Appendix 4. Guidance for Water Quality-Based Effluent Limits

Final Draft

Guidance for Water Quality-Based Effluent Limits for the State of Idaho

Prepared for

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1.1 Purpose and Origin of Guidance

1.1.1 Clean Water Act Background

The Federal Water Pollution Control Act, or Clean Water Act (CWA), is the primary U.S. law addressing pollutants in receiving waters (for example, streams, rivers, lakes, and reservoirs). The CWA was originally enacted in 1948. It 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 reducing discharge of pollutants under the National Pollutant Discharge Elimination System (NPDES) permit program.

1.1.2 Water Quality Standards

A water quality standard (WQS) defines the water quality goals for a water body. Water quality-based NPDES permit limits are a mechanism to achieve and/or maintain water quality standards in a specific receiving water. The Idaho water quality standards are contained in Idaho Administrative Code IDAPA 58.01.02.

The federal Water Quality Standards Regulation (40 CFR 131) describes state requirements and procedures for developing water quality standards and U.S. Environmental Protection Agency (EPA) procedures for reviewing and, where appropriate, promulgating water quality standards. The Idaho water quality standards were developed in accordance with the requirements of 40 CFR 131.

States adopt water quality standards to protect the public health and environment, in accordance with the requirements of the CWA. The water quality standard goals are defined by the following:

- Designating use or uses for water bodies
- Setting criteria necessary to protect the use
- Establishing provisions to prevent degradation of water quality (antidegradation)
- Establishing, at the discretion of states, policies such as mixing zones and variances.

1.1.2.1 Designation of Uses

States are required to specify water uses to be achieved or maintained. These uses are to be set taking into account the use and value of the water body. To be consistent with the CWA, states must provide water quality for the protection and propagation of fish, shellfish, and wildlife, and provide for recreation in and on the water (fishable/swimmable) where attainable (40 CFR 131.10 (j)).

The Idaho water quality standards uses assigned to water bodies (IDAPA 58.01.02.100) are as follows:

- Aquatic life
  - Cold water communities (COLD)
  - Salmonid spawning (SS)
  - Seasonal cold water communities (SC)
  - Warm water communities (WARM)
  - Modified communities (MOD)

- Recreation
  - Primary contact recreation (PCR) (for example, whole body contact such as swimming)
  - Secondary contact recreation (SCR) (partial body contact such as fishing or boating)
- Water supply
  - Domestic water supply (DWS)
  - Agriculture (this use applies to all waters of the state)
  - Industrial (this use applies to all waters of the state)
- Wildlife habitat (this use applies to all waters of the state)
- Aesthetics (this use applies to all waters of the state)
- Nondesignated (to date). Prior to designation, these waters are protected for presumed beneficial uses including recreation and aquatic life and wildlife, wherever attainable.

Idaho waters can also be designated as follows:

- Special Resource Water (SRW) as described in IDAPA 58.01.02.056. SRWs are water bodies needing intensive protection to preserve outstanding or unique characteristics or to maintain current beneficial uses.
- Use Unattainable (NONE)
- Outstanding Resource Water (ORW) (if designated by the state legislature as described in IDAPA 58.01.02.055). An ORW is a high-quality water, such as national or state parks and wildlife refuges, and waters of special or recreational or ecological significance.

The designated use is the formal, legally enforceable use of the water body as listed in the State's water quality standards. EPA defines the existing uses as "uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." Existing and attainable (or potential) uses may or may not conform to designated uses. For example, if a water body has been assigned the designated use of cold water biota but has not maintained cold water populations since 1975, then this is not an existing use. However, cold water biota would be considered an attainable use if the cause of non-attainment could be remedied through application of protective effluent limits and cost–effective and reasonable best management practices (BMPs) for nonpoint sources.

1.1.2.2 Narrative and Numeric Water Quality Criteria

Water quality criteria (WQC) are established to protect designated uses and often vary in accordance with the use designation. They can be either narrative or numeric in form. The Idaho WQS consist of both narrative and numeric criteria. Narrative criteria are strictly verbal descriptions such as those listed under IDAPA 58.01.02.200.01 through .09, several examples of which are given below:

> *02. Toxic Substances. Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses. These substances do not include suspended sediment produced as a result of nonpoint source activities.*
>
> *06. Excess Nutrients. Surface waters of the state shall be free from excess nutrients that can cause visible slime growth or other nuisance aquatic growths impairing designated beneficial uses.*
>
> *09. Natural Background Conditions. When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the*

> *applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401.*

Numeric criteria define the specific concentration of the pollutant or parameter allowed in, or necessary for, the water body to achieve or maintain its designated use.

The CWA stipulated that EPA develop a list of numeric criteria to serve as guidance for the states. EPA has published several criteria lists and guidance documents for developing criteria. These are not legally enforceable criteria until a state formally adopts them into its water quality standards. Idaho's adopted numeric criteria are provided in the following sections of IDAPA 58.01.02:

- Section 210. Numeric Criteria for Toxic Substances for Waters Designated for Aquatic Life, Recreation, or Domestic Water Supply Use
- Section 250. Surface Water Quality Criteria for Aquatic Life Use Designations
- Section 251. Surface Water Quality Criteria for Recreation Use Designations
- Section 252. Surface Water Quality Criteria for Water Supply Use Designations
- Section 253. Surface Water Quality Criteria for Wildlife and Aesthetics Use Designations

Water quality criteria are generally established for broad categories of use that are applicable statewide. Idaho has established numeric criteria for the broad categories of aquatic life, recreation, water supply, and wildlife and aesthetics uses. However, site-specific water quality criteria also may be set by the State, with EPA review and approval. Procedures for establishing site-specific water quality standards are provided in IDAPA 58.01.02.275. The procedures are developed for implementation by the permittee in cases where the adopted numeric criteria may not appropriately represent the toxicity of the parameter in a particular water body segment. They can also be used to develop criteria for parameters where criteria have not yet been developed.

EPA documents provide detailed study plans for the development of site-specific criteria. Studies are to be conducted in accordance with *Guidelines for Deriving Numerical Aquatic Site-Specific Water Quality Criteria by Modifying National Criteria*, EPA 1984, and the *Water Quality Standards Handbook*, EPA 1994b. EPA-approved procedures for site-specific criteria development are briefly summarized as follows (IDAPA 58.01.02.275.01h.ii.):

- **Recalculation Procedure.** Recalculation of the criteria value using permittee-developed site-specific data on: 1) the types of resident species present; and/or 2) any supported changes or corrections to the existing EPA criteria database regarding the toxicity of the parameter to the resident species. Changes or corrections to the existing EPA criteria database are generally performed by conducting laboratory toxicity tests.

- **Indicator Species Procedure.** Using an indicator species that is resident or an acceptable non-resident, conduct toxicity tests in site water to establish a site-water toxicity value that can be used to replace existing EPA data used to calculate the criteria value. The site water test is intended to account for differences in biological availability and/or toxicity of a chemical in site water compared to laboratory water.

- **Resident Species Procedure.** Using a resident species, conduct toxicity tests in site water. This procedure accounts for both the sensitivity of resident species and the toxicity of the pollutant in the site water. The data generated is used in the development of the site-specific criteria.

- **Water Effect Ratios.** The water effect ratio procedure accounts for the difference that exists between the toxicity of a pollutant in laboratory water (recognizing that statewide criteria are developed using lab water) and its toxicity in site water. It has most commonly been used for metals such as copper, lead, cadmium, and zinc.

- **Other Scientifically Defensible Procedures**. These include relevant aquatic field studies, laboratory tests, biological translators, fate and distribution models, risk analyses or available scientific literature. One example currently under development is the Biotic Ligand model for metals toxicity to aquatic organisms (EPA 1999c).

The 1987 amendments also required states to establish biological criteria, or biocriteria. To date, most states have narrative biological criteria in place, while only several states have numeric biocriteria in place. Numeric criteria rely on indices descriptive of the diversity and abundance of the aquatic communities. The State of Idaho has narrative biological criteria (IDAPA 58.01.02.053 and IDAPA 58.01.02.090.03) and has developed implementing guidance contained in the *Water Body Assessment Guidance* (IDEQ 2002). This guidance, however, does not address how biological criteria are to be implemented in NPDES permits. EPA is also in the process of developing sediment criteria guidance to protect benthic (bottom-dwelling) organisms from toxic effects caused by the accumulation of pollutants in sediments. Sediment toxics criteria have not yet been published by EPA or adopted in Idaho water quality standards, and no NPDES implementing procedures have been put forth by either agency to date. Thus, the guidance contained herein addresses only water quality criteria specific to the water column.

1.1.2.2.1 Parameters that Affect Toxicity of Specific Chemicals. The aquatic toxicity of several parameters is a function of water quality characteristics, and numeric criteria set by EPA reflect this. Ammonia toxicity in fresh water is a function of temperature and pH. Metals toxicity in fresh water varies as a function of water hardness; therefore the numerical criteria for several metals is an equation that incorporates water hardness.

Ammonia Criteria – Cold Water Aquatic Life (IDAPA 58.01.02.250.02.d). The acute criteria for ammonia is based on a 1-hour average exposure of total ammonia nitrogen (in mg N/L) that is not be exceeded more than once every 3 years. The value is calculated from the following equation:

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

The chronic criteria for ammonia is based on a 30-day average concentration (whereas for parameters other than ammonia, the chronic criteria is based a 4-day average concentration) that is not to be exceeded more than once every 3 years. The value is obtained from the following equation:

When fish early life stages are likely present:

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

When fish early life stages are likely absent:

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

Note: The highest 4-day average within the 30-day period should not exceed 2.5 times the CCC. The permittee must information demonstrating that early life stages are likely absent to Idaho Department of Environmental Quality (IDEQ). In the absence of an alternate determination by the IDEQ, early life stages are assumed to be likely present.

Ammonia Criteria—Warm Water Aquatic Life (IDAPA 58.01.02.250.04.d). The warm water aquatic life ammonia acute criteria is also based on a 1-hour exposure not the be exceeded more than once every 3 years. The value is calculated from the following equation:

$$CMC = \frac{0.411}{1+10^{7.204-pH}} + \frac{58.4}{1+10^{pH-7.204}}$$

The warm water aquatic life ammonia chronic criteria are not to exceed those established for cold water aquatic life.

Toxic Metals Criteria (IDAPA 58.01.02.210). Idaho has adopted the National Toxics Rule (NTR) (40 CFR 131.36) values for toxic substances, including metals, with exceptions noted in IDAPA 58.01.02.210. These criteria are provided in Appendix A. As noted, many of the metals criteria are hardness-dependent, and these equations are in the NTR. The dissolved metal fraction is used to set and measure compliance with the water quality criteria (*Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria,* EPA 1993c). The permit is required to have limits expressed as total recoverable metal (40 CFR 122.45(c)).The *Stay of Federal Water Quality Criteria for Metals* (NTR Stay) (EPA 1995c), which codified the use of dissolved criteria under the NTR (as adopted and modified in IDAPA 58.01.02.210) lists the Conversion Factor (CF) values to be used when converting metals values from dissolved criteria to total recoverable criteria. Converting permit limitations between dissolved and total recoverable is usually accomplished using a site-specific Chemical Translator (CT) (EPA 1996b). If a site-specific CT is not available, the CFs are commonly used as default CTs. The CFs included in the NTR Stay are further described in Section 2.3.2.1.1.

In addition to the ammonia-pH/temperature and metals-hardness relationships, the toxicity of other parameters, including metals, can also be influenced by organics and/or sediments in the receiving waters), or by the presence or absence of sensitive species in a particular water body. As noted previously in this guidance, EPA has defined procedures to modify EPA criteria to develop site-specific criteria that can account for the toxicity of a parameter in the specific receiving water, or to protect local aquatic species. EPA-approved procedures for site-specific criteria development are provided at IDAPA 58.01.02.275.01h.ii.

1.1.2.2.2 Whole-Effluent Toxicity. Protection against toxic discharges is required by the CWA. The CWA and the EPA require the use of integrated approaches to ensuring protection against toxic discharges. Narrative and numerical criteria applicable to whole effluent toxicity (WET), WET monitoring and, in some states, WET limits, are part of a state's integrated water quality standards program.

Idaho has not adopted numeric criteria for WET, but does have a narrative criterion at IDAPA 58.01.02.200.02 that reads: "*Toxic Substances. Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses. These substances do not include suspended sediment produced as a result of nonpoint source activities.*"

Numerical WET criteria (or numerical interpretation of a narrative criterion) identify a specific toxicity threshold value for acute (short-term) and chronic (long-term) in-stream toxicity. When mixing zones are part of state's program, dilution in the receiving water can be used in the calculation to determine the need for and calculation of a permit limit for WET, similar to that for chemical specific toxics, to achieve the state's WET numerical or narrative criteria.

1.1.2.3 Antidegradation Requirements

The antidegradation policy is provided at IDAPA 58.01.02.051. The policy provides that:

- The existing in stream water uses and the level of water quality needed to protect those uses must be maintained.

- For high-quality waters (where the quality exceeds that necessary to support the designated uses), the quality must be protected unless IDEQ determines that allowing lower quality is necessary for importance economic or social development. In making this determination, the inter-governmental and public participation provisions of IDEQ's continuing planning process must be followed. The quality must be maintained at a level to protect the existing uses. The highest statutory and regulatory requirements must be maintained for each new point source, and non-point sources shall have cost-effective and reasonable BMPs.

- Outstanding Resource Waters shall be maintained and protected from the impacts of point and non-point sources.

1.1.2.4 General Policies Such as Mixing Zone Requirements and Variances to Water Quality Standards

Water quality standards regulations allow states to include policies such as mixing zone requirements and variances to water quality standards in their standards. A mixing zone is an area of limited spatial extent in which an effluent diluted by a receiving water body must meet the water quality criteria. The mixing zone policy is defined at IDAPA 58.01.02.060 and is described in more detail later in this guidance.

Variance procedures are defined at 58.01.01.260. These procedures allow IDEQ to grant a temporary non-attainment of a designated use by allowing a variance from the water quality standard on a pollutant- and discharger-specific basis. A variance is granted for a 5-year term (or the life of the permit). At the end of the 5-year term, the permittee must reapply for the variance. Specific demonstrations must be made by the permittee in order to be considered for a variance, and to have the variance reinstated. A variance can be used as an alternative to removing a designated use when the state believes that, ultimately, the designated use can be achieved. By maintaining the designated use, the State can better ensure that future progress is made in achieving the necessary standard.

1.1.3 Technology-Based Limits vs. Water Quality-Based Limits

Under the CWA, the requirements for discharge controls on industries were to first meet limits that could be achieved through the use of best practicable technology (BPT) for wastewater treatment, and later by improved best available technology (BAT). BPT and BAT 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.

Technology-based effluent limits are the treatment requirements set under Section 301(b) of the Act. They are the minimum level of control that must be imposed in a discharge permit issued under Section 402 of the Act.

