Missouri Department of Natural Resources
Water Protection Program
Water Pollution Control Branch

4 Part IV: Reasonable Potential to Exceed (RPTE) and WQBEL Processes

4.1 General RPTE and WQBEL Process

In Part 3, we introduced the concept of assessing point source discharges to determine whether controls are necessary based on water quality standards. We make these assessments by conducting an analysis, called the Reasonable Potential Analysis (RPA), of the self-monitoring and reporting of the effluent discharge to determine whether the discharge causes, has the "reasonable potential" to cause, or contributes to an excursion of any water quality criteria in the receiving water (see Figure 4). EPA regulations at 40 CFR 122.44 (d)(1)(i) require effluent limitations for all pollutants that are or may be discharged at a level that have a reasonable potential to cause an in-stream excursion above a narrative or numeric water quality standard. When considering the reasonable potential to cause excursion above ambient criteria, the EPA regulations at 40 CFR 122.44 (d)(1)(ii) require the regulatory authority to consider factors such as 1) existing controls on point and non-point sources, 2) variability of the pollutant in the effluent, 3) sensitivity of the species to toxicity testing, and 4) dilution of the effluent in the receiving waters.

We conduct RPAs due to changes in facility operation, an increase in facility design flow or loading, failure of WET Tests attributable to ammonia toxicity, or changes in water quality criteria. Total ammonia nitrogen, metals, and other toxics are a common pollutant of domestic wastewater and may be discharged at a level that will cause or contribute to an in-stream excursion above numeric water quality criteria. The assimilative capacity of the receiving water during low-flow conditions, the level and efficiency of treatment, and the established pretreatment program prior to reaching the wastewater treatment facility, will determine whether or not an excursion will occur.

Data Requirements -- A RPA cannot be conducted without adequate data[1]. Adequate data for conducting a RPA is a minimum of eight to 12 effluent samples per year for the pollutant of concern. For example, a RPA for total recoverable lead must have a minimum of eight to 12 effluent samples per year for hardness and total recoverable lead. In the absence of adequate data (Section 4.2.4 below), acceptable conservative default values may be used to conduct the RPA. For example, as indicated in the of EPA's *Technical Support Document for Water Quality-Based Toxics Control* (TSD) [EPA/505/2-90-001] on Page 50, Box 3-2, if the sample size is less than ten (10) then the coefficient of variation is estimated to be equal to 0.6. If adequate data are available for conducting a RPA, the analysis must be conducted. If adequate data are not available and conservative default values are not used to conduct the RPA, the permit should be (re)issued with monitoring requirements for the pollutants of concern to yield a statistically significant dataset from which to perform the RPA at renewal. Permit writers

[1] Permit limits may be imposed upon whole effluent toxicity testing or individual pollutants without facility specific monitoring data or prior to the generation of effluent data (TSD, Section 3.2, page 50). The requirements of 40 CFR 122.44 (d)(1)(ii) must be satisfied.

have discretion to add a reopener clause to the permit to perform the RPA sooner than renewal provided adequate data become available.

Interpreting Results -- If the results of the RPA indicate reasonable potential exists to cause or contribute to an excursion above applicable water quality criteria, WQBELs for the pollutant of concern must be in the permit. RPAs should be conducted at subsequent renewals to determine whether the effluent limitations are still required. If the results of the RPA indicate reasonable potential does not exist, a monitoring-only requirement for the pollutant of concern must be in the permit until the next renewal. If the results of the second RPA confirm reasonable potential does not exist, the monitoring-only requirement will be removed and no further RPAs will be conducted. However, grounds for revisiting the RPA include: 1) changes in facility operation, 2) an increase in facility design flow or loading, 3) failures of WET Testing, 4) changes in water quality criteria, or 5) changes in procedures for conducting water quality reviews.

Methods and procedures for conducting a reasonable potential analysis follow those found in Section 3.3.2 of TSD [EPA/505/2-90-001]. Example spreadsheets containing previous RPAs are available upon request (see *WQAR Instructional Guidance*, Appendix A).

In the Section 4.4 below, WQBELs for specific pollutants are treated in more detail. To summarize this guidance document's informational sources to determine WQBELs, 1) Part II of this guidance document describes methods for calculating the low flow conditions, stream design flows for water quality criteria, and mixing considerations; 2) Part III treats the general water quality standards application to the permitting process, introducing the concept of wasteload allocations, statistics and distributions, maximum daily and average monthly limitations. *WQAR Instructional Guidance*, Appendix B, provides additional details on the formulas and statistics to use for the effluent limitation development steps.

