Missouri Department
of Natural Resources

Missouri Antidegradation Rule and Implementation Procedure

April 20, 2007

Revised May 7, 2008

(Changes "tracked")

(Pending rulemaking & EPA approval.)

Note: Bolded terms are defined in the *Glossary*.

Division of Environmental Quality

Water Protection Program

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GLOSSARY (continued)

Degradation: An increase in the concentration of the **pollutants of concern** (**POC**s) within a surface water measured on a **pollutant-by-pollutant basis**.

Department: Missouri Department of Natural Resources.

Designated Use: A **beneficial use** designated to a water of the state as shown in Tables G and H of the **Water Quality Standards** (**WQS**).

Existing Source: Permitted discharge facilities that are in compliance with the terms and conditions of their permits at the time **existing water quality** (**EWQ**) is first determined for a segment.

Existing Use: Those **beneficial uses** actually attained in the water body on or after November 28, 1975, whether or not they are designated in the **Water Quality Standards**.

Existing Water Quality (EWQ): A characterization of level of the **pollutant of concern** (**POC**) in a water segment on the effective date of this document.[1] The **EWQ** shall be representative of the water quality at or immediately upstream from the point a new discharge would enters the water body, and or below the point a discharge that existed before the effective date of this document enters the water body. This determination shall be made at the time the discharge is subject to an **antidegradation** review in accordance with the procedures in this document. Once established, **EWQ** is a fixed quantity/quality expressed as a concentration of a water quality parameter. *For waters receiving **pollutants** from an **existing source** (where full design capacity has not been reached), the **EWQ** shall include the levels of **pollutants** already permitted to be discharged at maximum design flow.*

EWQ: See **Existing Water Quality**.

FAC: See **Facility Assimilative Capacity**.

Facility Assimilative Capacity (FAC): The **assimilative capacity** applicable to an individual facility and determined through the establishment of the existing and probable **pollutant** concentrations at the point where the facility's effluent enters the **segment**. (Also see **SAC**.)

Less-Degrading Alternative: A reasonable discharging alternative identified through an **alternatives analysis** that results in less **degradation** then the alternative that protects **existing use**s and achieves the highest statutory and regulatory requirements, i.e., the more stringent of the water quality-based effluent limits for **existing use** protection or the technology-based effluent limits.

Minimal Degradation: The reduction of the **facility assimilative capacity** for any **pollutant** by less than 10 percent as a result of any single discharge and the reduction of the **segment assimilative capacity** for any **pollutant** by less than 20 percent as a result of all discharges combined after **existing water quality** was determined. Events or activities causing **minimal degradation** are not required to undergo a **Tier 2 review**.

Non-Degrading Alternative: A reasonable alternative to a proposed discharge that would not result in **degradation** of water quality as characterized by the **existing water quality** (**EWQ**) assessment.

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[1] The effective date of this document (i.e., the *Missouri Antidegradation Rule and Implementation Procedure*) is the date this document was incorporated by reference into rules at 10 CSR 20-7.031(2)(D).

mixing. When an increased **pollutant** load has the potential to cause an increased accumulation of the **pollutant** within sediments or in fish tissue, the applicant may be required to assess the potential for such an accumulation of these **pollutants** in determining the significance of **degradation**.

- The activity will result in only **temporary degradation** of water quality;
- An existing facility is applying for renewal with no new or expanded discharge;
- The reduction of the **facility assimilative capacity (FAC)** for an **pollutant** by less than 10 percent as a result of any single discharge and the reduction of the **segment assimilative capacity (SAC)** for any **pollutant** by less than 20 percent as a result of all discharges combined after **EWQ** was determined;
- Combined ~~and sanitary~~sewer overflow (CSO ~~and SSOs~~) control projects resulting in a net decrease in the CSO~~/SSO~~-related **pollutant** loadings to surface waters shall be excluded from review requirements when these loadings are included in department-approved plans (e.g., Nine Minimum Controls, Long-Term Control Plan) in accordance with national guidance or policies. Treatment byproducts ~~of~~ created by CSO ~~and SSO~~ discharges are also excluded from review requirements when the discharges are identified in a department-approved plan;
- The **department** concludes that the proposed activity will not cause **significant degradation** based upon the specifics of any watershed-based trading that has been agreed to by the project applicant. NOTE: Because Missouri does not currently have a watershed-based trading program in place, the applicant might experience some permitting delays in pursuing this exemption unless the **department** is given significant advanced notice of the applicant's proposal; or
- The activity is a thermal discharge that has been approved through a Clean Water Act 316(a) demonstration.

If a determination is made that **significant degradation** will occur, or it is assumed, the **department** will determine from information provided by the discharger whether or not the **degradation** is necessary to allow important economical and social development in the geographical areas in which the waters are located (See Sections II.B and II.E of this document).

1. Determining **Existing Water Quality**

   Determining **existing water quality (EWQ)** may be avoided if the discharger chooses to proceed on the assumption that all **POCs** will cause **significant degradation**. Dischargers wishing to make this assumption may skip to an **alternatives analysis** discussed in Section II.B of this document. Dischargers wishing to determine **EWQ** shall perform the following steps:

   a) Summary of Approach

      EWQ either:

      - provides confirmation that the water quality for a **POC** is below, at or near **WQS** and therefore justifies a **Tier 1 review**, or
      - serves as the yardstick by which available **assimilative capacity** is measured for the **POCs** to receive a **Tier 2 review**.

If the net increase in loading from the new or expanded facility is 10 percent or more of the **FAC**, then a **Tier 2 review** is required.

