01.b) (Figure 5).

#### 3.4.3.1.2 Narrative Criteria

Water quality must meet WQS, 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.

> Zone of initial dilution ~~(ZID)~~ 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).

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. Therefore, 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. It is also important to 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. Similarly, 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 regarding 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* and *Idaho Comprehensive Wildlife Conservation Strategy*. These plans, including lists of Idaho species of greatest conservation need (e.g., Bull Trout, Snake River physa) and critical habitat designations (see 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, see reference list). Bull Trout recovery plans, critical habitat, and other information are available from the US Fish and Wildlife Service (USFWS). Coordination with USFWS (for threatened species such as Bull Trout) and the National Marine Fisheries Service (NMFS) (for anadromous fish such as Chinook Salmon) may be advisable 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 can be found on EPA, USFWS, and NMFS websites (e.g., *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 any 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 have a significant impact on the aquatic community as a whole. This may be the case with respect to particular species in the community that are of ecological or economic importance, as well as species more sensitive to added impact due to depressed populations.

#### 3.4.3.2.1 Toxicity to Aquatic Organisms

Idaho water quality standards include narrative water quality criteria (IDAPA 58.01.02.60.01.d) and numeric water quality criteria (IDAPA 58.01.02.210) that address the effects of toxic pollutants on aquatic life. Further toxicity data can be 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 one-hour period. It can also be assumed that no lethality to passing organisms will occur in the following four scenarios (EPA 1991):

1. The acute criteria are met at end-of-pipe.
2. The discharge is of high velocity (≥3 meters/second) and the ZID is less than 50 times the discharge length scale in any direction.
3. The discharge is of low velocity (<3 meters/second) and the most restrictive of the following conditions is met:
    a. The 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 is equal to 10 or more) in any spatial direction.
    b. The 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).
    c. The acute criterion will be met within a distance of 5 times the local water depth in any horizontal direction from the outfall.

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

4. A drifting organism, when traveling through the path of maximum exposure, 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. Since 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 such that 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 micrograms per liter (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 in order 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. However, 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., the low-flow design discharge conditions) and the effluent discharge (Section 3.4.3.9.1). Channel morphology could be evaluated in conjunction with modeling efforts, as these efforts may involve 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. As indicated, such considerations must take into account requirements of species of greatest conservation need (e.g., migrating Chinook Salmon or sessile aquatic invertebrates). In 2014, the National Marine Fisheries Service issued a toxics substances biological opinion that provides significant guidance regarding salmonids and zone of passage considerations (specifically, Appendix F: Salmonid Zone of Passage Considerations). This publication can be accessed through DEQ's website on toxics substances criteria: *http://www.deq.idaho.gov/water-quality/surface-water/water-quality-criteria/toxic-substances-criteria/* .

### 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; there are some situations in which aquatic life are attracted to a toxic discharge (ref., *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. Review of scientific literature (e.g., EPA's 1991 TSD) or other peer-reviewed documentation may be necessary where attraction is a concern.

#### 3.4.3.2.5 Spawning

Of particular concern in Idaho is protecting the spawning activities of salmonids (trout and salmon). *Oncorhynchus* spp. spawn by depositing eggs and sperm in a depression (known as 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 most often selects a redd site in an area of the stream with fine gravels. Detailed descriptions of Chinook Salmon, steelhead, and Bull Trout spawning preferences and habitat needs by life stage are described within documents and links available from the Salmon Recovery Federal Caucus (*http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead.html*). Information on Sockeye Salmon habitat requirements can be obtained from the IDFG (*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 is to be authorized during fish spawning seasons should be carefully evaluated. Specifically, discharges with a thermal mixing zone should not cause unreasonable interference, or danger to, 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 ~~include Cutthroat Trout, Bull Trout, Steelhead, Chinook Salmon, Kokanee, and White Sturgeon (~~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~~: Snake River physa, Banbury Springs lanx, Bruneau hot spring snail, and the Bliss Rapids snail~~. A list of these currently listed species 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 there are species of greatest conservation need, 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, therefore, 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 be adequately protective of 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 ~~of Sockeye Salmon, Chinook Salmon, Steelhead, Kootenai River population of White Sturgeon, or Bull Trout. Furthermore, mixing zones may be very limited or prohibited within the habitat of Idaho's special status snails~~.

### 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, 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 US Geological Survey (USGS) Toxic Substances Hydrology Program website: *http://toxics.usgs.gov*. More information on and examples of bioaccumulative pollutants can be found at TRI Program website: *https://www.epa.gov/toxics-release-inventory-tri-program/persistent-bioaccumulative-toxic-pbt-chemicals-covered-tri*

The Idaho WQS specifically state that mixing zones shall not cause unreasonable interference, or danger to, beneficial uses. The bioaccumulation of pollutants (as defined in IPDAPA 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. Thus, 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, PCBs, and methylmercury. Of the 121 toxic substances included in Idaho WQS (96 of which have criteria), 36 are currently defined as bioaccumulative. Substances are considered bioaccumulative if they have a bioaccumulation factor (BAF) or bioconcentration factor (BCF) exceeding 1000 liters per kilogram (L/kg)[i].This value is a threshold for high risk of harm through bioaccumulation.

[i] The 1000 L/kg threshold is used by EPA in determining if a chemical is bioaccumulative under the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986. The value 1000 L/kg is based on a combination of science and policy and does not imply that chemicals with lower BAF values do not bioaccumulate or are incapable of causing harm to beneficial uses.

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) regarding the potential for such substances to bioaccumulate or bioconcentrate in organisms residing in the receiving water body. In addition, 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 establishment of the discharge. This monitoring will provide insight into the potential impacts of the discharge on species present in the receiving water body and may be included as a requirement in an IPDES permit.

Within Idaho's mixing zone rule, 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" (IDAPA 58.01.02.060.01.d.iii).

### *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 including: 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; concentrations of pollutants that exceed Maximum Contaminant Levels (MCL) at drinking water intake structures; and conditions which impede or prohibit recreation in or on the water body (IDAPA 58.01.02.60.01.d). Potential impacts can be evaluated through water quality criteria associated with ingestion of water (domestic water supply uses) and consumption of 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 Sections 100 through 160 identify the designated beneficial uses of Idaho's water bodies.

> **For more information on bioaccumulation:**
> List of Bioaccumulative Pollutants (DEQ)
> *www.deq.idaho.gov/media/60160659/bioaccumulative-pollutants.pdf*
> US EPA Water Data and Tools
> *www.epa.gov/waterscience/gli/mixingzones*
> US 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*

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

#### 3.4.3.3.1 Domestic Water Supply

Those water bodies designated for domestic water supply (in IDAPA 58.01.02.100.03.a) should have water quality available for use as drinking water. Thus, 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 criterion maximum concentration (CMC) is 3 µg/L. More information regarding applicable human health-based (and aquatic life-based) water quality criteria is given in IDAPA 58.01.02.210.

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 maximum contaminant level 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 (such as low [e.g., 7Q10] and high [e.g., 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, best professional judgment 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. Thus, any mixing zone must generally protect these uses. Idaho's WQS prohibit authorizing a mixing zone for *E. coli* and any condition that impedes or prohibits recreation in and on the water body (IDAPA 58.01.02.60.01.d.vi).

When considering whether to authorize a mixing zone in an area designated or presumed for contact recreation uses, specific information is needed regarding 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). Additional information may be requested from the discharger regarding 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, crawdads) is not a distinct beneficial use in Idaho, it is considered to be part of recreation use through the activity of 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. Application of 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; and
3. The frequency with which organisms are harvested in the vicinity of the mixing zone.

Thus, 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 regarding 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 best professional judgment 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 so as to maintain protection of 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. However, DEQ has the discretion to depart from these requirements in certain circumstances. The following subsections discuss each of the size and location requirements for flowing and non-flowing 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 WQS 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 (see Section 3.4.3.6). Table 24 lists the receiving water low-flow criteria that apply to mixing zones, as described in 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<br>1B3: biologically based low flow which 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<br>4B3: biologically based low flow which 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<br>4B3: biologically based low flow which 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<br>1B3: biologically based low flow which indicates an allowable exceedance of once every 3 years |
| Ammonia – Chronic Criterion (CCC)[b] | 7Q10 or 4B3 | 7Q10: lowest 7-day average flow with an average recurrence frequency of 10 years<br>4B3: biologically based low flow which indicates an allowable exceedance for 4 consecutive days once every 3 years |
| Phosphorus[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<br>Or<br>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)<br>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 WQS, 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 total maximum daily loads, 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 Clean Water Act 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/*.

In some instances a discharger may request DEQ consider alternative streamflow estimates in calculating the reasonable potential to exceed and any associated mixing zone authorization. DEQ would consider these requests in cases where it is clear that differing sets of circumstances exist which should be considered when developing effluent limits (e.g., different effluent flows, receiving water flows, hydrologic or climatic conditions). These requests must contain information sufficient to show that use of 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 the 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 (EPA, 1996). 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 WQSs allow for the flexibility of incorporating seasonal or tiered effluent limits in discharge permits. Authorization of 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 the effluent flow. Critical dilution ratios may be calculated as the highest ratio expected to occur in a 4 day period once every 4 years corresponding to the biologically based water quality critical flows. 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 such that the concentration of the pollutant(s) being discharged should 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 (see 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. Additionally, 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, therefore, 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 (HEC-RAS) 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, the width and length of the effluent plume, and the 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 prior to becoming wider than 25% of the stream width at all flow conditions.

However, there may be instances where streamflow and velocity increases cause the effluent plume to travel greater distances before sufficient mixing occurs to meet criteria. Additionally, 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*

While DEQ understands EPA's position (1994) that shore-hugging plumes be avoided, Idaho WQS do not specifically prohibit shore-hugging plumes in flowing waters. However, 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. Additionally, 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 there may be instances where installing a diffuser results in more harm than good, or does not result in any added environmental benefits, diffusers generally result in more rapid mixing, decreasing the area containing elevated concentrations and thus 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. For example, 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 Non-flowing Waters

Water bodies with a mean detention time of 15 days or greater are considered non-flowing. 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. Non-flowing 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. As such, DEQ will review mixing zones within non-flowing waters with respect to effluent attributes (e.g., flow volume, velocity, buoyancy, etc.), mixing conditions, and bioaccumulative pollutants.

*Horizontal Area Requirement*

For existing discharges to non-flowing waters authorized prior to July 1, 2015, the size of the mixing zone is not to exceed 10% of the non-flowing water body's surface area (IDAPA 58.01.02.060.01.h.iii). For all new discharges to non-flowing 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 non-flowing 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 Non-flowing Waters*

New dischargers to non-flowing waters are required to use diffusers and design the outfall such that 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 the 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 WQS do not require a submerged discharge point for new or existing discharges into flowing waters. However, a submerged discharge is preferable because it enhances hydrodynamic mixing. For new discharges into non-flowing 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 subsection 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 section 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 waterbody. While this is typically an option for new discharges, it may be a consideration during facility upgrades. For example, a discharger may choose the use of 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 to switch from chlorination to UV disinfection; a process alternative may be the use of a less toxic chemical.

Managerial options typically involve water management such that a lesser volume of effluent is discharged, levels of treatment, or improving process efficiency so that less wasted 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 there are available wasteload allocations (e.g., specifically allocated for a discharger or included in a reserve for growth) in an approved total maximum daily load (TMDL) or other applicable plans or analyses (such as 4b implementation plans, watershed loading analyses, or facility-specific water quality pollutant management plans) that demonstrate that there is available assimilative capacity. The most current EPA-approved Integrated Report should be used to determine the beneficial use support status of the receiving water body (see *www.deq.idaho.gov/integrated-report*).

In assessing assimilative capacity, it is also prudent to consider upstream permitted discharges, which may not yet be discharging at their permitted maximum loads. If this is the case, then 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 the combined discharges of zinc from the City of Coeur d'Alene, the City of Post Falls, and the Hayden Area Regional Sewer Board 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 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 therefore 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 (Nickel, 2007a).