The function of water quality-based limits is to ensure protection of water quality primarily through the maintenance of the water quality standard. We use the concept called "worst case" or "design" conditions. These represent restrictive conditions under which water quality standards must be met such as 7Q10 streamflow, pollutant of concern background (upstream) concentrations, and simultaneous maximum effluent discharge of POC. The development of limits that comply with water quality standards are determined at "steady state" conditions using, as described in Part 3, simple dilution or steady-state models.

4.2 Data Quality and Quantity Considerations

4.2.1 Background

Quality Assurance is one of the EPA's highest priorities related to environmental data.

In accordance with Federal regulations at 40 CFR 31.45, 40 CFR 35.6055 or 35.6105 and EPA Order 5360, data of sufficient quality to meet the projects objectives must be met. To support the development of technology-based limits or water quality-based limits, the Environmental Protection Agency (EPA) recommends the use of a data quality objective process. This process was developed by EPA to ensure that the type, quantity, and quality of the environmental data used in decision making are appropriate for the intended application. The planning process must take place before data collection to define data requirements and acceptable error.

Thus, the department requires a quality assurance project plan (QAPP) for projects such as the collection of water quality data (existing water quality or EWQ) for the purposes of fulfilling the requirements of the Antidegradation Rule (See template QAPP, located at: http://www.dnr.mo.gov/env/wpp/permits/QAPPtemplate.pdf). It is the responsibility of the Water Protection Program to ensure that QAPPs are developed for environmental data that is generated by the regulated community. These QAPPs must follow the current version of *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5).

As reviewer, we will use discharge monitoring data (DMR) and EWQ from applicants to make decisions on the effluent limitations. The department does not have the resources to collect effluent or receiving stream water quality data on each discharge, and therefore, we rely upon the self-monitoring of DMR data. The validity or quality of the DMR data is ultimately the permittee's responsibility and is a direct result of the adequacy and proper functioning of the permittee's self-monitoring program. For the program to function properly, data requirements must be structured so that responses will provide the decision makers with information necessary to determine compliance and support enforcement. For more information see: EPA's NPDES *Permit Writer's Guide on Data Quality Objectives* at http://www.epa.gov/npdes/pubs/owm0092.pdf.

The following sections will briefly cover the terms and procedures used to assess environmental data to ensure compliance with water quality standards.

4.2.2 Analytical Detection and Quantification Levels

The quantification level (QL) is the measurement of the concentration of a chemical obtained by using a specified laboratory procedure, at a specified concentration above the detection level. A minimum quantification level (ML) is a good example of a QL because it is the concentration in the sample that is equivalent to the concentration of the lowest calibration standard analyzed by the specific analytical procedure. This ML is not the same as the method detection level (MDL), which is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. For compliance purposes, EPA does not recommend the use of the MDL because the MDL is not as precise as the ML (TSD [EPA/505/2-90-001]).

For the reasonable potential to exceed evaluations, the EPA's Draft *National Guidance for the Permitting, Monitoring, and Enforcement of Water Quality-Based Effluent Limitations Set Below Analytical Detection/Quantitation Levels*, March 1994 provides guidance to represent data of POCs that include non-detectable values. The reviewer of the data must first consider other site-specific information on existing data (the laboratory's ability to calibrate at a lower quantification level than the minimum level), dilution in the stream, history of compliance, and toxicity of the pollutant to aquatic life or human health. Representation of the non-detect value is not a minor problem particularly for metals and priority pollutants if less refined approaches are taken. As a general approach, the following can be used to represent non-detect values:

1) 1/2 the detection limit or minimum level, where a value is below the minimum level.
2) An alternative method approved in *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* (EPA/600/R-96/084 July 2000).

In all cases where data is manipulated, such as using 1/2 the detection limit, an explanation of this manipulation must appear with the analysis.

