3 Evaluating Potential to Degrade

This portion of the document outlines the procedure for evaluating an activity or discharge to determine whether it will degrade or lower water quality, that is, ~~move~~ change the concentration of a pollutant closer to a criterion ~~(i.e., a change in a pollutant that is adverse to designated or existing uses)~~. Only an activity or discharge that might cause degradation is subject to a Tier 2 antidegradation evaluation. This evaluation is performed parameter by parameter for parameters associated with the activity or discharge. If water quality is degraded by any one parameter, that will mean the activity as a whole degrades the water.

A proposed activity can result in existing receiving water quality being degraded, improved, or unchanged. To evaluate which of these will occur, expected water quality for two different effluent scenarios must be determined and then compared with each other. These two scenarios are:

1. without the increased activity or discharge, ~~(~~i.e. existing~~now~~ or current~~)~~, and

2. with the new or increased activity or discharge, ~~(~~i.e. proposed or future ~~or proposed)~~.

Existing water quality is that which is ~~allowed~~ permitted to occur ~~under the current discharge condition~~, before any changes in the permitted activity or discharge. Existing water quality will likely need to be estimated rather than measured, due to variations in discharge and receiving stream conditions. Proposed water quality is that which may be allowed to occur in the future after changes in an activity or discharge are licensed or permitted. Proposed water quality can not be measured and must be estimated.

~~The Estimating p~~Potential existing water quality is ~~determined~~ estimated by calculati~~o~~ng ~~of~~ the mixing of the maximum permitted ~~existing~~ discharge with the receiving water under critical conditions~~, i.e. mathematical mixing~~. Performing this calculation again with the proposed discharge gives the potential future water quality. To perform these calculations we need to know five things:

1. the upstream water quality,
2. the effluent quality that is currently allowed (zeros if the proposal is for a new discharge),
3. the effluent quality that would be allowed under the proposal,
4. the activity's design or maximum production-based flow, and
5. the appropriate critical flow of the receiving water, or multiple flows for a "flow-tiered" permit situation.

All new regulated activities or discharges may degrade water quality as they present new pollutant loads added to the receiving water body. Similarly, an expansion or increase of

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an existing discharge may also cause degradation of water quality. However, degradation may be avoided if, for example, the quality of the new discharge is as good as or better than receiving water body quality, or if the increased loads are offset by companion load reducing activities.

Existing activities that propose no expansion or existing discharges that propose no change in their discharge upon renewal of their permit or license will not cause degradation of water quality[5]. Non-degrading activities and discharges are not subject to Tier 2 antidegradation review. Thus, once it is determined that an activity would not expand or a discharge would not increase, the only antidegradation question is whether Tier 1 requirements are met.

3.1 Receiving Water Quality

It is the change in ~~downstream~~ receiving water quality caused ~~after mixing of the pollutant loads from~~by an activity or discharge that is the concern of antidegradation policy. In flowing waters ~~While~~ our focus is on downstream water quality that results from mixing of discharge with the receiving stream. However, ~~,~~ in order to calculate resulting water quality ~~this~~ for a new activity or discharge or for an increase in an existing discharge, we need to know the quality of the receiving water body~~'s quality~~ unaffected by the increased or new activity or discharge in question, before mixing or upstream in flowing waters. Thus, receiving water quality at two locations is of interest:

1. Before / upstream. A location where the water body is not influenced by the source under consideration. This is~~,~~ either immediately upstream (in a river or stream) or outside the influence of the plume (for lakes or reservoirs) for existing sources; or ~~this is the upstream water quality~~water quality at the place of discharge before new discharge begins.

2. After / downstream. The location where water quality ~~would~~ reflects the addition of pollutants from the proposed activity or discharge~~; this is the downstream water quality.~~.

   ~~**Existing/Proposed**~~

   ~~Existing receiving water quality is what is allowed to occur before a new source commences activity or there is a permitted increase in an existing source. Proposed water quality is what would be allowed to occur after a new source, or an increase in an existing source, is authorized. In either case what is allowed may not actually occur and thus may not be observed or measured. While it is possible that existing conditions reflect this potential worst case and could simply be~~

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[5] It is possible that water quality could decline even if an activity or discharge does not increase, such as due to a decrease in flow and thus assimilative capacity of the receiving water body. If this change in flow is not due to the activity or discharge under review then that activity or discharge will be not be held responsible with regard to antidegradation requirements. In such a situation compliance with water quality-based effluent limits may require a reduction in activity or discharge independent of antidegradation requirements.