While toxics control had been an element of the Act since 1980 and was reiterated as an important element in 1984, the 1987 amendments included a stronger focus on controlling toxic pollutants. Technology-based limits remain for the selected industrial types and “secondary treatment” for publicly owned treatment works (POTWs), but with the 1987 amendments, dischargers would also be subject to more rigorous permitting determinations to protect receiving waters from toxic discharges. The more stringent of the two limiting criteria, technology-based and water quality-based, must be met by the discharger. Although the water quality-based approach was not new to the Act or its implementation prior to 1987 (for example, it was commonly used to regulate conventional pollutants such as biochemical oxygen demand and ammonia to protect dissolved oxygen criteria), the new emphasis on toxics pursuant to the 1987 amendments was a significant escalation in its application in permits. These amendments led to EPA’s promulgation of the NTR in 1992. The NTR established toxics criteria and some implementation methods for states that had not yet acted to adopt their own, including Idaho.

One element of EPA’s oversight role is to ensure that the methods used to establish water quality-based permit limits are technically sound. To assist in state program development, EPA has issued several guidance documents and memoranda on water quality-based permitting procedures. One such guidance document is the *Technical Support Document for Water Quality-Based Toxics Control* (TSD) first published in September 1985 and updated in March 1991 (EPA 1991a). EPA subsequently promulgated *Water Quality Guidance for the Great Lakes System* in March 1995 (EPA 1995a), otherwise known as the Great Lakes Initiative (GLI). The GLI included water quality criteria for toxics and a number of implementing procedures for translation of these criteria into NPDES permit conditions. The GLI reiterated a number of the TSD methods, defined methods that were not addressed in the TSD, and provided direction on which TSD approach to use in cases in which the TSD offered alternatives. Most recently, EPA published new guidance relating to how WET testing, and its inherent variability, is to be implemented in permits (EPA 2000c).

In addition to this body of EPA guidance, all states with NPDES primacy have developed their own guidance and/or rules to develop water quality-based effluent limits (WQBELs). These state programs provide useful examples of how national guidance has been tailored to meet state-specific conditions and regulatory frameworks.

1.1.3.1 General Standards-to-Permits Process

1.1.3.1.1 Overview of NPDES Program. One of the key programs mandated by the CWA is the National Pollutant Discharge Elimination System (NPDES). The NPDES program provides control of pollutant discharges through a permit system. Discharges of pollutants from point sources to waters of the United States are prohibited unless an NPDES permit is obtained. NPDES permits contain several key elements:

- Effluent limitations (40 CFR 122.44)
- Monitoring and reporting requirements (40 CFR 122.48)
- Schedules of compliance (40 CFR 122.47)

Both technology-based and water quality-based controls are implemented through NPDES permits. Permits based on protection of the water quality standards are termed water quality-based.

The process to calculate permit limits to enable the protection of water quality standards is referred to in this document as the “standards-to-permit process.”

1.1.3.1.2 Derivation of WQBELs in the Standards-to-Permit Process. WQBELs are derived based on wasteload allocations (WLA) calculated for point sources to establish the level of effluent (discharge) quality necessary to protect the water quality standards of the receiving stream. These calculated wasteload allocations are compared to the expected discharge concentrations in the effluent. If there is a "reasonable potential to exceed" (RPTE) the water quality standard in-stream, then a permit limit is applied to control the pollutant or pollutants of concern—whether that pollutant is a chemical-specific parameter or whole effluent toxicity.

The general process can be summarized in the following steps:

1. Define water quality standards for the water body (designated uses, criteria, mixing zones, antidegradation).
2. Characterize the effluent (chemical-specific and WET), considering variability of effluent.
3. Define required discharge characteristics based on WLA.
4. Determine the reasonable potential to exceed the WLA. If the effluent characteristics do not exceed the WLA, limits are not required. If the effluent characteristics do exceed the WLA, limits are required.
5. Derive permit limits.

The determination of reasonable potential to exceed is a critical component of the process of setting permit limits. If the discharge causes, has the reasonable potential to cause, or contributes to an excursion that exceeds water quality criteria or a narrative standard, a limit must be set (40 CFR 122.44 (d)(1)).

To determine if reasonable potential exists, the characteristics of the effluent and receiving stream are evaluated to determine the effluent pollutant concentration that can be discharged and still maintain the water quality standards. This effluent concentration is the WLA. If the WLA is exceeded by the effluent, taking into account the predicted variability of the effluent quality, then permit limits must be set for the chemical-specific parameter or WET. Effluent variability is an important consideration in the determination of reasonable potential. Permit limits set based on this procedure are WQBELs.

Equations for WLAs, and procedures for estimating effluent variability are provided in Section 2 of this guidance.

1.1.3.1.3 Modeling Considerations in Water Quality-Based Permitting

Pollutant Fate and Transport. The use of simple WLA mass-balance equations may not accurately reflect the receiving water conditions for some parameters such as the following:

- The heat contained in thermal discharges (those with temperature greater than the receiving water) will dissipate in the receiving water as it responds to other heating and/or cooling factors and moves toward an equilibrium condition.
- Non-conservative parameters, such as ammonia that will naturally convert to nitrates over time, or biochemical oxygen demand (BOD) that will naturally degrade but consume dissolved oxygen in the process.
- Parameters that are volatilized and thus leave the water column, such as volatile organics.
- Pollutants that bind to particulates, that may drop from the water column or simply become non-bioavailable in particulate form.

Consideration of the fate and transport of pollutants such as these should be accounted for in the use of water quality and mixing models to establish WLAs where appropriate. Such models may also be appropriate in multiple discharge situations to determine how much of a pollutant from an upstream discharge is decayed or assimilated before reaching the location of a downstream discharge.

Steady-State and Dynamic Modeling. The two major types of water quality models used for WLA determinations are steady-state and dynamic modeling. The output of each type of model is used differently in the permit limit development process.

The steady-state model uses one- or two-value inputs, and, therefore, can be used for a single condition such as the maximum discharge effluent flow at the lowest receiving water flow condition. It is referred to as “steady-state” because the values input and models (or equations) used are not time-variable but are instead fixed for that set of inputs. Because this type of modeling can be used with less data and can be set up to provide clearly protective results, EPA recommends that steady-state modeling be used in most cases. It is particularly suitable where there is not a complete record of receiving water or effluent flows or other characteristics.

Steady-state modeling is highly protective, and may be overly protective to meet the criteria. For the example cited above, the highest effluent flow to the lowest receiving water flow, each condition in itself has a low probability of occurrence, and the combination of both at the same time may occur rarely or never. Criteria are set to require protection over a time return interval, such as Idaho’s once in 3-years average frequency for excursion of both acute and chronic criteria. With steady-state modeling, the return frequency may be much longer than needed to protect the criteria.

Dynamic modeling uses estimates of effluent and receiving water variability to develop effluent requirements. Dynamic models account for the daily variations and of probability-based relationships between flow, effluent, and environmental characteristics. An advantage to dynamic models is that they can be designed to enable protection of the water quality standard at the return frequency required by the standard.

1.1.3.2 Single vs. Multiple Discharges

This guidance document primarily addresses continuous point source discharges in situations in which water quality standards in the receiving water body are generally being met. The equations and calculation methods provided in this guidance illustrate the case of a single discharge to a receiving water. There will be cases where there are multiple discharges to a receiving water body, and the pollutant in question is not fully decayed or assimilated by the receiving water between an upstream source and a downstream source. In these cases, the simplest approach is to account for the upstream source in the background receiving water concentration for the downstream source (see Section 2.3.1.1.5).

It will be more appropriate in some cases to evaluate equitable allocation scenarios between two or more point sources if discharges from upstream sources substantially affect the requirements placed on a downstream discharger.

Development of a total maximum daily load (TMDL) is a method for evaluating multiple discharges in situations where it has been determined by IDEQ that standards are not being met. This procedure is described at IDAPA 58.01.02.054. To summarize the TMDL process, if IDEQ determines that a water body is not supporting its designated use, IDEQ will evaluate the existing, and potentially multiple, dischargers to the water body for the purpose of determining if additional pollutant controls would restore the water body to supporting its designated use. The TMDL places limits on pollutants entering the water body from point and nonpoint source activities. Load allocations (LAs) are given to nonpoint source activities such as farming, ranching, road and housing development, and forestry activities. WLAs are given to point sources such as municipal wastewater treatment plant discharges and industrial discharges. Evaluation of multiple discharges in a TMDL is performed using the following equation for an individual parameter:

$$\begin{aligned}\mathrm{TMDL} = \mathrm{Load\ Capacity} = \mathrm{LA}_1 + \mathrm{LA}_2 + \mathrm{LA}_n + \mathrm{WLA}_1 \\ + \mathrm{WLA}_2 + \mathrm{WLA}_n + \mathrm{MOS} + \mathrm{background} + \mathrm{reserve\ for\ growth}\end{aligned}$$

Italic elements are optional; LA_2, LA_n, WLA_2, and WLA_n represent different sources of pollutants. For example LA_1 might be forestry, LA_2 might be agriculture, and so on.
The terms are defined as follow:
Load Capacity (TMDL) is the maximum load of a pollutant that can be discharged to a water body that will result in meeting the water quality standards in-stream.
Load Allocation (LA) is the future load that nonpoint sources can discharge into the water body. Nonpoint source load allocations can be aggregated by geographic area or source as appropriate.
Wasteload Allocation (WLA) is the future load that each point source can discharge into the water body.
Margin of Safety (MOS) is a portion of the load capacity not available for load allocation which accounts for any lack of knowledge or uncertainty in the load capacity. MOS may be explicit (a specified value) or implicit (highly protective modeling assumptions) or both.
Background is the biological, chemical, or physical condition of waters measured at a point immediately upstream (upgradient) of the influence of individual point or nonpoint source discharges. Depending on the context, background could be either: 1) the pollutant load entering a water body from natural sources and not resulting from man's activities (natural background); or 2) the pollutant load entering a water body from upgradient/upstream sources which may be natural or man caused.

TMDL development will not be addressed in this guidance. Other considerations when receiving water background exceeds criteria are discussed in Section 2.5.

1.1.3.3 Antibacksliding Considerations

The general concept behind "antibacksliding" provisions of the CWA is that NPDES permit limits should not be relaxed except under certain circumstances or exceptions. The 1987 amendments to the CWA included new antibacksliding provisions and required EPA to develop implementing regulations. To date, EPA has established rules for technology-based limits set using the permit writer's best professional judgement (BPJ), but has not established antibacksliding rules for WQBELs. However, the 1987 amendments do provide a general framework for antibacksliding as related to WQBELs, as is described in the TSD (see TSD Section 5.7.7). In summary, the CWA allows relaxation of WQBELs if at least one of the following circumstances applies and WQS (including antidegration requirements) will be met:

- If water quality standards are currently being attained in the water body receiving the discharge, relaxation is allowed if state water quality standards will be met and compliance with technology-based limits will be assured

- If water quality standards are **not** currently being attained in the water body receiving the discharge, relaxation is allowed if the existing limits were based on a TMDL/WLA process and water quality standards will be met with the relaxed limit
- There has been substantial expansion or alteration of the facility after permit issuance
- Good cause exists due to events beyond the permittee's control for which there is no reasonably available remedy
- The permittee has properly installed and maintained required treatment equipment but still has been unable to meet the permit limits
- New information (other than revised regulations, guidance, or test methods) is available.

Note that the last exception above only applies if the relaxed limits result in a net reduction in pollutant loadings and are not the result of another discharger's elimination or substantial reduction of its discharge for reasons unrelated to water quality.

1.1.4 Purpose of Guidance

This guidance is intended to provide a basis for setting permit limits for NPDES permits in Idaho. The processes to be defined in this guidance includes:

- Calculation of WLAs
- RPTE the water quality criteria
- WQBELs calculation procedures

This guidance provides a technical backup to support state decision-making. This guidance focuses on simple methods using single-discharge scenarios, steady-state wasteload allocation, and conservative substances.

All possible scenarios cannot possibly be predicted or covered in this guidance; therefore, the discretion of the permit writer will still be needed in some cases. References are provided to other documents to assist the permit writer with more complex permitting scenarios.

This version of the guidance focuses primarily on control of toxic substances such as certain metals, ammonia, pesticides/herbicides, cyanide, solvents, and other toxic organic compounds. WQBELs are often considered or needed for other "conventional" pollutants such as oxygen-demanding materials (e.g., BOD) and suspended solids. Models more complex than those described in this version of the guidance are generally used to develop WQBELs for conventional pollutants as described in Section 1.1.3.1.3.

1.1.5 Origin of Guidance

This guidance was based on a review of EPA guidance and regulations as well as guidance and regulations of mature, EPA-approved state NPDES programs. The State of Wisconsin's approach was used as a model in most cases because: 1) it is a mature, successful, well-regarded program (for example, its toxic rules were promulgated in 1989, one of the first in the nation following the 1987 amendments); and 2) it has recently been subject to formal EPA review for consistency with the GLI (EPA 2000a). Because Wisconsin's WQBELs approach has been in place for more than a decade, they have had several rounds of NPDES permits issued under this approach, providing strong empirical evidence that the approach is protective and sound. EPA's recent review and approval of the elements of this approach provide additional reassurance of its integrity. Exceptions to the Wisconsin program are taken only where it appeared warranted (e.g., for specific elements that EPA did not approve), with the rationale for exceptions explained. In these cases, EPA guidance generally was incorporated or used as a model.

The rationale and technical source of the individual technical procedures are cited in this guidance for user reference. This guidance should be a living document—that is, it should be revised as new science emerges and new rules and policies are adopted. Water quality-based permitting procedures are still evolving.

1.1.6 Content of Guidance

The guidance document includes all equations used for RPTE and WQBEL calculations, and also provides sample calculations for several data sets that illustrate the methods and can be used by permit writers to check their methods and ensure that use of these equations in spreadsheets results in correct values being calculated.

2.0 Methods for RPTE and WQBELs Analyses

2.1 General RPTE and WQBELs Process

Determining RPTE requires first defining the allowable concentration of pollutant(s) that can be present in the discharge without exceeding the criteria in-stream. The process for determining this concentration for an individual discharger is a WLA.

A WLA equation is a steady-state mass balance using single-point values for effluent and receiving water flows, receiving water background values, and the selected criteria value. The WLA is set up to calculate the allowable discharge concentration to maintain the criterion. The WLA can be set up with default mixing zone allowances, such as 25 percent of the volume of the stream flow (IDAPA 58.01.02.060.01.e.iv).

A WQBEL will be applied when there is RPTE the criteria, or to contribute to an exceedance of the criteria, in-stream, as determined by comparing of the effluent concentration to the WLA. A reasonable potential to exceed the criteria is present based on factors described in Section 2.3.1.2.

When the effluent concentration indicates that there is a “reasonable potential,” the water quality-based effluent limit will be calculated according to procedures established by EPA technical guidance described herein.

There are some important differences between the RPTE and WQBELs calculations for specific chemicals compared to WET; thus Section 2.3 is for specific chemicals and Section 2.4 is for WET.

2.2 Data Quality and Quantity Considerations

2.2.1 Background

Sampling and analytical methods used to determine compliance are to conform to the guidelines of 40 CFR 136 (IDAPA 58.01.02.090.01) unless otherwise specified in the NPDES permit. Procedures for conducting clean and ultra-clean metal analysis, and procedures for conducting biological tests should be based on EPA-approved procedures as described in IDAPA 58.01.02.090.02 -.03.

Regulatory agencies and permittees collect data on effluent and in-stream ambient waters for use in a variety of applications, including: determining if water bodies are meeting the water quality standards; estimating effluent concentrations and variability for permit limit development or compliance; and for estimating background concentrations for WLAs or TMDLs.

