UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF WATER

MEMORANDUM

SUBJECT: NPDES Permit Writer's Guide on Data Quality Objectives

FROM: Acting for Cynthia Dougherty, Director
Permits Division (EN-336)

acting for Rich Kozlowski, Director
Enforcement Division (EN-338)

TO: Water Management Division Directors
Regions 1 - 10

Attached for your use is the final version of the subject document. The purpose of this document is to help permit writers understand the process for establishing Data Quality Objectives (DQOs), thus ensuring that environmental data collected or required will be adequate for decision making under the National Pollution Discharge Elimination System (NPDES).

This document provides specific guidance on developing DQOs for the collection of data to support the development of NPDES permit limitations and on determining compliance with those limits. The DQO process is a decision making tool that may be used by the permit writer to ensure that resources are being expended in the most efficient way and that data collected are sufficient to support the decision making process. By using the DQO process, the permit writer will be better able to determine the level of uncertainty that is acceptable, and therefore, the type and quality of data that should be considered necessary for the permitting and compliance process.

The document consists of three chapters and an appendix. Chapter One provides a general introduction to the DQO process. Chapters Two and Three discuss the DQO process in terms of permit development and compliance determination respectively. The appendix examines four permitting scenarios as they might be addressed through the DQO process.

We have incorporated comments from the Regions in the development of the document. The latest version was sent out on April 12, 1990, and reviewed by the branch chiefs in the Water Management Division. We plan to include the document in the permit writer training course. If you have any questions, please contact Deborah Gillette FTS-475-9541 or Samuel To at FTS-475-8322.

Attachment

NPDES PERMIT WRITER'S GUIDE TO DATA QUALITY OBJECTIVES

NOVEMBER 1990

Office of Water Enforcement and Permits
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ABSTRACT

This manual provides the permit writer with guidance for developing data quality objectives (DQOs). DQOs are statements of the level of uncertainty that a decision maker is willing to accept in results derived from environmental data, when the results are going to be used in a regulatory or programmatic decision (e.g., setting or revising a standard, or determining compliance). DQOs are a tool that may be used by the permit writer to ensure that resources are being expended in the most efficient way, and that data collected are sufficient to support the decision making process and not extraneous to that process. The information and methods presented in this manual are not procedural requirements that permit writers must follow. However, review of this document is intended to provide the reader with an understanding of the principles of DQOs and the advantages that they provide. Specifically, this document describes steps for the systematic evaluation of data needs, allowing for the optimal use of available resources. DQOs will assist the permit writer in identifying the number of data elements and the types and quality of data necessary to support permit limits development as well as in assessing compliance with permit conditions.

This guidance discusses the process that should be followed in developing and defining DQOs. A comprehensive DQO should contain the following elements:

- Definition of the decision to be made regarding the data and the specific permit that is to be written
- Statement of why the environmental data are needed and how they will be used
- Time and resource constraints on data collection
- Description of the environmental data to be collected
- Specifications regarding the domain of the decision
- Calculations, statistical or otherwise, that will be performed on the data in order to arrive at the result.

Having defined the DQOs, permit writers will need to complete three additional steps: 1) define the decision; 2) clarify the information needed for the decision; and 3) design the data collection program. The development of DQOs and these final three steps must be sensitive to the regulatory need to determine compliance with permit conditions and limitations and be integrated into the permit writing process.

1. INTRODUCTION

Purpose

For the purposes of this document, data quality objectives (DQOs) are statements of the level of uncertainty that the decision maker is willing to accept in results derived from environmental data, when the results are to be used in a regulatory or programmatic decision. The purpose of this manual is to provide guidance to develop DQOs for the collection of data to support the development of National Pollutant discharge Elimination System (NPDES) permit limitations and to determine compliance with those limits. The DQO process will enable the permit writer to determine the level of uncertainty that is acceptable to support each programmatic decision and, therefore, the type and quality of data that must be collected. This process results in optimal use of available resources.

The Office of Water Enforcement and Permits (OWEP) has developed a method for establishing DQOs. This guidance is designed to improve permit writers' understanding of the principles represented by the DQO process and in the value of systematically evaluating the specific data needs of each situation. In explaining the value of DQOs, an analogy may be drawn with a trip to the grocery store before preparing a meal. Care must be taken in determining the nature of items needed, the number and size of each item, and perhaps the brand name (representing quality and price). Without these details, it is quite probable that the shopper will buy either too much or too little of the items needed or even the wrong things. Two results are possible: either too much money is spent for unnecessary and extravagant items or too little is purchased, which prevents the meal from being prepared. Similarly, permit writers have the potential to require extensive monitoring as part of the permit issuance process or as part of compliance evaluation. Through the systematic examination of objectives, the DQO process attempts to identify only the necessary data elements and to optimize the use of limited monitoring resources.

The permit writer should not accept any data at face value. Rather, he/she should use data from these sources only when they meet the DQOs set forth during the permit development process. State and Regional permit writers should develop their own DQOs that are tailored to requirements of their permitting policies. At a minimum, those DQOs should meet and be consistent with the Federal DQO guidelines. The issues discussed in this document provide NPDES permit writers with a basis for developing DQOs and a sensitivity toward the DQO factors: precision, accuracy, comparability, representativeness, and completeness.

NPDES permit writers typically collect environmental data primarily to derive permit limits and to evaluate the discharge's effects on the environment. Prior to setting permit limits, permit writers must collect data on the characteristics of the receiving waters and the facility's wastewater discharges. Data on the receiving water must be collected to determine if water quality-based limits are needed, the extent of environmental degradation, and specific problems (e.g., metals accumulation in the sediment) that should be addressed through the permitting process. The permittee's discharge also should be evaluated to determine specific constituents and their concentrations, as well as the overall level of toxicity in the effluent. These data can assist the permit writer in determining if toxicity limits are necessary or which constituents must be limited.

Data are also needed after the permit is issued to evaluate the impacts of the discharge on the receiving stream. Methods for data collection can involve such measures as chemical or biological testing of the effluent and/or receiving stream, ambient biological surveys of the receiving stream, and sediment analysis. This document will explain the relevance of the DQO process and concepts to these aspects of the NPDES permitting program.

Environmental data play a critical role in many NPDES decisions by providing information to decision makers on the quantity and quality of the effluent, the status of compliance with permit requirements, the adequacy of operation and maintenance procedures, and the impact on water quality. To ensure that this data quality is adequate for use in decision making, the permit writer must clearly define the regulatory objectives of the program, the decisions that will be made with the data collected, and the possible consequences of an incorrect decision. The DQO process allows for the development of unambiguous permits requiring the optimal collection of data necessary to support program objectives.

Background of the NPDES Program

The NPDES permit process is authorized by Section 402(a)(1) of the Clean Water Act. The permit process begins when the owner or operator of a facility desiring to discharge wastewater submits a permit application. All wastewater discharges to waters of the United States from point sources must have an NPDES permit.

The authority to issue permits may be delegated to States meeting certain technical, administrative, and legal requirements. The NPDES permit program is administered by the 10 Environmental Protection Agency (EPA) Regions and 39 approved NPDES States as of July 20, 1989. Not all of the States have received delegation for the five categories of permit programs municipal and industrial NPDES permits, NPDES permits for Federal facilities, pretreatment, general NPDES permits and sludge permits.

The types of application forms that proposed dischargers must complete have changed as the NPDES program has evolved. The older forms will eventually be replaced by revised application forms. The current forms are:

Standard Form A and Short Form A-S are used by publicly owned treatment works (POTWs). The standard form is used for major dischargers and the short form is used for minor dischargers. Definitions of "major" and "minor" may be found on the application forms. These two forms will be replaced by Form 2A, which is now being developed by the Agency.

Form 1 is a general form and is used with all "series 2" NPDES permit applications. It provides general information including the name of the facility, location, and contact person. The other four forms are used depending upon the type or class of discharger.

Form 2B is used by concentrated animal feeding operations or aquatic animal production facilities.

Form 2C is used by existing industrial dischargers, including privately owned waste treatment facilities and water treatment plants, whether publicly or privately owned.

Form 2D is used by the following categories of dischargers if they discharge process wastes:

- o New manufacturing and economical facilities
- o New minor manufacturing and mining facilities
- o New minor commercial dischargers.

Form 2E is used by new and existing facilities that discharge only sanitary wastewater and/or noncontact cooling water. (Form 2E is the revised Form 2C-S.)

Form 2F is used for stormwater discharges associated with industrial activity.

Approximately 32,200 facilities are expected to be able to use Form 2C while approximately 15,600 facilities are expected to be able to use Form 2E. Animal feedlot permits (Form 2B) number about 2,900, while the number of new industrial dischargers is expected to remain in the hundreds. As the number of permits for existing sources far exceeds all other types of discharge permits, processing Form 2C will remain the main topic of concern with respect to industrial discharges.

A considerable amount of correspondence may be required before the permit writer obtains an application that can be considered "complete" and "accurate." Some offices employ checklists to review application forms. In addition, it is often useful to send form letters to applicants when certain portions of the application are either missing or inadequate. As the permit writer gains experience in writing permits, it will become easier to detect omissions and errors in the permit application form.

Overview of DQOs and the DQO Process

DQOs are statements of the level of uncertainty that a decision maker is willing to accept in results derived from environmental data, when the results are going to be used in a regulatory or programmatic decision (e.g., setting or revising a standard use or determining compliance). They are a tool that the permit writer may use to ensure that resources are being expended in the most efficient way, and that data collected are sufficient to support the decision-making process and not extraneous to that process. To be complete, these quantitative DQOs must be accompanied by clear statements of:

- Decision to be made
- Why environmental data are needed and how they will be used
- Time and resource constraints on data collection
- Descriptions of the environmental data to be collected
- Specifications regarding the domain of the decision
- Calculations, statistical or otherwise, that will be performed on the data in order to arrive at a result.