~~measured, this is highly unlikely and so in practice, potential existing water quality will be calculated where appropriate instream monitoring data is not available. Potential future water quality can only be calculated or estimated. Calculations will be based upon appropriate mixing.~~

~~Furthermore, for both existing and proposed water quality, we are interested in the "critical" water quality conditions allowed. Therefore, we are concerned with the maximum discharge the permit or license allows, in combination with critical conditions for dilution in the receiving water, which may be multiple flow combinations for "flow tiered" permits.~~

~~Although it is a detrimental change in downstream water quality that would *potentially* result from a new source or an increase in an existing source that we are concerned with, we also need to know the upstream water quality in order to calculate what the downstream water quality would be.~~

Upstream vs. Downstream

It ~~is~~ may be tempting to view degradation of water quality simply as the change in quality from upstream to downstream. While this comparison works for a new activity or discharge – because it amounts to the same thing as the before/after change in downstream water quality – ~~–~~it does not work for an existing discharge. For exisiting~~Once a~~ discharges ~~is operating~~ there ~~will of course~~ may be a change in water quality from upstream to downstream, but this difference ~~is not~~may not ~~an~~ indicat~~ion a of~~ worsening conditions due to a change in discharge. Antidegradation review is forward looking and so to fairly judge both new and existing discharges we look at the change in downstream water quality ~~they may cause~~ before and after a change in permitted operation.

Characterizing Upstream Water Quality

~~Knowing the Characterizing~~ Knowing the upstream water quality data is essential to calculating potential degradation. While it is important to adequately characterize upstream water quality, how much data this takes will depend on water quality variability and how much uncertainty can be tolerated in the analysis. Depending upon the quantity of available background data, DEQ will generally use a conservative estimate of pollutant concentrations when calculating degradation.

~~It is common practice~~ EPA Region 10 typically ~~to~~ uses the 95th percentile (i.e., the value that is expected to be exceeded 5% of the time) of measurements as a conservative characterization of ambient concentrations when evaluating permit limits[6]. In particular, EPA uses this value for evaluating limits based on receiving water criteria applicable to

[6] Idaho has proposed methods for calculating WQBELs, including how to define ambient concentrations, in both a WQBELs guidance document and a Board of Environmental Quality rule-making (both developed in 2002). EPA has not adopted DEQ's guidance or rule for permitting purposes, and thus DEQ's antidegradation calculation procedures will need to be consistent with EPA's permitting calculations for as long as EPA retains NPDES primacy.

relativity short-term effects (e.g., acute and chronic aquatic life criteria). However, getting a reliable estimate of the 95th percentile requires sufficient data. Generally, 30 measurements across the full range of variation are recommended although as few as 12 (monthly samples for a year) will be acceptable. If fewer than 12 ~~data~~ measurements are available, DEQ will use the maximum observed during critical conditions, rather than an estimated 95th percentile. If no data are available, DEQ may request that the applicant obtain such data.

For other types of receiving water criteria (e.g., criteria based on longer form effects such as those applicable to human health or nutrients), a more appropriate assumption for upstream water quality would be a representation of the "central tendency" (such as a mean, geometric mean, or median)[7]. In addition, DEQ recognizes that differing time periods will apply to derivation of central tendency values for different types of designated uses and associated criteria. For example, annual averaging would be appropriate for mercury, annual or seasonal for nutrients, and during summer critical periods for pollutants such as dissolved oxygen and temperature. Such temporal considerations apply not only to upstream concentrations, but to other elements of limits calculations (sections 3.2 and 3.3).

DEQ expects sufficient data to usually be available in the permit or license application and discharge monitoring reports for existing NPDES-permitted discharges. For the latter, DEQ also expects to rely heavily on EPA's calculation of upstream water quality prepared in their drafting of effluent limitations for the permit. Depending on the permitting situations these calculations may need to address seasonal water flows and a flow-tiered discharge framework

Measurements of upstream water quality are important but may not be sufficient. This is because m~~M~~easurement of upstream quality may not reflect potential upstream quality, that is, the quality that would occur with other sources upstream discharging at their permitted limits. Potential upstream quality must be ~~determined~~ estimated so that we know the ~~estimated~~ remaining unallocated assimilative capacity and ensure that we do not over-allocate it. This also affects the determination of whether an increase in discharge is significant or not (see section 5.1). Therefore, some situations may require the calculation or modeling of upstream water quality. This may not be easy.

Most pollutants are not strictly conservative, meaning that they do not just accumulate or steadily increase downstream; instead they are physically, chemically, or biologically active and they experience transformation or fractionation with time and travel. They may adsorb to sediments, combine with other constituents and precipitate, be converted into a gaseous form and lost to the atmosphere, be taken up by living organisms, or

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[7] For example, DEQ's guidance for implementing its criteria for mercury recommends use of the mean value for water column or fish tissue concentration as related to the human health criterion, and recommends the geometric mean for potential future aquatic life criteria (DEQ, 2005). Another example is the Idaho Falls NPDES permit in which EPA evaluated phosphorus limits using a median value for the upstream concentration.

otherwise lost from the water column. Thus assimilative capacity is more than mere dilution.