The quality of data used is a critical issue. In order to ensure that the data collected for regulatory decision-making are valid and not affected by contamination from sampling or analytical techniques, continuing attention to quality control must be incorporated in all sampling event planning, sample collection, sample preparation, and analysis activities.

Quality control requirements for trace metals sampling and analysis are necessarily particularly rigorous because of the high risk for inadvertent sample contamination. Most of the water quality standards and ambient stream metal concentrations are at trace levels. Trace level metals data can be compromised by contamination during standard sampling, filtration, storage, and analysis. Procedures referred to as “clean sampling” and “ultra-clean sampling” have been developed by EPA to provide guidance in planning and executing sample collection and analysis. The objective of the guidance is to both minimize the potential for contamination and, where contamination does still occur, to enable identification and quantification of that contamination. Additional information is provided in *Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring* (EPA 1996a) and *Sampling Ambient Water for Trace Metals* (EPA 1995b).

2.2.2 Analytical Detection and Quantitation Levels

Because many of the water quality criteria, as well as effluent and receiving water data, are at trace levels, there could be a number of sampling results that are below a concentration that would be considered detectable or quantifiable by the analytical laboratory. Consequently, many data sets will include uncensored values (that is, a measured or quantified value) and censored data (reported by the lab as below detection or quantitation levels). The differences between detection levels and quantitation levels, and how censored data are to be handled for RPTE and WQBELs calculations is an important component of the overall process. The proper use of censored values in permit compliance determinations is also critical, but not the main subject of this guidance, although some thoughts on that subject are provided in Section 2.2.3 below.

This issue continues to evolve on both technical and policy levels, and the approach included in this guidance manual should be interpreted as an interim approach and revisited as appropriate or adjusted on a permit-by-permit basis at the discretion of the permit writer. EPA definitions are to be used until such time as DEQ has established its own list of approved test methods and definitions, with corresponding detection and quantitation levels. EPA's Method Detection Limit (MDL) is defined as the minimum concentration of an analyte (substance) that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero as determined by the procedure set forth at Appendix B of 40 CFR 136. EPA specifies that the laboratory is required to determine the MDL for each analyte in accordance with the procedures in that part. EPA's Minimum Level (ML) is defined as the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point, and is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed. MLs are given for specific methods by EPA, for example the EPA 1600 series method provides MLs. EPA has provided draft guidance (EPA 1994a) suggesting that an interim ML (IML) should be calculated when a method specified ML does not exist. The IML in this draft guidance is equal to the MDL multiplied by a factor of 3.18.

2.2.3 Compliance with WQBELs Below MDL

At times, WQBELs will be calculated that are below the MDL and/or ML. These WQBELs generally should be included in the permit if there is RPTE. However, when the WQBEL for any substance in a permit is less than the MDL or the ML, procedures and compliance determinations are as follows [based on NR 106.07(6)]:

- The permittee will monitor using an approved analytical methodology for that substance in the effluent which produces the lowest appropriate MDL and ML using a method specified by IDEQ. The lowest appropriate values will be such that the method produces quantifiable results relative to the WQBEL in question, if an approved method with that degree of sensitivity is available.
- Compliance with concentration and mass limitations will be determined as follows:
  - When the WQBEL is less than the MDL, effluent levels less than the MDL are in compliance with the WQBEL.
  - When the WQBEL is less than the MDL, effluent levels greater than the MDL, but less than the ML, are in compliance with the WQBEL except when analytically and statistically confirmed by a sufficient number of analyses of multiple samples and use of appropriate statistical techniques. IDEQ may require additional monitoring when effluent levels are between the MDL and the ML.

– When the WQBEL is greater than the MDL, but less than the ML, effluent levels less than the MDL or less than the ML are in compliance with the WQBEL.

2.2.4 Importance of Data Quantity and Representativeness

The variability inherent in environmental samples makes it important to obtain a number of samples to accurately quantify the characteristic of a water body or an effluent. A limited amount of data makes for a greater uncertainty of the nature of the water body or effluent. The greater the expected variability, the greater the number of samples needed for an accurate characterization.

The methodologies used to determine RPTE and to set WQBELs are more robust, less uncertain, and more precise if more data are available; therefore, it is generally to the permittee's advantage to have a sufficient quantity and quality of data available for regulatory decision-making. For example, the procedures differ based on whether there is more than or less than 10 or 11 valid data points for use in the calculations. These procedures are described later in this guidance.

Any test result used should be relatively recent (that is, at least within the 5-year permit cycle) and should be representative of current and projected effluent quality. For example, if there were any significant process or analytical methodology changes at a facility that could substantially affect the characterization of the effluent, then only data collected subsequent to these change(s) should be used for RPTE and WQBELs calculations.

2.2.5 Outlier Analysis

It is fairly common for effluent and river data sets to contain values that are so different than the rest or stand out from the trend to the extent that they are not representative and should be considered as aberrant values or "outliers." These may be due to gross errors in sampling, analysis, or data recording; or due to a specific definable event or occurrence that has a very low probability of happening again.

As a first screening step, if at least 11 results exist for a given parameter, an outlier analysis should be done to determine if any of the values could be excluded from the data set for the RPTE analysis or the calculation of the WQBELs. The default outlier analysis recommended in this guidance is the Grubbs' test (Iglewiz and Hoaglin 1993; Barnett et al. 1994). This method is also called the ESD method (extreme studentized deviate).

Statistical outlier analyses such as the Grubbs' test should be coupled with professional judgement. Before data are rejected as outliers, the permit writer should review process and analytical information for the facility to determine if there is specific explanation for the unusual value and then make a judgement about the representativeness of the data point(s) in question. Any data points that are rejected should be documented in the permit record, along with the rationale for their exclusion.

2.3 Chemical-Specific RPTE and WQBELs Calculations

2.3.1 Calculations for Most Chemicals (Other Than Certain Metals and Ammonia)

2.3.1.1 Wasteload Allocation Calculations

2.3.1.1.1 Equations. The first step in calculating permit limits based on water quality is to calculate the wasteload allocation (WLA) to meet aquatic life acute and chronic toxicity criteria, or human health toxicity criteria in the receiving stream. This is done using mass balance equations shown below.

The general mass balance, steady-state equation used for calculating the WLA of a conservative toxic substance discharged to a receiving water (river, stream, or uni-directional reservoir) is as follows:

$$\text{WLA} = \frac{(WQC * (Q_e + (Q_r * M)) - (C_r * Q_r * M))}{Q_e}$$

Where:

WLA	=	The wasteload allocation for a point source discharge; calculated separately for each type of WQC (i.e., acute, chronic, human health, etc.), concentration
WQC	=	Water quality criterion, concentration
Q_e	=	Effluent design flow
Q_r	=	Receiving water design flow
C_r	=	Background concentration in the receiving water
M	=	Fraction of receiving water flow allowed for mixing

Types of WLAs include:

WLA_a	=	WLA for aquatic life acute WQC
WLA_c	=	WLA for aquatic life chronic WQC
WLA_h	=	WLA for human health WQC

For discharges to lakes and multi-directional reservoirs:

$$WLA = (D + 1)(WQC) - D * C_r$$

Where:

D	=	Dilution factor at mixing zone boundary, defined as a unitless ratio of the sum of the effluent and receiving water volumes to the effluent volume
WQC	=	Water quality criterion, concentration
C_r	=	Background concentration in the receiving water

Note that the value of the dilution factor (D) can be determined by field dilution studies (e.g., using a fluorescent dye), computer mixing models, or both as discussed in Section 2.3.1.1.3.

An example of calculating a WLA_a for generic chemical for a river or stream is shown below:

WQC	=	14 μg/L acute criterion
Q_e	=	1 mgd
Q_r	=	3.5 mgd (the 1Q10, described in the following paragraphs)
C_r	=	5 μg/L (the geometric mean, described in the following paragraphs)
M	=	25 percent (acute criteria default, described in the following paragraphs)

$$WLA = \frac{(14 * (1 + (3.5 * 0.25)) - (5 * 3.5 * 0.25))}{1.0} = 22 \mu g / L$$

2.3.1.1.2 Idaho Water Quality Criteria. The complete Idaho water quality criteria are contained in IDAPA 58.01.02.200–284.

Numeric criteria for toxic substances for waters designated for aquatic life, recreation, or domestic water supply use are the National Toxics Rule, 40 CFR 131.36 (b)(1), as of July 1, 1993, incorporated by reference by IDAPA 58.01.02.210.01, with the exception of arsenic and other exceptions noted in 58.01.01.210.02.

The numeric criteria from the NTR that have been adopted by Idaho are included in Appendix A.

2.3.1.1.3 Mixing Zones for Use in WLA. Idaho has a mixing zone policy in its water quality standards (see IDAPA 58.01.02.060); therefore, it was not necessary to consider Wisconsin or EPA approaches for this aspect of WQBELs and RPTE. Appendix B provides more detailed information on mixing zone background, policy, and IDEQ implementation practices.

The following are the default mixing zones for use for point source discharges in free-flowing streams for WLA equations:

- 25 percent of stream flow for acute and chronic criteria
- 100 percent of stream flow for human health criteria
- Because of inherent differences in the nature of WET testing compared to specific chemical analyses, the mixing zone determination for WET is as defined in Appendix B

These default mixing zones can be used provided the other limiting conditions are met as defined in IDAPA 58.01.02.060.01.a –h.

No default mixing zones exist for lakes and multi-directional reservoirs. These are to be determined on a case-by-case basis by IDEQ.

The permittee may conduct mixing zone studies to provide a basis for alternate or site-specific mixing zones. The permittee is encouraged to submit a study plan to IDEQ prior to implementation. The following provide representative guidance and modeling and field procedures for conducting mixing zone studies:

- Mixing in Inland and Coastal Waters (Fischer et al. 1979)
- TSD Sections 4.3 and 4.4
- *Dilution Models for Effluent Discharges,* 4th Edition (Visual Plumes) (Frick et al. 2001)

Wisconsin rules (NR 106) restrict the mixing zone allowance to no more than 25 percent of the receiving water design flow related to chronic WQC if the state determines that the discharge has the potential to jeopardize the continued existence of any listed endangered or threatened species. This aspect of the Wisconsin rules have been approved by EPA as consistent with the GLI, which in turn was subject to Endangered Species Act consultation. The Idaho approach also sets 25 percent as the default for aquatic life WQC, with allowance for case-by-case determinations (see Appendix B).

2.3.1.1.4 Receiving Water Design Flows. The values for Q_r for the WLA calculations are as follows, depending on the type of WQC being considered:

- Q_r for Acute WQC. The minimum 1-day flow which occurs once in 10 years on average (1Q10) or, if sufficient information is available to calculate a biologically based receiving water design flow, the flow which prevents an excursion from the criterion using a duration of 1 day and a frequency of less than once every 3 years (1-day, 3-year biological flow or 1B3).

- Q_r for Chronic WQC . The minimum 7-day flow which occurs once in 10 years on average (7Q10) or, if sufficient information is available to calculate a biologically based receiving water design flow, the flow which prevents an excursion from the criterion using a duration of 4 days and a frequency of less than once every 3 years (4-day, 3-year biological flow or 4B3).

- Q_r for Human Health (non-carcinogens) WQC. The minimum 30-day flow which occurs once in 5 years on average (30Q5)

- Q_r for Human Health (carcinogens) WQC. The harmonic mean flow. This is the number of daily flow measurements divided by the sum of the reciprocals of the flows (that is, the reciprocal of the mean of reciprocals).

The receiving water design flows listed above are consistent with the Idaho WQS, NTR, TSD, and GLI. The design flows for chronic and human health (carcinogens) are also consistent with the Wisconsin approach. Wisconsin does not specify a design flow for acute WQC and uses the harmonic mean flow for both types of human health WQC.

The 1Q10 and 7Q10 flows are commonly referred to as “hydrologically-based” flows and are determined via statistical analysis of daily flow data. A log-Pearson type II data distribution is assumed for this calculation. Hydrologically-based flows have been the prevalent flow statistic used historically by the USGS for gaging stations throughout the country. Thus, an extensive database exists for these flow statistics. Regression models have been developed to calculate these flows from drainage areas and other watershed parameters so that design flows can be developed for ungaged discharge locations. The 1B3 and 4B3 flows are referred to as “biologically-based” flows because they are based on a time frame and calculation method that is more closely aligned with the time frames for aquatic life criteria. For example, acute and chronic WQC are not to be exceeded more frequently than once every 3 years. There is not as much data compiled for these compared to the hydrologically-based flows, but if gaging data are available, EPA’s DFLOW program can be used to calculate both types of design flows.

Note that if a discharger withdraws its intake water from the same stream or river that it discharges to, the withdrawal must be accounted for the specification of Q_r. For example, if a river design flow is 10 cfs, a discharger withdraws 1 cfs and returns it to the river, and 0.25 is the M factor, then in this example Q_r should be 3.25 cfs (i.e., 25 percent of the 9 cfs remaining in the river after the withdrawal).

2.3.1.1.5 Receiving Water Background Concentration. The default background concentration for Idaho is calculated as the geometric mean of the data. The geometric mean is specified as the default value for estimating the central tendency of the background concentrations. The geometric mean is appropriate for this purpose because this type of data is typically log-normally distributed. Use of the geometric mean is specified in the Wisconsin rules (NR 106) as the default (though the State reserves the option to determine this on a case-by-case basis). The GLI, applicable to 8 states and several EPA regions, also specifies the geometric mean for receiving water background. The TSD does not define how to calculate background, but notes in numerous locations that environmental data tend to be log-normally distributed.

When evaluating background concentration data, commonly accepted statistical techniques will be used to evaluate data sets consisting of values both above and below the MDL. When there are values in the data set below the MDL or ML, those values should be set to zero and the arithmetic mean used instead of the geometric mean. When all of the acceptable available data in a data set category, such as water column or fish tissue, are below the MDL for a pollutant, then all the data for that pollutant in that data set will be assumed to be zero.

In cases where there are multiple dischargers, the background concentration in the receiving water for a downstream source should account for pollutants from the upstream source if they are not fully decayed or assimilated in the intervening reach. This can be accomplished by direct monitoring or by use of mass balance and decay equations.

2.3.1.1.6 Effluent Design Flows for RPTE WLA Calculations. The effluent design flow for RPTE WLA calculations is defined in this guidance as the following, based on the Wisconsin baseline:

- **Municipalities.** The annual average design flow for the facility unless it is demonstrated that this is not representative of projected flows. Exceptions might include, but are not limited to, high-growth areas and those with design capacities well in excess of flows anticipated during the permit duration. These exceptions should be implemented on a case-by-case basis using the permit writer's best professional judgement (BPJ).
- **Industrial Discharges.**
  - For calculations related to aquatic life chronic and human health criteria—the actual annual average flow that represents normal operations
  - For calculations related to acute aquatic life criteria—the maximum effluent flow, expressed as a daily average, that represents normal operations
  - DEQ may also consider a projected increase in effluent flow that will occur when production is increased or modified or another wastewater source is added to an existing facility
- For seasonal or intermittent discharges, the effluent design flow is to be determined on a case-by-case basis.
- Note that the effluent design flows used for WQBELs calculations may be different than those described above as explained in Section 2.3.1.3.