The **SAC** is calculated similar to the **FAC** but -

- Cs is ~~always set equal to the EWQ (~~established for the entire **segment~~)~~, and
- The applicable flow is equal to the flow at the most downstream extent of the water **segment** (i.e., sum of the stream critical flow and all upstream discharge flows).

If the cumulative net increase in loadings for a water **segment** is 20 percent or more of the **SAC**, then a **Tier 2 review** is required. The cumulative loading used for comparison to the **SAC** is limited to loadings attributed to new or expanded discharges since establishment of **EWQ**. The **FAC** and **SAC** should always be calculated at appropriate **critical flow conditions** (e.g., **7Q10**).

Methods for calculating **FAC**, **SAC**, and **minimal degradation** for various scenarios are available in Appendix 3 of this document. The example calculations are based on conservative **pollutant**s. Consideration for assimilation of the pollutant within the water body should be given when calculating **minimal degradation** for non-conservative pollutants.

4. **Temporary Degradation**

Activities resulting only in **temporary degradation** will be given a **Tier 1 review**. The **department** will determine if **degradation** from a discharge qualifies as temporary following a review of information provided by the applicant. The information provided by the applicant must include a) length of time during which water quality will be lowered, b) percent change in ambient conditions, c) parameters affected, d) likelihood for long-term water quality benefits to the **segment** (e.g., as may result from dredging of contaminated sediments), e) degree to which achieving the applicable **WQS** during the proposed activity may be at risk, and f) potential for any residual long-term influences on **existing use**s.

B. Review for Alternatives to **Degradation**

An applicant proposing any new or expanded discharge that would significantly degrade water quality is required to prepare an evaluation of alternatives to the proposed discharge. The purpose of this evaluation is to determine whether or not the proposed discharge is "necessary," that is, no reasonable alternative(s) exist to prevent **significant degradation**. These alternatives are compared (in terms of practicability, economic efficiency and affordability) to the controls required to protect **existing use**s and to achieve the highest statutory and regulatory requirements (i.e., the more stringent between the water quality-based effluent limits to protect an **existing use** and the applicable technology-based effluent limits).

APPENDIX 3

Examples of Calculations for Minimal Degradation

NOTE: For the following six examples, the variables/terms are defined as follows *(as is true in this entire document, bolded terms are defined in the Glossary)*:

Symbols:

Existing source	New source	Existing source to be replaced

cfs = cubic feet per second

Cc = chronic criterion (Note: Although the provided examples use the "chronic" criterion, in some cases it may be more appropriate to use the "acute" criterion.)

Qs = stream flow (**7Q10** or other representative flow)

~~Qd = average daily design flow of discharge in cubic feet per second (cfs)~~

Qd_1 = average daily design flow of existing discharge in cubic feet per second (cfs)

Qd_2 = average daily design flow of new or expanded discharge (cfs)

Cs = **pollutant** concentration in stream immediately below the point where the facility's effluent enters ~~a water~~the segment

CF = conversion factor used to convert a pollutant mass loading into the desired units. For example, using a CF of 5.4 to derive a load in "lbs/day" is appropriate when the **WQS** is represented in mg/L and flow is represented in cfs [(mg/L) · (cfs) · 5.4) = (lbs/day)]

~~Cd = discharge concentration~~

Cd_1 = existing discharge concentration (mg/L)

Cd_2 = new or expanded discharge concentration (mg/L)

EWQ = **existing water quality**, a characterization of the current approved levels of **pollutant**s within a **segment** of water at the point of discharge (Also see the definition in the Glossary of this document.)

SAC = **Segment assimilative capacity** (lbs/day) – See Glossary.

FAC = **Facility assimilative capacity** (lbs/day) – See Glossary.

Steps for Calculating the Percent Reduction in **FAC** from a Proposed Discharge:

Step 1: Calculate the **FAC**

(1a) **FAC** for proposed new discharges = $[\mathbf{WQC}\cdot(Qs+Qd_2) - Cs\cdot Qs]\cdot CF$

(1b) **FAC** for existing (expanding) discharges = $[\mathbf{WQC}\cdot(Qs+Qd_2) - Cs\cdot(Qs+Qd_1)]\cdot CF$

Step 2: Calculate the load of the new or expanded discharge and the current load of the existing discharge (if applicable)

(2a) Load of proposed new or expanded = $(Cd_2\cdot Qd_2)\cdot CF$ = "New discharge load"

(2b) Load of existing discharge = $(Cd_1\cdot Qd_1)\cdot CF$ = "Current discharge load"

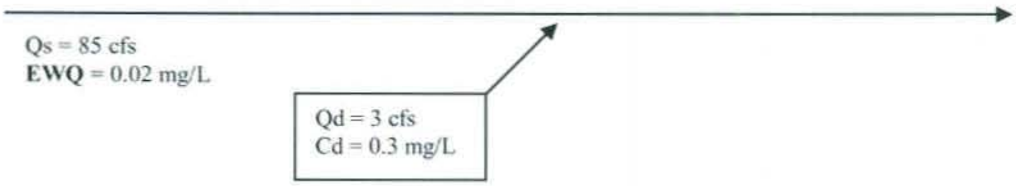
Step 3: Determine whether the new or expanded load is greater than 10 percent of the **FAC**

(3) Percent of **FAC** = [(New discharge load – Current discharge load)/**FAC**]·100

Example 1. Example calculation for determining minimal degradation from a new discharge

Scenario:

- A municipality plans to build a new wastewater treatment facility with a design flow of 3 cfs (Qd) and an effluent zinc concentration of 0.3 mg/L (Cd).
- The receiving stream has a **7Q10** (Qs) of 85 cfs.
- The **EWQ** for the **segment** is 0.02 mg/L of zinc.
- The chronic criterion (Cc) of zinc is 0.151 mg/L.