Although the possibilities are nearly endless, there are a few parameters and pollutants for which relatively common and dominant transformations are known well enough to be modeled. Dissolved oxygen, nutrients, and temperatures are examples of very non-conservative parameters. Any estimate of their concentration that is not representative of a physical point near the source of load increases will likely be more accurate if modeled to account for known transformations.

Upstream water quality may be affected by distant sources, some of which may not currently be discharging at their allowed limits. This is a situation in which modeling can be quite useful and perhaps necessary. Ultimately, the decision whether to estimate water quality with modeling or with simpler mixing calculations is up to the person analyzing effects on water quality. This decision to model should be driven by the pollutant, acceptable error in the estimates, and whether time and data are available to conduct modeling. Even though monitoring data may not reflect potential upstream water quality it is valuable in calibrating model predictions.

Simple mixing estimates that ignore pollutant fate and transport are always a starting point and may be sufficient in many instances. There is no point in conducting modeling that will not improve upon simpler estimates.

Recommendations for modeling:

- Always model dissolved oxygen and temperature.
- Seriously consider modeling forms of phosphorus and nitrogen, as suggested by tolerance of uncertainty.
- Only model other pollutants if needed to reduce bias in conservative mixing estimates.

To summarize, upstream water quality can be determined by a number of methods. The method(s) used will depend on the site-specific situation, such as the extent of monitoring data available, existing ~~if any~~ upstream point source discharges ~~exist~~, and the specific characteristics of the pollutant(s) of interest. For certain situations, the use of monitoring data, especially where there are extensive data (for example 30 or more measurements to calculate a 95th percentile concentration) may be sufficient. For other situations, calculations or modeling using the appropriate model for the parameter(s) of interest may be needed.

3.2 Effluent Characteristics

Much of the needed information on effluent quality and quantity will be found in the current and/or proposed permit or license. Additional information may be found in the permit application and, for an existing discharge, in discharge monitoring reports.

For pollutants with quantitative limitations in a permit or license, those limits will be used in calculation of the discharge's effect on water quality. However, there are two common situations in which data in the permit alone will be inadequate to assess the effect of a new or an increased existing discharge on water quality:

- **No permit limits:** In either a new or an increased existing discharge, a pollutant may be known to be present for which there are no effluent limitations (no technology-based effluent limitation requirements) and for which it has been determined there will be no reasonable potential to exceed (RPTE) criteria. In this case, there will be no permit limits in either the new or reissued permit from which to calculate degradation.
- **First time permit limits:** In the renewal of an existing permit, a pollutant may be added for the first time, either because of new regulation or due to an increase in discharge leading to RPTE. In this situation, there will be a limit in the reissued permit but not a limit in the old permit.

~~An absence of permit limits does not necessarily equate to a pollutant not being of concern.~~ Even for ~~for~~ pollutants ~~without for which there are not~~ without permit limits ~~there can be cause~~ there can be degradation of water quality. Thus it ~~will be~~is will be necessary to determine both the current and proposed quality of the effluent for pollutants of concern regardless of whether they rise to the level of needing~~re are~~ permit limits. For NPDES discharges this ~~this pollutants of concern~~ is typically limited to information on characteristics of the discharge as described in the permit application.

A first time permit limit suggests there will be ~~implies d~~egradation of water quality but this is not necessarily the case. A new limit could be due solely to a change in regulation, e.g., a new or more stringent criterion or a new effluent limitation guideline, and therefore not result in worsening of water quality. In these situations it will be necessary to determine the quality of the effluent prior to the limit, and compare it to the quality with the proposed new limit. Current effluent quality for a pollutant without a prior ~~effluent~~ limitation must be based on discharge monitoring data or, lacking monitoring data, estimated based on other similar discharges.

Where new ~~proposed~~ limits are a result of reasonable potential analysis in absence of any actual increased discharge of pollutants, it is essential to ~~use~~ apply the same statistical procedures to characterize the quality of the effluent prior to a new limitation as ~~is~~ are used in developing the new limit, e.g., procedures in EPA's Technical Support Document for Water-Quality Based Toxics Controls (TSD) (EPA, 1991)[8]. ~~To do otherwise~~If the same statistical procedures are not used water quality could appear to change when in fact it is unchanged.~~would be an unfair comparison.~~ Information on proposed effluent quality with regard to a limited pollutant may be found in the permit application or, lacking such information in the permit application, may be estimated based on other similar

[8] Citation of the TSD here is used as an example of the statistical procedures that are often used in deriving NPDES permit limits. This is not to say the TSD is appropriate for all pollutants or discharge situations, or that other statistical procedures may not be used. The point is that the same statistical procedures should be applied to both the current and future discharge scenarios when judging if discharge has increased.

discharges.