2.3.1.2 RPTE Evaluation Process and Calculations

A water quality-based effluent limit (WQBEL) will be applied when there is reasonable potential to exceed a criterion, or to contribute to an exceedance of the criterion, in-stream. The RPTE approach used herein is taken mostly from the Wisconsin rule (NR 106.05), which have been evaluated by EPA for consistency with the GLI and approved (EPA 2000a).

A reasonable potential to exceed a criterion is present if any one of the following apply:

- The effluent concentration for any day exceeds the MDL and the WLA_{acute}
- The arithmetic average discharge concentration for any consecutive 4 days exceeds the $WLA_{chronic}$
- The arithmetic average of the discharge concentration for any 30 consecutive days exceeds the $WLA_{Human\ Health}$
- If at least 11 effluent data points are greater than the MDL, and the upper 99th percentile (P_{99}) of the:
  - Daily discharge concentration exceeds the WLA_{acute}; or
  - Four-day average discharge concentration exceeds the $WLA_{chronic}$; or
  - Thirty-day average discharge concentration exceeds the $WLA_{Human\ Health}$

- If fewer than 11 effluent data points are greater than the MDL, use the maximum effluent value multiplied by the Reasonable Potential Multiplying Factor (RPMF) [for the 95 percent probability basis and 95 percent confidence limit, using a coefficient of variation (CV) of 0.6] exceeds any of the WLAs.

Effluent values that are below the MDL are set to zero for all arithmetic average calculations above if an approved analytical method was used. If the analytical methods used are not the approved methods, all values reported as less than the MDL will be discarded from the data set.

The rationale for using 1-day values for acute WLA, 4-day values for chronic WLA, and 30-day values for human health WLA is that the effluent quality value will be consistent with the exposure duration for the types of criteria that drive the related WLAs.

The only element in the process described above that deviates from the baseline Wisconsin RPTE approach is how RPTE is determined if there are fewer than 11 data points. The current Wisconsin approach is to multiply the average effluent concentration by 5 and compare that value to the WLA_a and WLA_c. The Idaho approach under these circumstances is taken from the TSD. The TSD approach for small data sets provides a more defensible statistical approach that accounts for the number of data points available rather than using a single multiplier value in all cases.

For the cases where there are 11 or more valid data points, the specific equations used to calculate the upper 99th percentile of n–day average values in a data set (P_{99}) are given below:

$$P99 = EXP(\mu_{dn} + ZP_a\ \sigma_{dn})$$

EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
μ_{dn}	=	Estimated log-mean of n–day average of samples in data set greater than the MDL. (Note: $\mu_{dn} = \mu_d$ if n = 1) $= \mu_d + [(\sigma_d)^2 - (\sigma_{dn})^2] + LN[(1-d)/(1-d^n)]$
LN	=	Natural logarithm
ZP_a	=	Z value corresponding to the upper pth percentile of the standard normal distribution for the P_a $= Zv - (2.515517 + 0.802853{*}Zv + 0.010328{*}(Zv^2)) / (1+1.432788{*}Zv + 0.189269{*}(Zv^2) + 0.001308{*}(Zv^3))$
Zv	=	Variable used to calculated $ZP_a = (LN(1/((1-P_a)^2)))^{0.5}$
P_a	=	99th percentile adjusted for censored values = $(0.99-d^n)/(1-d^n)$
d	=	Ratio of the number of samples in data set less than the MDL to the total number of samples
n	=	Number of samples used to calculate an average over a specified monitoring period (n=1 for daily concentrations, 4 for 4–day averages and 30 for 30–day averages)
σ_{dn}^2	=	Estimated log variance of n–day average of samples in data set greater than the MDL. (Note: $\sigma_{dn}^2 = \sigma_d^2$ if n = 1.) = $LN[(1-d^n)([1+(s/m)^2]/[n(1-d)]+(n-1)/n)]$
μ_d	=	Estimated log-mean of samples greater than the MDL = $LN\ m - 0.5\ \sigma_d^2$
σ_d^2	=	Estimated log variance of samples greater than the MDL. = $LN[1 + (s/m)^2]$
m	=	Mean of samples above the MDL in data set = $\Sigma Xi/k$
s	=	Standard deviation of the samples above the MDL in data set = $[\Sigma(X_I - m)^2/(k-1)]^{0.5}$
X_i	=	Each individual sample above the MDL
k	=	Total number of samples in data set

For the cases where there are 10 or fewer valid data points, using the default CV of 0.6, the reasonable potential multiplying factor (RPMF) to use is given in Table 1.

TABLE 1
RPMF for 1 to 10 Samples with CV = 0.6

Number of Samples	RPMF
1	6.2

TABLE 1
RPMF for 1 to 10 Samples with CV = 0.6

Number of Samples	RPMF
2	3.8
3	3.0
4	2.6
5	2.3
6	2.1
7	2.0
8	1.9
9	1.8
10	1.7

2.3.1.3 WQBELs Calculations

2.3.1.3.1 Concentration Limits. Note that the approach described below for WQBELs is different than that contained in Wisconsin rules (NR 106). The Wisconsin approach uses the WLAs as direct permit limitations without further statistical manipulation (for example, the WLAa is used directly as the maximum daily limit). Wisconsin is not the only state using this approach (Michigan is another example); however, this element of Wisconsin's approach was developed prior to publication of the TSD. EPA Region 10 has stated that the Wisconsin approach is problematic because it does not specifically address effluent variability in the WQBELs calculations (EPA 2002a).

One of the substantial concerns with the EPA TSD approach is that WQBELs will be based on effluent variability characteristics (for example, the standard deviation and hence CV) that are likely to change after WQBELs are included in the permit (see TSD Section 5.4.4 and Virginia DEQ 2000a). The change will result from the limits leading to a change in effluent treatment and/or source control measures in order for the permittee to comply. It will often be the case that the effluent variability will be lower after imposition of WQBELs because treatment systems, such as nitrification for ammonia removal, tend to reduce effluent variability and concentration. As a consequence, in these cases, WQBELs will be more stringent than necessary to protect water quality standards. Nonetheless, to ensure protectiveness, the default approach for Idaho is based on the TSD approach that uses effluent variability measures. The permit writer has the flexibility, however, to use BPJ estimates of anticipated effluent variability subsequent to installation of new treatment processes. This estimate may be based on treatability studies or experience at similar facilities.

Procedures for Aquatic Life Criteria. WQBELs calculations shown below are in accordance with Chapter 5 of the TSD. WQBELs for acute and chronic criteria are calculated using the long-term average (LTA) of the effluent concentration that will meet the acute and chronic wasteload allocations (LTA_a, LTA_c).

$$LTA_a = WLA_a \text{ x } EXP(0.5\sigma^2 - Z_{99}\sigma)$$

$$LTA_c = WLA_c \text{ x } EXP(0.5\sigma^2{}_n - Z_{99}\sigma_n)$$

Where:

EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
σ^2	=	$LN(CV^2 + 1)$
σ	=	Square root of σ^2
$\sigma^2{}_n$	=	$LN[(CV^2/n) + 1]$
σ_n	=	Square root of $\sigma^2{}_n$

Where:

LN	=	Natural logarithm (base e)
CV	=	Coefficient of variation = s/m

Where:

m	=	Mean of samples above the MDL in data set = $\Sigma Xi/k$
s	=	Standard deviation of the samples above the MDL in data set = $[\Sigma(X_I - m)^2/(k-1)]^{0.5}$
X_I	=	Each individual data point
k	=	Total number of samples in data set
n	=	4 for 4-day chronic criteria, and 30 for 30-day chronic criteria
Z_{99}	=	Z score for the 99th percentile probability basis = 2.326

The effluent design flows (Q_e) for WQBEL WLA calculations are the same for municipal discharges as described in Section 2.3.1.1.6 above except for alternative wet weather mass limits described in Section 2.3.1.3.2 below. For industrial discharges, Q_e for the WQBEL WLA calculation are as follows:

- For aquatic life acute criteria, the maximum actual daily average flow that represents normal operations
- For aquatic life chronic criteria, the maximum actual weekly average flow that represents normal operations

The lowest LTA (LTA_a or LTA_c) is used to calculate the Maximum Daily Limit (MDL) and the Average Monthly Limit (AML). The MDL and AML are calculated from the following formulas shown below.

$$MDL = LTA_{low} \text{ x } EXP(Z_{99}\sigma - 0.5\sigma^2)$$

$$AML = LTA_{low} \text{ x } EXP(Z_{95}\sigma_n - 0.5\sigma^2{}_n)$$

Where:

EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
σ^2	=	$LN(CV^2 + 1)$
σ	=	Square root of σ^2
$\sigma^2{}_n$	=	$LN[(CV^2/n) + 1]$
σ_n	=	Square root of $\sigma^2{}_n$

Where:

CV	=	Coefficient of variation = s/m
m	=	Mean of samples above the MDL in data set = $\Sigma Xi/k$
s	=	Standard deviation of the samples above the MDL in data set = $[\Sigma(X_I - m)^2/(k-1)]^{0.5}$
X_i	=	Each individual data point
k	=	Total number of samples in data set
LN	=	Natural logarithm (base e)
n	=	number of samples per month
Z_{99}	=	Z score for the 99th percentile probability basis = 2.326
Z_{95}	=	Z score for the 95th percentile probability basis = 1.645

The TSD, Table 5-2, provides LTA multipliers for different CVs that can be used instead of calculating $EXP(Z_{99}\sigma - 0.5\sigma^2)$ and $EXP(Z_{95}\sigma_n - 0.5\sigma^2{}_n)$. However, these tables range from CVs equal to 0.1 to 2.0 and show only CVs to the 0.1 place. Therefore table multipliers should not be used if the CV is other than an exact value given in the table.

Procedures for Human Health Criteria. WQBELs for human health criteria are calculated differently than aquatic life criteria because the exposure period for human health is much longer than for aquatic criteria (up to 70 years), and because the average exposure (for example, over a lifetime) is of concern rather than a single maximum exposure. It is necessary to set a permit limit that is protective of the wasteload allocation every month. The procedure for setting WQBELs for human health criteria is as follows (see Section 5.4.4 of the TSD):

- Set the AML equal to the WLA
- Calculate the MDL based on the variability of the effluent (as calculated by the CV) and the number of samples per month using the Multiplier Value (MV) which is the ratio of the MDL to AML calculated as shown below

$$MDL = AML \text{ x } MV$$

$$MV = MDL/AML = [EXP(Z_{99}\sigma - 0.5\sigma^2)]/[EXP(Z_{95}\sigma_n - 0.5\sigma^2{}_n)]$$

The variables shown above are defined the same as for aquatic life-based limits. If the human health WQBELs are calculated for the same chemical as aquatic life WQBELs, the more restrictive of these MDLs and AMLs would be used as the final WQBELs for that permit.

The effluent design flows (Q_e) for WQBEL WLA calculations are the same for municipal discharges as described in Section 2.3.1.1.6 above except for alternative wet weather mass limits described in Section 2.3.1.3.2 below. For industrial discharges, Q_e for the WQBEL WLA calculations is the maximum actual monthly average flow that represents normal operations.

The probability values for calculating WQBELs above use the 99 percentile probability basis for the acute and chronic LTA and MDL and 95 percentile probability basis for the AML. The TSD does not make a firm recommendation on which of these two probabilities to use, but the approach included here for Idaho has become fairly standard practice, though there are exceptions (e.g., Virginia uses the 97^{th} percentile basis for all Z scores [VDEQ 2000a]).

The TSD also notes that "n" (the number of samples per month) used for calculating AMLs should not be lower than four even if sampling is required less frequently than that in the permit (see Section 5.5.3 of the TSD). This provides a more protective calculation of the AML in cases when the required sampling frequency is lower than weekly because the higher the value of "n," the more stringent the AML will be. This should be an acceptable degree of protection for permittees, however, because they are not precluded from sampling more frequently than the minimum required by the permit in order to establish a representative monthly average effluent value for compliance purposes.

One additional note about the WQBELs calculations above relates to how effluent values below the MDL are used for calculating the mean and standard deviation (hence the CV) of the data sets. The equations above suggest that these statistical parameters be calculated using values in the data set that are above the MDL. This should be considered a default approach, but the permit writer's judgement, and acceptable statistical procedures, should also enter into this decision. It can be an important component of the WQBELs calculation because effluent variability has a substantial effect on the outcome and how values below the MDL are handled can have a substantial effect on the CV.

2.3.1.3.2 Mass Limits. EPA regulations [40 CFR 122.45(f)] generally require limitations to be expressed in terms of mass (for example, pounds per day or kilograms per day). For WQBELs, these mass limits generally will be in addition to concentration limits.

A concentration limit is converted to mass as shown below.

$$\text{Mass Limit (in lb/day)} = \text{Concentration limit (mg/L)} * Q_e \text{ (in mgd)} * 8.34$$

$$\text{Mass Limit (in lb/day)} = \text{Concentration limit (ug/L)}/1000 * Q_e \text{ (in mgd)} * 8.34$$

$$\text{Mass Limit (in kg/day)} = \text{Mass limit (lb/day)} * 0.454$$

Where:

Q_e = design effluent flow as defined in Section 2.3.1.1.6 above for municipal discharges; for industrial discharges the maximum actual daily average flow should be used for the MDL and the maximum actual monthly average flow should be used for the AML.

8.34 and 0.454 are unit conversion factors

If a mass limitation based is included in a municipal permit based on the procedures above, the permit should also include an alternative wet weather mass limitation [see NR 106.07(9)]. This alternative wet weather mass limitation will be applicable, and supercede the other mass limitations if they are exceeded, if the discharger demonstrates to DEQ that the exceedance is caused by and occurs during a wet weather event. A wet weather event occurs during and immediately following periods of precipitation or snowmelt, including rain, sleet, snow, hail, or melting snow, during which water from the precipitation, snowmelt, or elevated groundwater enters the sewerage system through infiltration or inflow. The effluent design flows (Q_e) to be used for these alternative wet weather mass limitations are the maximum day design flow for the MDL and monthly design flow for the AML.

2.3.1.4 Seasonal Considerations and Flow-Based WQBELs

In Idaho effluent and receiving water conditions often vary substantially on a seasonal basis. Under these conditions, the RPTE and WQBELs calculations should be done on a seasonal basis with the appropriate seasonal time periods determined on a case-by-case or watershed basis. For example, as described in Section 1.1.2.2.1 and 2.3.2.2, ammonia criteria are temperature and pH related, and these parameters commonly vary substantially on a seasonal basis. River flows are also commonly higher in one season compared to another, for example, during the spring snowmelt period. Some river flows are also regulated for hydropower and irrigation purposes. Therefore, in addition to seasonal calculations for RPTE and WQBELs, it is also appropriate to develop flow-based or “flow-tiered” WQBELs.

A hypothetical example of seasonal and flow-tiered WQBELs is shown below:

	Summer (May through October)		Winter (November through April)	
River Flow Tier	MDL (mg/L)	AML (mg/L)	MDL (mg/L)	AML (mg/L)
10 to 50 cfs	4	2	10	5
51 to 100 cfs	8	4	15	10
> 100 cfs	12	8	20	15

2.3.2 Special Considerations for Certain Metals and Ammonia

The equations and procedures for calculating WLAs, RPTE, and WQBELs for certain metals and ammonia are generally as provided above for other chemicals, but there are several important differences. Certain metals, for example, have toxicity associated with the water hardness for freshwater aquatic life. Some metals also have their criteria expressed in the dissolved form rather than the total or total recoverable form of the metal. In addition, ammonia toxicity is related to the water pH and temperature for freshwater aquatic life.