FAC = [(Cc·(Qs+Qd)) – (EWQ·Qs)]·CF
= [(0.151 mg/L·(85 cfs + 3 cfs)) – (0.02 mg/L·85 cfs)]·5.4
= [(0.151·88) – (1.7)]·5.4
= 62.6 lbs/day

New discharge load = Qd·Cd·CF
= 3 cfs·0.3 mg/L·5.4
= 4.9 lbs/day

Percent of **FAC** = (New discharge load/FAC)·100
= (4.9/62.6)·100
= 7.8%

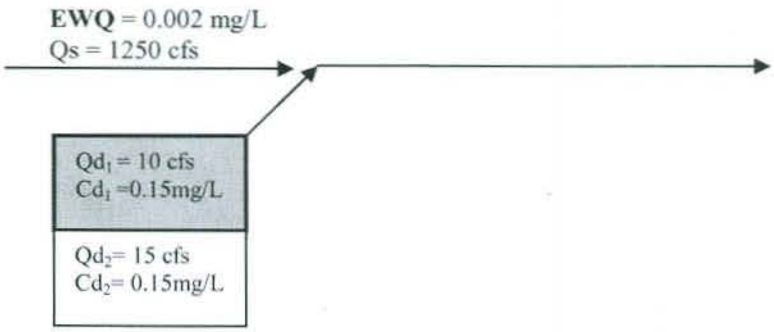
The discharge could be allowed without an **antidegradation** review since the **FAC** consumption is less than the 10% **minimal degradation** threshold. A higher total discharge could be allowed if an **antidegradation** review indicates the activity may proceed.

NO CHANGES TO THIS PAGE.

Example 2. Example calculation for determining minimal degradation from an expanding discharge

Scenario:

- A municipality plans to expand its current wastewater treatment facility (an **existing source**) from 10 cfs (Qd_1) to 15 cfs (Qd_2) and maintain its effluent copper concentration of 0.15 mg/L (Cd_1 and Cd_2).
- The receiving stream has a **7Q10** (Qs) of 1250 cfs.
- The **EWQ** upstream of plant is 0.002 mg/L of copper.
- The chronic criterion (Cc) of copper is 0.010 mg/L.



Cs: Stream load = EWQ·Stream flow (i.e., Qs)·CF = 0.002 mg/L·1250 cfs·5.4 = 13.5 lbs/day

Current discharge load =Current copper effluent concentration·Current discharge flow·CF
= $Cd_1 \cdot Qd_1 \cdot CF$ = 0.15 mg/L·10 cfs·5.4
= 8.1 lbs/day

Total load = Stream load+Current discharge load = 13.5+8.1 = 21.6 lbs/day

To solve for Cs:

21.6 lbs/day = $[Cs \cdot (Qs+Qd_1)] \cdot 5.4$ = [Cs·(1250 cfs+10 cfs)]·5.4 = [Cs·1260 cfs]·5.4
21.6/5.4 = [Cs·1260]·5.4/5.4
4 = Cs·1260
4/1260 = Cs
Cs = 0.0031746 mg/L

FAC = $[(Cc \cdot (Qs+Qd_2))$ – ~~EWQ·Qs~~ $\underline{(Cs \cdot (Qs+Qd_1))}] \cdot CF$
= [(0.01 mg/L·(1250 cfs+15 cfs)) – (0.0031746 mg/L·(1250 cfs+10 cfs))]·5.4
= 46.71 lbs/day

New discharge load = $Qd_2 \cdot Cd \cdot CF$
= 15 cfs·0.15 mg/L·5.4
= 12.2 lbs/day

Net increase = New discharge load – Current discharge load
= 12.2 lbs/day – 8.1 lbs/day
= 4.1 lbs/day

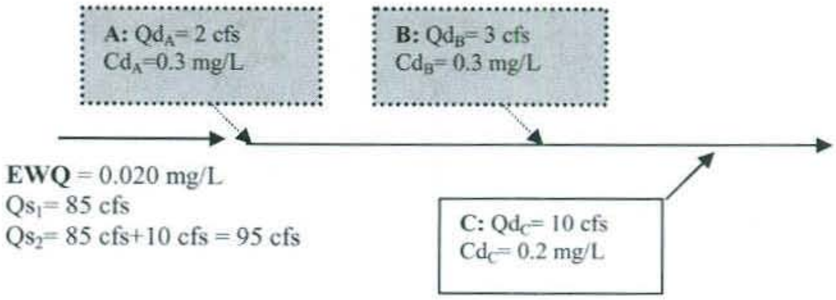
Percent of **FAC** = (Net increase/FAC)·100
= (4.1/46.71)·100
= 8.78%

The discharge could be allowed without further **antidegradation** review since the net percent consumption of the **FAC** is less than the 10% **minimal degradation** threshold. A higher total discharge could be allowed if an **antidegradation** review indicates the activity may proceed.