3.3 Calculating the Effect of an Activity or Discharge – Will Degradation Result?

Antidegradation is concerned with ~~any~~ adverse change[9] in water quality that may occur due to a new or changed activity or discharge. Therefore, for rivers and streams, our focus is at a point downstream of the activity or discharge and on a comparison between potential existing water quality (under the current permit or license or lack thereof), and potential water quality in the future (under the proposed permit or license). For lakes and reservoirs, modified methods of calculating the effect are in the section on Modification for Lakes and Reservoirs, page 33~~29~~. As a practical matter we also focus on the near-field change in water quality (see Box 3.1)

Box 3.1 Near-field versus Far-field

When examining the effect of a discharge we can consider effects near the point of discharge or those far beyond the point of discharge. Near-field effects are those that generally occur up to the edge of any authorized mixing zone. The times involved are generally too short for significant transformations of pollutants to occur and therefore pollutant concentrations in the near-field may be reasonably calculated considering dilution only, even for non-conservative pollutants.

Farther away from the point of discharge fate and transport for non-conservative pollutants becomes increasingly important. In the far-field, distant from the point of discharge, accurate estimates of pollutant concentrations require accounting for fate and transport.

For all activities or discharges we calculate their effect on downstream water quality as:

$C_p - C_c = C_{diff}$ or ΔC *Equation 1. Effect on downstream water quality*[10]

Where:

C_p = proposed downstream water quality, after mixing

C_c = current downstream water quality, after mixing

ΔC = change in downstream water quality, after mixing

DEQ will evaluate the effect on water quality for each pollutant of interest. If ΔC is in an adverse direction, i.e., it moves pollutant concentration closer to a criterion for a particular use, there is degradation of water quality.

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[9] An adverse change in water quality is one which moves the concentration of a pollutant closer to the most limiting applicable criterion, thus reducing assimilative capacity.

[10] Please note that the equations presented are general, i.e. without units of measure. In use, consistent measurements units must be used and/or appropriate conversion factors. For example to get pollutant load expressed in lbs/day from equation 3 with a flow measured in millions of gallons/day and a pollutant concentration measured in mg/l the result must be multiplied by a unit conversion factor of 8.34.

Now let us turn our attention to calculating current and proposed water quality for use in *Equation 1*~~*Equation 1*~~. For this, we will consider two situations: first, a completely new activity or discharge—more simply a *new discharge;* second, an expansion or increase in an existing activity or discharge—more simply an *increased discharge.*

For both new and increased discharges, the following simple mixing equation ~~is~~ can be used:

$$C = \frac{LR_{up} + LR_{dis}}{Q_{up} + Q_{dis}}$$

Equation 2. Mixing equation for effect of discharges

Where:

C = fully mixed concentration in the receiving water body resulting from discharge, generally downstream

LR_{up} = receiving water body pollutant loading rate, upstream of the discharge

LR_{dis} = discharge pollutant loading rate

Q_{up} = receiving water body flow, upstream of the discharge

Q_{dis} = discharge flow

Loading rates are calculated as product of flow and concentration, such that:

$LR_{up} = Q_{up} \times C_{up}$, and

$LR_{dis} = Q_{dis} \times C_{dis}$

Equation 3. Loading rates

Where:

C_{up} = pollutant concentration in receiving water body, upstream of the discharge

C_{dis} = pollutant concentration in the discharge

Equation 2~~*Equation 2*~~ is generic and dynamic. It ~~and~~ has infinite solutions but we are interested in a particular pair of solutions ~~in particular~~ for each pollutant of interest. These two solutions are 1) for the current receiving water concentration (C_c), and 2) for the receiving water concentration that would result from the proposed permit limits (C_p)[11]. If seasonality or 'flow-tiered' permit limits are involved there will be multiple such pairs. These concentrations are determined using low-flow conditions in the receiving water body and permit conditions associated with the instream low-flow condition. These flow conditions are termed critical conditions and are described ~~more~~ in greater detail in the following section.

[11] Note that *Equation 2* works as well if Q_{dis} were zero and the discharge load a direct input. Upstream load on the other hand is always calculated from *Equation 3*, because receiving stream flow must be known as well as concentration.