Thus, the aquatic toxicity of these parameters is a function of water quality characteristics, and numeric criteria adopted by Idaho reflect this. In addition, dissolved criteria for metals add complexity to the calculations because WQBELs generally must be expressed in the total or total recoverable form per EPA regulations (discussed more below).

2.3.2.1 Toxics Metal Criteria (IDAPA 5801.02.210)

2.3.2.1.1 Metal Toxicity Variability with Water Hardness. Many of the metals criteria are hardness-dependent in freshwater, and these equations that incorporate water column hardness are incorporated into the Idaho WQS. Criteria values are calculated from the following:

- Acute water quality criterion (dissolved) = (Water Effect Ratio) EXP$\{m_A\,[\ln(\text{ hardness})] + b_A\}$ (acute CF); or

- Chronic water quality criterion (dissolved) = (Water Effect Ratio) EXP$\{m_C\,[\ln(\text{hardness})] + b_C\}$ (chronic CF)

The parameters specified (m_A, etc.) are listed in Table 2. The conversion factors (CFs) are provided in the following section of this guidance.

TABLE 2
Parameters for Calculating Freshwater Dissolved Metals Criteria that are Hardness-Dependent

Chemical	m_A	b_A	m_C	b_C
Cadmium	1.128	-3.828	0.7852	-3.49
Chromium III	0.8190	3.688	0.8190	1.561
Copper	0.9422	-1.464	0.8545	-1.465
Lead	1.273	-1.460	1.273	-4.705
Nickel	0.8460	3.3612	0.8460	1.1645
Silver	1.72	-6.52	--	--
Zinc	0.8473	0.8604	0.8473	0.7614

The equations above for acute and chronic metals criteria incorporate the Water Effect Ratio (WER) into the calculation consistent with the NTR which has been adopted by reference in the Idaho water quality standards (with exceptions). According to EPA under the Alaska Rule (EPA 2000d) the WER represents a "performance-based" component of the water quality standard because the "WER methodology is sufficiently detailed so that its site-specific application is formulaic and predictable" (EPA 2000d). A performance-based approach such as the WER has implementation procedures of sufficient detail, and with suitable safeguards, so that additional oversight by EPA would be redundant. Thus, the Alaska Rule along with Idaho's adoption of the NTR equations above provides an opportunity for site-specific permit calculations using a WER even if the WER has not been separately adopted into the Idaho Water Quality Standards.

As noted, metals toxicity can also be influenced by organics and/or sediments in the receiving waters, or by the presence or absence of sensitive species in a particular water body. EPA-approved procedures for site-specific standard development are provided at IDAPA 58.01.02.275.01h.ii.

The WQC, RPTE, and WQBELs should be calculated two ways. The first is based on the hardness of the receiving water after mixing with the effluent at the mixing factor allowed for the discharge. The RPTE and WQBELs calculations then use these WQC along with the same mixing factors. In cases where the effluent hardness is greater than the river hardness, as a check, the permit writer should also calculate WQC using mixed hardness after complete mixing. These complete-mix WQC are then again used for the RPTE and WQBELs calculations, but in this case using the complete river flow rather than some fraction (i.e., M = 1.00 for 100% mixing). In most cases, the former calculation will provide the more conservative outcome, but the latter may in cases such as when the background metal concentration is high enough that the increase in dilution does not more than offset the lower criteria.

The hardness of the effluent and receiving water used in the mixed hardness calculation is the geometric mean of each. The use of the geometric mean for effluent and receiving water hardness is consistent with the Wisconsin baseline [NR 106.06(5)]. The TSD and GLI do not address this consideration.

In some situations, the hardness of the receiving water may be correlated with its flow (for example, hardness values may be higher at lower flows). Evaluation of this relationship should be done on a case-by-case basis. If the permit writer determines that there is valid correlation, the relationship between flow and hardness should be used to determine the river hardness at design river flow conditions.

2.3.2.1.2 Dissolved Fraction of the Metal. EPA policy for certain metals is to use the dissolved fraction of the metal to set criteria and measure instream compliance (*Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria, EPA 1993d*). This is because the dissolved metal fraction more closely approximates the bioavailability of the metal. EPA (and Idaho) WQC for metals are (with a few exceptions) based on the dissolved form. The dissolved WQC is calculated by multiplying the total recoverable criterion by the Conversion Factor (CF) for each metal as shown in Table 3:

TABLE 3
Metal Conversion Factors (CF)

	Acute	Chronic
Arsenic (III)	1.000	1.000
Cadmium	0.944[a]	0.909[a]
Chromium (III)	0.316	0.860
Chromium (VI)	0.982	0.962
Copper	0.960	0.960
Lead	0.791[a]	0.791[a]
Mercury	0.85	N/A
Nickel	0.998	0.997
Silver	0.85	N/A[b]
Zinc	0.978	0.986

[a]The freshwater conversion factors (CF) for cadmium and lead are hardness-dependent and can be calculated for any hardness [see limitations in § 131.36(c)(4)] using the following equations:

Cadmium

Acute: CF=1.136672—[(ln hardness)(0.041838)]

Chronic: CF=1.101672—[(ln hardness)(0.041838)]

Lead

(Acute and Chronic): CF = 1.46203—[(ln hardness)(0.145712)]

The CFs shown in the table above for cadmium and lead are for a hardness of 100 mg/L

[b]No chronic criteria are available for silver.

However, NPDES permits are required to have limits expressed as total recoverable metal (40 CFR 122.45(c)), with the following exceptions:

> *1) An applicable effluent standard or limitation has been promulgated under the CWA and specifies the limitation for the metal in the dissolved or valent or total form; or*
>
> *(2) In establishing permit limitations on a case-by-case basis under § 125.3, it is necessary to express the limitation on the metal in the dissolved or valent or total form to carry out the provisions of the CWA; or*
>
> *(3) All approved analytical methods for the metal inherently measure only its dissolved form (e.g., hexavalent chromium).*

Therefore, for most metals it becomes necessary to convert, or translate, dissolved values into total recoverable values for NPDES permit limits. The numerical factors used to convert from dissolved to total metals are termed "conversion factors" (CFs) or "chemical translators" (CTs).

As noted previously in Section 1.1.2.2.1, the NTR Stay included CFs for metals. In addition, EPA has developed procedures to identify site-specific CTs (EPA 1996b), and Idaho allows permittees to develop site-specific CTs (IDAPA 58.01.02.275. 01.a.ii). In the absence of site-specific CTs, the CFs listed in Table 3 above serve as default CTs.

2.3.2.1.3 RPTE Methods for Dissolved Metals Criteria. This combination of dissolved WQC and total recoverable WQBELs, and the possible availability of dissolved and/or total recoverable effluent and/or receiving water data, plus possible availability of site-specific CTs, leads to a number of possible ways to conduct the RPTE analyses for these metals as illustrated in the cases below:

- **Case 1.** Only total recoverable data are available for both effluent and receiving water and there is no site-specific CT: This case is fairly straightforward, the dissolved WQC should be converted to total recoverable using the CF and the RPTE evaluation conducted on a total recoverable basis. If there is RPTE, the WQBEL is directly calculated on a total recoverable basis.

- **Case 2..** Only total recoverable data are available for the effluent and only dissolved data are available for the receiving water and there is no site-specific CT: In this case the permit writer has the option of doing the RPTE analysis in either the dissolved form (by multiplying the effluent data times the CF) or the total recoverable form (by dividing the receiving water data by the CF).

- **Case 3.** Total recoverable and dissolved data are available for both the effluent and receiving water and there is a site-specific CT available: Again, in this case the permit writer has the option of doing the RPTE analysis using a dissolved or total recoverable approach:

  - For the dissolved form, no conversion of any parameter is necessary for the RPTE calculation. If there is RPTE, then the WQBEL would be calculated by converting the LTA, MDL and AML derived on a dissolved basis to total recoverable limits by dividing the dissolved WQBEL by the CT.

  - For the total recoverable form, the dissolved WQC are converted to total recoverable by dividing by the CF and using the total recoverable river and effluent data for RPTE. If the total recoverable RPTE approach is taken, and there is RPTE, then the WQBEL is directly calculated on a total recoverable basis.

  - It is possible that the outcome of these two RPTE approaches will be different. The most defensible of the two approaches will depend on several factors, and should be determined at the permit writer's discretion on a case-by-case basis. The dissolved RPTE approach is the simplest and most straightforward approach, and directly relevant to the protection of a dissolved criterion. There are circumstances, however, in which the total recoverable RPTE approach is more defensible. One such case is when the combination of effluent and receiving water characteristics indicate that enough particulate metal contained in an effluent could become dissolved in the water column of the receiving water and potentially violate the WQC. EPA guidance in the TSD and GLI do not address this case.

> The Wisconsin approach is to conduct RPTE and WQBELs on a total recoverable basis as the default, at least in part because their WQC are expressed in the total recoverable form as the default. Wisconsin does, however, allow the permittee to request these analyses be conducted on a dissolved basis if there is RPTE shown on a total recoverable basis [see NR 106.06(7)].

It will generally be to the permittee's advantage to develop as robust a data set as practicable for effluent and receiving water for metals with dissolved criteria, including both dissolved and total recoverable forms. Development of site-specific CTs is also advisable. If resources permit, data also should be collected for use in the Biotic Ligand model (for example, major anions and cations, organic carbon, pH) (EPA 1999d). The cost for such data collection may be prohibitive for some permittees, of course. A general rule of thumb for the permittee and permit writer to consider is that the cost of monitoring should be balanced against the potential outcome in relation to the cost of compliance with WQBELs. In cases where WQBELs are indicated based in part on limited data sets, and treatment or control costs would be burdensome, consideration should be given to including more extensive monitoring during the schedule of compliance included in the permit. This additional monitoring will provide a more informed decision on the need for and appropriate values of WQBELs.

2.3.2.1.4 Example Calculations for Metals. Table 4 presents the data table for copper and hardness in the effluent and river.

TABLE 4
Metals and Hardness Data

Effluent Data			River Data		
Dissolved Copper (µg/L)	**Total Recoverable Copper (µg/L)**	**Hardness (mg/L)**	**Dissolved Copper (µg/L)**	**Total Recoverable Copper (µg/L)**	**Hardness (mg/L)**
10	11	100	1	1	50
20	22	115	4	5	80
25	28	120	2	3	56
8	9	95	5	6	63
15	17	130	4	5	70
12	13	115	2	2	53
22	24	122	1	2	68
17	19	104	1	2	53
9	10	93	1	1	60
16	18	108	3	4	65
30	33	110	2	3	57
4	4	115	5	7	55
13	14	117	4	5	50
19	21	105	1	2	64
16	18	120	3	4	52

Note: All copper values are >= MDL of 1 µg/L

The permit writer in this case is using a dissolved RPTE approach because the data demonstrate that it is improbable that significant particulate copper in the effluent will dissolve in the river because there is very little particulate copper in this effluent to begin with (that is, 90 percent of the total copper in the effluent is dissolved). A site-specific CT has also been developed for this discharge, which is 0.90 (geometric mean of the ratios for each pair of dissolved and total recoverable data).

Table 5 presents the physical setting information that applies to this example:

TABLE 5
Example Copper Calculation

	Acute	Chronic
Mixed Hardness (mg/L) as calcium carbonate	79	73
WQ Criteria (dissolved) at mixed hardness (µg/L)	13.6	8.7
Effluent Flow (cfs) (Q_e)	23.2	18.6
Receiving water flow (cfs) (Q_r)	150 (1Q10)	200 (7Q10)
% of Receiving Water Flow for Mixing (M)	25	25
Background (Cr) – geometric mean (µg/L)	2.2	2.2

Wasteload Allocation Formulas

$$WLA_a = \frac{(AC*(Q_e + (Q_r * M)) - (C_r * Q_r * M))}{Q_e}$$

Solutions

$$WLA_a = \frac{(13.6*(23.2+(150*0.25))-((2.2*150*0.25))}{23.2}$$

$$WLA_a = 32.1 \mu g / L \ dissovled \ copper$$

$$WLA_c = \frac{(CC*(Q_e + (Q_r * M)) - (C_r * Q_r * M))}{Q_e}$$

$$WLA_c = \frac{(8.7*(18.6+(200*0.25))-((2.2*200*0.25))}{18.6}$$

$$WLA_c = 26.3 \mu g / L \ dissolved \ copper$$

Because more than 11 effluent values are greater than the MDL, the P_{99} is used for the RPTE evaluation. Table 6 presents the calculation of the P_{99} effluent values for use in the RPTE evaluation.

TABLE 6
P_{99} Values for Effluent Copper

	Acute RPTE	Chronic RPTE
Total number of samples (k)	15	15
Number of samples > MDL	15	15
Number of samples < MDL	0	0
Maximum of samples > MDL	30	30
Ratio of samples < MDL (d)	0.0	0.0
Mean of samples > MDL (m)	15.733	15.733
Standard deviation of samples > MDL (s)	6.850	6.850

TABLE 6
P_{99} Values for Effluent Copper

	Acute RPTE	Chronic RPTE
Number of consecutive days (n) for P	1	4
P adjusted for non-detected values (P_a)	0.990	0.990
SQRT(LN(1/((1-P_a)^2)))	3.035	3.035
Z_p	2.327	2.327
1+$(s/m)^2$	1.190	1.190
σ_d^2	0.174	0.174
μ_d	2.669	2.669
σ_{dn}^2	0.174	0.046
μ_{dn}	2.669	2.733
P_{99} exponent	3.638	3.233
P_{99}	38.0	25.4
Exceed WLA?	Yes	No

Thus, in this case, there is reasonable potential to exceed because the 1-day P_{99} exceeds the WLA_a. Table 7presents the permit limit calculations.

TABLE 7
Permit Limit Calculations for Copper

Statistical Parameter	Value
Effluent CV	0.44
Number of samples per month	4
WLA_a, dissolved, µg/L	32.1
WLA_c, dissolved, µg/L	26.3
σ^2	0.173585
$\sigma^2_{n=4}$	0.046302
Z @99%	2.326
LTA_a, dissolved, µg/L	13.3
LTA_c, dissolved, µg/L	16.3
LTA_{low} (controlling)	13.3
Z @95%	1.645
MDL, dissolved, µg/L	32.1
AML, dissolved, µg/L	18.5
Chemical Translator	0.90
MDL, total recoverable, µg/L	35.6
AML, total recoverable, µg/L	20.5

2.3.2.2 Ammonia

Idaho's WQS for ammonia is based on the EPA's 1999 Update of Water Quality Criteria for Ammonia (EPA 1999b). These criteria reflect the pH and temperature relationship of the acute and chronic criteria and the averaging period of the chronic criterion. Note that the averaging period for the chronic ammonia criterion is 30 days, and thus 30 should be used for "n" in the calculation of the LTA_c. The acute criterion for ammonia is dependent on pH and fish species, and the chronic criterion is dependent on pH and temperature. At lower temperatures, the chronic criterion is also dependent on the presence or absence of early life stages of fish. The temperature dependency results in a gradual increase in the criterion as temperature decreases, and is more stringent when early life stages of fish are expected to be present.