Example 3. Example calculation for determining minimal degradation from a new discharge replacing two existing discharges *(Page 1 of 2)*

Scenario:

- A municipality plans to build a new wastewater treatment facility (Plant C) with a design flow of 10 cfs (Qd_C) and an effluent zinc concentration of 0.2 mg/L (Cd_C).
- The new wastewater treatment facility is to replace two current facilities (Plants A and B).
- Plant A (**existing source**) has a design flow of 2 cfs (Qd_A) and an effluent zinc concentration of 0.3 mg/L (Qd_A).
- Plant B (**existing source**) has a design flow of 3 cfs and an effluent zinc concentration of 0.3 mg/L (Cd_B).
- The receiving stream has a **7Q10** (Qs_1) of 85 cfs.
- The **EWQ** upstream of Plant A is 0.020 mg/L of zinc.
- The chronic criterion (Cc) of zinc is 0.151 mg/L.



Note: Qs_1 is the flow upstream of the affected **segment** (i.e., upstream of Plant A) and Qs_2 is the flow downstream of Plant C after the consolidation.

Cs: Stream load = EWQ·Stream flow (i.e., Qs_1)·CF = 0.020 mg/L·85 cfs·5.4 = 9.2 lbs/day

Current discharge load = (Current zinc effluent concentration·Current discharge flow·CF) for Plants A and B combined.

= $[(Cd_A \cdot Qd_A \cdot CF)+(Cd_B \cdot Qd_B \cdot CF)]$

= [(0.3 mg/L·2 cfs·5.4)+ (0.3 mg/L·3 cfs·5.4)]

= [(3.24)+(4.86)]

= 8.1 lbs/day

Total load = Stream load+Current discharge load = 9.2+8.1 = 17.2 lbs/day

To solve for Cs:

17.3 lbs/day = $[Cs \cdot (Qs_1+Qd_A+Qd_B)] \cdot CF$ = [Cs·(85 cfs+2 cfs+3 cfs)]·5.4 =[Cs·90]·5.4

17.3/5.4 = [Cs·90]·5.4/5.4

3.2 = Cs·90

3.2/90 = Cs

Cs = 0.03556 mg/L

FAC = $[(Cc \cdot Qs_2)$ – ~~EWQ·Qs~~ $\underline{(Cs \cdot (Qs_1+Qd_A+Qd_B))}] \cdot CF$

= [(0.151 mg/L·95 cfs) – (0.03556 mg/L·(85 cfs+2 cfs+3 cfs))]·5.4

= [(14.345) – (0.03556·3.2004)]·5.4 = [11.1446]·5.4

= 60.181 lbs/day

New discharge load = $Qd_C \cdot Cd_C \cdot CF$

= 10 cfs·0.2 mg/L·5.4

= 10.8 lbs/day

Net increase = New discharge load – Current discharge load

= 10.8 lbs/day – 8.1 lbs/day

= 2.7 lbs/day

Example 3. Example calculation for determining minimal degradation from a new discharge replacing two existing discharges *(Page 2 of 2)*

Percent of **FAC** = (Net increase/FAC)·100
= (2.7/60.181)·100
= 4.5%

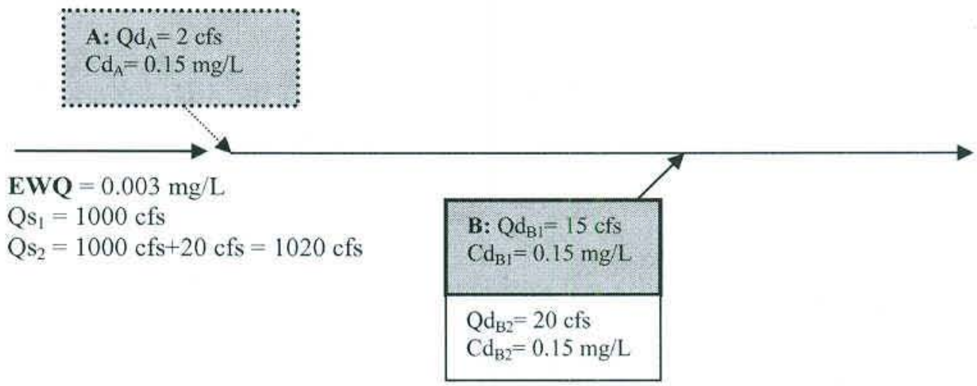
The discharge could be allowed without further **antidegradation** review since the net percent consumption of the **FAC** is less than the 10% **minimal degradation** threshold. A higher total discharge could be allowed if an **antidegradation** review indicates the activity may proceed.

Example 4. Example calculation for determining minimal degradation from an expanding discharge replacing an existing discharge *(Page 1 of 2)*

Scenario:

A municipality plans to expand its current wastewater treatment facility (Plant B) (an **existing source**) from 15 cfs to 20 cfs while maintaining its effluent copper concentration at 0.15 mg/L.

- The expansion will replace Plant A (an **existing source**).
- Plant A has a design flow of 2 cfs (Qd_A) and an effluent copper concentration of 0.15 mg/L (Cd_A).
- Plant B has a design flow of 15 cfs (Qd_{B1}) and an effluent copper concentration of 0.15 mg/L (Cd_{B1}).
- The receiving stream has a **7Q10** (Qs_1) of 1000 cfs.
- The **EWQ** upstream of Plant A is 0.003 mg/L of copper.
- The chronic criterion (Cc) of copper is 0.010 mg/L.



Note: Qs_1 is the flow upstream of the affected **segment** (i.e., upstream of Plant A) and Qs_2 is the flow downstream of Plant B after the consolidation/expansion.

Cs: Stream load = EWQ·Stream flow (i.e., Qs_1)·CF = 0.003 mg/L·1000 cfs·5.4 = 16.2 lbs/day

Current discharge load = (Current copper effluent concentration·Current discharge flow·CF) for Plants A and B combined.