Critical Conditions

Critical conditions are typically a combination of the maximum permitted effluent flow, maximum projected effluent concentrations or maximum allowable effluent limitations, critical conditions (e.g., "critical flows") of the receiving stream, and upstream receiving water quality concentrations (as determined by monitoring, calculation or modeling). If there is consideration of seasonality or 'flow-tiered' effluent limits there will be multiple sets of these critical conditions.

When flow or volume in the receiving water body is low, addition of a pollutant will have a greater effect on its concentration than when flow or volume is high, simply because there is less water to dilute the pollutant load. Therefore, to evaluate what could be a realistic "near worst case scenario", we must consider critical conditions for dilution that could occur. ~~These cCritical conditions are typically a combination of the maximum permitted effluent flow, maximum projected effluent concentrations or maximum allowable effluent limitations, critical conditions (e.g. "critical flows") of the receiving stream, and upstream water quality concentrations (either as determined by monitoring, or by calculation or modeling). If there is consideration of seasonality or 'flow-tiered' effluent limits there will be multiple sets of these critical conditions.~~

The maximum discharge flow is based on the facility design capacity or production-based maximum discharge. This will be stated in the permit or license for the current discharge and in the permit application for the proposed discharge. The receiving water body critical flow is determined according to the WQS (at §210.03) for each pollutant evaluated, e.g., for chronic aquatic life criteria, this is the 7Q10 flow. For nutrients, it is recommended that the 30Q10 flow during the growing season (e.g. April-September) be used. For mercury, it is recommended that the annual average flow be used. For temperature and dissolved oxygen, the 7Q10 flow is also useful but may be calculated on a monthly basis to account for seasonality.[12]

For the effluent, the critical load is the maximum permitted load ~~if~~ stated in the permit or license or, if a load is not stated, the product of:

- the maximum discharge flow as described above, and
- the maximum permitted effluent concentration.

The receiving water body critical load is the product of the critical flow described above and the potential upstream concentration determined as described in section 3.1 Receiving Water Quality~~3.1 Receiving Water Quality~~.

There will be at least two sets of critical conditions to be evaluated[13]; one for the current permit or license and ~~one~~ a second for the proposed permit or license. These will yield C_e and C_p in *Equation 2*~~*Equation 2*~~, for each pollutant evaluated, to be then ~~input~~ used in~~to~~ *Equation 1*~~*Equation 1*~~. It is possible, but unlikely, that the receiving stream critical

[12] Calculation of low-flows for regulated systems should only include flow data from the period of flow regulation.

[13] There will be even more pairs of conditions to be evaluated if seasonality or flow-tiered effluent limits are involved, one pair of critical conditions for each season or flow-tier.

conditions used in the analysis will also differ between now and the future. An anticipated change in upstream flow regulation or diversion would ~~create~~ be one ~~such possibil~~possible cause ~~ity~~of a change in critical stream flow.

Modification for Lakes and Reservoirs

Application of criteria ~~for~~ to lakes and reservoirs depends upon how slowly water moves through the water body, also known as the~~'s~~ ~~ir~~ detention time~~, how slowly water moves through them~~. A lake or reservoir with 15-days or less detention time ~~are~~ is treated as flowing, i.e. as a stream or river. Those with more than a 15-day detention time are treated differently and the calculations described above need to be modified. This is because if there is little flow ~~and~~ then the concept of upstream and downstream loses meaning ~~if~~ and there is not sufficient velocity in the receiving water to facilitate rapid mixing.

Instead of flow rate in the receiving water body ~~flow rate~~ we will look instead at volume available for mixing, which is limited by rule. And instead of loading rates, we ~~will need to~~ look at total load added over some period of time. Similar to the situation with flowing waters, critical conditions determine the appropriate values for these input variables.

$$C = \frac{L_{10} + L_{dis}}{V_{10} + V_{dis}}$$

Equation 4. Mixing equation for lakes and reservoirs

Where:

C = mixed concentration resulting from discharge

L_{10} = receiving water body pollutant load in V_{10}

L_{dis} = effluent pollutant load delivered over the time it takes to exchange mixed volume of receiving water body at critical inflow

V_{10} = receiving water body volume available for mixing

V_{dis} = volume of effluent discharged over time it takes to exchange mixed volume of receiving water body at critical inflow

The limitation on mixing volume in lakes and reservoirs is based on the limitation in the Idaho WQS that the horizontal extent of a mixing zone in a lake or reservoir is not to take up more than 10% of the surface area (IDAPA 58.0102.060.01.f). In place of Q_{up} we use V_{10}, the volume of the lake or reservoir beneath a circle centered on the point of discharge that encompasses one-tenth the minimum surface area of the water body. If the water body is stratified this volume should be limited to the layer (e.g. epilimnion or hypolimnion) to which the discharge occurs. ~~The limitation on mixing volume is based on the limitation in the Idaho WQS that the horizontal extent of a mixing zone in a lake or reservoir is not to take up more than 10% of the surface area (IDAPA 58.0102.060.01.f).~~ A circle is used as a simplified depiction of the plume, which could instead be modeled or determined through a tracer study if a more accurate assessment is desired. The ambient load is a product of this volume and the ambient concentration outside the influence of the discharge plume.