The criteria are dependent on pH because ammonia toxicity is much higher for un-ionized ammonia (the higher the pH the larger the fraction of un-ionized ammonia) than with the ammonium ion (lower pH). It is believed that un-ionized ammonia is the more toxic form because it is a neutral molecule and thus is able to diffuse across the epithelial (gill) membranes of aquatic organisms much more readily than the charged ammonium ion. More detailed assessment of the pH and temperature relationship to ammonia toxicity are provided in the EPA criteria document.

In the calculation of a WLA for ammonia, the WQC should be based on the pH of the mixed flows (effluent and receiving water) at the mixing zone factor allowed for the discharge. The RPTE and WQBELs calculations then use these WQC along with the same mixing factors. In cases where the effluent pH is lower than the river pH, as a check, the permit writer should also calculate WQC using mixed pH after complete mixing. These complete-mix WQC are then again used for the RPTE and WQBELs calculations, but in this case using the complete river flow rather than some fraction (i.e., M = 1.00 for 100% mixing). In most cases, the former calculation will provide the more conservative outcome, but the latter may in cases such as when the background ammonia concentration is high enough that the increase in dilution does not more than offset the lower criteria.

The pH of the effluent and receiving water flow to be used in the WLA equation is the arithmetic average of the available data. The use of the arithmetic mean is consistent with Wisconsin NR 106.06(5)(a). However, in order to calculate the mixed pH it is necessary to have alkalinity data for the effluent and receiving water. In the absence of alkalinity data, the receiving water pH should be used in most cases. An exception would be where the effluent dominates the flow of the receiving water at design conditions. In these cases, the effluent pH should be used to calculate the WQC. The geometric mean of the receiving water and effluent temperature should be used for the mixed temperature, again consistent with the Wisconsin baseline [NR 106.06(5)]. For ammonia, WQBELs should be on a seasonal basis as discussed in Section 2.3.1.4. The chronic (but not acute) ammonia criteria are temperature related, and have an averaging period of 30 days. Thus, the appropriate seasonal temperature to use for criteria and WQBELs calculations should be the highest 30-day geometric mean value within each season.

2.3.3 Special Considerations for Effluent Dominated Streams

Placeholder for further development later.

2.4 Whole Effluent Toxicity RPTE and WQBELs Calculations

Whole effluent toxicity (WET) testing and control in NPDES permits has been ongoing in the U.S. for several decades. However, concern still exists regarding test method variability, quantitation levels, and specific implementation of WET conditions in permits. This concern over WET methods led to several recent activities: 1) litigation regarding EPA WET methods by organizations representing permittees, 2) a settlement agreement between the parties in July 1998, 3) extensive national studies of WET method variability, and 4) EPA guidance on WET method variability and application in NPDES permits (EPA 2000c). This latest EPA guidance (the *Variability Document*) concludes that WET test variability is within the range of variability experienced in other types of analyses and that TSD procedures for WET remain appropriate. This Idaho guidance manual relies at this time on current WET approaches for the Wisconsin baseline supplemented as needed by EPA procedures. As noted often in this guidance, a number of the specific methods and approaches related to RPTE and WQBELs continue to evolve and thus the procedures used herein should be revisited frequently and revised as needed in response to improvements in scientific and regulatory practice.

2.4.1 WET Criteria

Idaho's narrative criterion for toxicity (described in Section 1.1.2.2) is interpreted for the purposes of this guidance as:

- Acute whole effluent toxicity is not to exceed 0.3 toxic units (Tu_a)
- Chronic whole effluent toxicity is not exceed 1.0 TU_c

TU_a is defined as 100/Acute Toxicity Test Endpoint as percent effluent. TU_c is defined as 100/Chronic Toxicity Test Endpoint as percent effluent.

This interpretation is consistent with the Wisconsin approach, the TSD, and GLI.

2.4.2 Whole Effluent Toxicity Testing

Until such time as specific test requirements for Idaho are established, procedures for WET testing will be based on those in 40 CFR Part 136 and the most current EPA WET testing manuals (note that the first two manuals are expected to be revised by EPA in the near future):

- *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (EPA 1993d)
- *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA 1994a)
- *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing* (EPA 2000b).
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants; Whole Effluent Toxicity Test Methods* (EPA 2002b)

2.4.2.1 Acute WET Tests

Consistent with the Wisconsin approach, a facility generally should not be required to monitor for WET if the in-stream waste concentration (IWC) is less than or equal to 1 percent because IWC values less than 1 percent present minimal to no potential for a WET effect in the receiving water. The IWC_a is defined as:

$$IWC_a = Q_e/[(Q_r * M) + Q_e]$$

Where:
Q_e = Effluent design flow = same as chemical-specific WLA calculations
Q_r = Receiving water design flow = 1Q10 or 1B3 as defined for chemical-specific WLA calculations
M = Fraction of receiving water flow allowed for mixing

The calculation of the end points will differ for acute toxicity tests depending on the IWC. For discharges that have an IWC_a of greater than 33 percent effluent, the endpoint will be the No Observed Adverse Effect Concentration (NOAEC). Discharges that have an IWC_a less than or equal to 33 percent effluent will have their endpoints calculated as an LC_{50}. The LC_{50} endpoint estimates the concentration of the sample that is lethal to 50 percent of the organisms tested.

This NOAEC is used when the IWC_a is greater than 33 percent because it determines the highest effluent concentration that is not significantly different from the control and is expressed as one of the following:

- NOAEC is greater than or equal to 100 percent effluent
- NOAEC is the highest percent concentration where there was no significant difference when compared to the controls. This is interpreted as the highest percent concentration where there is no significant difference when compared to the controls, and below which there is no statistically significant adverse effect.

The NOAEC result is converted to TU_a as shown below.

$$100/NOAEC$$

The rationale for using the NOAEC test for IWC_a values greater than 33 percent instead of the LC_{50} test was taken from the State of Virginia's approach (Virginia DEQ 2000b). The description of the rationale below is a slightly paraphrased version for Idaho:

> This is because of the 0.3 acute criterion that is to be met after any allowable dilution. The factor of 0.3 in the acute criterion is used to adjust the LC_{50} point estimate (50 percent mortality) from an acute toxicity test to an LC_1 (virtually no mortality). The conversion of 0.3 TU_a to its equivalent LC_{50} value is shown below.

$$100/0.3\ TU_a = LC50\ of\ 333.3\ \%$$

> The endpoint of 333.3 percent effluent is impossible to test, of course. The highest dilution of effluent that can be tested is 100 percent, which if using the LC_{50} endpoint, could allow for up to 50 percent of the organisms to die. This is not protective of the narrative criterion waters of the state must "be free from toxic substances in concentrations that impair designated beneficial uses" (see Section 1.1.2.2). The LC_1(concentration lethal to 1 percent of the organisms tested) endpoint is not practical in that no mortality is allowed to the test organisms; yet, up to 10 percent mortality is allowed for the control organisms for an acceptable test. The TSD states that the 0.3 factor was found to include 91 percent of observed LC_1 to LC_{50} ratios in 496 acute effluent tests. As a result, whenever there is a dilution ratio of less than approximately three parts receiving water to one part effluent (3:1),

the resulting WLA will be lower than the minimum level of acute toxicity that the LC_{50} test can measure. The NOAEC endpoint is thus more appropriate, in that it statistically determines whether the toxicity of 100 percent effluent is significantly different than the controls.

Alternative approaches to calculating endpoints that are scientifically defensible that consider variability and method quantitation limits will be considered. In general, alternative approaches should be approved in writing by IDEQ.

The test species for the acute tests are *Ceriodaphnia dubia* and *Pimephales promelas* (fathead minnow) or other species deemed appropriate by IDEQ.

2.4.2.2 Chronic WET Tests

Consistent with the Wisconsin approach, a facility generally should not be required to monitor for WET if the in-stream waste concentration (IWC) is less than or equal to 1 percent, and the discharge is continuous. IWC values less than 1 percent should present minimal to no potential for a WET effect in the receiving water. The IWC_c is defined as:

$$IWC_c = Q_e/[(Q_r * M) + Q_e]$$

Where:

Q_e	=	Effluent design flow = same as chemical-specific WLA calculations
Q_r	=	Receiving water design flow = 7Q10 or 4B3 as defined for chemical-specific WLA calculations
M	=	Fraction of receiving water flow allowed for mixing

A “continuous discharge” is a discharge that occurs without interruption throughout the operating hours of the facility, except for infrequent shutdowns for maintenance, process changes, or other similar activities. A chronic test is performed for duration of 6 to 8 days.

Chronic toxicity testing is not required for discharges which are intermittent in nature. Intermittent is defined as having a continuous discharge for less than 5 consecutive days. This exemption from chronic testing is due to the short duration of the discharge that reduces exposure time of the toxicants to the organisms in the receiving water. Consequently, with reduced exposure time to toxicants there is less chance that the biota are being chronically affected.

The linear interpolation method is used to calculate a point estimate, called the inhibition concentration (IC), of a toxicant that causes a 25 percent reduction in reproduction or growth when compared to the controls. Other end point calculations will be considered, if the IC_{25} method is not appropriate for the data.

Alternative approaches to calculating endpoints that are scientifically defensible that consider variability and method quantitation limits will be considered.

The test species for the chronic tests are *Ceriodaphnia dubia* and *Pimephales promelas* (fathead minnow) or other species deemed appropriate by IDEQ.

2.4.2.3 Test Dilutions for Acute and Chronic Tests

For routine monitoring when WQBELs have not been included in the permit, all tests will be done at the IWC_a or IWC_c and with two concentrations above and two concentrations below the IWC_a or IWC_c. For monitoring to meet WQBELs, tests generally should be done at the WQBELs and two concentrations above and two concentrations below the MDL and/or AML. One of these 5 tests will be a 100 percent effluent concentration. If the LC_{50} or IC_{25} is greater than 100 percent effluent, the TU_a or TU_c will be less than 1.0. In cases of very high or very low IWCs, it may be appropriate to include or substitute an additional dilution on the low or high end of the range, respectively, to establish a clearer dose-response relationship. This will be considered the default MDL for WET tests. For RPTE and WQBELs calculations all values reported as less than 1.0 TU_a or TU_c will be entered as 0.5 (one half the detection limit).

Any tests that do not include a 100 percent effluent concentration and do not have any toxicity at the highest concentration tested, are to be reported as greater than the highest concentration tested and the TU_a or TU_c calculated as 100 divided by the highest concentration tested. These TUs will be used for the RPTE analysis, outlier analysis and in the calculations of WQBELs.

LC_{50} and IC_{25} concentrations that are calculated as less than the lowest concentration tested are to be reported as less than the lowest concentration tested and the TU_a or TU_c calculated as 100 divided by the lowest concentration tested. These TUs will be used for the RPTE analysis, outlier analysis and in the calculations of WQBELs.

2.4.3 Calculation of Wasteload Allocation (WLA)

The wasteload allocation to meet acute WET criteria (WLA_a) in unidirectional receiving waters (rivers, streams and unidirectional reservoirs) is calculated from the mass balance equation shown below.

$$WLA_a = \frac{(AC*(Q_e + (Q_r * M)) - (C_r * Q_r * M))}{Q_e}$$

Where:

WLA_a	=	The wasteload allocation to meet acute toxicity criteria for a point source discharge
AC	=	Acute Whole Effluent Criterion = 0.3 TU_a
Q_e	=	Effluent design flow = same as chemical-specific WLA calculations
Q_r	=	Receiving water design flow = 1Q10 or 1B3 as defined for chemical-specific WLA calculations
C_r	=	Background concentration in the receiving water (default = 0)
M	=	Fraction of receiving water flow allowed for mixing

The wasteload allocation to meet chronic WET criteria (WLAc) in unidirectional receiving waters (i.e. rivers and streams) is calculated from the mass balance equation:

$$WLA_c = \frac{(CC*(Q_e + (Q_r * M)) - (C_r * Q_r * M))}{Q_e}$$

Where:

WLA_c	=	The wasteload allocation to meet chronic toxicity criterion for a point source discharge
CC	=	Chronic Whole Effluent Criterion = 1.0 TU_c
Q_e	=	Effluent design flow = same as chemical-specific WLA calculations
Q_r	=	Receiving water design flow = 7Q10 or 4B3 as defined for chemical-specific WLA calculations
C_r	=	Background concentration in the receiving water (default = 0)
M	=	Fraction of receiving water flow allowed for mixing

For discharges to lakes and multi-directional reservoirs:

$$\text{WLA} = (\text{D} + 1)(\text{WQC acute or chronic}) - \text{D} * \text{C}_\text{r}$$

Where:

D	=	Dilution factor at mixing zone boundary

The dilution factor for lakes is determined on a case-by-case basis as described for chemical-specific WLA calculations.

2.4.4 RPTE

This approach for WET RPTE is different than that contained in Wisconsin rules (NR 106). The Wisconsin approach was disapproved by EPA for use in the Great Lakes portions of the state because EPA determined that it was inconsistent with the GLI WET RPTE approach (EPA 2000a). Thus, to ensure protective calculations, this approach for Idaho is based on approaches described in the GLI, TSD and Variability Document.

2.4.4.1 Data Quantity and Quality Considerations

Because WET tests are more complicated and expensive than most other types of analyses, the number of test results for a given permittee will often be less than other commonly evaluated substances (see Section 2.4.4.1.1). 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 *Ceriodaphnia dubia* and *Pimephales promelas*. However, as an alternative when there is a lack of acute or chronic testing data, the acute to chronic ratio (ACR) will be used to convert acute data to chronic or chronic data to acute. If chronic data are not available, the acute data are converted to chronic data by multiplying each acute toxicity TU_a by the TSD default ACR of 10. If acute data is not available, the chronic data is converted to acute data by dividing each chronic TU_c by the default ACR of 10.

2.4.4.1.1 Minimum Number and Representativeness of Data Points. If at least 10 acute or chronic data points are not available, a RPTE analysis generally should not be done. In this case monitoring will be required where data is lacking. For major facilities, acute and chronic monitoring should be on a semi-annual basis so that 10 valid data points will be available by the end of the permit cycle. In these cases, the permit should include WET "triggers" (defined in Section 2.4.6). For minor facilities for which there is no reason to suspect effluent toxicity, a single test within the final year of the 5-year permit cycle will be sufficient to confirm lack of toxicity. If there is reason to suspect that a minor facility's effluent may be toxic (for example, fewer than 10 representative WET results for the facility exist but some of the valid results have exhibited a significant toxic response), then additional testing should be required for that facility. In such cases, WET triggers also should be included in the permit. It is also preferred, but not necessary, that at least one acute and one chronic test be done for each species.

Any test result used should be relatively recent (that is, at least within the 5-year permit cycle) and should be representative of current and projected effluent quality. For example, if there were significant process or analytical methodology changes at a facility that could substantially affect WET characteristics of the effluent, then only data collected subsequent to these change(s) should be used for RPTE and WQBELs calculations.

2.4.4.1.2 Outlier Analysis. It is fairly common for effluent and river data sets to contain values that are so different than the rest or stand out from the trend to the extent that they are not representative and should be considered as aberrant values or "outliers." These may be due to gross errors in sampling, analysis, or data recording; or due to a specific definable event or occurrence that has a very low probability of happening again.