$= [(Cd_A \cdot Qd_A \cdot CF)+(Cd_{B1} \cdot Qd_{B1} \cdot CF)]$

= [(0.15 mg/L·2 cfs·5.4)+(0.15 mg/L·15 cfs·5.4)]

= [(1.62)+(12.15)]

= 13.8 lbs/day

Total load = Stream load+Current discharge load = 16.2+13.8 = 30 lbs/day

To solve for Cs:

30 lbs/day = $[Cs \cdot (Qs_1+Qd_A+Qd_{B1})] \cdot CF$ = [Cs·(1000 cfs+2 cfs+15 cfs)]·5.4 =[Cs·1017]·5.4

30/5.4 = [Cs·1017]·5.4/5.4

5.556 = Cs·1017

5.556/1017 = Cs

Cs = 0.005463 mg/L

FAC = $[(Cc \cdot Qs_2)$ – ~~EWQ·Qs~~ $\underline{(Cs \cdot (Qs_1+Qd_A+Qd_{B1}))}] \cdot CF$

= [(0.010 mg/L·1020 cfs) – (0.005463 mg/L·(1000+2+15 cfs))]·5.4

= [(10.2) – (0.005463 ·1017)]·5.4

= [10.2 – 5.555871]·5.4

= 25.1 lbs/day

New discharge load = $Qd_{B2} \cdot Cd_{B2} \cdot CF$

= 20 cfs·0.15 mg/L·5.4

= 16.2 lbs/day

Example 4. Example calculation for determining minimal degradation from an expanding discharge replacing an existing discharge *(Page 2 of 2)*

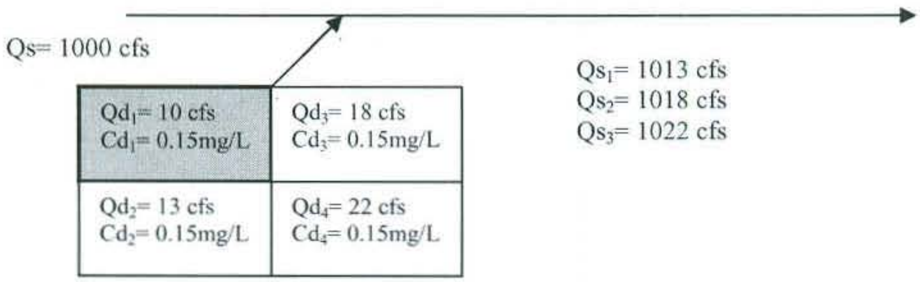
Net increase	= New discharge load – Current discharge load
	= 16.2 lbs/day – 13.8 lbs/day
	= 2.4 lbs/day
Percent of **FAC**	= (Net increase/FAC)·100
	= (2.4/25.1)·100
	= 9.6%

The discharge could be allowed without further **antidegradation** review since the net percent consumption of the **FAC** is less than the 10% **minimal degradation** threshold. A higher total discharge could be allowed if an **antidegradation** review indicates the activity may proceed.

Example 5. Example calculation for determining minimal degradation from an expanding discharge undergoing multiple expansions *(Page 1 of 3)*

Scenario: Over a period of many years a municipality plans three separate expansions of its wastewater treatment facility (WWTF).

- Each expansion increases the design flow by an additional 4 cfs while maintaining its effluent copper concentration at 0.15 mg/L.
- The original design (Qd_1 = 10 cfs; Cd_1 = 0.15 mg/L of copper) is an **existing source**.
- The **EWQ** upstream of the WWTF is 0.002 mg/L of copper.
- The receiving stream has a **7Q10** (Qs) of 1000 cfs.
- The chronic criterion (Cc) of copper is 0.010 mg/L.



Note: Qs is the **7Q10** stream flow. Qs_1, Qs_2, and Qs_3 are the stream flows (i.e., **7Q10** plus facility flow) downstream of the WWTF after the first, second, and third expansions, respectively.

First Expansion:

Cs: Stream load = EWQ·Stream flow (i.e., Qs)·CF = 0.002 mg/L·1000 cfs·5.4 = 10.8 lbs/day
Current discharge load = Current copper effluent conc.·Current discharge flow·CF
= Cd_1·Qd_1·CF = 0.15 mg/L·10 cfs·5.4
= 8.1 lbs/day
Total load = Stream load+Current discharge load = 10.8+8.1 = 18.9 lbs/day

To solve for Cs:

18.9 lbs/day = [Cs·(Qs+Qd_1)]·CF = [Cs·(1000 cfs+10 cfs)]·5.4 = [Cs·1010 cfs]·5.4
18.9/5.4 = [Cs·1010]·5.4/5.4
3.5 = Cs·1010
3.5/1010 = Cs
Cs = 0.003465 mg/L

FAC = [(Cc·Qs_1) – ~~EWQ·Qs~~ (Cs·(Qs+Qd_1))]·CF
= [(0.010 mg/L·1013 cfs) – (0.003465 mg/L·(1000 cfs+10 cfs))]·5.4
= [(10.13) – (0.003465 mg/L·1010 cfs)]·5.4 = [(10.13) – (3.49965)]·5.4
= 35.804 lbs/day

New discharge load = Qd_2·Cd_2·CF
= 13 cfs·0.15 mg/L·5.4
= 10.5 lbs/day

Net increase = New discharge load – Current discharge load
= 10.5 lbs/day – 8.1 lbs/day
= 2.4 lbs/day

Percent of **FAC** = (Net increase/FAC)·100
= (2.4/35.804)·100
= 6.7%

The first expansion could be allowed without further **antidegradation** review since the net percent consumption of the **FAC** is less than the 10% **minimal degradation** threshold.