This document explains the information needed for each of the items above and suggests a step-by-step process by which all of the items may be prepared.

The document also presents four scenarios to illustrate the DQO process (see Appendix A). These scenarios summarize real-life permitting decisions faced by permit writers. They are intended to show how the DQO process can be employed to help the permit writer systematize his/her permitting efforts and ensure that all data elements are complete.

Developing DQOs should be the first step in initiating any significant environmental data collection program that will be conducted by or for EPA or State agencies. The DQO process helps to define the purposes for which environmental data will be used and sets guidelines for designing a data collection program that will meet the agency's regulatory objectives. Once DQOs have been developed and a design for the data collection activity expected to achieve these objectives has been selected, DQOs are used to define quality assurance (QA) and quality control (QC) requirements specifically tailored to the data collection program being initiated. A "QA Project Plan" is prepared, documenting all of the activities needed to ensure that the data collection program will produce environmental data of the type and quality required to satisfy the DQOs. Without first developing DQOs, a QA program can only be used to document the quality of obtained data, rather than to ensure that the data quality obtained will be sufficient to support a (permitting) decision.

The DQO process consists of three stages, each containing several steps. The first two stages result in proposed DQOs with accompanying specifications and constraints for designing the data collection program. In the third stage, potential designs for the data collection program are evaluated. Stage III results in selecting a design both that is compatible with the constraints and that is expected to meet the DQOs. The process is meant to be interactive. The proposed constraints from Stage I, the proposed DQOs from Stage I, the proposed DQOs from Stage II, and the design alternatives analyzed in Stage III must be compatible.

Stage I: Define the Decision

This stage is the decision maker's responsibility. The decision maker states an initial perception of what decision must be made, what information is needed, why and when it is needed, how it will be used, and what the consequences will be if adequate information is not available. Initial estimates of the time and resources that can reasonably be made available for the data collection activity are presented.

Stage II: Clarify the Information Needed for the Decision

This stage is primarily the responsibility of the senior program staff with guidance and oversight from the decision maker and input from technical staff. The information from Stage I is carefully examined and discussed with the decision maker to ensure that senior program staff understand as many of the nuances of the program as possible. After this interactive process, senior program staff members discuss each aspect of the initial problem, exercising their prerogative to reconsider key elements from a technical or policy standpoint. The outcome of their work, once explained and concurred upon by the decision maker, leads to the generation of specific guidance for designing the data collection program. The products of Stage II include proposed statements of the type and quality of environmental data required to support the decision, along with other technical constraints on the data collection activity that will place bounds on the search for an acceptable design in Stage III. These outputs are the proposed DQOs.

Stage III: Design the Data Collection Program

This stage is primarily the responsibility of the technical staff. However, it involves both the senior program staff and the decision maker to ensure that the outputs from Stages I and II are understood. The objective of Stage III is to develop data collection plans that will meet the criteria and constraints established in Stages I and II. It is the prerogative of the decision maker to select the final design that provides the best balance between time and resources available for data collection and the level of uncertainty expected in the final results.

Precision, accuracy, representativeness, completeness, and comparability are characteristics that serve to qualitatively and quantitatively identify a particular set of data. All data are subject to error. Different types of errors occur during the accumulation and interpretation of data. When the errors become magnified, the data quality decreases. In some cases, this situation cannot be avoided. It is important to know the "quality" of data when evaluating NPDES permits [e.g., discharge monitoring report (DMR) data]. Each of these five DQO factors is explained below.

Precision

Precision is used to describe the reproducibility of results. The precision of an analytical procedure can be determined by replicate analyses (more than one) of a uniform sample. Precision refers to the agreement among a group of experimental results and implies nothing about their relationship to the true value. In the case of a single laboratory and analyst, the sample is analyzed N (>1) independent times under a specified set of conditions. The method used to analyze the sample is the same in all cases. Analytical precision varies over the range of a procedure and is worst near the detection limit. This is important in monitoring because many pollutants are regulated near the detection limit.

Pollutants such as cyanide and mercury are regulated near the detection limit, and the precision of the analyses for these pollutants is strongly affected by the presence of other pollutants in the sample, referred to as interferences or matrix effects. For example, EPA's ambient water quality criteria for cyanide (49 Fed. Reg. 4551) propose an acute freshwater toxicity concentration of 22 ug/l of free cyanide (HCN + CN-) and a chronic toxicity concentration of 4.2 ug/l. However, the approved NPDES analytical procedure for total cyanide has a detection limit of 20 ug/l. Precision data for the test procedure using mixed industrial and domestic wastewater samples at concentrations of 60 and 280 ug/l indicate standard deviations of +5 and 31 ug/l, respectively.

Determining analytical precision is made more difficult by theoretical limitations because most statistical analyses of scientific data assume a constant variance over a range of concentrations, which rarely occurs. Although analytical precision can and does affect variability, it can be quantified and taken into consideration when reporting data for NPDES permits. Usually the methods used for water and wastewater analysis have precision and accuracy factors reported.

Accuracy

The term "accuracy" means the nearness of a measurement to its real, or true, value. The true value of any quantity is really not known. In analytical chemistry, the analyst acts as though the true value of a quantity were known when the uncertainty in the value is less than the uncertainty in something else with which it is being compared. For example, the percentage composition of a standard sample can be treated as correct in evaluating an analytical method; differences between the standard values and the results obtained by the analytical method are treated as errors in the method.

An accurate result agrees closely with the real value. The closer the result to the real value, the more accurate the result. A typical analysis could give results that are accurate with respect to the true value but not be precise. Precise values may well be inaccurate since an error causing deviation from the true value can affect all the measurements. When evaluating a particular test method, precision and accuracy characterize the amount of variability and bias found in a given data set. Essentially, all the data reported in the DMR are controlled by requiring the use of EPA-approved test procedures. In addition, EPA and State permitting authorities inspect permittee laboratories on a regulatory basis. Performance evaluation samples are sent to each major permittee once a year with results evaluated by EPA.

Information about accuracy is available for most EPA-approved analytical methods. The notable exceptions are BOD and TSS, the parameters most commonly regulated under the NPDES program. Accuracy information is not available for TSS because no standards exist against which the accuracy of this test can be measured. As for BOD, there is no organic substance that produces an equivalent to its theoretical oxygen demand because the BOD test is actually a biological rather than a chemical analytical test.

Comparability

Comparability is another characteristic associated with the data quality set. It refers to the similarity of data evaluation from different sources. Standard procedures for sampling sites, analyses of samples, and reporting of analyses must be observed to ensure that comparability of results is maintained. For example, if more than one person is collecting samples for an analysis, the same procedures for handling and preservation must be used to ensure comparable results. Different procedures will have different accuracy and precision levels, thus invalidating a comparison of results. As another example, if more than one laboratory is analyzing the samples from a particular wastestream, the same procedures for the analytical test should be used, preferably with identical instrumentation. Each instrument has its own set of errors that will invariably affect the accuracy and precision of the results. Using identical procedures ensures that the different data sources are measuring similar parameters and performing the measurements in the same way.

Representativeness

Representativeness refers to the extent to which the data collected accurately reflect the group or medium being sampled. An example would be the case of dilution. If a plant discharges its wastewater to a stream and it 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. Since 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 noncomposited sample will not distinguish any differences in the waste flow, whereas the composite sample technique will. Composite samples average stream composition over time. When sufficient samples are taken and mixed together (amount of sample should be proportional to flow for greater accuracy), the results obtained will be similar to taking a sample from a completely mixed tank and more representative numbers will result. On the other hand, if batch processes are the method of production (prepared at one time) and composite samples of the wastewater are taken, erroneous results may distort the data.

Composite samples are not always the most representative samples of a waste discharge. Some wastewater characteristics change rapidly with time or cannot be composited, resulting in nonrepresentative samples if 24-hour composite samples are used. These characteristics are pH, temperature, cyanide, total phenols, residual chlorine, oil and grease, and fecal coliforms. Although NPDES regulations specify that grab samples must be used for these pollutants when sampling the wastewater for a NPDES permit application [40 CFR 122.21(g)(7)], the sample type specified on an individual NPDES permit is left to the permit writer's discretion. Consequently, some DMR data are reported using grab samples, while other data are from composite samples. Not only are the data unrepresentative of the facility's discharge, but comparability of data from different sources may not be valid.

Completeness

Completeness 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, a flow is measured four times a year for a plant that operates continuously 7 days a week, 365 days a year (an exaggerated case). The four measurements are not enough to characterize accurately the flow being discharged. In addition, nothing is said about changes in flow, process upsets, or diurnal swings resulting from seasonal changes. More information is required before the flow can be fully characterized with respect to the plant and its surroundings. Conclusions cannot be readily drawn and compliance with NPDES permits cannot be determined without sufficient data.

Completeness is of great concern in the development and maintenance of the permit development files and background documents. These reports and data are critical to the entire permit process as they provide the documented basis upon which the permit was derived--documentation that is vital if the permit is ever challenged.

The following table describes some of the general considerations relevant to determining the basis for permit limits, setting permit limits, and determining compliance.