Whether the water body is stratified at the time of critical low inflow will be based on when that critical flow occurs and depends on the pollutant. For example, if the pollutant is a metal that is toxic to aquatic life, then the critical low inflow would be the 7Q10 for all inflows combined. If critical inflow occurs the last week of September then that is the time when presence or absence of stratification would be judged. It would also mark the time when the volume available for mixing would be determined.

To determine the appropriate volume of discharge, and thus corresponding load to use in the calculation, we must determine the time period over which the discharge should be evaluated. This will be called the renewal time, and is ~~here~~ described here as~~,~~ the ~~amount of~~ time it would take critical inflow to replace the volume of water allowed for mixing. The ~~is~~ volume of effluent discharged in this time ~~is in~~is then mathematically ~~turn the volume of the~~ mixed with the volume of water in the lake or reservoir allowed for mixing form above ~~upper layer that corresponds to 10% of the water body area centered on the plume, when critical inflow occurs~~.

Ideally, a measurement or estimate in the area surrounding the point of discharge would be used. In absence of this, it is recommended that a suitable time be based on the volume of the mixed layer (e.g., epilimnion) for the entire water body divided by the critical inflow for the entire water body; lets call this the residence time. For example, if the volume of the entire epilimnion of a lake or reservoir ~~was~~ is 1,000 acre-feet and the 7Q10 for all inflow ~~was~~ is 25 cubic feet per second (cfs), then the residence time would be about 20 days (1,000 acre-ft / (25 cfs * 1.984 ac-ft/day/cfs) = ~20). So in the absence of more specific information about renewal time in the actual area allowed for mixing, we expect the volume allowed for mixing to exchange at the same rate as for the entire water body[14]. Thus, in this example, the volume and load of effluent used in *Equation 4*~~*Equation 4*~~ would be that which is discharged in 20 days.

As with streams and rivers, *Equation 4*~~*Equation 4*~~ would be calculated for two ~~current~~ conditions – existing and ~~for~~ proposed. ~~conditions and t~~Those paired results would be used in *Equation 1*~~*Equation 1*~~ to quantify the proposed change in water quality.

Alternatively, a three-dimensional hydro-dynamic model could be used to identify the worst case water quality conditions at the edge of any authorized mixing zone, with the mixing zone not to exceed 10% of the lake or reservoir's surface area.

~~Degradation of~~Change in water quality requires change in discharge

It should be obvious that t~~T~~here has to be a change in an existing discharge in order for that discharge to cause a change in water quality that may be subject to regulation.

[14] This is a crude approximation that is unlikely to hold true in portions of lakes and reservoirs that have irregular shorelines and deep bays. In such areas, the exchange rate could be considerably slower than for the water body as a whole and the residence time much longer. This simplifying assumption should be used with caution. Where the simplifying assumption is not appropriate, area specific exchange rates will be evaluated and used.

Therefore, for purposes of antidegradation review, we can conclude an existing discharge is non-degrading if there are no changes in the discharge. Appendix C contains ~~some~~ various examples of ~~how~~ new or increased discharges and how they would be addressed.

Normally, an existing discharge must increase its pollutant loading in order to degrade the receiving water body's quality[15]. An i~~I~~ncrease in load may occur through either an increase in concentration at static discharge volume ~~for any one pollutants~~ or an increase in the discharge volume with no change in, or possibly even a decrease in concentration. Concentration changes may be pollutant specific, while changes in discharge volume affect the ~~increasing the~~ loads of all pollutants~~, or both~~.

While~~Typically,~~ increased loads typically ~~lead to~~result in worse water quality~~;~~, ~~however,~~ it is possible for an increased discharge load to ~~not result in increased~~decrease concentrations of a pollutant in the receiving water body. This oddity occurs when effluent quality is ~~equal to or~~ better than receiving water quality. It may also occur when flow tiers in a flow-tiered permit are adjusted with no increase is discharged load.

Mixing

Below the point where an activity or discharge adds pollutant load to the receiving water body, downstream water quality is in transition, changing more or less rapidly. Eventually, after full mixing, downstream receiving water quality will reach a steady state. Mixing zone characteristics, particularly location and diffuser design, are important to minimiz~~inge~~ the physical size of this transition zone and possible adverse effects, and these characteristics often limit the volume that may be used to dilute a discharge.