#### 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 2003). Thermal plumes should not cause: impairment to the integrity of the aquatic community, including interfering with successful spawning, egg incubation, rearing, or passage of aquatic life; and, 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 2003):

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

   When assessing the appropriate mixing zone size in non-flowing 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. This will require that the receiving water body's bathymetry be assessed in order to calculate the volume of water available for dilution.
3. 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.
4. Additionally, DEQ performs a mixing zone analysis to determine the size of the plume and its effects on the receiving water body.
5. Once acceptable regulatory mixing zones are defined, DEQ drafts the permit using these mixing zone sizes for dilution.

The permit writer will document, in the fact sheet, the end of pipe pollutant concentration and low flow criteria used in the RPA. ~~mixing zone analysis, affiliated with the mixing zone sizing, so that the concentration, mixing zone size, and receiving water low flow attributes are all documented in the permit.~~ 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 non-flowing 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 is small in order to meet WQS, then 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. Rather, 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. These conditions are described in further detail in Section 3.4.3.9.1. DEQ has 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.

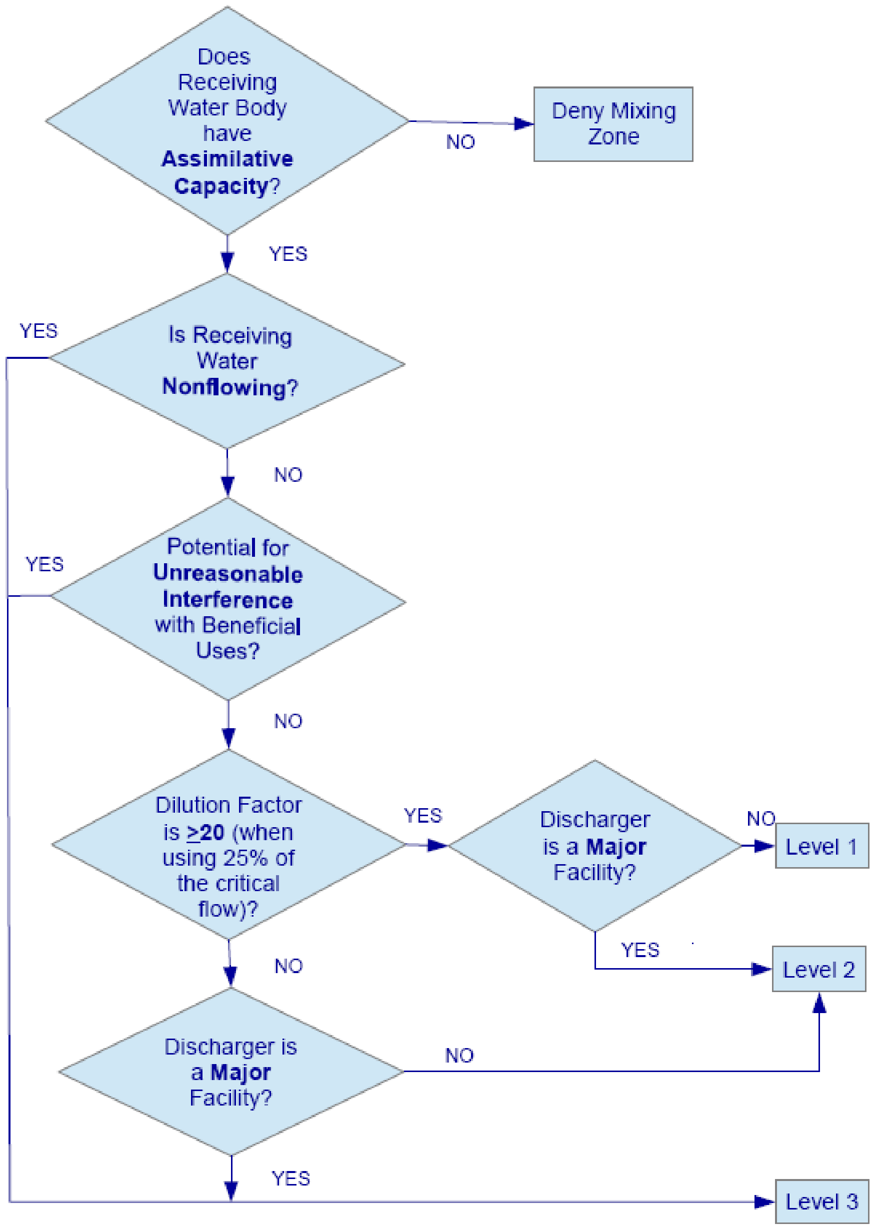



**Figure 7. Decision flow chart for determining level of analysis.**

### 3.4.3.9.1 Determining 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*

There may be situations where a discharge has the potential for unreasonable interference with, or danger to, the beneficial uses of a water body. Such situations may include, but are not limited to, the following:

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 (see 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).

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

**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, then 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, then the appropriate proportion of streamflow according to the “Flow Requirement” discussion in Section 3.4.3.4.1 must be used in the evaluation of RPTE and subsequent calculation of WQBELs. However, if a level 2 or 3 analysis is appropriate, then 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, then 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 industrial users.

#### 3.4.3.9.2 Level 1—Simple

The simple (or mass balance equation) approach represents the simplest form of calculating an appropriate dilution factor for the RPA and WQBEL calculations. This level of analysis is appropriate when the following conditions are met:

- There is no known potential for unreasonable interference with, or danger to, beneficial uses or lowering of water quality.
- The discharger is considered minor.
- The dilution factor is greater than or equal to 20.

Limited data are needed for this analysis, and no modeling is required. In most situations, pre-discharge 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 appropriate when there is no known potential for unreasonable interference with beneficial uses and one of the following conditions are met:

- The dilution factor is greater than or equal to 20, and the discharger is considered major.
- The dilution factor is less than 20, and the 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. This level of analysis is appropriate when one of the following conditions is met:

- There is potential for unreasonable interference with beneficial uses (e.g., a water body that is effluent dominated); or
- There is no known potential for unreasonable interference with beneficial uses, the dilution ratio is less than 20, and the 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. Pre-discharge (or upstream/downstream) biological and chemical data for the receiving stream will be required prior to 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(s) 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 regarding 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(s) for the draft IPDES permit and its associated fact sheet. DEQ will address comments related to the authorized mixing zone(s) prior to 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 the use of 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, the size of the pipe or channel opening, the angle or direction of flow, and the 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 in an effort to characterize these forces and predict how the two water bodies will mix, the rate at which they will mix, and the size of the resulting plume in the receiving water (length, width, depth). Models help determine how fast pollutants dilute to specific levels and when and where certain concentrations exist. We can divide models into two basic categories: those that predict the results of immediate mixing (near-field mixing) where jet forces are at work and 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. Thus, in principle, 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 since 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. In simple terms, the near-field region is typically the region that is controlled by the characteristics of the discharge itself (discharge flow rate, momentum, etc.).

### 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, then continued mixing must be accomplished by ambient forces, which can result in much larger mixing zones. This situation is typical in non-flowing 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 (see Figure 8) loses its "memory" of its initial conditions, and mixing is mainly a function of the ambient conditions (ambient velocity and density field, channel roughness and meanders, etc.).

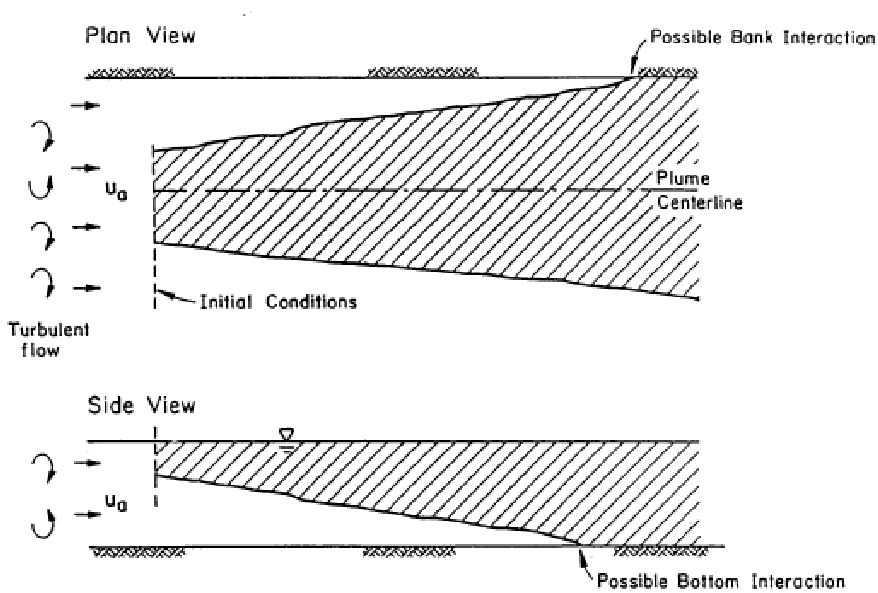



**Figure 8. Far-field plume, passive ambient diffusion processes (Jirka et al. 1996).**

### *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, then it is highly recommended that the applicant discuss this with DEQ prior to 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 semi-empirical 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 semi-empirical since 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 available for free testing and evaluation from Mixzon, Inc., at *http://www.mixzon.com/*.

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.

Visual Plumes (VP) (Baumgartner et al. 1994; Frick et al. 2003) is another initial dilution model available for analyzing mixing zones. It is freely available from the EPA Center for Exposure Assessment Modeling at *www2.epa.gov/exposure-assessment-models/visual-plumes*. VP can list salinity, temperature, and current variations at different depths. VP simulates single and merging submerged plumes in arbitrarily stratified ambient flow and buoyant surface discharges. VP addresses the issue of model consistency in a unique way, by including other models in its suite of models. In this way, it promotes the idea that in the future, modeling consistency will be achieved by recommending particular models in selected flow categories. VP includes the following models:

- Davis, Kannberg, and Hirst model for Windows (DKHW) that is based on the universal Davis, Kannberg, and Hirst density model (UDKHDEN) (Muellenhoff et al. 1985)
- Prych, Davis, and Shirazi surface discharge model (PDS) (Davis 1999)
- 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 (ref., *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 WQS. The discharger is encouraged to consult with DEQ early in the process to ensure that DEQ concurs with the modeling approach.

**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 GPS receiver. When measured then 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

#### 3.4.3.14.1 Analytical Methodologies

Where possible, analytical methods listed in 40 CFR Part 136 should be used to measure pollutants in the effluent and receiving water body. Further, the detection limits and reporting limits should be sufficiently low to ensure that concentrations of concern can actually 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

In practice, 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, then DEQ may require field sampling to gather the necessary data for either conducting or verifying the mixing zone modeling analysis. The following paragraphs briefly describe sampling work that 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 will be discussed in the next subsection. 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 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, which can be downloaded free of charge, may be used. Alternatively, the USGS SWSTAT or Idaho StreamStats may be used. Other statistical methods can be proposed by dischargers in consultation with 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.

> For more information on flows (accessed February 4, 2014):
> - 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*

#### 3.4.3.14.3 Receiving Water Quality

Background water quality information is desirable to thoroughly evaluate mixing zones. Depending on the quantity of available background data, DEQ will generally use a conservative estimate (e.g., maximum or 95$^{th}$ percentile) of background pollutant concentrations when assessing mixing zones.

Some criteria are dependent on other water quality parameters (chemical or physical). For example, the ammonia criteria are dependent 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 it is necessary to use conservative values for these parameters to ensure criteria are only rarely exceeded, after allowing for mixing. It may also be that critical temperatures, pH, or hardness do not correspond in time with critical low flows. This situation may call for a more sophisticated evaluation than simply using independently derived conservative values for each parameter. For example, the preferred approach may involve creating a time series of criteria values overlaying a time series of receiving stream flows to evaluate when assimilative capacity is at its minimum.

As discussed in Section 3.4.3.4.1, low-flow design discharge conditions for toxics criteria are specified in the WQS (IDAPA 58.01.02.210.03.b) and are based on the frequency component of the toxics criteria. Idaho WQS 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 that a conservative estimate of background concentrations of these three parameters should be used to calculate an applicable edge of mixing zone pollutant concentration in the following manner.