4.2.3 Compliance with WQBEL below Minimum Level (ML)

Technology-based effluent (TBEL) limits that EPA developed are set at levels that are quantifiable by laboratory methods. However, when TBELs are not protective of water quality, WQBEL are imposed in permits to protect the designated uses of the receiving waters, even when the WQBEL is less than the analytical detection limit or the QL. Having a pollutant's limit that is below minimum level commonly occurs with toxic or bioaccumulative pollutants with extremely low water quality standard concentrations. The EPA's Draft *National Guidance for the Permitting, Monitoring, and Enforcement of Water Quality-Based Effluent Limitations Set Below Analytical Detection/Quantitation Levels*, March 1994, provides guidance on addressing WQBELs that are less than the analytical detection limit or the quantification level (QL). This guidance document provides direction for incorporating MLs into permits, developing MLs that are not currently available and translating analytical values below the ML into discharge monitoring report data for compliance evaluation such as the reasonable potential analysis. Also, see TSD [EPA/505/2-90-001], page 112.

In most permitting situations where WQBEL is below the ML, EPA recommends that the compliance level be defined in the permit as the ML (TSD [EPA/505/2-90-001]). The MLs are to be used for reporting and recording purposes. EPA believes that the use of MLs encourages permittees to maintain the highest QA/QC standards, as well as strict standard operating procedures and accurate discharge monitoring reporting. The ML must be included as a footnote to the POC's WQBEL in the permit.

Example:
The effluent limits for total residual chlorine (TRC) are below the minimum quantification level (ML) of the most common and practical EPA-approved TRC methods. The department has determined the current acceptable ML for total residual chlorine to be 0.13 mg/L when using the DPD Colorimetric Method #4500–CL G from *Standard Methods for the Examination of Waters and Wastewater*. The permittee will conduct analyses in accordance with this method, or equivalent, and report actual analytical values. Measured values greater than or equal to the ML of 0.13 mg/L will be considered violations of the permit and values less than the ML of 0.13 mg/L will be considered to be in compliance with the permit limitation. However, the ML does not authorize the discharge of chlorine in excess of the effluent limits stated in the permit.

4.2.4 Importance of Data Quantity and Representativeness

The Missouri Effluent Regulations [10 CSR 20-7.015] establishes minimum sampling quantities and sampling types for discharges to certain waterbodies. To determine compliance with State Water Quality Standards and Effluent Regulations consideration must be given to the quantity and representativeness of the data collected. Appendix U of the *Water Pollution Control Branch's Permit Writer's Manual* provides guidance on determining sampling frequency and sampling types based upon facility type, parameter, and compliance issues.

Data quantity refers to the amount of data that is collected with respect to the amount intended or required. A certain percentage of the intended amount of data must be collected before conclusions based on the data can be drawn. For example, flow that is measured four times a year for a plant that operates continuously seven days a week, 365 days a year is not enough to characterize upsets, variations in daily flow, and the overall flow being discharged. Conclusions cannot be readily drawn and compliance with NPDES permits cannot be determined without sufficient data.

Representativeness refers to the extent to which the data collected accurately reflect the group or medium being sampled. For example, waste load allocation studies that collect stream water quality data during periods other than summer low stream flow periods would allow too much dilution to meet the requirement of Missouri State Regulations. Thus, these data could not be compared to data collected during low flow periods. Another dilution example: A plant discharging its wastewater to a stream but the wastewater is diluted with stormwater before the sampling point; the result will not be representative with respect to the treatment plant effluent. Sampling before the stormwater dilution point provides a more accurate assessment of pollutant concentrations and loadings discharged to the receiving stream.

Another example of representativeness is sample type. Because waste flows can vary widely in magnitude and composition over a 24-hour period, the sampling type is important. Grab samples reflect the chemical composition at a given instant. A grab or

non-composited sample will not distinguish any differences in the waste flow, whereas the composite sample technique will. Composite samples average waste composition over time. Some wastewater characteristics or parameters change rapidly with time or cannot be composited, resulting in non-representative samples if 24-hour composite samples are used. These parameters are pH, temperature, dissolved oxygen, cyanide, total phenols, residual chlorine, oil and grease, volatile organics, sulfides, chromium VI, and coliform bacteria.

4.2.5 Outlier Analysis

Prior to conducting analysis with discharge monitoring or water quality assessment data, the data should be screened for outliers. Potential outliers of laboratory results or measurements are extremely large or small values compared to the remainder of the data, and therefore, they may not represent the population from which they are collected. Failure to remove true outliers could lead to distortions of the water quality parameter or discharge of that parameter. Statistical outlier tests give the analysis probabilistic evidence that an extreme value does not fit within the distribution. The reviewer may use these tests to identify those data that need further investigation as to the probable cause of the extreme value.