Irrespective of how quickly mixing occurs or the size of a regulatory mixing zone, w~~W~~e can calculate downstream water quality that results from an activity or discharge only if we ~~know~~ specify the volume of water it mixes with. Using that volume we can calculate the fully mixed result as a reference point for change in water quality. ~~Regulatory mixing zones represent partial mixing, may change with time, and are always sized so as to meet criteria at the edge of the zone.~~ As a practical matter we ~~can~~ recommend assessing changes in water quality for antidegradation purposes based on full mixing. We recommend this because r~~, even though the magnitude of change would be less than would be calculated at some partial mix point.~~ egulatory mixing zones represent partial mixing, may change in size with time, such as due to a change in diffuser design, and are always sized so that criteria are met at the edge of the zone.[16]

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[15] Although very unusual, it is possible that where effluent discharge dominates water quality the receiving water quality becomes worse even though discharge load decreases, e.g. a decrease in discharge volume coupled with an increase in effluent pollutant concentration.

[16] Pollutant concentrations resulting from discharge will always be less at full mix than partial mix, so too the magnitude of change in those concentrations due to an increase in load. A partial mix point could be used for assessing change, but the dilution ratio would need to be the same for existing and future conditions.

3.4 Other Considerations

In evaluating changes in water quality, there are several other things to consider. These include~~, particularly~~ whether upstream pollution reductions will offset downstream increases, whether adverse changes are temporary, and whether more information is needed to draw conclusions.

Use of offsets

The Idaho antidegradation rule allows for the use of offsets to proposed increases in pollutant load to Tier 2 and 3 waters (Tier 1 waters are already covered by pollutant trading). The rule requires that the offsets occur before an activity or discharge commences and be upstream of any potential degradation. The diagram in Figure 3 shows degradation resulting from a discharge with no offset. The diagram in Figure 4 shows no degradation resulting because water quality upstream is improved before the discharge is added—the upstream ~~raising~~ improvement of water quality offsets the downstream lowering of water quality resulting from the discharge.

For some pollutants, e.g. nutrients, there may be a lag in their effect on water quality. This would appear as a gap between the point of discharge and the water quality degradation shown in Figure 3. In this case the location of an offset could be below the point of discharge yet upstream of degradation.

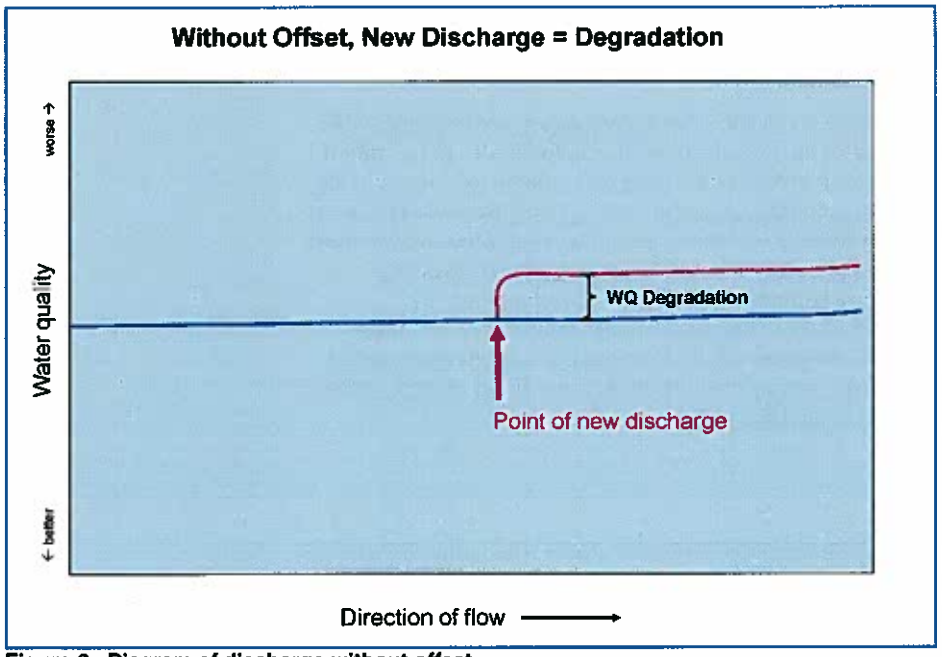

Figure 3. Diagram of discharge without offset.