TABLE 1

	Precision	Accuracy	Comparability	Representativeness	Completeness
Determining the Basis For Limit Setting	Procedures and methodologies used to collect data and evaluate the stream and discharge characteristics must be reproducible. They should be based on standardized, accepted methods.	Data should be compared to known values and standards to determine the accuracy of stream and discharge measurements.	Data collection and analysis for the same facility or stream must be made with the same procedures, so that data from different sampling events are comparable.	Data must be collected that represent the actual discharge and stream conditions as accurately as possible. Sampling designs must take into account site specific characteristics, such as hardness, dilution, stream flow patterns, etc.	Enough data must be collected to provide the permit writer with a picture of the situation under all circumstances, such as high and low flow conditions.

Data used as a basis for setting limits must have all the qualities mentioned above to ensure that limits are both protective of the receiving stream and accurately reflect the pollutants and/or toxicity of the facility's discharge.

	Precision	Accuracy	Comparability	Representativeness	Completeness
Determining Compliance with Permit Limits	Permit writers should determine and specify exact sampling and analysis protocols that ensure the reproducibility of self-monitoring and compliance monitoring data.	Whenever possible, sample analysis must compare effluent samples to known standards. Acceptable levels of error should be determined by the NPDES authority. Laboratories that perform analysis should be required to report levels of error.	Permittees should be required to use consistent methodologies for sampling and analysis to allow for comparisons of data over time.	Monitoring requirements should be designed to provide the NPDES authority with a representative picture of the discharge and, where appropriate, instream impacts. For example, permit writers may wish to specify more than one species for toxicity testing to ensure that the most sensitive as well as least sensitive species are evaluated.	The permit writer should require that enough monitoring data are collected to evaluate the permittee under all conditions, such as changing flows, manufacturing processes, etc.

2. PERMIT DEVELOPMENT

NPDES permit writers need to collect a significant amount of data to determine the appropriate basis for setting limits and to derive those limits. The decision to impose technology-based or water quality-based limits on a facility will depend on whether the receiving water quality is meeting designated uses. To determine if the receiving water quality is impaired, permit writers can conduct or require to be conducted a number of biological and chemical tests.

In evaluating permit applications and developing permits, NPDES permit writers can use a broad range of information sources. These sources can be used to check or uncover discrepancies in the application forms, obtain more information from or about the discharger, and guide the permit writer in identifying appropriate technological or water quality-based limits.

Information Sources

- NPDES application forms
- Abstracts of Industrial NPDES Permits
- NPDES Best Management Practices Guidance Document
- Technical Support Document for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants
- Economic achievability protocol (Workbook for Determining Economic Achievability for NPDES Permits, August 1982)
- NEIC reports on specific facilities
- Toxicity reduction evaluations for selected industries
- Industry experts within EPA
- Section 308 questionnaires
- Effluent guidelines information
  - Screening and verification data
  - Development documents
  - Contractors' reports

- Proposed regulations
- Project officers

- Permit Compliance System (PCS) data
- Permit file
  - Previous NPDES application forms
  - Discharge monitoring reports
  - Compliance inspection reports
- Other media permit files [such as Resource Conservation and Recovery Act (RCRA) permit applications]
- Technical journals and books
- STORET
- Other data bases [e.g., Chemical Information System (CIS)]
- Local permitting authority's regulations
- Treatability manuals.

Prior to performing any tests or requiring the permittee to perform tests, the NPDES permit writer should evaluate the data and data quality needs of the permit development process:

- Decisions to be made with the data
- Why data are needed and how they will be used
- Time and resource constraints on data collection
- Descriptions of data to be collected
- Domain of the decision
- Calculations that will be performed on the data.

These steps constitute Stages I and II and should avoid the collection of unnecessary or unusable data. Each of these steps is discussed below in the context of NPDES permit writing.

STAGE I: DEFINING THE DECISION

In the permit development phase, two major decisions must be made by the NPDES permit writer. The permit writer must determine a basis for the limits (e.g., technology-based or water quality-based) and, once this has been done, the parameters to be regulated and the specific limits. To make these decisions, the permit writer will need to collect and analyze a substantial amount of data on the facility's discharge characteristics and the receiving stream.

Prior to collecting these data, the permit writer should set DQOs using the three-stage process described in this document. For each major decision described above, the Stage I analysis will be discussed.

<u>Determining the Basis for Limit Setting</u>

To determine if a facility's limits should be based on technology or water quality considerations, the permit writer needs to collect data on the permittee's discharge and the water quality of the receiving stream. In some cases, data requirements may be substantial. Where dynamic modeling is necessary to determine the need for technology-based or water quality-based limits, data collection may need to be extensive and precise. However, if simple dilution analysis is used as a screening tool, data needs may be much more limited. The DQO process allows the permit writer to determine both the needed data elements and the necessary data quality from the outset, avoiding collection of unusable, extraneous, or insufficient data.

<u>Why Data are Needed and How They Will be Used</u>

Data on the facility's discharge and the receiving stream are needed to determine if technology-based standards will achieve designated uses, if designated uses are currently being met, and the current impact of the discharge on stream quality. Data on the facility's effluent are needed to reveal the presence of toxic, nonbiodegradable, and/or bioaccumulative pollutants; oxygen demanding pollutants; pH; and overall toxicity. Using dilution analysis or modeling, these data can predict instream impacts under different scenarios (e.g., no treatment, technology-based limits, or water quality-based limits). Data on the receiving stream can identify specific problems, such as contaminated sediments, impacts on indigenous species, and bioaccumulation of toxics in fish, that may be addressed in the permit. These data will be used to determine the basis for setting limits and to justify the types of limits incorporated into the permit.

<u>Time and Resource Constraints on Data Collection</u>

Time constraints on data collection may depend on the date that the previous permit expires, seasonal changes that affect data gathering, or statutory deadlines. The permit writer will need to design data-gathering plans that allow for the timely issuance of permits, while providing adequate input into the permit development process. Resource constraints may be felt by both the permitting authority and the permitted facility.

It is important to understand that monitoring in the context of an NPDES permit is primarily carried out by the permittee and is, therefore, a self-monitoring program. Potential problems that can result from a self-monitoring system include improper sample collection, poor analytical technique, falsification of records, and other abuses of the system. The DQO process should address these potential problems.

Deriving Permit Limits

To derive permit limits, the permit writer must collect and evaluate information on the types of processes at the facility, the pollutants detected in the wastestream, the treatment processes, effluent toxicity, and in some cases, receiving water assimilative capacity. The permit limits derived from these data may have a significant economic impact on the permittee and a significant environmental impact on the receiving stream. Consequently, it is important to obtain high-quality data that accurately reflect the discharge and receiving streams.

Decision to be Made

The decision made during this phase of the permit development process is two-fold: which parameters should be limited and what should those specific limits be? Data collected during the characterization of the facility and the receiving stream are intended to answer these questions.

Why Data are Needed and How They Will be Used

Data are needed to determine if the facility is subject to categorical standards, if it can meet those standards, and what those standards must be if process waste mixes with nonprocess waste. If the facility cannot meet categorical standards, compliance schedules must be developed. Variability in the wastestream composition and treatment performance will help the permit writer obtain instantaneous and average limits. If the facility must meet water-quality based limits, the appropriate dilution available to the facility must be determined, which may entail the use of models with very specific data requirements. In addition, data can be used to identify pollutants present in the discharge that must be limited in the permit. The type of model used to develop appropriate permit limits (e.g., steady state or dynamic) will determine many of the DQOs. Model inputs typically include low (7Q10) and average stream flow, wastewater flow (used to determine the instream waste concentration), and the size of the mixing zone. For more information on model inputs, please refer to EPA's Technical Support Document for Water Quality-Based Toxics Control.

The model provides a measure of effluent quality that is necessary to protect water quality in the receiving water. It is very important to consider how the model addresses variability in effluent quality. For example, a model output for nutrients or bioaccumulative pollutants could be expressed as the average effluent quality, because the total loading of these pollutants is of concern. On the other hand, an output for toxic pollutants is normally expressed as a maximum value for the effluent because the concentration of these pollutants is of more concern than the total loading. Therefore, it is important to recognize that the duration and frequency of occurrence of the required effluent quality is an important aspect of a water quality model.

There is a significant risk of incorrectly using the output from a water quality model if effluent variability and the basis for both the water quality model and the permit limits are not considered. The permit writer should be especially careful to ensure that the limits designed to implement the recommendations of water quality models are consistent with the assumptions and requirements associated with those models.

Time and Resource Constraints

The permit writer faces time and resource constraints in collecting data that are used to calculate limits. If water quality-based limits for specific pollutants or toxicity are needed, data collection can be particularly extensive. Water quality models often require large amounts of site-specific stream data. Data completeness requirements for modeling may be difficult to achieve. Technology-based permits require less data, as they do not involve analysis of the receiving stream. To ensure that resources are effectively used, permit writers should determine all necessary data elements prior to initiating extensive data gathering. This can be done by selecting water quality models and/or methodologies for setting limits in advance of requiring data-gathering by the permittee. For example, if the facility is located on a water quality-limited stream, the permit writer can then begin to identify needed data and require such data through the permit application or a Section 308 letter.

STAGE II: CLARIFYING THE INFORMATION NEEDED FOR THE DECISION

In this stage, senior program staff members should review the DQOs developed in Stage I to ensure that all necessary data elements have been identified, that the quality of needed environmental data will be adequate, and that all relevant technical and policy issues are addressed. After Stage II analysis has been completed, statements should be written on the type and quality of environmental data to be collected, specifications on the domain of the decision, and the calculations that will be performed on the data. The following sections discuss these statements in the context of the permit development process.