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. It has been general practice to use the 95th percentile of ambient pH and temperature data and the $5^{th}$ percentile of ambient hardness data as conservative estimates of background concentrations to be used 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.

For purposes of calculating criteria that are 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, then 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, then 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, then the permit should contain flow and stream quality monitoring requirements to collect data to assess the relationship between flow and hardness for the receiving water.
- If the data justify reopening the permit after the data has been evaluated, then 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 prior to obtaining data identifying hardness response to stream flow rates, then the permit writer may be required to search for upstream or downstream data that would 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 receipt of 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) to intermediate (Figure 9-d) to strong (Figure 9-c) and very strong (Figure 9-b).

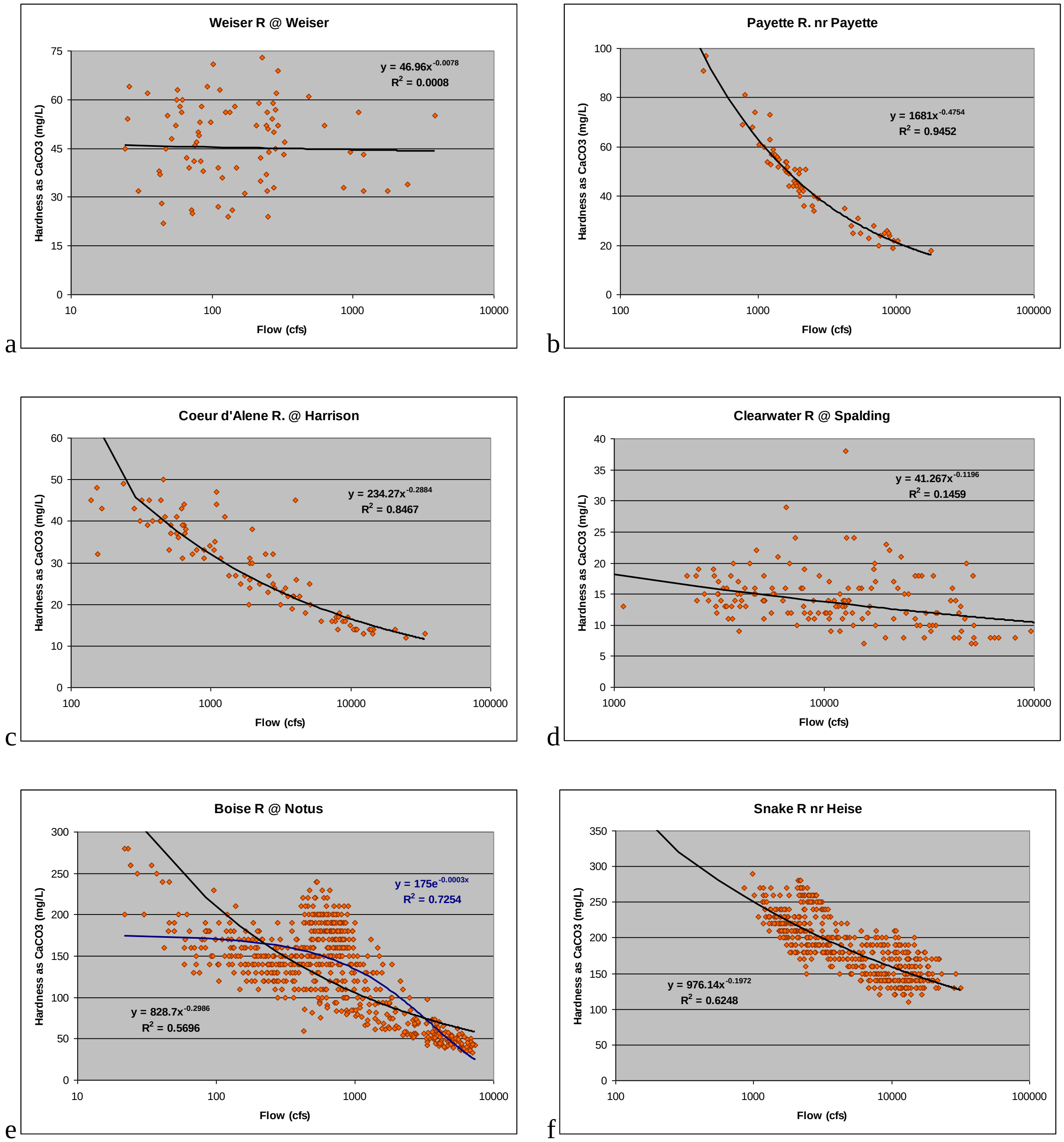



**Figure 9. Example plots of water hardness versus flow.**

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 5$^{th}$ percentile hardness value irrespective of flow and applying it at low flows could be overly conservative in many cases (e.g., Figure 9-b). If there is little relation between flow and hardness (Figure 9-a), then a 5$^{th}$ percentile of all hardness data will be representative of all flows, including low flows. But if an inverse relation exists, even if weak (Figure 9-d), then using all hardness data will not be representative of low-flow hardness.

Idaho WQS 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.)

Thus, the hardness data must be representative of low flows. However, DEQ recognizes that availability of hardness data during low flows (or during a restricted range of flows that are 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 $5^{th}$ percentile. Therefore, when there is a relation between hardness and flow, which will most often be the case, DEQ suggests that the maximum window of flows acceptable for getting hardness data representative of 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 (e.g., 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.

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 $5^{th}$ 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 $5^{th}$ percentile hardness at design flow will be accurate and not overly protective.

If sufficient data are available, then an alternative would be to use the statistical relation (nonlinear regression) between hardness and flow to estimate the hardness at the design flow. In this case, DEQ recommends at least 30 paired samples of flow and hardness over a range of flows, and the lower $95^{th}$ 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 (see 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, the pollutant concentration data may be obtained 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 the WQS, 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(s)
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 mixing zone analysis. Measuring tracer concentration in the mixing zone and the effluent discharge allows the direct determination of 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, then the field results could be used as an alternative to modeling. In the event that 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. The use of preliminary modeling to design a dye or tracer study is highly recommended to ensure the use of adequate dye or tracer mass for detectable concentrations and the selection of spatial sampling locations. Chapter 4 of the EPA TSD (EPA 1991) provides a detailed discussion of dye studies.

## 3.4.4 Conduct a Reasonable Potential Analysis (RPA)

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, stream surveys), as the basis for a decision. The permit writer:

- Might already have data available from previous monitoring
- May work with the permittee to collect data before public notice
- May include 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 begin far enough in advance of permit development to allow sufficient time to conduct chemical analyses. Where 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):

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

**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 | From receiving water data |
| $C_e$ = critical effluent pollutant concentration | Calculated value using Equation 27 |

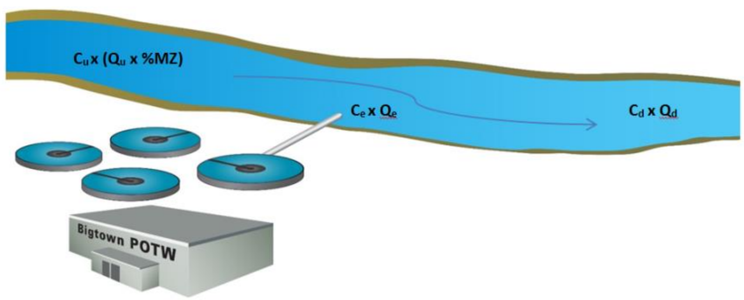



**Figure 10. Graphic illustration of the simple mass balance equation.**

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. This requires that the number of samples reported in the permit application be identified, the coefficient of variation (Equation 8) be calculated, and a reasonable potential multiplying factor (RPMF) be selected from Table 26, the 95th percentile RPMF, or Table 27, the 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 number of samples evaluated in determining the MOEC should be used in this table. 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 27):

$$C_e = MOEC \; x \; RPMF$$

**Equation 27. 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 28 to calculate the probability corresponding to the number of samples collected, and Equation 29, which yields the RPMF. The first step is to calculate the percentile representing the MOEC using Equation 28:

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

**Equation 28.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 28, the associated z-score can be selected 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, an RPMF can be calculated from Equation 29:

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

**Equation 29. 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 28 and Table 28 |
| σ = square root of $\sigma^2$ | |
| $\sigma^2 = Ln(CV^2+1)$ | Ln is the natural log of base e |
| CV = coefficient of variation | Equation 8 |

The RPMF calculated from Equation 29 can be used in Equation 27 to convert the maximum observed effluent concentration (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, there is reasonable potential, 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 depletion of dissolved oxygen below acceptable values in the receiving water).

If $C_e$ is equal to or less than the applicable criterion, then there is no reasonable potential and, thus far, there is no demonstrated need to calculate WQBELs.

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. Then, the projected concentration can be compared to the applicable water quality criterion.

For water bodies needing Tier II antidegradation protection (see 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, then the permit writer will need to follow the antidegradation implementation procedures for evaluating alternatives to discharge, socioeconomic justifications, and ensuring that 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 as input into a steady-state model. In these cases, the permit writer determines RPA using a qualitative approach. The permit writer will rely on the methods outlined in Section 3.2 of the TSD, which include considering:

- Effluent variability information, such as history of compliance problems and toxic impacts

- Point and nonpoint source controls such as existing treatment technology, the type of industry, POTW treatment system, or BMPs in place
- Species sensitivity data including in-stream 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 may be required to gather additional data. The permit writer may 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 the Fact Sheet*

Permit writers will document the details of the RPA in the IPDES permit fact sheet. The documentation will include:

- Statutory or regulatory citation
- Applicable site specific water quality standards considered
- The process used to determine the water quality model, critical conditions, and dilution allowance
- The 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 WQS at the edge of the mixing zone, then the permit writer must develop WQBELs for that pollutant parameter. The calculation of WQBELs for toxic pollutants and for a number of conventional or non-conventional pollutants with effluent concentrations that tend to follow lognormal distribution will 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 other 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):

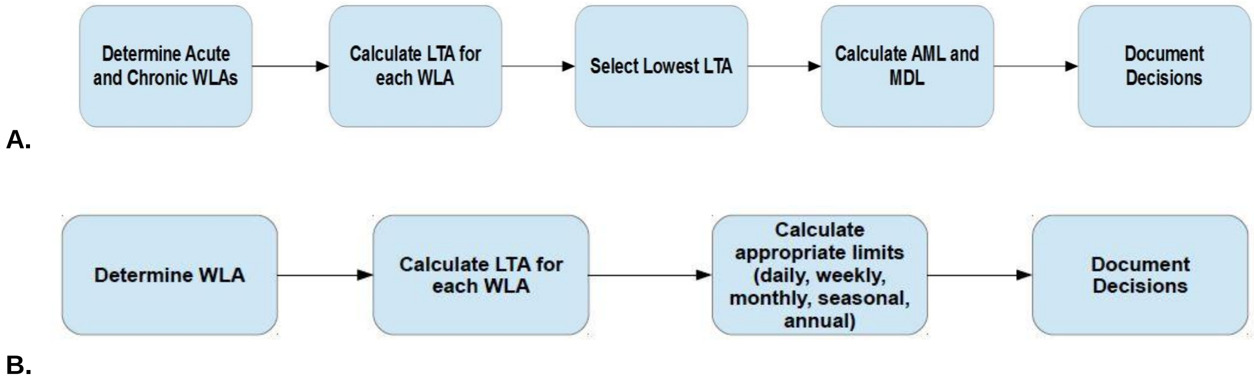



**Figure 11. Process for developing chemical specific WQBELs; A—Toxics, B—Nonconventional.**

DEQ will follow EPA's TSD (1991) process for calculating WQBELs from aquatic life criteria using the five steps in Figure 11A, and described in the sections that follow. 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 the process of 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, then 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, see Equation 30. $C_e$ must be calculated for both acute and chronic criteria. The downstream receiving water concentration, $C_d$, will be replaced with the water quality criterion (WQC), 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 30. 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 | From receiving water data |
| $C_e$ = $WLA_{(a\ or\ c)}$ = waste load allocation (acute or chronic) | |

Equation 30 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 non-flowing waters, the receiving water volume surrounding the discharge point must be determined. Nonflowing water are defined in the Water Quality Standards (IDAPA 58.01.02.060.h.iv) as:

> 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 non-flowing waters is presented in Equation 31:

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

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

Where:

| | |
|---|---|
| $WLA_{(a\ or\ c)}$ = waste load allocation (acute or chronic) | Calculated value |
| $WQC_{(a\ or\ c)}$ = pollutant water quality criterion (acute or chronic) | |
| D = Dilution ratio | Calculated from Equation 32 |
| $C_r$ = critical receiving water pollutant concentration (acute & chronic) | |

The dilution ratio (D) used in Equation 31 is a simple ratio of the effluent volume and the receiving water volume. The dilution ratio can either be determined through modeling or using Equation 32:

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

**Equation 32. Non-flowing water dilution ratio.**

Where:

| | |
|---|---|
| D = Dilution ratio | Calculated (unitless) |
| $V_r$ = non-flowing 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 non-flowing waters will need to be calculated for both acute and chronic values using Equation 31.