Example 5. Example calculation for determining minimal degradation from an expanding discharge undergoing multiple expansions *(Page 2 of 3)*

Second Expansion:

Cs: Stream load = EWQ·Stream flow (i.e., Qs)·CF = 0.002 mg/L·1000 cfs·5.4 = 10.8 lbs/day
Current discharge load = Current copper effluent conc.·Current discharge flow·CF
= $Cd_2 \cdot Qd_2 \cdot CF$ = 0.15 mg/L·13 cfs·5.4
= 10.5 lbs/day
Total load = Stream load+Current discharge load = 10.8+10.5 = 21.3 lbs/day

To solve for Cs:
21.3 lbs/day = [Cs·(Qs+Qd_2)]·CF = [Cs·(1000 cfs+13 cfs)]·5.4 = [Cs·1013 cfs]·5.4
21.3 /5.4 = [Cs·1013]·5.4/5.4
3.9 = Cs·1013
3.9/1013 = Cs
Cs = 0.0038 mg/L

FAC = [(Cc·Qs_2) – ~~EWQ·Qs~~ (Cs·(Qs+Qd_2))]·CF
= [(0.010 mg/L·1018 cfs) – (0.0038 mg/L·(1000 cfs+13 cfs))]·5.4
= [(10.18) – (0.0038·1013)]·5.4 = [(10.18) – (3.849)]·5.4 = [6.33]·5.4
= 34.18 lbs/day

New discharge load = $Qd_3 \cdot Cd_3 \cdot CF$
= 18 cfs·0.15 mg/L·5.4
= 14.6 lbs/day

Net increase = New discharge load – Current discharge load
= 14.6 lbs/day – 10.5 lbs/day
= 4.1 lbs/day

Percent of **FAC** = (Net increase/FAC)·100
= (4.1/34.18)·100
= 12.0%

The second expansion will consume more than 10% of the **FAC**, therefore, further antidegradation review is needed. Even though exceeding 10% of the **FAC** requires the antidegradation review to continue, calculate the consumption of the **SAC** by the Second Addition in order to create an administrative record of the remaining **SAC** to use as reference when reviewing future expansions (See Third Expansion).

Cumulative net increase in discharge load = 1^{st} Net increase+2^{nd} Net increase
= 2.4 lbs/day+4.1 lbs/day
= 6.5 lbs/day

SAC = [(Cc·Qs_2) – ~~EWQ·Qs~~ (Cs·(Qs+Qd_1))]·CF
= [(0.010 mg/L·1018 cfs) – (0.0038 mg/L·(1000 cfs+10 cfs))]·5.4
= [(10.18) – (3.8)]·5.4 = [6.38]·5.4
= 34.45 lbs/day

Cumulative Percent of **SAC** = (Cumulative net increase/SAC)·100
= (6.5/34.45)·100
= 18.9%

Example 5. Example calculation for determining minimal degradation from an expanding discharge undergoing multiple expansions *(Page 3 of 3)*

<u>Third Expansion:</u>

Cs:

Stream load = EWQ·Stream flow (i.e., Qs)·CF = 0.002 mg/L·1000 cfs·5.4 = 10.8 lbs/day
Current discharge load = Current copper effluent conc.·Current discharge flow·CF
= $Cd_3 \cdot Qd_3 \cdot CF$ = 0.15 mg/L·18 cfs·5.4
= 14.6 lbs/day
Total load = Stream load+Current discharge load = 10.8+14.6 = 25.4 lbs/day

To solve for Cs:

25.4 lbs/day = $[Cs \cdot (Qs+Qd_3)] \cdot CF$ = [Cs·(1000 cfs+18 cfs)]·5.4 = [Cs·1018 cfs]·5.4
25.4/5.4 = [Cs·1018]·5.4/5.4
4.704 = Cs·1018
4.704/1018 = Cs
Cs = 0.004621 mg/L

FAC = $[(Cc \cdot Qs_3)$ – ~~EWQ·Qs~~ <u>$(Cs \cdot (Qs+Qd_3))$</u>]·CF
= [(0.010 mg/L·1022 cfs) – (0.004621 mg/L·(1000 cfs+18 cfs))]·5.4
= [(10.22) – (.004621 mg/L·1018 cfs)]5.4
= 29.786 lbs/day

New discharge load = $Qd_4 \cdot Cd_4 \cdot CF$
= 22 cfs·0.15 mg/L·5.4
= 17.8 lbs/day

Net increase = New discharge load – Current discharge load
= 17.8 lbs/day – 14.6 lbs/day
= 3.2 lbs/day

Percent of **FAC** = (Net increase/FAC)·100
= (3.2/29.786)·100
= 10.7%

Since the Third Expansion will consume more than 10% of the **FAC**, further **antidegradation** review is needed. Even though exceeding 10% of the **FAC** requires the antidegradation review to continue, you should calculate the consumption of the **SAC** by the Third Expansion in order to create an administrative record of the remaining **SAC** to use as reference when reviewing future expansions.