Description of Data to be Collected

Once the permit writer has determined why data are needed and how they will be used, he/she should describe precisely what data are needed, including general monitoring points (e.g., treatment plant influent and final effluent, sediment below outfall, and various locations on the receiving stream). In addition, the permit writer should specify the type of test (e.g., 48-hour static acute toxicity test with *Daphnia pulex*, or priority pollutant scan) and the frequency with which the test needs to be conducted. The types of samples (e.g., grab or composite), the sampling frequency, and the analytical methods should be established at this stage or in Stage III, where the overall data collection strategy is developed. However, the data descriptions should be sufficient to meet all data needs and to be statistically significant (representative sampling). Also, the data should reflect variability resulting from seasonal changes in the receiving environment and fluctuations in plant processes and treatment plant operations.

Domain of the Decision

In the case of NPDES permit development, the domain of the decision is, at a minimum, the permitted facility and the receiving environment. If the receiving stream is water quality-limited and a wasteload allocation is used to set permit limits, more than one facility may be affected by the decision. The spatial boundaries of the receiving stream affected by the decision depend on the area of impact from the effluent. The temporal impact of the decision will be the duration of the permit, or until the permit is reopened.

Calculations of Data

As part of the DQO process, the permit writer should identify all calculations, such as dilution analysis, determining the contribution of nonprocess wastestreams, or calculating appropriate categorical standards as they apply to the end of the pipe. Identification of calculations can help the permit writer determine the data inputs needed in terms of precision and accuracy prior to initiating data gathering. This ensures that data gathering is complete and that the data are of sufficient quality to be useful in performing the calculations.

STAGE III: DESIGN OF THE DATA COLLECTION PROGRAM

The permit writer should design a data collection plan that is tailored to the characteristics of the permitted facility. A number of factors should be taken into account in designing the plan: types of chemicals expected in wastestream, manufacturing processes, treatment units, size of the facility (flow), and physical and chemical characteristics of the receiving stream.

In determining the extent of any new data-gathering activities, the permit writer should be aware of any available information, such as the facility's existing NPDES permit, the permit application, discharge monitoring reports, inspection reports, and any actual effluent sample analysis data or toxicity test results. In addition, water quality information can be retrieved from STORET.

Information may also be available from Section 308 letters sent to the facility. The permit writer may wish to consider the use of Section 308 letters as an integral part of the data collection process. The use of Section 308 letters can be consistent with the intent of the DQO process. For example, if a complex facility's permit is approaching renewal and it is known that the facility will be submitting only a single set of analytical data, a Section 308 letter could be used to reduce the expenditure of resources on the part of both the permit writer and the permittee. A Section 308 letter could be used to explain the data needs and to request the required information (Section 308 letters used to request additional data or monitoring should include a statement that sampling and analysis must be in accordance with EPA approved procedures). A time savings is realized since both the permit writer and the facility are immediately aware of the data needs. Additionally, resources are saved since the permittee can design the sampling and analysis scheme just once, knowing that the information required will be acceptable to the permitting agency.

The factors above should all be carefully considered and serve as the basis for designing a sampling plan. The sampling plan should provide for the collection of representative data necessary to identify water quality impacts from the facility, those wastewater constituents that are causing the impacts, the current level of treatment, the level of treatment necessary to mitigate the adverse environmental impacts, and the sources of the constituents responsible for the impacts (e.g., spills or specific processes).

3. DETERMINING COMPLIANCE WITH PERMIT LIMITS

Introduction

There are a number of methods to determine a facility's compliance with its NPDES permit and the quality of reported data. The annual DMR QA program is designed to evaluate the ability of permittees to analyze and report self-monitoring data accurately. The results of performance evaluations are compared among other major permittees as well as other State and EPA laboratories. Responding permittees receive an evaluation of their data and are given guidance for checking for various error sources. In addition, while performance evaluations can indicate analytical problems, data quality can also be ascertained through on-site laboratory audits where analytical procedures, preservation techniques and quality control procedures can be reviewed.

NPDES permits require that monitoring frequency and sample type be specified for all effluent characteristics contained in the permit. Monitoring frequency varies from permittee to permittee and between parameters within a given NPDES permit. Some State agencies have policies regarding sampling frequency of common parameters, such as BOD and TSS, with different frequencies for POTWs, major permittees, and minor permittees. In most cases, monitoring frequency is left to the discretion of the permit writer who may consider the importance of the pollutant in characterizing the discharge, the cost of the analysis, and the number of parameters monitored, in determining sampling frequency.

Sampling frequency affects the representativeness of the data collected, not the representativeness of the sample. In most cases, a sampling frequency of three times per week will produce data that are more representative of the wastewater discharge than a frequency of once per week. Ideally, statistical procedures should be used to determine the number of samples per month needed to provide a statistically significant characterization of the data. Using statistics to determine the sampling frequency will result in more frequent sampling of effluent discharges that are highly variable, whereas permittees discharging a consistent quality effluent need to monitor less frequently.

Sampling frequency is also important in determining compliance with NPDES permits. Compliance is based on monthly and/or weekly average values and daily maximum values as reported on the permittee's DMRs. The monthly average can be based on a single sample, 2 samples, or 31 samples (for each day of the month), depending on the monitoring frequency; the same is true for the weekly average. The daily maximum is the highest value for the month and may be either the highest of up to 31 samples or the only value for the month; therefore, it could be the same as the monthly average if the monitoring frequency is once per month. Infrequent sampling may result in a violation of the monthly average if a single high value is averaged with a small number of lower values. A violation of the daily maximum may not result if the daily maximum limit is much greater than the monthly average permit limit. Consequently, the sampling frequency is related to data representativeness in determining compliance with permit limitations and apparent compliance or noncompliance may be a function of sampling frequency, rather than treatment system performance.

In terms of determining compliance, there are no differences in data quality requirements between water quality-based and technology-based permits that limit specific pollutants. In both cases, compliance is determined by the pollutant concentrations or mass loadings in the effluent being discharged since NPDES permits limit the concentrations or mass loading in the effluent. The difference exists in the water quality data used to develop the effluent limits for a water quality-based permit. The permit writer collects all available ambient water quality data, usually from the STORET data base or local studies. Desk-top calculations employing a mass balance or computerized water quality models are used to determine the allowable effluent discharge concentrations for the point source of interest based on the ambient water quality concentrations and water quality standards or criteria of the pollutants and low flow conditions. These allowable effluent concentrations become the effluent limitations for a water quality-based permit.

In addition to determining compliance, DMR data are used to develop effluent guidelines limitations and in some cases, permit limits. In developing effluent guidelines limitations for an industrial category, EPA collects daily data from a number of facilities in the category. Data from several facilities are compared and grouped into subcategories. Long-term averages of the data are computed along with variability factors. The variability factors account for fluctuations in treatment plant performance, analytical error, and differences among facilities within a subcategory. The daily maximum and monthly average limitations are computed as the product of the long-term averages and corresponding variability factors.

In cases where effluent guidelines limitations do not exist for an industrial facility (noncategorical industry), permit writers can derive effluent limitations based on DMR data, permit abstracts, and detailed process data provided by the permittee. The methodology used depends on the permit writer, but statistical procedures are commonly used.

STAGE I: DEFINING THE DECISION

Each direct discharger is regulated by an NPDES permit that specifies the point of discharge, limits on pollutants in the discharge, and self-monitoring requirements. The terms of each permit are determined largely by the permit writer following policies and regulations provided by EPA Headquarters. Permit writers must then define the type of data that must be obtained to support decisions made under the authority of the Clean Water Act and the regulations promulgated pursuant to it. The decision maker must also determine why and when the information is needed, how it is to be collected, and what the consequences will be if data of adequate quality are unavailable, and make initial estimates of the time and resources that can be reasonably made available for any data collection activities.

The stage of defining the decision typically occurs in four steps. During Step 1, the decision maker determines the purpose for which data are needed and presents an initial explanation of why the information is needed and the decision that must be made. Data collection activities that occur under the NPDES program may be designed and carried out to determine compliance status of the permittee and to decide upon appropriate remedial actions. Overall, data collection activities support the following determinations:

- Adequacy of construction progress
- Performance of treatment systems
- Compliance status of NPDES permittees
- Establishment of permit limits based on effluent guidelines, water quality standards, and BPJ.

To support these decisions, the permit writer must have a clear idea of the types of information needed for the decision.

In Step 2, the decision maker places initial bounds on the problem. This step allows the decision maker to address general questions that will guide the data collection activity. For example, the permit writer might wish to consider the time period in which data must be collected (such as season or time of day); the type of sample (grab or composite); and the frequency of monitoring. These elements are then determined and described in the permit. The primary data needed from the permittee are self-monitoring data, which are reported in the DMR. Ensuring the quality of the data reported by the permittee for decision-making purposes requires careful thought by the permit writer about the data elements necessary to determine compliance and characterize effluents.

In Step 3, the decision maker defines the uses of the data in effluent characterization and compliance assessment. Effluent data are needed to determine:

- Precise quality and quantity of effluent
- Status of compliance with permit requirements
- Adequacy of operation and maintenance procedures
- Impact on water quality.

Lastly, the decision maker considers the constraints of time and resources on data collection. The purpose of a resource estimate is to provide gross guidance and to propose some initial constraints on the resources available for the data collection activity. (Estimates generated during this stage should be considered subject to modification pending the results of the final stage when the balance between desired data quality, time, and resources is quantitatively assessed.)