### *3.5.1.2 Calculate Long-Term Average (LTA) Concentration for each WLA*

The second step in calculating WQBELs is to calculate long-term average (LTA) values for both acute and chronic WLAs. DEQ has 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 confidence level (CL) whenever calculating an LTA, acute or chronic, from the associated WLA; the 95th CL may be used for nutrients and temperature.

**Table 29. Acute and chronic WLA multipliers.**

| CV | Acute | | Chronic | |
|---|---|---|---|---|
| | 95th %tile | 99th %tile | 95th %tile | 99th %tile |
| 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 |

Source: TSD page 102

$LTA_a$ can also be calculated using Equation 33.

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

**Equation 33. Acute Long Term Average for Toxics**

Where:

| | |
|---|---|
| $LTA_a$ = acute long term average | Calculated value |
| $WLA_a$ = acute wasteload allocation | Calculated value. See Equation 30 and Equation 31. |
| e = base of natural log | Approximately 2.718 |
| σ = square root of $σ^2$ | |
| $σ^2 = Ln(CV^2+1)$ | 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 34.

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

**Equation 34. Chronic Long Term Average for Toxics**

Where:

| | |
|---|---|
| $LTA_c$ = chronic long term average | Calculated value |
| $WLA_c$ = chronic wasteload allocation | Calculated value. See Equation 30 and Equation 31. |
| e = base of natural log | Approximately 2.718 |
| $σ_n$ = square root of $σ_n^2$ | |
| $σ_n^2 = Ln[(CV^2)/n + 1)]$ | 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 = ~~number of samples specified in the permit to be analyzed each month~~ the averaging period for the chronic water quality criterion (typically 4 days) | Varies; |

### *3.5.1.3 Select the Lowest LTA as the Performance Basis for the 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 assures 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 has 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 ~~MDL~~ 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, then use Equation 35 to calculate the ~~MDL~~maximum daily limit.

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

**Equation 35. Maximum Daily Limit for Toxics.**

Where:

| | |
|---|---|
| $LTA_m$ = minimum long term average value | ~~Calculated~~The lesser value~~.~~ ~~See~~of Equation 33 and Equation 34. |
| ~~MDL = maximum daily limit~~ | ~~Calculated value~~ |
| e = base of natural log | Approximately 2.718 |
| σ = square root of $\sigma^2$ | |
| $\sigma^2 = Ln(CV^2+1)$ | Ln is the natural log of base e |
| $Z_{99}$ = z score of the $99^{th}$ 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, then 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 percentiles | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 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), then use Equation 36 to calculate the AML.

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

**Equation 36. Average Monthly Limit for Toxics.**

Where:

| | |
|---|---|
| $LTA_m$ = minimum long term average | ~~Calculated~~The lesser value~~.~~ ~~See~~of Equation 33 and Equation 34. |
| AML = average monthly limit | Calculated value |
| e = base of natural log | Approximately 2.718 |
| $\sigma_n$ = square root of $\sigma_n^2$ | |
| $\sigma_n^2 = Ln[(CV^2)/n + 1]$ | Ln is the natural log of base e |
| $Z_{95}$ = z score of the 95$^{th}$ 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 the Fact Sheet*

The rationale and calculations for the WQBELs must be in 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 anti-backsliding analysis conducted and the basis for resulting decisions

The WQBEL calculations in the fact sheet are used in setting permit effluent limits.

## 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 WQS: aquatic life (chronic), aquatic life (acute), consumption of water & fish, and consumption of fish only (IDAPA 58.01.02.210). When a pollutant has criteria in the WQS 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 is 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 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 use Equation 37 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 37. Human Health maximum daily limit from AML.**

Where:

| | |
|---|---|
| AML = Set equal to the WLA | Set equal to the Waste Load Allocation. |
| e = base of natural log | Approximately 2.718 |
| $\sigma$ = square root of $\sigma^2$ | |
| $\sigma^2 = Ln[CV^2 + 1]$ | Variance; where Ln is the natural log of base e |
| $\sigma_n$ = square root of $\sigma_n^2$ | |
| $\sigma_n^2 = Ln[(CV^2)/n + 1]$ | Variance; where Ln is the natural log of base e |
| $Z_a$ = The percentile exceedance probability for the AML | 1.645 @ 95th percentile; 2.326 @ 99th percentile |
| n = Number of samples specified in the permit to be | Typically n = 1, 2, 4, 10, or 30. |

analyzed each month

CV = coefficient of variation Equation 8

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

| | Maximum = 99th percentile Average = 95th percentile n | | | | | Maximum = 99th percentile Average = 99th percentile 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, then these WQBELs should be compared to any other WQBELs (e.g. WQBELs based on aquatic life criteria) and TBELS, and apply antidegradation and anti-backsliding 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 exists 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 since 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 which 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. There are advantages to performing Monte Carlo simulations:

- It can predict the frequency and duration of toxicant concentrations in a receiving water.
- It can be used with steady-state or continuous simulation models that include fate processes for specific pollutants.
- It can be used with steady-state or continuous simulation models that include transport processes for rivers, or lakes.
- It can be used with steady-state or continuous simulation models that are designed for single or multiple pollutant source analyses.
- It does not require time series data.
- It does not require model input data to follow a specific statistical distribution or function.
- It can 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:

- It requires more input, calibration, and verification data than do steady-state models.
- The model results need manipulation to calculate the effluent LTA concentration and CV to develop effluent limits.

Probabilistic models require significant amounts of data. In most instances 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. This is a significant, but not prohibitive restriction on 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) 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 Corp.) The results are presented in 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 is repeated for both acute and chronic criteria. The allowable frequency of excursion above the standard was once in three years (1 per 1095 days) as recommended in the TSD and included in Idaho

WQS. 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 Maximum Daily Limits and AMLs ($MDL_a$, $MDL_c$, $AML_a$, $AML_c$) 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 | Std Dev | 5th %ile | 95th %ile | GeoMean |
|---|---|---|---|---|---|---|---|
| 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 |
| Effl. flow (mgd) | NA | NA | 20 design<br>14.5 daily<br>13.8 weekly | NA | NA | NA | NA |
| Effl. Zinc (µg/L) | NA | NA | 15.8 | 6.9 | NA | 28.8 | NA |
| Effl. Hardness (mg/L) | NA | NA | 111 | NA | 87 | NA | 111 |

**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** |
| Max. 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)

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, non-toxic receiving water). Idaho WQS 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, semi-annual acute and chronic testing, which is generally recommended 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 a RPTE analysis, data should be available for acute and 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, then the permit writer has demonstrated RPTE and must calculate WET limits.

### 3.6.1 Expressing WET Limits or Test Results

There are two options for expressing WET limits or test results: directly in terms of endpoints or indirectly in terms of toxic units.

Toxicity in terms of endpoints is typically expressed in one of the following ways:

- No observed effect concentration (NOEC), the highest concentration of effluent (i.e., highest percent effluent) at which no adverse effects are observed on the aquatic test organisms;
- Lowest observed effect concentration (LOEC), the lowest concentration of effluent that causes observable adverse effects in exposed test organisms;
- Inhibition concentration (IC), a point estimate of the effluent concentration that would cause a given percent reduction in a biological measurement of the test organisms; or
- Effect concentration (EC), a point estimate of the effluent concentration that would cause an observable adverse effect in a given percentage of test organisms.

Each of these endpoints can be converted, where applicable, to toxic units by dividing 100 by the test result percentage. For example, if the $IC_{25}$ for a chronic test is 60% (Equation 37):

$$\frac{100}{60} = 1.7\ chronic\ toxic\ units\ (TU_c)$$

**Equation 37. Example of endpoint conversion to toxic units.**

However, it should be noted that 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 acute-to-chronic ratio (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, then 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 38):

$$ACR = \frac{Acute\ Endpoint}{Chronic\ Endpoint} = \frac{LC_{50}}{IC_{25}}$$

**Equation 38. ACR expression.**

A TU is the inverse of the sample fraction, as expressed in Equation 23, Acute Toxic Units, and Equation 24, Chronic Toxic Units, ~~(Equation 39). Therefore~~ repeated below for convenience:

$$TU_a = \frac{100}{LC_{50}}\ \text{~~and~~}\ \sout{TU_c = \frac{100}{IC_{25}}}$$

**~~Equation 37.~~ ~~UnitTU$_a$ and TU$_c$ expressions~~ Acute Toxic.**

$$TU_c = \frac{100}{IC_{25}}$$

**~~Equation 38.~~ Chronic Toxic Unit.**

Consequently, toxicity as percent sample, may be expressed ~~as in Equation 40~~ by rearranging the Acute and Chronic Toxic Unit equations as indicated below:

$$LC_{50} = \frac{100}{TU_a} \text{ and } IC_{25} = \frac{100}{TU_c}$$

**~~Equation 40. Toxicity expressed as percent sample.~~**

Substituting into Equation 38, we can rearrange to obtain Equation 39:

$$ACR = \frac{LC_{50}}{IC_{25}} = \frac{\frac{100}{TU_a}}{\frac{100}{TU_c}} = \frac{TU_c}{TU_a}$$

**Equation 39. ACR in terms of TU.**

*Example 1:*

Given $LC_{50}$ = 28%, $IC_{25}$ = 10%

Using Equation 39, $ACR = \frac{28\%}{10\%} = 2.8$

*Example 2:*

Given $TU_a$ = 3.6, $TU_c$ = 10.0

Using Equation 39, $ACR = \frac{TU_c}{TU_a} = \frac{10.0}{3.6} = 2.8$

*Example 3:*

Given the toxicity data for a facility's effluent for *C. dubia* (Table 35) and using Equation 39 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 39 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

The first step in performing RPA for WET is to assess the WET WLAs. The wasteload allocations for acute and chronic WET criteria ($WLA_{a/c}$) must be calculated from the simple mass balance equation presented in Equation 40, with a few terms changed.

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

**Equation 40. Simple mass-balance equation for WET WLA.**

Where:

| | |
|---|---|
| $WLA_{a/c}$ = wasteload allocation (acute or chronic) | Calculated value |
| $Q_e$ = critical effluent flow | From discharge flow data |
| $Q_u$ = 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 | Default is 0 |
| $WLA_{a/c}$ = waste load allocation (acute or chronic) | |
| AC = Acute Whole Effluent Criterion | 0.3 $TU_a$ |
| CC = Chronic Whole Effluent Criterion | 1.0 $TU_c$ |

### *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 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. However, 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 & 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 |

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, then an RPA may still be performed, see 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 semi-annual 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 take into account the following, as specified in IDAPA 58.01.25.302.06.a.ii:

- Existing controls on point and nonpoint sources of pollution
- The variability of the pollutant or pollutant parameter in the effluent
- The sensitivity of the species to toxicity testing
- The dilution of the effluent in the receiving water (where appropriate)

### *3.6.2.2 RPA Assessment*

An RPA can be assessed if there are at least 10 valid WET test results for acute, chronic, or both (whichever is applicable), and:

- The maximum probable effluent $TU_a$ at the 99% CL of the 99% probability level is greater than the WET $WLA_a$;
- The maximum probable effluent $TU_c$ at the 99% CL of the 99% probability level is greater than the WET $WLA_c$.