Cumulative net increase in discharge load = 1st Net increase+2nd Net increase+3rd Net increase
= 2.4 lbs/day+4.1 lbs/day+3.2 lbs/day
= 9.7 lbs/day

SAC = $[(Cc \cdot Qs_3)$ – ~~EWQ·Qs~~ <u>$(Cs \cdot (Qs+Qd_2))$</u>]·CF
= [(0.010 mg/L·1022 cfs) – (0.004621 mg/L·(1000 cfs+13 cfs))]·5.4
= [(10.22) – (4.681)]·5.4
= 29.9 lbs/day

Cumulative Percent of **SAC** = (Cumulative net increase/SAC)·100
= (9.7/29.9)·100
= 32.4%

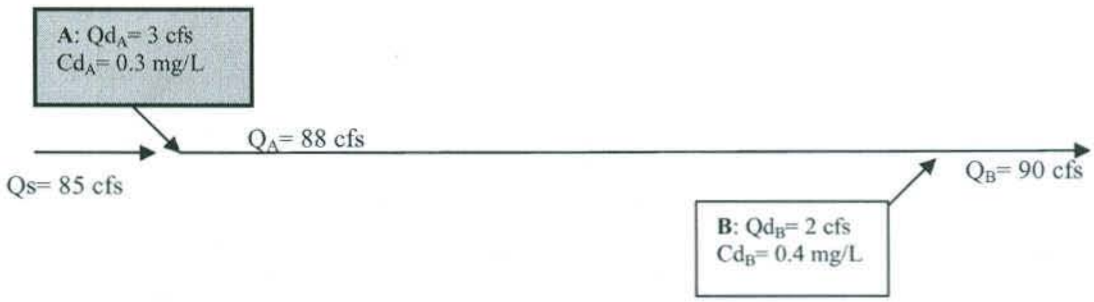
Since the Third Expansion exceeds 20% of the SAC, all future discharge expansions on the stream segment will require further antidegradation review.

Example 6. Example calculation for determining minimal degradation from multiple new discharges *(Page 1 of 3)*

Scenario:

- Plant A (an **existing source**) discharges into a stream **segment** with a **7Q10** of 85 cfs (Qs).
- The **EWQ** upstream of Plant A is 0.03 mg/L of zinc.
- Plants B, C, and D are subsequently constructed on the same **segment** of river as the **existing source**.
- All four plants discharge zinc at concentrations shown below.
- The chronic criterion (Cc) of zinc is 0.151 mg/L.

Plant B (1st Addition):



Note: Qs is the **7Q10** stream flow. Q_A and Q_B are the stream flows downstream of Plants A and B, respectively (i.e., **7Q10** plus facility flows).

The **EWQ** for plants B, C, and D would include the discharge from Plant A because it existed at the time the procedures become final. In other words, Plant A is "grandfathered" in and included in the determination of **EWQ** for Plant B, C, and D.

When Plant B is constructed this would be a "new" discharge to a segment that has an existing facility. The Cs would therefore be the same as the existing water quality that is downstream of Plant A.

Cs:

Stream load = EWQ·Stream flow (i.e., Qs)·CF = 0.03 mg/L·85 cfs·5.4 = 13.8 lbs/day

Current discharge load = Current zinc effluent conc.·Current discharge flow·CF

= $Cd_A \cdot Qd_A \cdot CF$ = 0.3 mg/L·3 cfs·5.4

= 4.9 lbs/day

Total load = Stream load+Current discharge load = 13.8+4.9 = 18.7 lbs/day

To solve for Cs:

18.7 lbs/day = $(Cs \cdot Q_A) \cdot CF$ = (Cs·88 cfs)·5.4

18.7/5.4 = (Cs·88)·5.4/5.4

3.46 = Cs·88

3.46/88 = Cs

Cs = 0.0393 mg/L

FAC

= $[(Cc \cdot Q_B) -$ ~~EWQ·Qs – ($Cd_A \cdot Qd_A$)~~ $(Cs \cdot (Qs+Qd_A))] \cdot CF$

= [(0.151 mg/L·90 cfs) – (.0393 mg/L·(85 cfs+3 cfs))]·5.4

= [13.59 –3.4584]·5.4 = [10.1316]·5.4

= 54.711 lbs/day

New discharge load = $Qd_B \cdot Cd_B \cdot CF$

= 2 cfs·0.4 mg/L·5.4

= 4.3 lbs/day

Percent of **FAC** = (New discharge load/FAC)·100

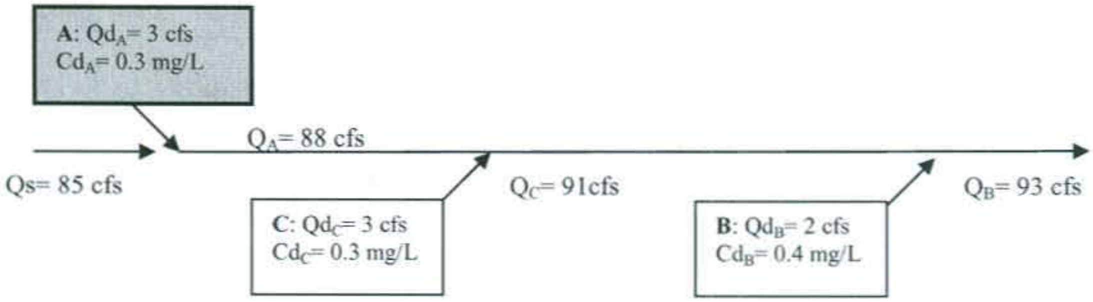
= (4.3/54.711)·100

= 7.86%

Plant B discharge could be allowed without further **antidegradation** review since the percent consumption of the **FAC** is less than the 10% **minimal degradation** threshold.

Example 6. Example calculation for determining minimal degradation from multiple new discharges *(Page 2 of 3)*

Plant C (2nd Addition):



Note: Qs is the **7Q10** stream flow. Q_A, Q_B, and Q_C are the stream flows downstream of Plants A, B, and C, respectively (i.e., **7Q10** plus facility flows).