Rationale for Self-Monitoring

Since it is not logistically or financially possible for the regulatory agency to collect and analyze all of the samples from a permittee's wastestream necessary to support compliance determinations, the burden of data collection falls primarily on the permittee. Self-monitoring provides the foundation of the NPDES program and is the primary basis for ensuring that permit limitations are met. It is also a basis for enforcement actions against permittees that violate their permits. Since monitoring for the NPDES permit system is primarily self-monitoring, there is a potential for problems to result, including improper sample collection, improper sample handling, poor analytical technique, falsification of the records, and other abuses.

The permit stipulates that "self-monitoring" requirements are the discharger's responsibility. Typically, the permit sets forth the frequency and type (grab and/or composite) of sampling requirements as well as the flow monitoring, analytical, and data reporting requirements. The validity or quality of the DMR data is ultimately the permittee's responsibility and is a direct result of the adequacy and 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.

STAGE II: CLARIFYING THE INFORMATION NEEDED FOR THE DECISION

In the second stage, senior program staff members typically generate the specific guidance to design the data collection program based upon guidance and oversight from the decision maker and input from other technical staff members. The final products of this stage include statements of the type and quality of the data required to support the decision in question, along with other technical constraints on the data collection activity.

In order to manage the NPDES program most effectively with limited resources, OWEP has developed objective criteria for making decisions based on the best available data. The criteria were needed to support and act upon effluent violations of primary concern. These violations are defined as a subset of those instances of noncompliance reported on Quarterly Noncompliance Reports and are called Significant Noncompliance (SNC). The SNC is used to report violations of primary concern within EPA's management accountability system and generally indicates the need for agency action. The SNC criteria are described and illustrated in the Guidance for Preparation of Quarterly and Semi-Annual Noncompliance Reports (per 40 CFR 123.45).

In the NPDES programs, regulations are in place and the need for compliance and enforcement monitoring is already defined. Therefore, the DQO process will most likely be initiated during Stage II, where the permit writer must focus on interpreting the data needs specified implicitly or explicitly by the regulations and incorporating them into conditions in the permit. The permit writer will also need to determine the level of uncertainty tolerable in the enforcement and compliance data.

Stage II is typically broken down into a series of steps described briefly below.

Step 1: Break Decision into Decision Elements -- Program staff members identify all questions that must be answered to make a decision. Answers to these questions will be referred to as "elements" of the decision in the remainder of the document. Each element of the decision should be classified as either dependent or not dependent on the data.

Step 2: Specify Data Needed -- In this step, data that will be needed for each element should be specified. Data should be specified in terms of the variables (e.g., specific pollutants) for which quantitative estimates are desired and the medium in which they will be measured.

Step 3: Define the Domain of the Decision -- The domain is that portion of the environment or physical system, delineated by spatial and temporal boundaries, from which samples will be collected and to which the decision will apply. The domain in the NPDES program refers to the type of facilities from which data are needed. In the NPDES program, there are 65,000 permittees, including municipal and industrial facilities. As a matter of priority, EPA focuses compliance action on 7,500 major permittees. The violations review action criteria (VRAC) in the Enforcement Management System (EMS) and the Technical Review Criteria on determining significant noncompliance are used to select permittees with persistent problems.

Step 4: Define the Results to be Derived from the Data -- The results consist of analyzed data that will be used to make the final decision. The results should answer the questions first posed in Stages I and II. The definition of the result should include the following items:

- Statistics that will be used to summarize the data (e.g., mean, range, and medium)
- "Action level" or other value to which the summary statistic will be compared
- For trends monitoring and research programs, the reference value (if any) to which the summary statistic will be compared.

Nature of Compliance Data

Because of the number of permittees involved, controlling data quality is a very complex task. For OWEP, controlling data quality is primarily an oversight function. Primary responsibility for the overall quality is dependent upon the permit writer; thus, the Regions and the States have control over data quality. Factors that influence data quality include:

- The level of data quality varies for each permittee as specified in the permit. Regions and NPDES State agencies control data quality through permit writing and compliance monitoring.
- The program relies heavily on self-monitoring, so knowledge of appropriate analytical techniques by permittees is critical. Training, inspection, and dissemination of information on approved methods are important.
- To control data quality, the use of 304(h) rules (EPA-approved test procedures) to analyze pollutants is required. The specific methods are promulgated by EPA's Office of Research and Development under 40 CFR Part 136.

Determining the Variables Needed and the Gaps that Need to be Filled

Data collection always involves some error. Error is an inherent characteristic of any sampling design, method used for sample collection or sample analysis, and statistics employed for raw data interpretation. With these potential error sources in mind, the permit writer must establish limits on the total error that can be accepted in the results of the data collection process in order to use the results in decision making. The conclusions based on effluent data may be in error in two ways. The effluent parameter values may be too high, which would show violations where none actually exist; or conversely, the values may be too low, thereby indicating compliance incorrectly.

Another factor to consider is that a sample may not be truly representative of the effluent, thus triggering the errors mentioned above. Referring to the appropriate industry effluent guideline (promulgated under Sections 301 and 304 of the Clean Water Act) will aid in ensuring that the data collected will correctly and accurately reflect the characteristics being measured. The guidelines include a careful statistical analysis, taking into account data variability. The guidelines are established at the upper bounds of acceptable treatment facility performance. Thus, a normally functioning treatment facility will have a very low probability of exceeding permit limitations.

STAGE III: DESIGN OF THE DATA COLLECTION PROGRAM

Collecting data is a multistep process that includes elements of statistical design, selection of sampling sites, the actual collection and analysis of the samples, data validation, and interpretation of the results. Selecting the method that incorporates each of these steps can vary widely depending upon data quality and level of acceptable risk that is associated with the decision to be made. In Stages I and II, the decision was defined and the objectives summarized to provide the basis for selecting the best approach to data collection in Stage III. This final stage focuses on evaluating the problems associated with each approach, and balancing the time and resource constraints against data quality and resultant levels of acceptable risk (each option has a different implication in terms of cost, time, data quality, and the risk of making an incorrect decision).

In the NPDES program, two elements are crucial to the collection of data: emphasis on good sampling design and strict QA of the data. To incorporate the DQO process into data collection activities required by the NPDES program, OWEP recommends addressing the following items when specifying monitoring requirements in individual permits:

- Analytical variability
- Representative sampling
- Effluent variability
- Data systems
- Monitoring frequency
- Confidence level variability
- Effluent toxicity testing.

Each of these items is discussed briefly below.

Analytical Variability

Analytical variability addresses the issues of precision and accuracy, which are quantitative measures that characterize the amount of variability and bias inherent in a given data set. Precision refers to the level of agreement among repeated measures of the same parameters. Accuracy refers to the difference between an estimate based on the data and the true value of the parameter being estimated. Analytical variability can result from two activities related to data collection: sample collection and sample analysis.

Accurate sample collection and analysis are essential in determining a permittee's compliance status with NPDES permit limits. However, sample collection is frequently an area in which errors are made, leading to analytical results that are not representative of the discharge in question. To avoid sampling errors that can lead to analytical variability, permit writers and permittees are referred to the following publication for a comprehensive discussion of wastewater sampling:

Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA Publication No. 600/4-82-029. Washington, DC: U.S. Environmental Protection Agency, September 1982. (NTIS Order No. PB83-124503.)

Analytical procedures performed by the permittee or contract laboratory introduce another source of analytical variability. The analytical methods required in conjunction with monitoring requirements are usually specified in the standard conditions portion of the permit. It is usually sufficient to require that all analyses be performed in accordance with the guidelines established by EPA under 40 CFR 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants. These guidelines, published in the Federal Register on October 26, 1984, and amended on January 4, 1985, cover:

- Lists of approved test procedures for:
  - Coliform and fecal streptococci
  - Inorganic chemicals
  - Nonpesticide organic chemicals
  - Pesticides
  - Radiological parameters
- References, sources, and costs for these approved test procedures
- Required containers, preservation techniques, and maximum holding times
- Appendices providing detailed descriptions of approved test procedures for a variety of organic chemicals
- QC requirements that establish acceptable limits of analytical performance for the toxic organic pollutants.

Other sources of analytical procedures are:

- Methods for the Chemical Analysis of Water and Wastes. EPA Publication No. 600/4-79/020. Revised March 1983.
- Test Methods: Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. EPA Publication No. 600/4-82/057. July 1982.
- Final Pesticide Regulations, 50 Fed. Reg. 40672, October 4, 1985.

Sampling

As stated in the previous section on analytical variability, sample collection is an integral component of determining permit compliance. In general, the following principles are suggested for both self-monitoring and compliance sampling:

- A permanent sampling location(s) should be identified for use by both the regulatory authority and the permittee.
- The sampling location should be easily accessible and provide a well-mixed representative sample of the discharge being monitored.

- All samples must be properly collected and preserved until they are analyzed. It is important to use the right container for sample collection and storage (e.g., do not use a metal container to collect or store a sample that will later be analyzed for metals). Large samples should be divided for appropriate pollutant preservation as soon as possible, but for no longer than 24 hours.

- Accurate records should be required indicating the time, date, location, type of sample, method of collection and preservation, name of person who collected the sample, and any pertinent comments.

In designing a data collection program, completeness of the data collected must be considered, i.e., the amount of data that is successfully collected with respect to the amount intended in the design. Successful collection of all the data required is important because missing data may reduce the precision of the estimates, introduce bias, and lower the level of confidence in the results.