Select the appropriate RPMF from Table 27 based on the CV and number of tests performed.

These analyses will result in 4 possible Maximum Probable Concentrations (MPC), an acute and a chronic value for each of the 2 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, then no RPTE exists, and no WET WQBELs need be generated. If RPTE are indicated, then WET limits may need to be calculated for WET $WLA_a$, WET $WLA_c$, or both.

### 3.6.3 Determine WET Triggers and Limits

If there is no RPTE, then the permit writer should determine a trigger value. If a WET monitoring result exceeds the trigger value, then 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).

$$C_e = \frac{\left(C_d \times \left((\%MZ \times Q_u) + Q_e\right) - (C_u \times Q_u)\right)}{Q_e}$$

**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.

$$C_e = \frac{\left(C_d\left((\%MZ \times Q_u) + Q_e\right) - (C_u \times Q_u)\right)}{Q_e}$$

$$C_e = \frac{\left(1.0TU_c \times \left((0.10 \times 15) + 0.39\right) - (0TU_c \times 375)\right)}{0.39}$$

$$C_e = 4.8TU_c$$

Typically, only chronic WET triggers are developed since a dilution factor exceeding 1000:1 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, then use the EPA recommended default value of 10 to obtain the equivalent value in chronic toxic units (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 using the 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 40. |
| e = base of natural log | Approximately 2.718 |
| σ = square root of $\sigma^2$ | |
| $\sigma^2$ = 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 ~~(MDL)~~, using 99th percentile z-score, and use Equation 44 to calculate the Average Monthly Limit (AML), using the 95th percentile z-score.

$$\text{~~MDL~~ Maximum Daily Limit}_a = LTA_a \times e^{(z_{99}\sigma - 0.5\sigma^2)}$$ **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. |
| ~~$MDL_a$ = acute maximum daily limit~~ | ~~Calculated value~~ |
| $AML_a$ = acute average monthly limit | Calculated value |
| e = base of natural log | Approximately 2.718 |
| σ = square root of $\sigma^2$ | |
| $\sigma_n$ = square root of $\sigma_n^2$ | |
| $\sigma^2$ = 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 = 1 |
| 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 using the 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 40. |
| e = base of natural log | Approximately 2.718 |
| $\sigma_4$ = square root of $\sigma_4^2$ | |

| | |
|---|---|
| $\sigma_4^2 = Ln[(CV^2/4) + 1]$ | 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 ~~(MDL)~~, using 99th percentile z-score, and use Equation 47 to calculate the Average Monthly Limit (AML), using the 95th percentile z-score.

$$\text{~~MDL~~ Maximum Daily Limit}_c = LTA_c \times e^{(z_{99}\sigma - 0.5\sigma^2)}$$

**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. |
| ~~$MDL_c$ = chronic maximum daily limit~~ | ~~Calculated value~~ |
| $AML_c$ = chronic average monthly limit | Calculated value |
| e = base of natural log | Approximately 2.718 |
| σ = square root of $\sigma^2$ | |
| $\sigma_n$ = square root of $\sigma_n^2$ | |
| $\sigma^2 = Ln(CV^2+1)$ | 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 = 1 |
| CV = coefficient of variation | Equation 8 |

### 3.6.4 Document RPA and WQBEL Calculations for WET in the 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 – the required WET monitoring frequency
- RP determinations – the calculations for deriving or revising WET limits or WET triggers, and the associated RPA workbook.
- WET triggers and limits – the decision making process and calculations for establishing the permittee's WET triggers or limits.
- Justification for inclusion or omission of 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, then the reasons for not using certain data or using other data must be clearly explained.

## 3.7 Special Considerations

The special considerations provided here introduce topics DEQ believes may impact effluent limits and are beyond the scope of straightforward calculations. Each subsection 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 term encompassing this 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 causes, has the reasonable potential to cause, or contributes to an excursion of numeric or narrative water quality criteria. If reasonable potential is identified, then 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.

Subsection 3.7.1.1 will discuss 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. However, unless a specific chemical is identified in the WQS as a toxic, the permit writer will aggregate the chemicals bearing nitrogen (as total nitrogen [TN]) and phosphorus (as total phosphorus [TP]).

##### 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, influenced by both temperature and pH, as defined in IDAPA 58.01.02.

Nitrate is regulated in Idaho's WQS under the narrative criteria as a toxic (IDAPA 58.01.02.200.02) and as a nutrient (IDAPA 58.01.02.200.06). 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 maximum contaminant level of 10 mg-N/L, above which children under six 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 (TIN) and total nitrogen (TN) 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*

Idaho WQS (IDAPA 58.01.02.200.06) state, "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." Several factors in addition to nutrient concentrations determine the impact of nutrients on receiving water quality. The additional factors that influence the extent of algal growth include, but are not necessarily limited to:

- 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 Section 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 (see 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 WQS narrative criteria. See Section 3.3.2.3 for details. Since, in these cases 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:

- 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.
- Canvass 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 (see Section 3.7.1.6.2).

#### 3.7.1.2.3 Non Impaired 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, then the permit writer will work with the Surface Water Program to establish a local nutrient target that can be used to calculate appropriate limits (see Section 3.7.1.6.2).

### *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 WQS 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). Nutrients do not have the same impacts and these averaging periods are not appropriate. An appropriate averaging period for nutrient waste loads 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 noted in their guidance for developing waste load allocations for lakes and reservoirs, EPA (1983) that:

> 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, 2010) recommends that "…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*

Since the environment responds differently to nutrient stimulation than to toxics 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, then the corresponding receiving water duration should be aligned. This will require that receiving waters with seasonal nutrient loads use corresponding seasonal flows. This concept will be addressed more thoroughly in section 3.7.1.6.

Additionally, 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. Alternatively, for long-retention time systems large flows may result in greater nutrient response. The larger flows may increase the nutrient contribution from non-point 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 three 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 three 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 would align the critical flow condition (30Q3) with the nutrient averaging period (30-day) to produce an effluent limit that would ensure nutrient concentrations in the receiving water are not exceeded more than once in a three 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 three years. If an annual averaging period is appropriate for the receiving water, then it is recommended that the harmonic mean flow 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 mixing of nutrients may be increased above 25%, but not expanded to be larger than necessary, if justification is provided by the permittee considering siting, technological, and managerial options available to the discharger as required in the WQS mixing zone policy. Additionally, since 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 identified in Section 3.4 to determine if there is a reasonable potential to exceed the narrative nutrient criteria for the water body. DEQ will typically determine RPTE using the 95$^{th}$ percentile for nutrients (both TN and TP), 95$^{th}$ percentile of monthly daily max effluent based on daily max DMR data, the RPMF (calculated using Table 26), and the simple mass-balance equation (Equation 26). Assessing the resulting nutrient critical effluent concentration and nutrient load with respect to an RPTE requires consultation 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 ~~three~~ 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:

- ~~Modifying the TSD statistical approach to align nutrient averaging period and receiving water body low flow criteria (Altered TSD Statistical Method)~~
- 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, then 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 due to the perception that this practice is insufficiently conservative. This is an appropriate assumption 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 is typically not the situation 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 tend to support the use of WLAs as WQBELs are based on the conservative nature of WLA models, the conservative nature of water quality criteria, and the requirement for a margin of safety in TMDLs. Steady–state WLA models tend to 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 which do not exhibit neither acute or chronic toxic effects on aquatic life or human health. A brief example and Table 37 help 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 99$^{th}$ percentile basis. Properly 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. Hence, 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 to 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 |

### ~~3.7.1.6.2 Altered TSD Statistical Method to Accommodate Nutrients~~

~~This altered TSD methodology may be used in instances where a nutrient WLA has not been allocated to the permittee in a TMDL. The lack of a WLA may be because a TMDL has not been developed, is in development, or has not been approved by EPA. In these cases, the stream has been identified as not meeting its beneficial uses due to excess nutrients. In these instances the IPDES program will work in conjunction with the Surface Water Program staff to establish an appropriate numeric value based on the effluent's nutrient load, the receiving water body's nutrient load, and other receiving water body attributes.~~

~~This altered TSD statistical method focuses on aligning the averaging periods for nutrient discharges and the receiving water critical flow duration and frequency. There are additional factors that will impact any resulting limits. These additional factors are presented prior to investigating the equations and viewing examples.~~

~~*Coefficient of Variation*~~

~~The value for the CV is calculated using Equation 8 (section 3.1.2.2).~~

*Effluent's Statistical Variance*

In the instances where a receiving water body does not have an approved nutrient TMDL the effluent's statistical variance should be consistent with the seasonal or annual averaging period selected. Equation 49. presents the effluent's statistical variance calculation:

$$\sigma_n^2 = ln\left(\frac{CV^2}{n} + 1\right)$$

**Equation 49. Effluent statistical variance consistent with the n-day averaging period.**

Where

CV = coefficient of variation

Equation 9

n = # of days in the averaging period for the WLA

The key to implementing this method is to define the period that nutrients are to be averaged over (seasonal or annual), and use this season length to establish the statistical variance ($\sigma_n^2$). This statistical variance will be used to calculate the LTA. Since no water quality criterion or TMDL WLA is available, a numeric target will be assigned, developed in conjunction with the Surface Water Program's staff, providing an interpretation of the nutrient narrative criterion. The numeric target will be used to determine the WLA. The impact of this action is highlighted in an example, presented below.

### 3.7.1.6.3 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. See Figure 12 for 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, seasonally, etc.).

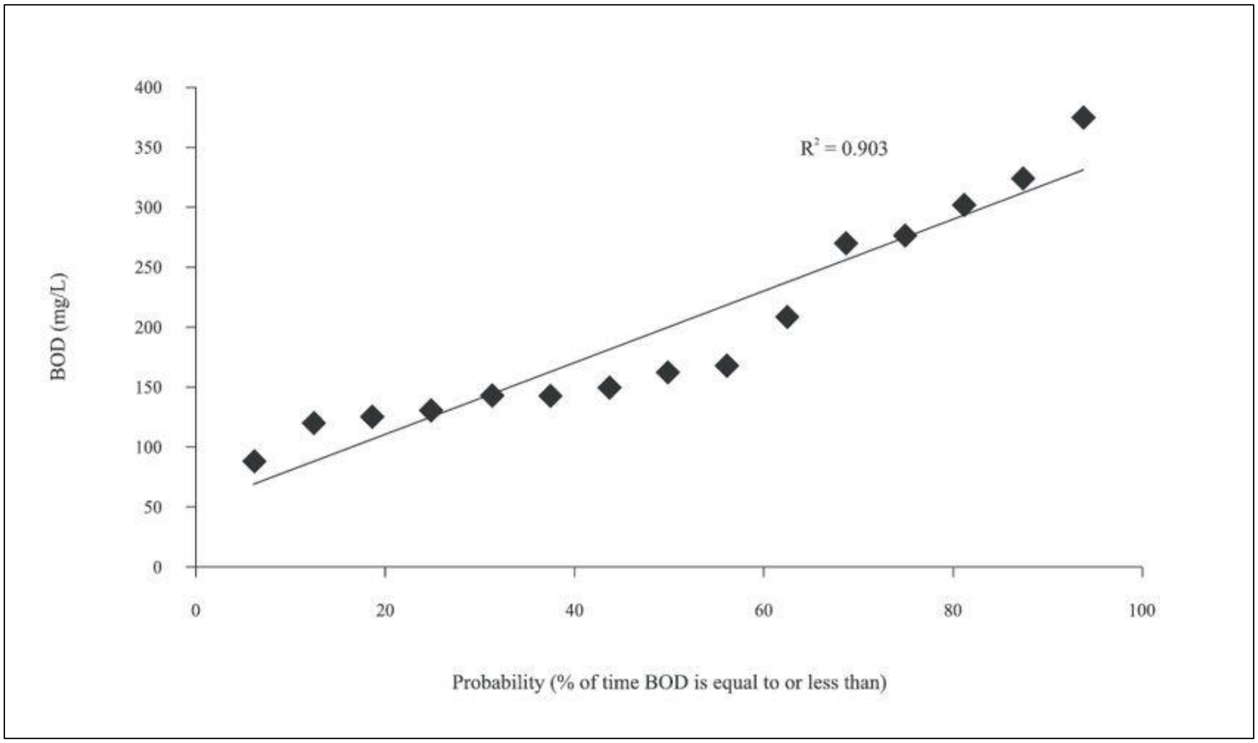



**Figure 12. BOD probability distribution plot.**

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 that the ratio of percentiles is constant (i.e. the 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 (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 $90^{th}$-$99^{th}$ 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., $95^{th}$-$99^{th}$ percentile) of the probability plots."