Cs = 0.0393 mg/L

Note: Cs remains the same as calculated for the 1st Addition because the 2nd Addition is downstream of Plant A (the original source) but upstream from Plant B (the 1st Addition).

FAC = [(Cc·Q_C) – ~~EWQ·Qs (Cd$_A$·Qd$_A$)~~ (C_S·(Qs+Qd_A))]·CF
= [(0.151 mg/L·91 cfs) – (0.0393 mg/L·(85 cfs+3 cfs))]·5.4
= [(13.741) – [0.0393 mg/L·88]]·5.4
= 55.526 lbs/day

New discharge load = Qd_C·Cd_C·CF
= 3 cfs·0.3 mg/L·5.4
= 4.9 lbs/day

Percent of **FAC** = (New discharge load/FAC)·100
= (4.9/55.526)·100
= 8.82%

Since Plant C will consume less than 10% of the **FAC**, an **antidegradation** review may not be needed. However, the cumulative increase needs to be compared to the cumulative 20% threshold before a final determination may be made regarding the necessity of an **antidegradation** review.

SAC = [(Cc·Q_B) – ~~EWQ·Qs~~ (C_S·Q_A)]·CF
= [(0.151 mg/L·93 cfs) – (0.0393 mg/L·88 cfs)]·5.4
= 57.204 lbs/day

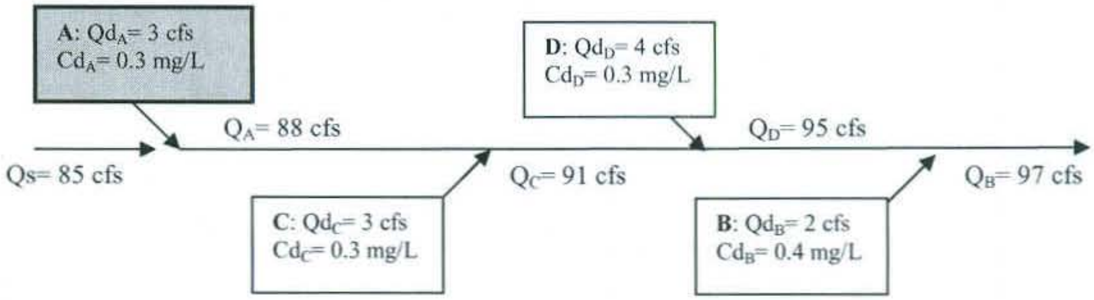
Cumulative net increase in load = Plant B New discharge load+Plant C New discharge load
= 4.3 lbs/day+4.9 lbs/day
= 9.2 lbs/day

Cumulative Percent of **SAC** = (Cumulative net increase/SAC)·100
= (9.2 lbs/day /57.204 lbs/day)·100
= 16.1%

Plant C discharge could be allowed without further **antidegradation** review since the percent consumption of the **FAC** is less than the 10% **minimal degradation** threshold and the cumulative percent consumption of the **SAC** is less than the 20% **cumulative degradation** threshold.

Example 6. Example calculation for determining minimal degradation from multiple new discharges *(Page 3 of 3)*

Plant D (3rd Addition):



Note: Qs is the **7Q10** stream flow. Q_A, Q_B, Q_C and Q_D are the stream flows downstream of Plants A, B, C, and D respectively (i.e., **7Q10** plus facility flows).

Calculate the instream concentration (Cs) below Plant C and above Plant B, where Plant D is proposed. Then use this in the equation to determine FAC.

Cs:

Stream load = EWQ·Stream flow (i.e., Qs)·CF = 0.03 mg/L·85 cfs·5.4 = 13.8 lbs/day

Plant A Current discharge load = Current zinc effluent conc.·Current discharge flow·CF
= $Cd_A \cdot Qd_A \cdot CF$ = 0.3 mg/L·3 cfs·5.4
= 4.9 lbs/day

Plant C Current discharge load = Current zinc effluent conc.·Current discharge flow·CF
= $Cd_C \cdot Qd_C \cdot CF$ = 0.3 mg/L·3 cfs·5.4
= 4.9 lbs/day

Total load = Stream load+Current discharge load = 13.8+4.9+4.9= 23.6 lbs/day

To solve for Cs:

23.6lbs/day = $(Cs \cdot Q_C) \cdot CF$ = (Cs·91 cfs)·5.4
23.6/5.4 = (Cs·91)·5.4/5.4
4.37 = Cs·91
4.37/91 = Cs
Cs = 0.0480 mg/L

FAC = $[(Cc \cdot Q_D)$ – ~~$EWQ \cdot Qs - (Cd_C \cdot Qd_C) - (Cd_A \cdot Qd_A)$~~ $(C_S \cdot (Qs + Qd_A + Qd_C))] \cdot CF$
= [(0.151 mg/L·95 cfs) – (0.0480 mg/L·(85 cfs+3 cfs+3 cfs))]·5.4
= [(14.345) – (4.368)·5.4
= 53.8758 lbs/day

New discharge load = $Qd_D \cdot Cd_D \cdot CF$
= 4 cfs·0.3 mg/L·5.4
= 6.5 lbs/day

Percent of **FAC** = (New discharge load/FAC)·100
= (6.5/53.876)·100
= 12.1%

Since Plant D will consume more than 10% of the **FAC**, further **antidegradation** review is needed. Even though exceeding 10% of the **FAC** requires the antidegradation review to continue, calculate the consumption of the **SAC** by the 3rd Addition in order to create an administrative record of the remaining **SAC** to use as reference when reviewing future expansions.