Samples should also accurately reflect the population, group, or medium being sampled. To obtain representative data, sampling sites must be selected to measure accurately the discharge parameters and to reflect the discharge's impact. Sampling frequency required depends on the size and type of flow. Types of samples generally specified are either grab or composite samples. Grab samples, which are single, discrete samples, are used where the quality of the wastestream being sampled is not likely to change significantly over time. For larger facilities or in those cases where the material being sampled varies significantly over time as the flow changes, a composite sample is required. In this type of sample, a better representation of the effluent is determined by obtaining a number of samples over time or based upon flow volumes. For additional guidance on determining sample types for a data collection program, the reader is referred to the Handbook for Sampling and Sample Preservation of Water and Wastewater (1982) and the Training Manual for NPDES Permit Writers (1986).

Effluent Variability

In designing a data collection program, it is important to recognize that the quality of the effluent from a treatment facility will normally vary over time. Permit limits are generally set at the upper bounds of acceptable performance. Requirements are usually expressed using two types of permit limits. The daily maximum limit is the maximum allowable value for any single observation. The average daily or "monthly" permit limit is the maximum allowable value for the average of all observations obtained during one month. (Average daily limits for weekly periods are also used for POTWs.) It is important to note that statistical variability is already "built in" to the effluent limitation guidelines, and the permit writer need not perform a separate evaluation in those cases where a permit limitation is derived from a guideline.

Data Systems

Data collection activities under the NPDES program must be designed to ascertain a permittee's adherence to its NPDES permit so that compliance evaluation and enforcement can be supported. A primary source of information that is used by compliance/enforcement personnel is PCS. PCS is a data management system used to compile all relevant facts about a facility's permit conditions, self-monitoring data, inspections performed, and any enforcement actions taken. PCS is the national data base for the NPDES program. As such, PCS promotes national consistency and uniformity in permit and compliance evaluations. To accomplish this goal, all required data are to be entered into and maintained regularly in PCS.

NPDES permits must be enforceable and capable of being tracked by PCS. There may be situations where permit limits and monitoring conditions are not initially compatible with PCS entry and tracking. In these cases, States should ensure that the permit writer takes appropriate steps to identify difficult permits to the PCS coder (either in the State or the Region) and to resolve any coding issues. The Training Manual for NPDES Permit Writers contains specific suggestions for collecting data to be entered into PCS so that PCS coders can accurately interpret and code the permit.

Monitoring Frequency

Establishing monitoring frequencies that balance the expense of self-monitoring with the need for representative sampling data represents a major task. The quantity and temporal distribution of data collected must ensure adequate measurement of the daily, weekly, and seasonal patterns, depending on the size of the facility. Types of parameters in the effluent and the frequency of monitoring specified in the NPDES permit must provide sufficient data to evaluate compliance.

While establishing self-monitoring frequencies, a number of major factors should be taken into account, including:

- Design capacity of the treatment facility (relative to the size of the receiving stream)
- Type of treatment method used
- Significance of the pollutant

- o Cost of the monitoring relative to the discharger's capabilities.

Useful tools for the permit writer in establishing monitoring requirements include any general State or EPA guidance, Abstracts of Industrial NPDES Permits, information from facility inspections, plant performance data, and receiving water quality data.

Confidence Level Variability

The collection of data always involves some error. Error is an inherent characteristic of any sampling design, method for sample collection, or sample analysis. As discussed in Stage II, the decision maker must define the necessary accuracy requirements for the results of the data collection program. The conclusions based on effluent data may affect the confidence level in two ways: the values may be too high, thereby indicating violations when none actually existed (false positive); or the values may be too low, which would incorrectly show compliance (false negative). Also, the sample may not be truly representative of the actual effluent because of sampling errors, thereby triggering one of the two errors. When establishing permit limits, referring to the effluent guidelines promulgated under Sections 301 and 304 of the Clean Water Act for the appropriate industry will aid in the likelihood that data collected will correctly and accurately reflect the characteristics being measured. The guidelines include a careful statistical analysis that takes into account data variability. The guidelines are established at the upper bounds of acceptable treatment facility performance. A normally functioning treatment facility will have a very low probability of exceeding permit limitations.

Effluent Toxicity Testing

Whole effluent toxicity testing is often used as a screening and assessment tool. It is a preliminary step in the process of setting water quality-based permit limitations for toxic pollutants. Preliminary testing may indicate that the effluent is not toxic and that toxicity-based limits are not warranted. Toxicity testing may also take the form of a monitoring requirement. Such a requirement could be used in conjunction with toxicity-based limits or as a separate condition. In the latter case, results of the testing requirement would indicate whether the existing limitations were sufficient or whether more stringent limitations were required.

A number of special considerations apply to the specific area of developing permit limitations and conditions for whole effluent toxic limits. This extremely important area is increasingly becoming an integral part of EPA and State permit programs. It is, therefore, recommended that all permit writers have a basic understanding of the subject. For additional information, refer to the Technical Support Document for Water Quality-Based Toxics Control (September 1985).

National Policy

EPA issued a National policy on water quality-based permit limits for toxic pollutants on March 9, 1984 (40 Fed. Reg. 9016). The main feature of this policy is the statement that an integrated strategy, using both biological and chemical methods, will be necessary to control the discharge beyond the application of BAT. Thus, the policy recognizes that it is not always possible to set limits on every chemical of concern (as determined by a technology-based limit or as established by a water quality model). There may often be too many chemicals to limit or there may be unknown toxicants. In addition, chemical limits do not address the extent to which a wastewater discharge may impact aquatic organisms (bioavailability). Therefore, it is often necessary to use toxicity as an assessment tool and effluent control parameter.

Quality Assurance

To maintain proper overview, EPA uses a variety of methods to determine facility compliance and DMR data quality. One is the DMR QA Program for major permittees. It is designed to evaluate the ability of permittees to analyze and report self-monitoring data accurately. Permittees are required to analyze the performance evaluation samples using the analytical methods required under 40 CFR Part 136. In addition, analytical performance of the permittee is compared to other State and EPA laboratories. This ensures that validity and objectivity of monitoring operations are obtained and that analytical data will support compliance and enforcement decisions.

APPENDIX A

APPENDIX A

SCENARIOS ILLUSTRATING THE USE OF DATA QUALITY OBJECTIVES WHEN ISSUING NPDES PERMITS

INTRODUCTION

The NPDES Permit Writer's Training Manual and this DQO guide point to the reliance on a permit writer's best professional judgment (BPJ) during the NPDES permit development process. The DQO process is used to reduce the uncertainty related to data collection and evaluation activities of the NPDES permit development process.

This appendix presents four scenarios to illustrate how the DQO management tool can be used. By following the DQO process, the permit writer should be able to develop a facility-specific blueprint of data adequate to draft, using his/her best professional judgment, a representative and enforceable discharge permit. The scenarios are based on actual information submitted as part of the permit application or as a supplement to the permitting process. Scenario 1 examines how the DQO process relates to the adequacy of information contained in NPDES permit applications. Scenario 2 examines the implication of using DQOs when developing a permit for a facility with production tied to the marketplace. Scenario 3 looks at the use of DQOs when determining whether technology-based permit limits will adequately protect the designated use of the receiving water body. Scenario 4 examines the use of DQOs to determine the type of information needed when deciding whether a POTW requires whole effluent toxicity limitations and testing.

SCENARIO 1

Three permittees in the Steam Electric Power Generating Point Source Category have submitted applications for reissuance of their NPDES permits. The facilities are ranked by the State Permitting Authority from "minor" to "major" depending on the potential environmental impact of their discharges. They are Facility A - a "minor" facility; Facility B - a "minor" facility with the potential to be of major concern; and Facility C - a "major" facility.

The objective of this scenario is to show how the DQO process, in conjunction with a permit writer's best professional judgment, can be used to maximize the quality and quantity of data necessary to develop discharge permits for similar industrial facilities with different environmental impact potentials. The DQO process is highlighted by analyzing discharge permit applications and follow-up data. Two data components are analyzed in this scenario: 1) operations contributing flow data from the 2C form; and 2) effluent chemical data from the 2C form.

DESCRIPTION OF APPLICATION INFORMATION

Facility A

Operations contributing flow

Outfall 001 - 4 MGD of once-through cooling water
Outfall 002 - 0.02 MGD of cooling tower blowdown
Outfall 003 - 0.2 MGD of miscellaneous cooling water

None of the effluents is treated prior to discharge.

Effluent chemical data

Each outfall is in compliance with existing permit limitations for BOD, COD, TSS, pH, ammonia, oil and grease, free available chlorine, and temperature. The permittee indicates that each of the nonconventional and priority pollutants is "believed to be absent."

Facility B

Operations contributing flow

Outfall 001 - 2 MGD of once-through cooling water
Outfall 002 - 0.01 MGD of cooling tower blowdown
Outfall 003 - 0.1 MGD of miscellaneous cooling water

Effluent chemical data

The permittee reports data indicating compliance with existing permit limitations for conventional and nonconventional pollutants, including BOD, COD, TSS, pH, ammonia, oil and grease, total residual chlorine, and temperature. The permittee performed one priority pollutant analysis on each outfall and found that 0.1 mg/L chromium is present in outfall 003. Total residual chlorine is reported as less than 0.05 mg/L for each outfall.