This procedure can be implemented in a spreadsheet to assure consistency and accuracy. The results need to be checked against the ability of technological processes to achieve the identified limits. If system improvements to attain a lower discharge concentration expresses a reducing efficacy as is ramped up, then the assumption of a 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. It is important to remember that thermal energy is not necessarily "in" the water in the same sense as other pollutants (e.g., copper, ammonia). Thermal energy is absorbed by the water and manifested as temperature, a physical property of the water (Washington DOE, 2010).

Non-conservative 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.

#### *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 (max 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 and can be found at IDAPA 58.01.02.250 and summarized in Table 38. Additional temperature requirements can be found at IDAPA 58.01.02.401 regarding point source wastewater treatment requirements.

**Table 38. Summary of freshwater temperature water quality criteria.**

| ID 58.01.02 250 Reference | Beneficial Use | Temperature Criterion | Maximum Daily Average |
|---|---|---|---|
| 02.b | Cold Water | ≤22.0 °C | ≤19.0 °C |
| 02.f. | Salmonid Spawning | ≤13.0 °C | ≤9.0 °C |
| 03.a. | Seasonal Cold | ≤26.0 °C | ≤23.0 °C |
| 04.a. | Warm Water | ≤33.0 °C | ≤29.0 °C |

Following the procedures outlined at Section 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 there is a reasonable potential to exceed the temperature criteria for the water body. DEQ determines RPTE using the 95th percentile receiving water temperature (calculated from permittee data or based on USGS data), 95th percentile of monthly daily max effluent based on daily max DMR data, the appropriate dilution factor (calculated using **Error! eference source not found.** for flowing water and Equation 32 for non-flowing water), and the simple mass-balance equation (Equation 26).

Regarding mixing zones and temperature, the permit writer should refer to Section 3.4.3.7.2 discussing thermal plumes.

IDAPA 58.01.02.401.01 outlines additional rules regarding 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, then 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 ~~in Section 3.5 where the acute criterion is equivalent to the~~ below. These procedures should allow development of both a daily maximum temperature and ~~the chronic criterion is equivalent to the~~ a daily average temperature ~~criterion~~ limit ~~identified for the aquatic life use~~.

The water quality standards define the "daily mean" at IDAPA 58.01.02.010.19 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 1Q10 flow for the receiving water body. Equation 49 will be used to establish the instantaneous maximum temperature limit and the maximum daily average temperature limit, where in each case the downstream temperature ($T_d$) is set equal to the temperature criterion.

$$T_e = D_f \times (T_d - T_u) + T_u$$

**Equation 49. Temperature limit calculation.**

Where:

$T_e$ = Effluent temperature (°C)
$D_f$ = Dilution Factor for flowing receiving water (Equation 24)
$T_d$ = Water Quality Criterion (°C)
$T_u$ = Upstream receiving water body temperature (°C)

The dilution factor for flowing water is defined in Equation 50.

$$D_f = \frac{Q_e + P \times Q_u}{Q_e}$$

**Equation 50. Flowing Water Dilution Factor.**

Where:

$D_f$ = Dilution Factor for flowing receiving water
$Q_e$ = Effluent flow (cfs or MGD)
$Q_u$ = Receiving water body critical low flow (cfs or MGD)
$P$ = Percent mixing authorized (%)

For receiving water bodies impaired for temperature:

- If the receiving water body has an approved TMDL, then the permit writer will utilize the TMDL WLA established for the discharger to calculate appropriate limits. If the discharger cannot immediately achieve this limit, then 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 waterbody does not currently exist but is under development, then 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, then the permit writer may explore the options outlined above.

#### 3.7.2.5 Antidegradation

In identifying the tier of protection for the receiving water body, temperature has some unique considerations that need to 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, then 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, then tier II protections will apply to the receiving water.

Applying tier II protections to a receiving water body means that the permit writer needs to 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, then an alternatives analysis and socio-economic justification need to be done (see Section 3.8).

### 3.7.3 Water Quality Trading

Pollutant trading is recognized in Idaho's WQS at 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, total phosphorus, total ~~and~~ nitrogen, 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 implementation of best management practices or technological measures.

### 3.7.4 Emerging Contaminants of Concern

#### 3.7.4.1 PCBs

Polychlorinated biphenyls (PCBs) are man-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, the creation of PCBs as a manufacturing by-product is allowed. Thus, many commercially available items contain small amounts of PCBs. The products most commonly associated with small levels of PCBs include 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:

- 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 have been found in snow and sea water in areas far from where they were released into the environment. As a consequence, 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.

Idaho's WQS specify numeric criteria for PCBs under IDAPA 58.01.02.201. As mentioned elsewhere in this guidance, 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 use. However, EPA has not approved these criteria. Therefore, 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 (PVC) 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. They 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. Although exposure to phthalates can produce a variety of effects in laboratory animals, for certain phthalates the 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.

Idaho's WQS at IDAPA 58.01.02.210 specify 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 the DEQ to focus on watershed goals and consider multiple pollutant sources and stressors. The most common form of this is re-issuing permit according to a five-year rotating basin schedule, although there are other forms of this style of permitting.

The permit writer is encouraged to find more information at EPA's Watershed Permitting website regarding this style of permitting *www.epa.gov/npdes/watershed-based-permitting.*

### 3.7.6 Metal Translators

The EPA currently requires effluent measurement to be total recoverable (TR) metals data according to 40 CFR 122.45(c). Conversion factors and translators are used to convert to dissolved criteria when necessary since most facilities in Idaho provide TR data. Translators are the fraction of total recoverable metal in the downstream water that is dissolved; that is, the dissolved metal concentration divided by the total recoverable 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 total recoverable metal, or
- It may be developed through the use of 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 the development of 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 that is dependent on the amount of the pollutant in fish tissue.

DEQ has 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 ~~(EPA 2010b)~~ on developing effluent limits for mercury in fish tissue~~, which can be found at~~ ~~*https://nepis.epa.gov/Exe/ZyPDF.cgi/P1007BKQ.PDF?Dockey=P1007BKQ.PDF*~~ and may be used, with modification, for other pollutants that have fish tissue criteria. ~~This~~ The purpose of this section is to provide some practical considerations and references to help the permit writer find more specific information and direction to 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, analyzed using a sufficiently sensitive method for the data to be evaluated. 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, then the permit writer may reasonably conclude that the discharge does not have reasonable potential and that a WQBEL is not necessary (DEQ 2005). However, if data show there is a quantifiable amount of the pollutant, the permit writer should continue on 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, then the permit should include permit limits for that discharger as described in Section 3.7.7.4. below.

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 the collection of 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 vs. filet). In some instances, there are prescribed methods for gathering these samples such as for mercury (IDAPA 58.01.02.03.c.iv), 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, then the permit should include monitoring requirements for the facility if there is an expectation that the facility discharges 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 ~~in the receiving water~~ are below criteria values, then the permit writer may conclude that the discharge does not have an RPTE criteria (DEQ 2005). The permit writer should however 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, then the permit writer should consider that the discharger 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 there are water column data, 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, then the permit writer should conclude that there is reasonable potential 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, then the following methods can may be used to establish appropriate WQBELs:

- If there is a water column translation translator of the fish tissue criterion, then the permit writer may use that to develop an effluent limit. according to procedures in Section 3.5
- If a water column translation of the fish tissue criterion is not available, then 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, DEQ the permit writer may include in the minimization plan:
    - A trigger level,
    - Reduction goal, or
    - 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; or
  - Require the permittee to develop a site-specific water column translation of fish tissue criterion for the receiving water.

In some instances the source of mercury in a discharge may be the intake water taken directly from the same body of water to which the facility discharges. The permit writer should verify that this is the case, and then refer to section 3.9 to determine the correct method of calculating an effluent limit.

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 the application of 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 (BLM)

In some instances, such as for specific metals, the WQC is not a defined number but instead is 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 (DOC) and available inorganic ligands. The BLM results in criteria values that more accurately represent the aquatic life toxicity of copper in the receiving water. It is dependent on the following input parameters:

- Temperature
- pH
- DOC
- Calcium
- Magnesium
- Sodium
- Potassium
- Sulfate
- Chloride
- Alkalinity
- Sulfide
- 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 implementation of the BLM can be found in the *Implementation Guidance for the Idaho Copper Criteria for Aquatic Life: Using the Biotic Ligand Model (BLM)* (DEQ, draft 2016b).

#### *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 staff in the water quality standards group 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, then no further analysis is necessary. If the RPA indicates RPTE, then 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 in order 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 what is found in DEQ 2017b may be considered sufficient to demonstrate protectiveness.

## 3.8 Antidegradation Implementation

One objective of the CWA is to maintain water quality. To ensure states are doing this, federal regulations require antidegradation policies and procedures to be part of the WQS. Antidegradation should be considered throughout the permit development process such as when determining the applicable receiving WQS. The permit writer should have determined what tier(s) of protection should be assigned to the proposed receiving water for the pollutant(s) of concern (see 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 can be found in the Idaho Antidegradation Implementation Procedures guidance document (DEQ draft 2017).

### 3.8.1 Tier I Review

All waterbodies receive at least Tier I protection, which focuses on maintaining existing uses. The process of developing WQBELs provides Tier I protection by ensuring that the discharge does not cause or contribute to a violation of WQC. If a Tier 1 waterbody is impaired for a pollutant that would be present in the proposed discharge, then the permit writer should identify and consult any relevant TMDLs to determine what quantity of pollutant (if any) is appropriate.

### 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:

- Determining if resulting degradation is significant
- Assuring other point and nonpoint source controls are achieved
- Identifying nondegrading and least degrading alternatives
- Determining 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, then 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 best management practices.

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, then 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, then 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, then the permit writer will include such limitations in the IPDES permit for that discharge provided the limits meet all other applicable TBELs and WQS.

The permit writer must include in the fact sheet 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 the 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 prior to 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 I or 2) 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 are. 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 prior to the designation of 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 anti-backsliding analysis and, if necessary, revises the limits accordingly.

## 4.1 Applying Antibacksliding Requirements

Antibacksliding refers to provisions prohibiting the relaxation of effluent limits in reissued permits under the CWA, 40 CFR 122.44(l), and IDAPA 58.01.25.200. In general, the term 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. There are exemptions to the prohibition, and determining the applicability requires familiarity with provisions and exceptions existing in regulation.

### 4.1.1 Antibacksliding Provisions

There are two provisions that permit writers will review 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.

Firstly, CWA antibacksliding provisions address two specific situations where backsliding is prohibited:

- Relaxing a TBEL based on using case-by-case BPJ when less stringent effluent guidelines are promulgated, OR
- Relaxing limits based on state WQS unless the change is consistent with section 303(d)(4).

NPDES and IPDES regulations found at 122.44(l)(1) and IDAPA 58.01.25.200.01 prevent backsliding unless:

- 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 Section 122.62 [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 three bullets highlight the specific nature of each type of exception.