As a first screening step, if at least 10 results exist for a given parameter, an outlier analysis should be done to determine if any of the values could be excluded from the data set for the RPTE analysis or the calculation of the WQBELs. The default outlier analysis recommended in this guidance is the Grubbs' test (Iglewiz and Hoaglin 1993; Barnett et al. 1994). This method is also called the ESD method (extreme studentized deviate).

Statistical outlier analyses such as the Grubbs' test should be coupled with professional judgement. Before data are rejected as outliers, the permit writer should review process and analytical information for the facility to determine if there is specific explanation for the unusual value and then make a judgement about the representativeness of the data point(s) in question. Any data points that are rejected should be documented in the permit record, along with the rationale for their exclusion.

2.4.4.2 RPTE Basis

There is a RPTE if at least 10 valid data points are available and:

- The maximum probable effluent TU_a at the 95 percent confidence interval of the 95 percent probability level is greater than the WLA_a
- The maximum probable effluent TU_c at the 95 percent confidence interval of the 95 percent probability level is greater than the WLA_c

2.4.4.3 Calculation of 95 Percent Confidence Interval of the 95 Percent Probability Level

The calculation of the 95 percent confidence interval of the 95 percent probability level follows the procedures in the TSD (EPA 1991a) and the GLI (EPA 1995a).

If at least 10 toxicity values are available the actual CV for each species for each test type (acute or chronic) is used.

The CV of the TU_a and TU_c will be determined for each species and each test (acute and chronic) using the formula shown below.

$$CV = s/m$$

Where:

n	=	Number of tests
m	=	Mean = ΣTU/n
s	=	Standard deviation = $\Sigma(TU-m)^2/(n-1)$

The maximum probable concentration (MPC) for each species for each test type (acute and chronic) is the 95th confidence limit at the 95th percentile.

The MPC for each TU for each species for each test type (acute and chronic) is calculated by multiplying the maximum TU for each species and each test type by the reasonable potential multiplying factor (RPMF). The RPMF is calculated from the following procedure.

1. Calculate the percentile of the highest concentration in the data set data using the formula shown below.

$$P_n = (1 - CL)^{1/n}$$

Where:

P_n	=	Percentile of the highest concentration in the data set
CL	=	Confidence Level = 0.95
n	=	Number of samples in the data set

2. Calculate Reasonable Potential Multiplying Factor (RPMF) as the ratio of the 95th percentile of the data set to the upper bound of Pn using the formula:

$$RPMF = C_{95}/C_{Pn}$$

Where:

C_{95}	=	$EXP(Z_{95}\sigma - 0.5\sigma^2)$
C_{Pn}	=	$EXP(Z_{Pn}\sigma - 0.5\sigma^2)$

Where:

EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
σ^2	=	$LN(CV^2 + 1)$
σ	=	square root of σ^2
Z_{95}	=	Z score for the 95th percentile = 1.6542
Z_{Pn}	=	Z score for P_n
LN	=	Natural logarithm (base e)
CV	=	Coefficient of variation

Z_{Pn} can be looked up in a table of Z scores or calculated from the formula:

$$Z_{Pn} = Z_v - (2.515517 + 0.802853 * Z_v + 0.010328 * (Z_v^{\ 2})) \\ / (1 + 1.432788 * Z_v + 0.189269 * (Z_v^{\ 2}) + 0.001308 * (Z_v^{\ 3}))$$

Where:

Z_v	=	$(LN(1/((1-P_n)^2)))^{0.5}$

This analysis will result in four MPCs:

- MPC for acute *Ceriodaphnia dubia*
- MPC for acute *Pimephales promelas*
- MPC for chronic *Ceriodaphnia dubia*
- MPC for chronic *Pimephales promelas*

If the MPC for a species for a given test type (acute or chronic) is less than the appropriate WLA, then no WQBEL is needed for that species for that test type (acute or chronic). If the MPC for a species for a given test type is greater than the appropriate WLA, a WQBEL will be calculated for that species for that test type.

If there is a reasonable potential to exceed, there are three possible outcomes from the RPTE analysis for each species:

- **Case 1.** There is RPTE the WLA_a but not the WLA_c
- **Case 2.** There is RPTE the WLA_c but not the WLA_a
- **Case 3.** There is RPTE both the WLA_a and WLA_c

2.4.5 Calculation of WQBELs

The procedures used to calculate WQBELs are described below and are based on suggestions and recommendations in the TSD (EPA 1991a) and WET Variability Document (EPA 2000c). The GLI does not define a method for calculating permit limits.

If there is a RPTE for more than one species for a given test type (acute or chronic) the lowest calculated acute and chronic MDL and AML are used for the WQBELs.

2.4.5.1 Frequency of Testing to Assess Compliance with WQBELs

If there is a RPTE, the default WET testing frequency should be quarterly for major facilities unless IDEQ determines there is a need for an alternative testing schedule. This represents a doubling of the normal test frequency that would otherwise be required if there is no RPTE, but this increased frequency can be restricted to the test type and organism that led to the need for WQBEL. If there are fewer than 10 valid WET data points, the testing frequency is as described in Section 2.4.4.1.1.

2.4.5.2 Case 1—There is a Reasonable Potential to Exceed the WLAa but not the WLAc

For Case 1, there is no need for WET WQBELs for chronic toxicity but there is a need for WET WQBELs for acute toxicity.

1. Convert the chronic wasteload allocation to acute toxicity units as shown below.

$$WLA_{ca} = WLA_c \,/\, ACR$$

Where:

WLA_c	=	WLA in TU_c
WLA_{ca}	=	Chronic wasteload allocation in acute toxicity units
ACR	=	Acute to Chronic Ratio (default value is 10)

A site-specific ACR can be determined from an ACR site-specific study (ACRSS). The ACRSS will require the testing of a minimum of 10 samples of effluent that are simultaneously tested for acute and chronic toxicity using *Ceriodaphnia dubia* and *Pimephales promelas* as the test organisms. Samples that have toxicity end points of greater than 100 percent effluent cannot be used in the calculation of a site specific ACR. There must be a minimum of 10 data points where toxicity can be measured at less than 100 percent effluent. The site-specific ACR (SSACR) is the upper 90th percentile of the individuals ACRs determined.

2. Calculate the long-term average wasteload that will not exceed the acute and chronic waste load allocations at the 99th percentile as shown below.

$$LTA_a = WLA_a * EXP(0.5\sigma^2 - Z_{99}\sigma)$$

$$LTA_{ca} = WLA_{ca} * EXP(0.5\sigma_4^2 - Z_{99}\sigma_4)$$

Where:

LTA_a	=	Long term average to meet WLA_a in TU_a at 99th percentile
LTA_{ca}	=	Long term average to meet WLA_{ca} in TU_a at 99th percentile
σ^2	=	$LN(CV^2 + 1)$
σ	=	square root of σ^2
σ_4^2	=	$LN[(CV^2/4) + 1]$
Z_{99}	=	2.326 = Z score at the 99th percentile of the normal distribution
EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
LN	=	Natural logarithm (base e)
CV	=	Coefficient of variation

3. Determine the lower (more limiting) of the two long-term averages. The limiting long-term average (LTA_{low}) is the lowest LTA_{ca} or LTA_a value. It is used to calculate the daily maximum and average monthly permit limits.

4. Calculate the maximum and daily average monthly permit limits using the lower (more limiting) long term average. The daily maximum and average monthly permit limits are the TU_s that will not exceed the LTA_{low} at the 95th percentile.

The MDL and AML are calculated from the formulas shown below.

$$MDL = LTA_{low} * EXP(Z_{99}\sigma - 0.5\sigma^2)$$

$$AML = LTA_{low} * EXP(Z_{95}\sigma_n - 0.5\sigma_n^2)$$

Where:

MDL	=	Maximum Daily Limit in TU_a
AML	=	Average Monthly Limit in TU_a
σ^2	=	$LN(CV^2 + 1)$
σ	=	square root of σ^2
σ_n^2	=	$LN[(CV^2/n) + 1]$
σ_n	=	square root of σ_n^2
Z_{95}	=	1.645 = Z score at the 95th percentile of the normal distribution
Z_{99}	=	2.326 = Z score at the 99th percentile of the normal distribution
n	=	Number of samples taken per month: Default = 1
EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
LN	=	Natural logarithm (base e)
CV	=	Coefficient of variation

The TSD and WET Variability Document suggest that "n" should be set no lower than four when calculating permit limits, even if the discharger is allowed to sample less frequently (for example, monthly, quarterly, annually, etc.). As discussed for chemical-specific WQBELs calculations, this may be a reasonable approach in situations when a sample is taken on the first day of the month and it fails to meet the monthly WQBEL. A discharger can take up to three additional samples to demonstrate compliance and still have that result be consistent with the WQBEL calculation assumptions. Although this works for chemical-specific limits, it does not work in practice for WET. The typical laboratory turnaround time from when a sample is taken for WET analysis and when the results are made available to the discharger is often about 30 days. Therefore, unless the discharger schedules more than one test in a month, the fact that the sample has failed the WET test will not be known until the following month. Thus, it is recommended here that if testing is done less frequently than monthly, "n" should be 1 for calculation of AML WET WQBELs.

The MDL and AML from these calculations are in TU_a. If the MDL or AML is less than 1, the MDL or AML is set at the NOAEC using the acute toxicity test. Divide 100 by the TU_a to determine the percent effluent concentration that the LC_{50} must not exceed. This percent effluent concentration, along with 2 concentrations below and 2 concentration above this value and a 100 percent effluent concentration (if not normally included) are used for the acute toxicity test. If the WQBEL is the NOAEC, the test concentrations will typically be 100, 80, 60, 50 and 40 percent effluent or five other dilutions that are determined to be appropriate.

2.4.5.3 Case 2—There is a Reasonable Potential to Exceed the WLA_c but not the WLA_a

For Case 2, there is no need for WET WQBELs for acute toxicity, but there is a need for WET WQBELs for chronic toxicity.

1. Convert the acute wasteload allocation to chronic toxicity units as shown below.

$$WLA_{ac} = WLA_a * ACR$$

Where:

WLA_a	=	WLA in TU_a
WLA_{ac}	=	Acute wasteload allocation in chronic toxicity units
ACR	=	Acute to chronic ratio (default value is 10)

A site-specific ACR can be determined from an ACRSS. The ACRSS will require the testing of a minimum of 10 samples of effluent that are simultaneously tested for acute and chronic toxicity using *Ceriodaphnia dubia* and *Pimephales promelas* as the test organisms. Samples that have toxicity end points of greater than 100 percent effluent cannot be used in the calculation of a site specific ACR. There must be a minimum of 10 data points where toxicity can be measured at less than 100 percent effluent. The site specific SSACR is the upper 90th percentile of the individuals ACRs determined.

2. Calculate the long-term average wasteload that will not exceed the acute and chronic waste load allocations at the 99th percentile as shown below.

$LTA_{ac} = WLA_{ac} * EXP(0.5\sigma^2 - Z_{99}\sigma)$
$LTA_c = WLA_c * EXP(0.5\sigma_4^2 - Z_{99}\sigma_4)$

Where:

LTA_{ac}	=	Long-term average to meet WLA_{ac} in TU_c at 99th percentile
LTA_c	=	Long-term average to meet WLA_c in TU_c at 99th percentile
σ^2	=	$LN(CV^2 + 1)$
σ	=	square root of σ^2
σ_4^2	=	$LN[(CV^2/4) + 1]$
Z_{99}	=	2.326 = Z score at the 99th percentile of the normal distribution
EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
LN	=	Natural logarithm (base e)
CV	=	Coefficient of variation

3. Determine the lower (more limiting) of the two long term averages. The limiting long-term average (LTA_{low}) is the lowest LTA_{ac} or LTA_c value. It is used to calculate the daily maximum and average monthly WQBELs.
4. Calculate the maximum and daily average monthly WQBELs using the lower (more limiting) long term average. The daily maximum and average monthly WQBELs are the TU_s that will not exceed the LTA_{low}.

The MDL and AML are calculated from the formulas shown below.

$MDL = LTA_{low} * EXP(Z_{99}\sigma - 0.5\sigma^2)$
$AML = LTA_{low} * EXP(Z_{95}\sigma_n - 0.5\sigma_n^2)$

Where:

MDL	=	Maximum Daily Limit in TU_c
AML	=	Average Monthly Limit in TU_c
σ^2	=	$LN(CV^2 + 1)$
σ	=	square root of σ^2
σ_n^2	=	$LN[(CV^2/n) + 1]$
σ_n	=	square root of σ_n^2
Z_{95}	=	1.645 = Z score at the 95th percentile of the normal distribution
Z_{99}	=	2.326 = Z score at the 99th percentile of the normal distribution
n	=	number of samples taken per month: default = 1
EXP	=	Base e (or approximately 2.718) raised to the power shown between the parentheses
LN	=	Natural logarithm (base e)
CV	=	Coefficient of variation

The MDL and AML from these calculations are in TU_c. If the MDL or AML is less than 1, the MDL or AML is set at the NOAEC using the chronic toxicity test. Divide 100 by the TU_c to determine the percent effluent concentration that the IC_{25} must not exceed. This percent effluent concentration, along with 2 concentrations below and 2 concentration above this value and a 100 percent effluent concentration (if not normally included) are used for the chronic toxicity test. If the WQBEL is the NOAEC, the test concentrations will typically be 100, 80, 60, 50 and 40 percent effluent or five other dilutions that are determined to be appropriate.

2.4.5.4 Case 3—There is a Reasonable Potential to Exceed the WLAa and the WLAc

For Case 3, there is a need for WET WQBELs for both acute toxicity and chronic toxicity.

The WQBELs for acute toxicity are those described for Case 1. The WQBELs for chronic toxicity are those described for Case 2.

2.4.6 WET Triggers, Test Failures and TRE/TIE Studies

For cases in which an insufficient number of valid data points are available (that is, less than 10 values), a RPTE evaluation will not have been conducted, as described above. In these situations, the permit should contain WET monitoring combined with “triggers” for major facilities (or minor facilities for which toxicity is suspected). The triggers, if exceeded, would be viewed a test “failure” and the permit should require a retesting and response procedure as described below for exceedances of WET WQBELs. The triggers for each test species would be set equal to the IWC_a and IWC_c or these IWCs converted to TUs.