Potential outliers may be identified through graphical representation such as the box-and-whisker plot, ranked data plot, normal probability plot, scatter plot (two paired variables), time plot (temporal data) (see EPA's *Data Quality Assessment: Statistical Methods for Practitioners* [EPA QA/G-9S]). Once the outliers are identified, the next step is to apply a statistical test. Recommending which statistic procedures to follow for data editing is difficult and requires case specific analysis. The type of test may depend on the sample size. The Discordance Test or the Rosner's Test may be appropriate depending on the circumstances.

The reviewer may only exclude facility upset (upsets should not be confused with treatment bypasses which are not authorized discharges; see Glossary of Terms) apparent outlier data from statistical calculations of mean and standard deviation if it can be demonstrated that:

- the upset(s) occurred infrequently (no more than once every three years);
- they do not occur during or are not correlated to low stream flow periods;
- the amount of data is sufficient to establish an upset;
- the cause of the upset has been isolated and mitigative actions have been taken to prevent their future occurrence.

4.3 RPTE Evaluation Process and Calculations

The fundamental procedures for these RPA calculations can be found in Appendix A of the *WQAR Instructional Guidance*. A basic question for determining whether a facility

will require a water quality-based limit is: Does the POC have a "reasonable potential to exceed" the water quality criteria? If the answer is "yes", then "reasonable potential to exceed" is demonstrated. Some strategy of reducing that potential is pursued, typically the assignment of limits that are based upon water quality standards.

Basic steps:
1) Gather information such as discharge monitoring for analysis, all parameters, and all years (Five (5) + years typically) and look for a potential permit revision.
2) Calculate effluent statistics (see Appendix A, *WQAR Instructional Guidance*).
3) Calculate stream flow statistics (see Part II, Section 2.5.1).
4) Estimate the upstream concentrations (use average seasonal low flow values to represent background concentrations).
5) Use the mass balance equation to generate an instream concentration or receiving water concentration for each pollutant (use fraction of the design flows for stream with mixing zone considerations).
6) Compare the calculated instream value with the water quality standard for each pollutant

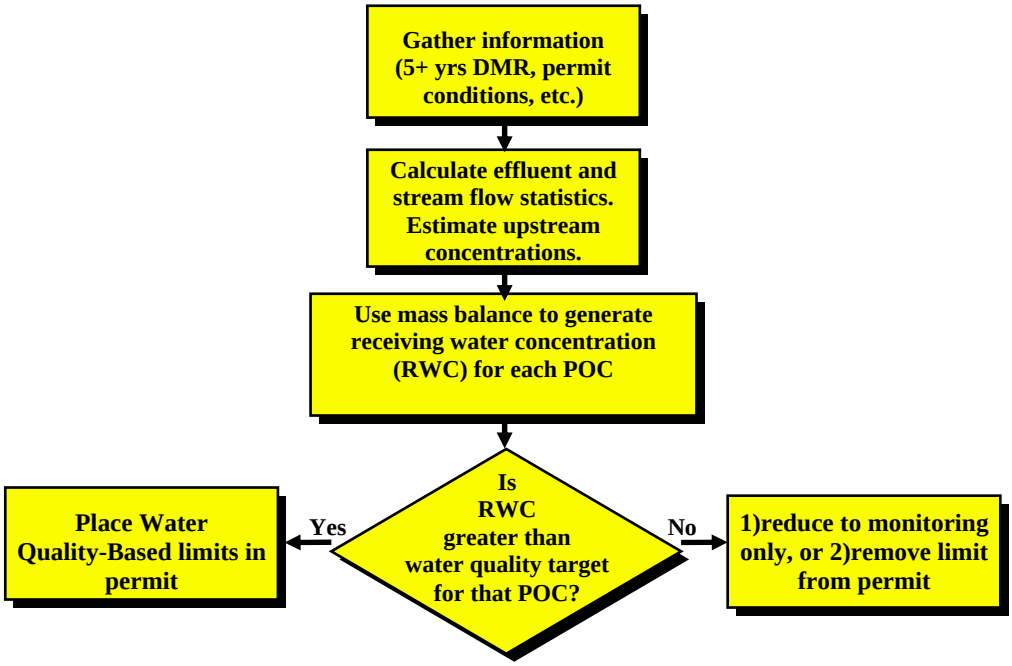

Figure 4. Reasonable Potential Analysis Process for the Protection Water Quality Standards.

Below is a list and brief description of revisions:

Version	Date Completed	Description
Version 1.0	December 22, 2009	Original version written by Todd Blanc.