Facility C

Operations contributing flow

The major permittee describes the following six outfalls:

Outfall 001 - 250 MGD of once-through cooling water
Outfall 002 - 350 MGD of once-through cooling water
Outfall 003 - 0.005 MGD of sanitary sewage
Outfall 004 - 0.2 MGD of low-volume wastes
Outfall 005 - 0.05 MGD of metal-cleaning wastes and boiler blowdown
Outfall 006 - 0.1 MGD of demineralizer wastes

The permittee describes the following treatment:

Outfall 001 - chlorination
Outfall 002 - chlorination
Outfall 003 - package treatment consisting of primary/secondary and final disinfection with chlorine
Outfall 004 - settling, skimming, separation
Outfall 005 - settling, neutralization, aeration
Outfall 006 - settling, neutralization, aeration

Effluent chemical data

The permittee reports representative conventional, nonconventional, and inorganic and organic chemical data, except pesticides, for each outfall except outfall 003, which has only conventional and nonconventional data. The data are based on the results of a single analysis. The results show that chromium and zinc are both found at less than the analytical detection limit of 0.01 mg/L, while total residual chlorine for outfalls 001 and 002 are reported as 0.00 mg/L. Pollutants detected at outfall 004 (low volume wastes) include 1,2,4- trichlorobenzene (50 ug/L), selenium (5 ug/L), and other metals above the lower analytical detection limit.

USE OF BPJ IN THE DQO PROCESS

Facility A

Often small or minor permittees interpret and respond to information requests based on facility operating and/or engineering practices instead of requirements based on environmental regulations. Based on the review of the permit application, it is known that outfall 003 from Facility A contains "miscellaneous cooling water." It is unclear which specific wastestreams comprise this outfall. In addition, the facility submitted no effluent chemical data. This is where the permit writer can use his/her best professional judgement in conjunction with the DQO tool. First, this facility is classified as a minor facility. Second, by reviewing the available information, the permit writer can see that Facility A probably does not chlorinate its cooling water. Therefore, there is little reason why the permit writer should require the facility to collect additional chemical data from its effluents. In addition, it probably is unnecessary to require the applicant to break down the component wastestreams of outfall 003 because the flow is very small compared with the major wastestream. Thus, even though the data from Facility A are not as representative as they could be, the permit writer can prepare the discharge permit with the reasonable assumption that the facility's effluent will exert little, if any, deleterious impact on the quality of the receiving water.

Facility B

Facility B is also a minor discharger, but has specific traits that cause the permit writer to investigate further. The facility indicates that outfall 003 also contains only "miscellaneous cooling water." Even though it is one-half the flow of Facility A, evidence indicates that metals are discharged via outfall 003. Here it would be prudent for the permit writer to require Facility B to provide more specific information about the wastestreams that comprise outfall 003. For example, this outfall may actually be comprised of continuous-flow office HVAC condensate and intermittent-flow metal cleaning wastes. The intermittent discharges of metal cleaning wastes may cause violations of water quality standards that would have previously gone undetected unless a sampling event coincided with a discharge event. The DQO process can provide the permit writer with this information so that he/she can tailor a sampling program specific to this situation. The sampling program will enable the permit writer to determine if the facility needs water quality or whole effluent toxicity based permit limits and if the facility is in compliance with its current permit.

Facility C

The permit writer sees that there are two basic deficiencies in the effluent chemical data of the major facility. First, the applicant used the results of a single analysis to describe representative effluent chemical data. The sheer magnitude of the facility discharge indicates that this permittee probably has more data available, but only reported the minimum results of one sample. The permit writer can then request additional data so he/she can determine the average and the variability of the data.

Second, the applicant reported that total residual chlorine in outfalls 001 and 002 was 0.00 mg/L. Data can only be reported as less than the lower analytical detection limit. Here the permit writer can set in motion procedures to require the applicant to report the analytical technique and the lower detection limit. Further, the applicant provided no information on how the sample for chlorine analysis was collected in terms of the duration of the chlorination event. The permit writer can use the sampling program element of the DQO process to overcome this deficiency. In this way, he/she can minimize the requirement of additional data that prolongs the permitting process.

CONCLUSION

The objective of this scenario was to show how the DQO process can be used to maximize the quality and quantity of data needed from facilities based on their potential environmental impacts. The comparison of the different quantity and quality of data required for these three similar facilities illustrates how the permit writer can couple the use of best professional judgment with the DQO process to develop representative and enforceable NPDES discharge permits.

SCENARIO 2

An aluminum forming facility's principal market is the commercial and residential building industry, which often shows seasonal dependence. The permittee's discharge permit application included information about daily maximum and monthly average maximum concentrations for conventional, nonconventional, and toxic pollutants.

Since effluent quality can be influenced by production variability, an important data quality objective is to reduce the amount of uncertainty associated with the quantity and quality of information about the applicant's production. The objective of this scenario is to examine how the formulation of statements about the quality and quantity of data can be used to prepare a discharge permit that echoes seasonal fluctuations in the production of an industry.

Following the general three stages of the DQO process, the following specific steps are addressed by the permit writer:

1. Decision to be made - determine if production output fluctuation warrants the development of seasonal production-based effluent limitations.

2. Why data are needed and how they will be used - average monthly aluminum production will be examined to determine if the fluctuations justify modified effluent limits. Average daily flow rates will be needed in case alternative concentration-based effluent limitations are required.

3. Time and resource constraints on data collection - constraints are minimal as the applicant needs to only search for the data and submit it; calculations to be performed by the permit writer are not time-intensive.

4. Descriptions of the data to be collected - average monthly production of etched extrusion and average daily effluent flow.

5. Specifications about the domain of the decision - the cleaning or etching rinse as per 40 CFR 467.33.

6. Calculations that will be performed on the data - seasonally-based average monthly gross production, production-based effluent limitations, and, if necessary, alternative concentration-based effluent limitations.

During the review of application form 2C and recent DMRs, the permit writer detects substantial differences in effluent flow during three months of the preceeding winter and is concerned that the production also may vary. The permit writer asks the applicant to submit average monthly production and flow information for at least the last two years. He/she also asks the applicant to describe any substantial differences between the last two years and include a production forecast for the immediate future. The permit writer then examines the production and written information to determine the extent of any fluctuations and the probability that they would continue into the life of the new permit.

The permit writer can justify seasonally-based effluent limitations if they are more representative of the permittee's effluent than limitations based on average annual production figures. The permit writer is also concerned about setting permit limits that are either too lax, so that violations go undetected or too stringent so that compliant discharges are seen as violations.

The permit writer tabulates the following production information for the last two years:

Year One (kg/day)				Year Two (kg/day)			
Jan.	150,000	July	150,000	Jan.	50,000	July	200,000
Feb.	150,000	Aug.	150,000	Feb.	50,000	Aug.	200,000
Mar.	150,000	Sept.	150,000	Mar.	200,000	Sept.	200,000
Apr.	150,000	Oct.	150,000	Apr.	200,000	Oct.	200,000
May	150,000	Nov.	150,000	May	200,000	Nov.	200,000
Jun.	150,000	Dec.	150,000	Jun.	200,000	Dec.	50,000

The permit writer also determines that, during the final fiscal quarter (Dec - Feb) of year two, the average daily effluent flow rate drops disproportionally from 250,000 L/day during March through November to 125,000 L/day during December through February.

The BAT effluent limitations for the cleaning or etching rinse found at 40 CFR Part 467.33 are applicable to this applicant and consist of the following pollutant limitations:

Pollutant	One Day Maximum (mg/off-kg)	Monthly Average Maximum (mg/off-kg)
Chromium	0.61	0.25
Cyanide	0.41	0.17
Zinc	2.03	0.85
Aluminum	8.95	4.45

The permit writer now calculates and compares annualized production-based effluent limitations with seasonally-adjusted annualized production-based limitations to determine which set is most representative.

<u>Annualized effluent limitations</u>

Calculate the production-based and equivalent concentration based effluent limitations for chromium based on the yearly averages of production and effluent flow.

$$\text{One day max} = \frac{0.61 \text{ mg/kg} * 162{,}500 \text{ kg/day}}{2{,}200{,}000 \text{ mg/lb}} = .045 \text{ lb/day}$$

$$\frac{.045 \text{ lb/day} * 2{,}200{,}000 \text{ mg/lb}}{218750 \text{ L/day}} = .453 \text{ mg/L}$$

Monthly avg max = .018 lb/day = .186 mg/L

<u>Seasonal-dependent effluent limitations</u>

Calculate the production-based and equivalent concentration-based effluent limitations for chromium from on the production and effluent flow rates for the two periods of March - November and December - February.

One day max for March - November:

$$\frac{0.61 \text{ mg/kg} * 200{,}000 \text{ kg/day}}{2{,}200{,}000 \text{ mg/lb}} = .055 \text{ lb/day}$$

$$\frac{.055 \text{ lb/day} * 2{,}200{,}000 \text{ mg/lb}}{250{,}000 \text{ L/day}} = 0.488 \text{ mg/L}$$

Monthly avg max for March - November = .023 lb/day = 0.200 mg/L

One day max for December - February:

$$\frac{0.61 \text{ mg/kg} * 50000 \text{ kg/day}}{2{,}200{,}000 \text{ mg/lb}} = .014 \text{ lb/day}$$

$$\frac{.014 \text{ lb/day} * 2{,}200{,}000 \text{ mg/lb}}{125{,}000 \text{ L/day}} = 0.244 \text{ mg/L}$$

Monthly avg max for December - February = .006 lb/day = 0.100 mg/L

The permit writer sees that one day and monthly average maximum effluent limitations derived from annualized production and flow data are approximately 18 percent too restictive during March through November. When the production drops during December through February, the annualized limitations are approximately three times more liberal than those adjusted to the reduced production levels.

From this exercise, the permit writer can determine the most representative permit limitations for a NPDES permittee with fluctuating production. Without the use of adjusted effluent limitations, compliant discharges during periods of high productivity may be determined to be in violation while violating discharges during periods of low production may go undetected.