- CWA section 402(o)(2) outlines six specific exceptions for TBEL case-by-case limits. The provision provides that relaxed limits may be allowed where:
    1. There have been substantial alterations or additions to the permitted facility.
    2. New information exists that was not available at the time of permit issuance.
    3. Technical mistakes or misinterpretations of the law were made in permit issuance.
    4. Good cause exists because of events beyond the permittee's control (e.g., natural disasters) and no reasonable available remedy exists.
    5. The permit has been modified under one of several CWA sections [§301(c), 301(g), 301(i), 301(k), 301(n), or 316(a)].
    6. The permittee is unable to meet the permit limits after properly operating and maintaining required treatment facilities.
- CWA section 402(o)(1) allows relaxation of WQBELs and effluent limits based on state standards if the relaxation is consistent with the provisions of CWA section 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 section 303(d)(4) has two parts, one for waters attaining standards, and second for 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, which is outlined in this ELDG Section 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 assure attainment of water quality standards or the designated use that is not being attained is removed in accordance with the WQS regulations.
- CWA section 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 effluent guideline or WQS, including antidegradation requirements.

Figure 13 outlines the antibacksliding process. The process is excerpted from the User's Guide Volume 1 (DEQ 2016a) and included here for easy reference.

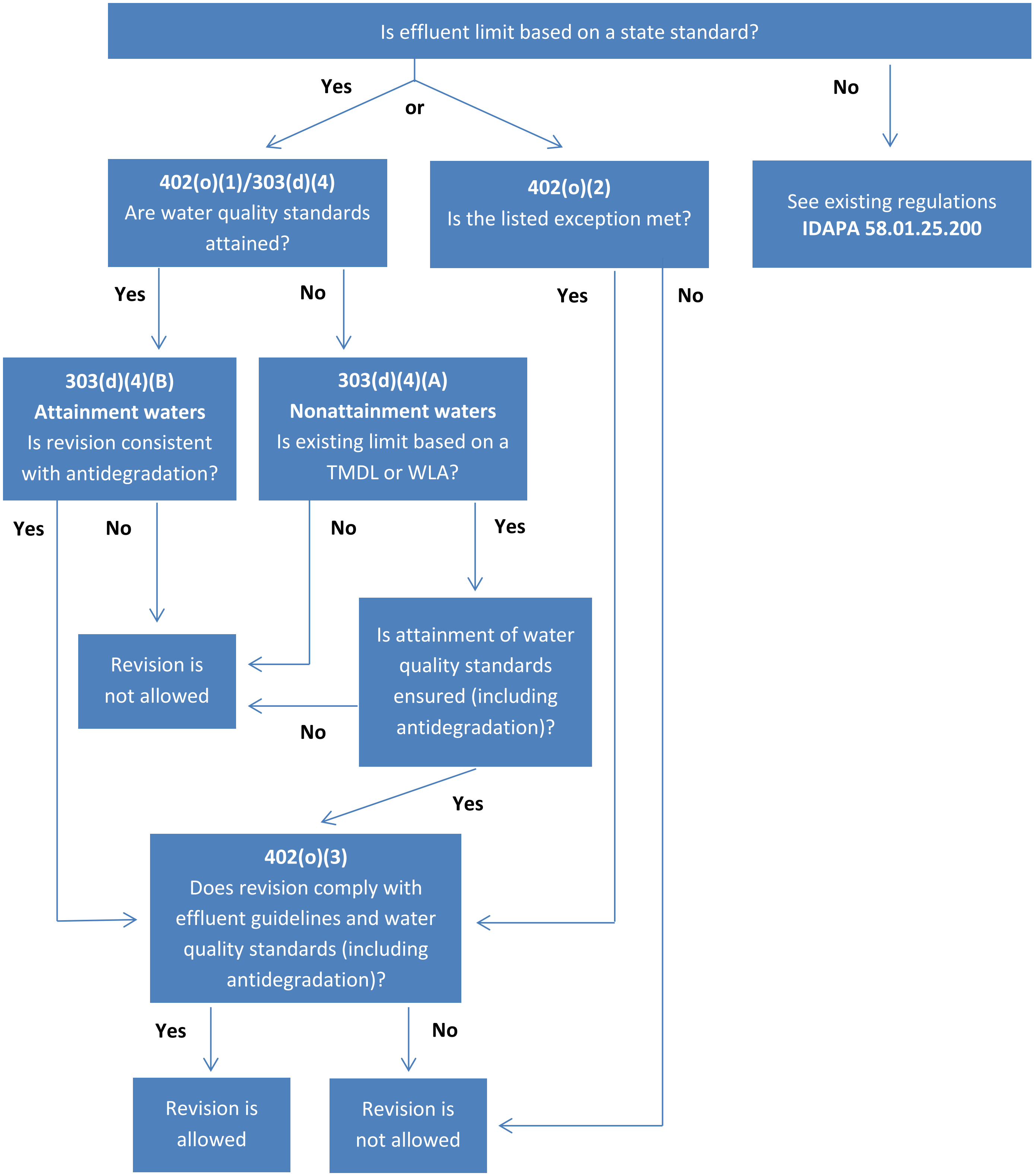



**Figure 13. Application of antibacksliding requirements.**

## 4.2 Document Final Effluent Limit Rationale in the 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 anti-backsliding 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. To see the official definition for a term, users should go directly to the rule that is referenced.

| 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 Limitation 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<br>• 1Q10 (IDAPA 58.01.02.210.03.b.i)<br>• 1B3 (IDAPA 58.01.02.210.03.b.ii)<br>• 7Q10 (IDAPA 58.01.02.210.03.b.iii)<br>• 4B3 (IDAPA 58.01.02.210.03.b.iv)<br>• 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 |
| **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<br>>10 mg/L = 2 sig figs | Report to 0.1 mg/L<br>Report whole numbers |
| CBOD | 2.0 to 45 mg/L | DO Probe | <10 mg/L = 2 sig figs<br>>10 mg/L = 2 sig figs | Report to 0.1 mg/L<br>Report whole numbers |
| TSS | 5.0 to 80.0 mg/L | Filtration/ Gravimetric | <10 mg/L = 2 sig figs<br>>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<br>>10 <100 = 2 sig figs<br>>100 = 3 sig figs | Report whole numbers only |
| DO | 8.0 to 10.0 mg/L | DO Probe | <10 mg/L = 2 sig figs<br>>10 mg/L = 3 sig figs | Report to 0.1 mg/L |
| Total chlorine residual (method dependent) | 0.02 to 1.0 mg/L<br>0.1 to 1.0 mg/L | Amperometric Titr.<br>DPD – colorimetric | <0.1 mg/L = 1 sig fig<br>>0.1 <10 mg/L = 2 sig figs<br>>10 mg/L = 3 sig figs | Report to 0.01 mg/L<br>Report to 0.1 mg/L<br>Report to 0.1 mg/L |
| Minimum UV dose | 35 millijoules | | | |
| pH | 6.0 to 9.0 | pH Probe | <10 = 2 sig figs<br>>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<br>>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<br>>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<br>>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<br>>0.1 <10 mg/L = 2 sig figs<br>>10 mg/L = 3 sig figs | Report to 0.01 mg/L<br>Report to 0.1 mg/L<br>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<br>>0.1 <10 mg/L = 2 sig figs<br>>10 mg/L = 3 sig figs | Report to 0.01 mg/L<br>Report to 0.1 mg/L<br>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 CWA Section 307(a) *priority* pollutants are a subset of this group of pollutants. The TSD (EPA 1991) provides a foundation for evaluating toxics; however, IPDES permit writers should be aware of currently-evolving issues regarding toxics, which include:

- Appropriate protocols and methods must be followed during the data collection of toxic pollutants or samples could easily be contaminated. If collection methods contaminate a sample, then the data should be blank corrected or censored and the data should be collected using appropriate methods and results should be appropriately handled (e.g. blank adjusted where needed).
- There are various methods for the laboratory analysis of toxics, which 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 is silent on this issue, 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 for toxics 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, Plus Others |
|---|---|---|---|---|---|
| **Characterize Effluent** | - Toxic and dissolved oxygen impacts<br>- MPEC 95th | - BLM | - Cause of background<br>- Metal Translator | - MPEC<br>- Geometric mean | - Blank correction |
| **Characterize Receiving Water** | - Little or no ambient | - DEQ guidance | - Geometric mean | - Geometric mean | - Geometric mean<br>- Blank correction |
| **Determine Applicable Water Quality Standards** | - Appropriate frequency and duration | - Updates to criteria | - WER recalculation<br>- 304(a) criteria | - Fish tissue | - Probabilistic approach<br>- Variances |
| **Determine the Need for WQBELs (RPA)** | - Monte Carlo<br>- Mixed pH<br>- Mixing zone | - Monte Carlo<br>- Mixing zone | - TSD<br>- Mixing Zone | - DEQ guidance | - Mixing zone<br>- Congener-specific approach[a] |
| **Interim and Final WQBELs** | - Monte Carlo | - Monte Carlo | - Monte Carlo<br>- Intake variance | - Dental BMPs<br>- Mercury minimization plans | - Toxic management plans<br>- Congener-specific approach[a] |

*Note*: BLM = Biotic Ligand Model; MPEC = Maximum Possible Effluent Concentration
a. PCB congeners may be used to support the total PCB limit required by WQS.

## 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 | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | |
| Nonferrous Metals Manufacturing | | | | | | | | | | | | | | | | | | X | X | X | | | | | | X | | | | | | | | |
| Oil and Gas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Organic Chems., Plastics, and Syn. | 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 | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | |
| Nonferrous Metals Manufacturing | | | | | | | | | | | | | | | X | | | | | X | | | | | | | | | | | | X | | |
| Oil and Gas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Organic Chems., Plastics, and Syn. | | | 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 | X | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | |
| Nonferrous Metals Manufacturing | | X | | | X | X | | | | | | | X | | X | X | | | | | | | | X | X | X | | | | X | | | | |
| Oil and Gas | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| Organic Chems., Plastics, and Syn. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 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 | Non-polar 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 | | | | | | | | | | | | | | | | | | | X | X | X | | | | | | | | | | | | |
| Nonferrous Metals Manufacturing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | |
| Oil and Gas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Organic Chems., Plastics, and Syn. | | | | | | | 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. 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<br>Concentration Limit in mg/L<br>Conversion Factor =<br>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<br>M = Raw Milk is the amount processed each day (lb/day)<br>PFPC = Percentage of F, P, & C in the raw milk |
| 3 | Constituent Input | $In_x = C_M \times C_{ELG}$ | $In_x$ = equivalent pollutant value<br>$C_M$ = Quantity of Macro Component<br>$C_{ELG}$ = Conversion coefficient from appropriate ELG |
| 4 | AML for new dairy sources | $AML = \left(\sum In_x\right) \times PS_{AML}$ | AML = Average Monthly Limit<br>$\Sigma In_x$ = Summation of equivalent pollutant values<br>$PS_{AML}$ = Performance Standard for AML |
| 5 | Maximum Daily Limit for new dairy sources | $Max. Daily\ Limit = \left(\sum In_x\right) \times PS_{MaxDailyLimit}$ | $\Sigma In_x$ = Summation of equivalent pollutant values<br>$PS_{MaxDailyLimit}$ = 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<br>$P_{rate}$ = Production Rate<br>$C_{ELG}$ = Effluent Limitation Guideline conversion factor |
| 7 | Tiered Limit calculation | $L_B = P_{Rate} \times C_f \times C_{ELG}$ | $L_B$ = Individual Component's Load<br>$P_{rate}$ = Production Rate<br>$C_{ELG}$ = Effluent Limitation Guideline conversion factor<br>$C_f$ = Conversion Factor |
| 8 | Coefficient of Variation (CV) | $CV = \frac{Standard\ Deviation}{Mean}$ | CV = Coefficient of Variation<br>Standard Deviation = a calculated value that indicates the extent of deviation for a group as a whole<br>Mean = a 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<br>$Q_{am}$ = arithmetic mean flow |
| 10 | 7Q10 calculation | $7Q10 = [Q_{hm}/(1.194XQ_{am}{}^{0.473})]^{1/0.552}$ | 7Q10 = the low 7-day average flow with a return frequency of once every 10 years |
| 11 | Alternative 7Q10 | $7Q10 = Q_{hm}/3.5$ | |
| 12 | 1Q10 calculation | 1Q10 = 7Q10/1.3 | 1Q10 = the 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 = the 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 = The max instantaneous or one (1) hour average concentration<br>WER = Water Effects Ratio<br>exp = base e exponential function (2.71828)<br>mA = slope of the acute regression line<br>ln hardness = natural log of total hardness<br>bA = y-intercept of the acute regression line<br>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 = The four (4) day average concentration<br>WER = Water Effects Ratio<br>exp = base e exponential function (2.71828)<br>mc = slope of the chronic regression line<br>ln hardness = natural log of total hardness<br>bc = y-intercept of the chronic regression line<br>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<br>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<br>ln hardness = natural log of total hardness |