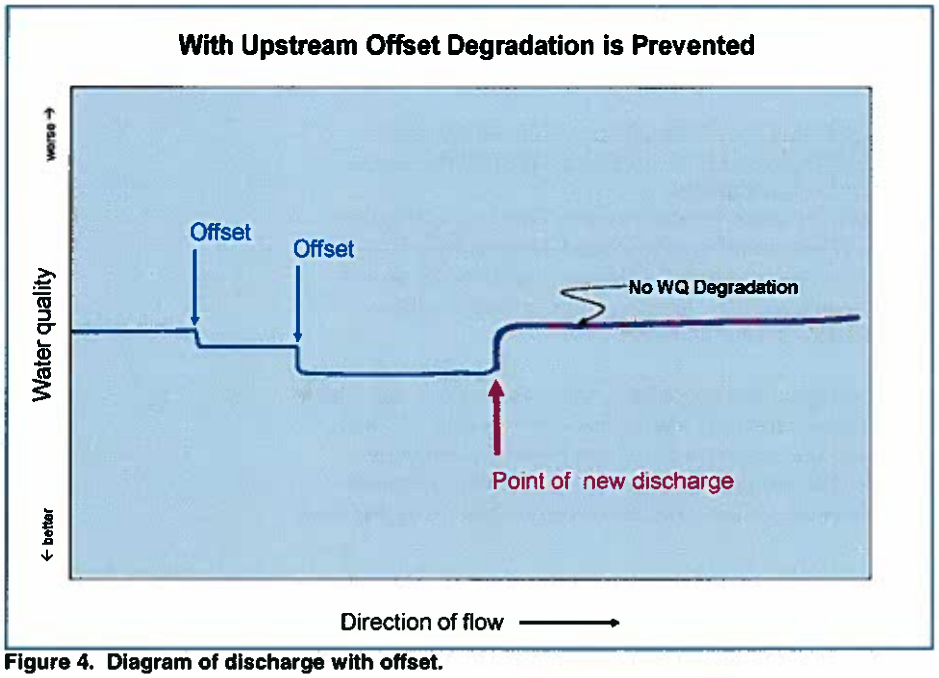

Figure 4. Diagram of discharge with offset.

The idea is that through properly conducted offsets there will be no net degradation (i.e. lowering) of water quality, not even in a portion of the receiving water, relative to current conditions. There would be, as the diagrams show, upstream to downstream changes in water quality. However, due to placement of the offsets, water quality at all points in the stream would still be better after than before the discharge plus its associated offsets. Degradation is avoided and this avoids the need for antidegradation analysis in Tier 2 waters and makes it possible to allow new or increased discharge in Tier 3 waters.

Because of placement considerations and lack of flow, the use of offsets in lakes and reservoirs to assure no degradation is problematic but may be considered by DEQ.

Temporary Degradation

~~Some a~~For activities that have only short-term or temporary water quality impacts, DEQ may conclude that because of the limited duration and scope of the discharge no significant degradation of water quality will occur. When evaluating such projects, DEQ may consider the following:

- duration and extent of water quality impact
- likelihood for long term water quality benefits to the water body; and
- potential for any long-term effects on existing beneficial uses.

DEQ may conclude that no significant, permanent degradation will occur if all appropriate and reasonable BMPs related to erosion and sediment control, project

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stabilization, and prevention of both short and long-term water quality degradation will be applied and maintained (e.g., preserving vegetation, stream bank stability, and basic drainage).

Examples of projects that may ~~only~~ result in only temporary water quality impacts include culvert replacements, bridge installations, and streambank restoration. Such projects may cause a temporary increase in sediment~~. –~~
~~e.g., a culvert replacement to enhance fish passage or reduce risk of road washout, are expected to worsen water quality only temporarily but result in long-term benefit to the public interest and cause no permanent injury to beneficial uses. Idaho's water quality standards allow for exempting such activities from meeting water quality standards (Short Term Activity Exemption IDAPA 58.01.02.080.02).~~

~~This allowance is consistent with the notion that degradation of real concern is that which is permanent or long-term, and that short-term degradation or even violations of water quality criteria are~~is ~~sometimes necessary to achieve long-term benefit. A properly designed activity that qualifies for a short-term activity exemption should incorporate measures to minimize its adverse short-term effects and thus would not cause degradation that needs antidegradation review.~~

As an example, culvert replacements which are done in accordance with the Idaho Forest Practices Act (FPA) may be deemed to comply with Idaho's antidegradation implementation rule.

Request for additional information

In evaluating proposed changes to water quality, DEQ may find it necessary to request ~~form~~ from the applicant additional information on the proposed activity or discharge. Such information may include details about the proposed project's location or operation ~~of the~~, outfall design, effluent characteristics, or monitoring data for the receiving water body. This is particularly likely if modeling is involved~~, e.g.,~~ in estimating upstream water quality or plume configuration.