SCENARIO 3

A coal-fired dual condenser steam power plant uses a once-through cooling water process to remove waste heat. Biofouling of the condensers is mitigated by treating the incoming water with chlorine for up to two hours per day. The effluent flow rate averages 20 cfs. The BAT effluent limitation for total residual chlorine (TRC) is 0.20 mg/L (40 CFR 423.13). The applicant has submitted monthly summaries of daily effluent TRC levels spanning the previous five years with application forms 1 and 2C.

The receiving stream segment 7Q10 is 200 cfs, which provides a critical low flow dilution of 9 percent. The water quality standard for the stream segment includes a total chlorine chronic toxicity limit of 11 ug/L, which must be met at the edge of the mixing zone.

The objective of this scenario is to show the implications of selecting the amount of data necessary to determine if the BAT TRC limitation is sufficient to meet the in-stream ambient total chlorine standard. On one extreme, a determination can be made using a simple methodology that does not require much data, but results in a large degree of uncertainty. Alternatively, a more data intensive approach can be used that will reduce the uncertainty. The first involves the use of simple dilution equations. The second involves the derivation of a water quality-based TRC effluent limitation through the use of effluent TRC long term average (LTA), the effluent TRC coefficient of variation (CV), and the dilution factor.

Following the general three stages of the DQO process, the following specific steps are addressed by the permit writer:

1. <u>Decision to be made</u> - determine if the designated use of the receiving stream segment will be protected by the technology-based effluent TRC limitation.

2. <u>Why data are needed and how they will be used</u> - effluent TRC data are needed to determine the coefficient of variation that is used to calculate a water quality-based chlorine effluent limitation.

3. <u>Time and resource constraints on data collection</u> - effluent data are not confidential information and can be collected from the permittee without excess expenditure of time and resources. No additional data are required as the permittee provided five years of TRC monitoring data.

4. Descriptions of the data to be collected - daily total residual chlorine measurements.

5. Specifications about the domain of the decision - the decision is concerned with the effluent and the potential water quality impacts.

6. Calculations that will be performed on the data - use simple dilution calculations and then compare the limit with one derived using EPA's Technical Support Document for the Development of Water Quality-based Permit Limitations for Toxic Pollutants (TSD).

Water quality-based limit using simple dilution procedure

This calculation assumes the conservation of mass and a zero upstream TRC concentration. This effluent limitation is calculated by dividing the BAT TRC limitation of 0.20 mg/L by the dilution factor of 9 to equal an effluent limitation of 0.022 mg/L (22 ug/L).

Water quality-based limitation using the TSD procedure

The permit writer first calculates the CV that will be used to derive a chlorine limitation. The data computation produced a CV=1.2. Now the daily maximum and monthly average maximum water quality-based total residual chlorine permit limits can be calculated using the dilution factor of 9 percent and a TRC CV=1.2

Assumptions

- Effluent TRC wasteload allocation (WLA) = 11 ug/L * 9 = 99 ug/L where, 11 ug/L = water quality standard at edge of mixing zone that will protect from chronic toxicity;

- 9 = dilution factor;

- CV = 1.2 (calculated from monitoring data);

- No upstream toxicity or TRC.

Calculations

1. Calculate a long term average (LTA) based on an average monthly monitoring frequency of N=20.

$$LTA = \exp(u + .5s^2)$$
$$\text{where, } u = u(20) - .5s^2 + .5\ln\{1 + [(\exp s^2 - 1)/20]\}$$
$$u(20) = \ln WLA - Z \text{ sqrt } \ln\{1 + [(\exp s^2 - 1)/20]\}$$

$s^2 = \ln (CV^2 + 1)$

$s = \text{sqrt } s^2$

Z = Z score at 99th percentile occurrence probability

$= 2.326$

$s^2 = 0.892$

$s = 0.944$

$u(20) = 3.987$

$u = 3.575$

Therefore, LTA = exp [3.58 + .5(0.892)] = 56.0 ug/L.

2. Calculate a maximum daily permit limit = exp [u + (Zs)] where, Z = Z score at 95th percentile occurrence probability

$= 1.645$

$u = \ln \text{LTA} - .5s^2$

$s^2 = \ln (CV^2 + 1) = 0.892$

$s = \text{sqrt } s^2 = 0.944$

Maximum daily limit =
$\exp \{[\ln 55.5 - .5\ln(1.2^2 + 1) + (1.645 * 0.944)\} = 192.7$ ug/L.

3. Calculate a monthly average maximum = exp $[u_n + (Z * s_n)$
where, $u_n = u + (s^2 - s^2_n)/2$

$s^2_n = \ln \{1 + [(\exp s^2 - 1)/20]\}$

$s_n = \text{sqrt } s^2_n$

$Z = 1.645$

$s^2_n = 0.070$

$u_n = 3.99$

Therefore, monthly average maximum =
exp [3.98 + (1.645 * 0.265)] = 83.5 ug/L.

The results of these calculations indicate that BAT TRC limitations may not protect the designated use of the receiving stream segment and that the discharge permit should be written to include water-quality based TRC permit limitations. Also, the use of the TSD procedure to calculate permit limits resulted in more liberal limitations than the simple dilution approach. This highlights the impact that data quality and quantity can have when deriving NPDES permit limitations.

SCENARIO 4

An NPDES Permitting Authority wishes to determine whether the permits of all major POTWs should be opened up for inclusion of water quality-based toxicity permit limitations. As part of this determination, the Permitting Authority decides to issue Section 308 letters requesting effluent biomonitoring information. Also as part of this overall effort, the permit writer is required to design a sampling program adequate to characterize the potential whole effluent toxicity of a major POTW.

This POTW, located in the south-central United States, is currently achieving permit limitations for conventional and nonconventional pollutants. The industrial contribution to the influent is less than one percent by flow. The Permitting Authority requires the POTW to conduct whole effluent toxicity (WET) tests of dechlorinated effluent. The objective of this scenario is to highlight the importance of natural effluent variability when deciding whether a permittee needs whole-effluent toxicity permit limitations.

Following the three stages of the DQO process, the following types of information are addressed by the permit writer:

1. Decision to be made - to assess the potential for in-stream toxicity to be caused by the permittee by using WET testing.

2. Why data are needed and how they will be used - the data will be used to determine the probability of in-stream toxicity by comparing the No Observable Effect Concentration (NOEC) with the calculated in-stream waste concentration.

3. Time and resource constraints on data collection - the permittee's permit must be renewed within 24 months or opened up at any time.

4. Descriptions of the data to be collected - Raw and final data from chronic toxicity tests and chemical effluent data.

5. Specifications about the domain of the decision - the decision is concerned with the effluent toxicity and the potential water quality impacts.

6. Calculations that will be performed on the data - verification of proper numerical and statistical methods used to derive the NOECs.

Before designing the sampling program, the permit writer makes a general assessment of the facility in terms of the potential for effluent toxicity. The permit writer makes the following assessments:

1. Episodes of toxicity may be independent of chlorination since dechlorinated effluent samples will be tested.

2. The small industrial contribution probably precludes industrial user discharges from being the causative agents.

3. The POTW DMR information shows that facility treatment performance is within 95 to 98 percent of the design efficiency. DMR data also show that effluent ammonia and pH increase during the summer months. The effluent chemical data show that all priority pollutants either are either not detected or less than water quality criteria levels.

4. The POTW's current NPDES permit includes seasonally-adjusted effluent limitations for ammonia and dissolved oxygen.

5. Receiving water quality studies have found that certain river reaches have poor water quality at certain times of the year and after heavy rainfall events.

The permit writer determines that the higher effluent ammonia concentrations in the summmer may justify amending this POTW's permit to include whole effluent toxicity limitations. The permit writer determines testing effluent samples on a monthly basis for one year will provide adequate information about the toxicity of the effluent. The permit writer also finds that this frequency will provide a buffer in the event that toxicity is the result of the presence of previously unknown nondomestic constituents.

The permittee conducts monthly biomonitoring tests with the cladoceran <u>Ceriodaphnia</u> <u>dubia</u> according to method 1002.0 located in EPA's <u>Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms</u>. The permit writer requires the permittee to test at the following effluent concentrations (percentages): 100, 75, 60, 45, and 30. The 7Q10 low flow corresponds to 60 percent effluent. The permit writer anticipates that statistically significant chronic toxicity at 60 percent effluent or less would require the POTW to conduct more definitive monitoring and possibly toxicity identification tests. The permit writer also requires the permittee to submit effluent ammonia monitoring data.

At the end of one year, the permit writer summarizes the No Observable Effect Concentrations (NOEC) of each test and tabulates the average monthly total ammonia conentration. The following results are as follows:

Month	NOEC (%)	Ammonia (mg/L)	Month	NOEC (%)	Ammonia (mg/L)
Jan.	75	0.50	July	45	2.71
Feb.	100	0.48	Aug.	30	1.98
Mar.	75	0.37	Sept.	30	1.88
Apr.	100	0.66	Oct.	75	0.68
May	100	0.56	Nov.	100	0.47
June	75	0.87	Dec.	100	0.55

The results of these biomonitoring and chemical tests show that the Permitting Authority can justify opening up or reissuing the NPDES discharge permit to include biomonitoring tests on a routine schedule and require, if necessary, implementation of a toxicity identification/reduction evaluation. The results of this exercise illustrate how a limited, less time-intensive data review and monitoring program may have been unable to adequately characterize the potential for whole effluent toxicity from a permittee consistently meeting secondary treatment effluent guidelines.