| Equation # | Description | Equation | Variables |
|---|---|---|---|
| 19 | Lead Acute & Chronic Conversion Factor | $Pb_{(acute\&chronic)}$ CF = 1.46203 – [(ln hardness) X(0.415712)] | $Pb_{(acute\&chronic)}$ CF = Lead Acute and Chronic Conversion Factor<br>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 = The one (1) hour average concentration of total ammonia nitrogen (in mg-N/L)<br>pH = 95th percentile of pH in the receiving water body upstream from the discharge |
| 21 | Chronic, early life stages present, Ammonia Criteria | $CCC = [0.0577/(1+10^{(7.688-pH)}) + 2.487/(1.10^{(pH-7.688)})]$ X $MIN[2.85, 1.45x10^{(0.028x(25-T)}]$ | CCC = the thirty (30) day average concentration of total ammonia nitrogen (in mg-N/L)<br>pH = 95th percentile of pH in the receiving water body upstream from the discharge<br>T = 95th percentile of the ambient upstream receiving water body temperature<br>MIN = the smallest value from the data set |
| 22 | Chronic, early life stages absent, Ammonia Criteria | $CCC = [0.0577/(1+10^{(7.688-pH)}) + 2.487/(1.10^{(pH-7.688)})]$ X $[1.45x10^{(0.028x(25-T)}]$ | CCC = the thirty (30) day average concentration of total ammonia nitrogen (in mg-N/L)<br>pH = 95th percentile of pH in the receiving water body upstream from the discharge<br>T = 95th percentile of the ambient upstream receiving water body temperature |
| 23 | Acute Toxic Units | $TU_a = 100/LC_{50}$ | $TU_a$ = Acute Toxic Unit<br>$LC_{50}$ = Lethal concentration at 50% survival rate |
| 24 | Chronic Toxic Units | $TU_c = 100/NOEC$<br>$TU_c = 100/IC_{25}$<br>$TU_c = 100/LOEC$ | $TU_c$ = Chronic Toxic Unit<br>NOEC = No Observable Effects Concentration<br>$IC_{25}$ = Inhibition concentration at which 25% of test subject suffer effects<br>LOEC = Lowest Observable Effect Concentration |
| 25 | Dilution Factor | $D = (Q_s \times P + Q_e)/Q_e$<br>Or, an alternate form<br>$D = [(Q_s \times P)/Q_e] + 1$ | D = Dilution Factor<br>$Q_s$ = receiving water low-flow condition (cfs)<br>P = mixing zone percentage<br>$Q_e$ = effluent discharge flow (cfs) |
| 26 | Simple mass-balance equation | $C_d = [C_eQ_e+(C_u(Q_u \text{ X } \%MZ))] / [Q_e + (Q_u \text{ X } \%MZ)]$ | $C_d$ = downstream receiving water concentration<br>$Q_e$ = critical effluent flow<br>$Q_u$ = critical upstream flow (1Q10 acute criterion, 7Q10 chronic, or harmonic mean) |

| Equation # | Description | Equation | Variables |
|---|---|---|---|
| | | | %MZ = percent of critical low flow provided by mixing zone<br>$C_e$ = critical effluent pollutant concentration<br>$C_u$ = critical upstream pollutant concentration |
| 27 | Critical Effluent pollutant concentration calculation | $C_e$ = MOEC X RPMF | $C_e$ = critical effluent pollutant concentration<br>MOEC = Maximum observed effluent concentration<br>RPMF = Reasonable Potential Multiplication Factor |
| 28 | Highest concentration reported percentile | $P_n = (1 - \text{Confidence Level})^{1/N}$ | $P_n$ = percentile corresponding to the highest reported pollutant concentration<br>N = number of samples<br>Confidence Level = $99^{th}$ |
| 29 | 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<br>e = base of natural log (2.71828)<br>$z_{99}$ = z score of the $99^{th}$ percentile normal distribution (2.326)<br>$z_{pn}$ = z score of the normal distribution corresponding to the “N” samples calculated using Equation 26<br>$\sigma$ = square root of $\sigma^2$<br>$\sigma^2 = \ln(CV^2 + 1)$<br>CV = coefficient of variation use Equation 8 |
| 30 | 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)<br>$Q_e$ = critical effluent flow<br>$Q_u$ = critical upstream flow (1Q10 acute criterion or 7Q10 chronic)<br>%MZ = percent of critical low flow provided by mixing zone<br>$C_u$ = critical upstream pollutant concentration<br>$C_e = WLA_{(a\ or\ c)}$ = waste load allocation (acute or chronic) |
| 31 | WLA for non-flowing water from simple mass-balance equation | $WLA_{(a\ or\ c)} = WQC_{(a\ or\ c)}(D+1) - D \times C_r$ | $WLA_{(a\ or\ c)}$ = waste load allocation (acute or chronic)<br>$WQC_{(a\ or\ c)}$ = pollutant water quality criterion (acute or chronic)<br>D = Dilution ratio<br>$C_r$ = critical receiving water pollutant concentration (acute & chronic) |

| Equation # | Description | Equation | Variables |
| --- | --- | --- | --- |
| 32 | Dilution Factor for Non-flowing water | $D = \frac{V_r}{Q_e \times t}$ | D = Dilution ratio<br>$V_r$ = non-flowing receiving water volume (MG)<br>$Q_e$ = effluent flow rate (MGD)<br>t = receiving water body residence time (days) |

| Equation # | Description | Equation | Variables |
|---|---|---|---|
| 33 | 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<br>$WLA_a$ = acute wasteload allocation<br>e = base of natural log<br>σ = square root of $σ^2$<br>$σ^2$ = Ln($CV^2$+1)<br>CV = Coefficient of Variation (default = 0.6)<br>$Z_{99}$ = z score of the $99^{th}$ percentile of the normal distribution |
| 34 | 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<br>$WLA_c$ = chronic wasteload allocation<br>e = base of natural log<br>$σ_n$ = square root of $σ_n^2$<br>$σ_n^2$ = Ln[($CV^2$)/n + 1)]<br>CV = Coefficient of Variation (default = 0.6)<br>$Z_{99}$ = z score of the $99^{th}$ percentile of the normal distribution<br>n = averaging period for the chronic water quality criterion (4 days) |
| 35 | 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<br>e = base of natural log<br>σ = square root of $σ^2$<br>$σ^2$ = Ln($CV^2$+1)<br>CV = Coefficient of Variation (default = 0.6)<br>$Z_{99}$ = z score of the $99^{th}$ percentile of the normal distribution |
| 36 | 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<br>AML = average monthly limit<br>e = base of natural log<br>$σ_n$ = square root of $σ_n^2$<br>$σ_n^2$ = Ln[($CV^2$)/n + 1]<br>$Z_{95}$ = z score of the $95^{th}$ percentile of the normal distribution<br>n = Number of sample specified in the permit to be analyzed each month<br>CV = coefficient of variation |

| **Equation #** | **Description** | **Equation** | **Variables** |
|---|---|---|---|
| 37 | 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<br>e = base of natural log<br>σ = square root of $\sigma^2$<br>$\sigma^2 = Ln[CV^2 + 1]$<br>$\sigma_n$ = square root of $\sigma_n^2$<br>$\sigma_n^2 = Ln[(CV^2)/n + 1]$<br>$Z_a$ = The percentile exceedance probability for the AML<br>n = Number of samples specified in the permit to be analyzed each month<br>CV = coefficient of variation |
| 38 | 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<br>$IC_{25}$ = Inhibition concentration at which 25% of test subject suffer effects |
| 39 | Alternate Acute to Chronic Ratio | $ACR = \frac{LC_{50}}{IC_{25}} = \frac{\frac{100}{TU_a}}{\frac{100}{TU_c}} = \frac{TU_c}{TU_a}$ | |
| 40 | WET WLA from simple mass-balance equation | $WLA_{a/c} = \frac{(AC\ or\ CC) \times [Q_e + (Q_u \times \%MZ)] - [C_u \times (Q_u \times \%M}{Q_e}$ | $WLA_{a/c}$ = wasteload allocation (acute or chronic)<br>$Q_e$ = critical effluent flow<br>$Q_u$ = critical upstream flow (1Q10 acute criterion or 7Q10 chronic)<br>%MZ = percent of critical low flow provided by mixing zone<br>$C_u$ = critical upstream pollutant concentration<br>$WLA_{a/c}$ = waste load allocation (acute or chronic)<br>AC = Acute Whole Effluent Criterion ($0.3TU_a$)<br>CC = Chronic Whole Effluent Criterion ($1.0TU_c$) |
| 41 | WET Trigger Calculation | $C_e = \frac{\left(C_d \times \left((\%MZ \times Q_u) + Q_e\right) - (C_u \times Q_u)\right)}{Q_e}$ | $C_e$ = Chronic WET trigger effluent concentration (value > Chronic WET criterion)<br>$Q_e$ = critical effluent flow<br>$Q_u$ = critical upstream flow (7Q10 chronic)<br>%MZ = percent of critical low flow provided by mixing zone<br>$C_u$ = critical upstream pollutant concentration |

| Equation # | Description | Equation | Variables |
|---|---|---|---|
| | | | (upstream chronic WET concentration = 0.0 $TU_c$)<br>$C_d$ = 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<br>$WLA_a$ = acute wasteload allocation<br>e = base of natural log<br>σ = square root of $\sigma^2$<br>$\sigma^2 = Ln(CV^2+1)$<br>$Z_{99}$ = z score of the 99th percentile of the normal distribution |
| 43 | Acute WET Maximum Daily Limit | $MDL\ Max\ Daily\ Llimit_a = LTA_a \times e^{(z_{99}\sigma - 0.5\sigma^2)}$ | $LTA_a$ = acute long term average<br>e = base of natural log<br>σ = square root of $\sigma^2$<br>$\sigma^2 = Ln(CV^2+1)$<br>$Z_{99}$ = 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<br>$LTA_a$ = acute long term average<br>e = base of natural log<br>$\sigma_n$ = square root of $\sigma_n^2$<br>$\sigma_n^2 = Ln[(CV^2/n) + 1]$<br>$Z_{95}$ = 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<br>$WLA_c$ = chronic wasteload allocation<br>e = base of natural log<br>$\sigma_4$ = square root of $\sigma_4^2$<br>$\sigma_4^2 = Ln[(CV^2/4) + 1]$<br>$Z_{99}$ = 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<br>e = base of natural log<br>σ = square root of $\sigma^2$<br>$\sigma^2 = Ln(CV^2+1)$<br>$Z_{99}$ = 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<br>$LTA_c$ = chronic long term average<br>e = base of natural log<br>$\sigma_n$ = square root of $\sigma_n^2$<br>$\sigma_n^2 = Ln[(CV^2/n) + 1]$<br>$Z_{95}$ = z score of the 95th percentile of the normal distribution |
| 48 | Concentration Probability | $P = \left(\frac{rank}{n+1}\right)$ | P = probability<br>n = the number of data points in the set<br>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)<br>$D$ = Dilution Factor (Equation 24)<br>$T_d$ = Water Quality Criterion (°C)<br>$T_u$ = Upstream receiving water temperature (°C) |
| 50 | Dilution Factor for Flowing Water | $D_f = \frac{Q_e + P \times Q_u}{Q_e}$ | $D_f$ = Dilution Factor for flowing receiving water<br>$Q_e$ = Effluent flow (cfs or MGD)<br>$Q_u$ = Receiving water body critical low flow (cfs or MGD)<br>$P$ = Percent mixing authorized (%) |