Because of large potential variability inherent in WET tests, the approach for WET test failures described below should be used in Idaho:

- If a toxicity test does not meet the quality assurance criteria for an acceptable test, the discharger must re-test the effluent with the test that failed the QA criteria within 30 days of receiving the test report from the testing laboratory.
- If an effluent exceeds a trigger, MDL or AML, the discharger must re-test the effluent with the test that failed and species that failed the WET test two times within 30 days of receiving the test report from the testing laboratory.
- If the effluent does not pass the two additional tests, the discharger is to institute a toxicity reduction and/or toxicity identification (TRE/TIE) study to determine the causes and solutions to reduce the toxicity to acceptable levels (that is, to meet the WQBELs if they exist, or to fall below the triggers if there are no WQBELs). Based on the results of the re-testing and TRE/TIE investigations, the permit writer may need to reopen the permit to include or modify WET WQBELs if necessary to protect designated beneficial uses of the receiving water.
- EPA guidance for conducting TRE/TIE studies should be used until such time as Idaho-specific guidance is available. EPA has developed a sequence of guidance manuals for TRE/TIE investigations, several examples include:
  - *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants* (EPA 1999a)
  - *Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures* (EPA 1991b)
  - *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I* (EPA 1992)
  - *Methods for Aquatic Toxicity Identification Evaluations: Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity* (EPA 1993a)
  - *Methods for Aquatic Toxicity Identification Evaluations: Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity* (EPA 1993b)

2.4.7 Example WET Calculation

Table 8 presents the physical setting information that applies to this example:

TABLE 8
Physical Setting Information

	Acute	Chronic
Criteria (AC and CC)	0.3 TU_a	1.0 TU_c
Effluent Flow (cfs) (Q_e)	10	10
Receiving water flow (cfs) (Q_r)	100	173
% of Receiving Water Flow for Mixing (M)	25%	25%
Background Toxicity (C_r)	0 TU_a	0 TU_c
IWC	28.6%	18.8%

Wasteload Allocation Formulas

$$WLA_a = \frac{(AC*(Q_e + (Q_r * M)) - (C_r * Q_r * M))}{Q_e}$$

Solutions

$$WLA_a = \frac{(0.3*(10 + (100*0.25)) - ((0*100*0.25))}{10}$$

$$WLA_a = 1.05\ TU_a$$

$$WLA_c = \frac{(CC*(Q_e + (Q_r * M)) - (C_r * Q_r * M))}{Q_e}$$

$WLA_c = ((1.0*(10+(173*0.25)) – (0*173*0.25)))/10$

$$WLA_c = 5.34\ TU_c$$

Table 9 presents the toxicity data that are available for this hypothetical effluent. This example is only for toxicity results for only one species. However the requirement is for WET test results for two species. When additional species data is used, the calculations are identical.

TABLE 9
Toxicity Data

Acute Test Data			Chronic Test Data		
LC_{50}	TU_a	TU_a Adjusted to 0.5 DL	IC_{25}	TU_c	TU_c Adjusted to 0.5 DL
>100	<1.0	0.50	>100	<1.0	0.50
75	1.333	1.33	36	2.773	2.77
80	1.250	1.25	57	1.766	1.77
60	1.667	1.67	64	1.559	1.56
50	2.000	2.00	91	1.105	1.10
60	1.667	1.67	33	3.068	3.07
70	1.429	1.43	55	1.814	1.81
20	5.000	5.00	26	3.846	3.85
>100	<1.0	0.50	>100	<1.0	0.50
>100	<1.0	0.50	95	1.048	1.05
>100	<1.0	0.50	39	2.594	2.59
>100	<1.0	0.50	62	1.622	1.62
50	2.000	2.00	53	1.892	1.89
50	2.000	2.00	35	2.860	2.86
50	2.000	2.00	86	1.161	1.16

Note that LC_{50} and IC_{25} data that are greater than 100 percent effluent (less than 1.000 TU), are set to 0.5 TU, which is one half of the detection limit of 1.00 TU.

Table 10 presents the results of the Grubb's Test for the acute data.

TABLE 10
Results of the Grubb's Test for Acute Data

Mean	0.18707
Standard Deviation	0.71557
No. of values	15
Outlier detected?	No
Significance level	0.05
Critical value of Z	2.548308

Row	TU_a Adj. for MDL	LN of TU_a	Z	Significant Outlier?
1	0.50	-0.6930	1.22988	
2	1.33	0.2880	0.14105	
3	1.25	0.2230	0.05022	
4	1.67	0.5110	0.45269	
5	2.00	0.6930	0.70703	
6	1.67	0.5110	0.45269	
7	1.43	0.3570	0.23748	
8	5.00	1.6090	1.98713	Furthest from the rest, but not a significant outlier (P > 0.05).
9	0.50	-0.6930	1.22988	
10	0.50	-0.6930	1.22988	
11	0.50	-0.6930	1.22988	
12	0.50	-0.6930	1.22988	
13	2.00	0.6930	0.70703	
14	2.00	0.6930	0.70703	
15	2.00	0.6930	0.70703	

Table 11 presents the results of the Grubb's Test for chronic data.

TABLE 11
Results of the Grubb's Test for Chronic Data

Mean	1.87388			
Standard Deviation	0.976579			
No. of values	15			
Outlier detected?	No			
Significance level	0.05			
Critical value of Z	2.548308			
Row	**TU_c Adj. for MDL**	**LN of TU_c**	**Z**	**Significant Outlier?**
1	0.5000	-0.693	1.406829	
2	2.7732	1.02	0.920888	
3	1.7661	0.569	0.110365	
4	1.5589	0.444	0.322534	
5	1.1047	0.1	0.787627	
6	3.0680	1.121	1.222758	
7	1.8141	0.596	0.061214	
8	3.8460	1.347	2.019417	Furthest from the rest, but not a significant outlier (P > 0.05).
9	0.5000	-0.693	1.406829	
10	1.0478	0.047	0.845892	
11	2.5941	0.953	0.737493	
12	1.6219	0.484	0.258023	
13	1.8923	0.638	0.018862	
14	2.8604	1.051	1.010179	
15	1.1607	0.149	0.730284	

The Grubb's test for outliers show that there are no significant outliers at the 0.05 probability level, for the set of acute or chronic tests. If the Z value for an individual data point was greater than the critical Z value, that data point would be considered and outlier and not included for calculation of the MPC and permit limits.

Table 12 presents the calculation of the 95 percent confidence level of 95 percent probability.

TABLE 12
95 Percent CL of 95 Percent Probability of Maximum Probability Concentration

	Acute Test Data	**Chronic Test Data**
Total number of values	15	15
Maximum value	5.00	3.07
Mean (m)	1.523	1.874
Standard deviation (s)	1.15	0.98
Coefficient of Variation (CV)	0.75	0.52
Confidence Level (CL)	0.95	0.95
Probability Basis	0.95	0.95
σ^2 (variance) = LN(CV^2+1)	0.4488	0.2403
σ (standard deviation of population)	0.6699	0.4902
Percentile of highest concentration (P_n)	0.819	0.819
Intermediate Z score calculation (Zv) for P_n	1.84881	1.84881
Z score of P_n - highest concentration (Z_{Pn})	0.9113	0.9113
Intermediate Z score calculation	2.448	2.448
Z score of Prob. Basis (= Z95)	1.6452	1.6452
C_{95}	2.4055	1.9864
C_{Pn}	1.4712	1.3862

TABLE 12
95 Percent CL of 95 Percent Probability of Maximum Probability Concentration

	Acute Test Data	Chronic Test Data
Multiplier 95% CL 95% probability	1.63	1.43
1-day maximum probability 95%CL 95% Prob.	8.17	5.51
Exceed WLA	Yes	Yes

The results of the maximum probable concentration show that the maximum probable concentration (MPC) for the acute and chronic WET tests both exceed the WLAs (Case 3). Therefore both acute and chronic MDL and AML limits are calculated as follows. Which means that acute and chronic WET tests will be required for this effluent.

The data submitted has 10 values that show both acute and chronic toxicity. Therefore a site specific acute to chronic ratio (ACR) can be calculated. The ACR is calculated as the upper 90th confidence level of the mean of the ratios. Using the example data in the TSD, the ratios are assumed to be normally distributed. Table 13 presents the calculation of the site specific ACR.

TABLE 13
Calculation of the Site-Specific ACR

Mean ACR	1.182
Standard deviation	0.5173
Number of values	10
Upper 90th percentile (P90)	1.851

Table 14 presents the permit limit calculations.

TABLE 14
Permit Limit Calculations

	Acute	Chronic
ACR	1.851	1.851
Number of samples per month	1	1
WLA_{ca} = (WLA_c/ACR)	2.882	NA
WLA_{ac} =(WLA_a*ACR)	NA	1.9
σ^2	0.4488	0.2403
σ_4^2	0.1324	0.0657
σ_n^2	0.4488	0.2403
Z_{95}	1.645	1.645
Z_{99}	2.326	2.326
LTA_a	0.2766	NA
LTA_{ac}	NA	0.701
LTA_{ca}	0.759	NA
LTA_c	NA	3.038
Controlling LTA	LTA_a	LTA_{ac}

TABLE 14
Permit Limit Calculations

	Acute	Chronic
Minimum LTA (LTA_{low})	0.2766	0.701
MDL in TU_a	1.05	NA
AML in TU_a	0.67	NA
Daily LC_{50} must be greater than percent effluent	95.2%	NA
Monthly average LC_{50} must be greater than percent effluent	150.3%	NA
MDL in TU_c	NA	1.94
AML in TU_c	NA	1.39
Daily IC_{25} must be greater than percent effluent	NA	51.4%
Monthly average IC_{25} must be greater than percent effluent	NA	71.8%

For this hypothetical effluent, there would be a requirement for acute and chronic testing.

The WQBELs for the acute toxicity tests are 1.05 TU_a for the MDL and 0.67 TU_a for the AML. This would mean that if the testing were done on a quarterly basis, the effluent would have to pass the acute test with 150.3 percent effluent. Since it is impossible to test 150.3 percent effluent, this would mean that the effluent would have to pass at the acute NOAEC at 100 percent effluent (no significant difference between the control and 100 percent effluent).

The WQBELs for the chronic toxicity tests are 1.94 TU_c for the MDL and 1.39 TU_c for the AML. This would mean that if the testing were done on a quarterly basis, the effluent would have to pass the chronic test with 71.8 percent effluent.

2.5 WQBELs When Receiving Water Background Exceeds WQC

As noted earlier (see Section 1.1.3.2), a TMDL process will normally be undertaken in circumstances in which a pollutant or pollutants cause or contribute to non-attainment of a designated use and/or exceedances of a WQC.

However, there will be situations in which natural conditions affecting a water body will preclude attainment of a WQC and/or designated use. In some of these situations where natural conditions exceed the criterion, there will also be one or more point source discharge. This will be a fairly common situation in southern Idaho for temperature because of the desert climate and natural lack of riparian cover. It will also occur in some areas for parameters that are naturally elevated as a result of local geology (for example, arsenic). Several options exist for addressing these situations. As described earlier, site-specific WQC can be established, designated uses can be modified via a use attainability analysis, and/or variances can be granted to account for natural background conditions. In addition to these approaches, which require water quality standards changes via a rule-making process (other than implementation of the WER as a site-specific permit calculation as described in Section

2.3.2.1.1), several other approaches are available that can be used on a permit-specific basis as part of the NPDES process without the need for a water quality standards change. These are described as follows:

- When natural background conditions exceed any applicable water quality criterion, the applicable water quality criteria do not apply; instead, pollutant levels are not to exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed (IDAPA 58.01.02.200.09).
- When natural background conditions cause the receiving water background temperature to exceed the temperature criterion, a point source discharge can be allowed to increase temperature in the receiving water by 0.3 degree Celsius (IDAPA 58.01.02.401.03.a.v)
- For metals whose aquatic life criteria are hardness-based, and the receiving water background exceeds such a criterion, permit limits have been derived by setting the WLAs for acute and chronic criteria to be equal to the criterion at the 5th percentile of the effluent hardness. This is a way to establish permit limits that will be clearly protective of WQS under these circumstances. This approach has been used by EPA for some permits in Idaho, though this may conflict with the first bullet above in cases where the exceedance is due to natural background conditions.
- The GLI has established a process in which one of two approaches can be taken depending on the intake water source for a point source discharger (see Appendix F, Procedure 5D):
  - If the permittee withdraws its intake water from the same water body that it discharges to, then the WQBEL will be set equal to the background concentration (a "no net addition limitation"); this provision was intended to be a short-term (i.e., 12-year) remedy, with the approach after that to be to undertake a TMDL process in these circumstances; the GLI specifically defines the "same body of water"
  - If the permittee withdraws its intake water from a different body of water than it discharges to, then the WQBEL will be based on the most stringent applicable WQC.

3.0 Abbreviations and Definitions

1Q10	Statistically derived daily low flow that has a reoccurrence of once every 10 years
7Q10	Statistically derived average low flow for 7 consecutive days that has a reoccurrence of once every 10 years
ACR	acute to chronic ratio
ACRSS	ACR site-specific study
Acute Toxicity Test	A short-term (48-hour) toxicity test where organisms are exposed to an effluent and lethality is measured
AML	average monthly limit
BAT	best available technology
BMP	best management practices
BOD	biochemical oxygen demand
BPJ	best professional judgment
BPT	best practicable technology
CFR	Code of Federal Regulations
Chronic Toxicity Test	A short-term (6- to 8-day) test where organisms are exposed to an effluent and growth or reproduction is measured
COLD	cold water communities
CV	coefficient of variation of the mean
CWA	Clean Water Act
DL	detection limit
DWS	domestic water supply
EPA	U.S. Environmental Protection Agency
ESD	extreme studentized deviate
EXP( )	expression or number in parentheses is the exponent applied to the base e
GLI	Great Lakes Initiative: Water Quality Guidance for the Great Lakes System; Final Rule
IC	inhibition concentration
IC_{25}	Concentration that caused a 25 percent reduction in the measured response in a chronic toxicity test (reproduction for *Ceriodaphnia dubia* and growth for *Pimephales promelas*)
IDEQ	Idaho Department of Environmental Quality
IWC	in-stream waste concentration
IWC_a	in-stream waste concentration to meet acute criteria (Qe/(Qe + Qr)

IWC_c	in-stream waste concentration to meet chronic criteria (Qe/(Qe + Qr)
LA	load allocation
LC_{50}	Concentration lethal to 50 percent of the organisms tested in an acute toxicity test
LN( )	Expression or number in parentheses is the positive real number for the natural logarithm
LTA	long term average
MDL	maximum daily limit
ML	minimum level
MOD	modified aquatic communities
MOS	margin of safety
MPC	maximum probable concentration
MV	multiplier value
NOAEC	Concentration not significantly different from the control using a hypothesis test
NONE	Uses not attainable
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
ORW	outstanding resource water
Outlier	A value that has a probability of less than 0.5 to have come from the same population as the other values in the group. The default statistical test used to make this determination is the Grubb's or ESD method
PCR	Primary contact recreation
POTW	Publicly owned treatment works
RPMF	reasonable potential multiplying factor
RPTE	reasonable potential to exceed
SC	seasonal cold water communities
SCR	secondary contact recreation
SRW	special resource water
SS	salmonid spawning
TMDL	total maximum daily load
TSD	EPA Technical Support Document for Water-Quality Based Toxics Control (EPA 1991a)
TU	toxic unit
TU_a	acute toxic units = $100/LC_{50}$ or 100/NOAEC
TU_c	chronic toxic units = $100/IC_{25}$
WARM	warm water communities

WET	whole effluent toxicity
WLA_a	wasteload allocation to meet acute criteria
WLA_c	wasteload allocation to meet chronic criteria
WQBEL	water quality-based effluent limits
WQC	water quality criteria

4.0 References

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Appendices

APPENDIX A

Idaho Water Quality Criteria

http://www2.state.id.us/adm/adminrules/rules/IDAPA58/58INDEX.HTM

APPENDIX B

Idaho Mixing Zone Procedures

http://www.deq.state.id.us/water/surface_water/mixing_zone_procedures.htm

Appendix 5. Annotated Outline for Storm Water Permitting Guidance Manual