

NPDES MONITORING RECOMMENDATIONS  
TO IMPROVE CONTAMINANT  
LOADING DATA AVAILABILITY

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U.S. Environmental Protection Agency  
Region 10

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TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION . . . . .	1
2.0 THE NPDES PERMITTING PROCESS . . . . .	3
3.0 DISCHARGE CHARACTERIZATION . . . . .	5
3.1 IDENTIFICATION OF DISCHARGE CONSTITUENTS . . . . .	5
3.2 DETERMINATION OF VARIABILITY AND INTERRELATIONSHIPS . . . . .	6
3.3 DISTRIBUTION OF CONTAMINANTS BETWEEN THE DISSOLVED AND SUSPENDED PHASE . . . . .	8
4.0 STANDARDIZED REPORTING . . . . .	10
5.0 COST OF EXPANDING THE NPDES MONITORING REQUIREMENTS . . . . .	12

## 1.0 INTRODUCTION

Effective management decisions concerned with the control of toxic chemicals entering Puget Sound require the identification of the contributing sources and quantification of the contaminant mass loading associated with these sources. Quantitative knowledge of chemical contaminant inputs into the Sound compiled with a good understanding of the transport and or fate of these materials in the receiving waters of the Sound is critical to: (1) the estimation of a toxic chemical mass balance, (2) the determination of the relationship between contaminant input, environmental distribution and effects, and (3) establishment of a realistic control, compliance and enforcement strategy.

A number of recently completed studies supported by EPA, Metro, and NOAA have attempted to evaluate contaminant mass loading to Puget Sound. The data deficiencies and inadequacies encountered during preparation of these studies emphasize the limitations of the historical database available to quantify contributions of priority pollutants from point source discharges. These limitations are further emphasized by the following statistics obtained from the EPA NPDES Source Ranking Database.

Of the current list of 354 wastewater sources permitted to discharge into the Puget Sound Basin, only 55 have Class II inspections on file. These inspections are analyses performed by EPA to confirm the concentrations of reported pollutants. Priority pollutant scans have only been performed for 5 discharges by the Washington Department of Ecology. Forty-four sources have NPDES permit applications indicating toxic organics in their effluents and 24 report metals in their DMR's.

Point source discharges to Puget Sound are regulated under the National Pollutant Discharge Elimination System (NPDES) permit program. The current NPDES permitting regulations therefore, contain the necessary framework within which to obtain the types of information required to

compute contaminant loading to Puget Sound. A few revisions and additions could be made within the existing NPDES program to substantially enhance the availability of contaminant loading data. This report presents a summary of the NPDES permit program and recommendations for enhancement of NPDES permit requirements to provide the discharge characterization data required to compute total loading of priority pollutants to Puget Sound from point source discharges.

## 2.0 THE NPDES PERMITTING PROCESS

The current NPDES permitting program is designed to ensure that appropriate effluent limits are established and observed. The permit applicant provides information on the activity producing the discharge and expected or measured discharge composition and flow rates. Based on this information provided by the applicant, on guidelines for similar discharges, the treatment processes utilized, receiving water quality, and potential impacts appropriate effluent limits and monitoring requirements are established. However, for most permits, the differences among discharges even for similar industries requires a case-by-case analysis. The properties of the discharge and receiving water, specifically the variability of discharge and the hazard of the pollutants, dictate in part what scope of monitoring will be required. Generally, enough monitoring will be required to ensure that representative samples are obtained and analyzed, and that the discharge remains in compliance with the permit effluent limitations.

The NPDES program for the Puget Sound Basin is administered by the Water Quality Planning and Management Section of the Water Quality Division in the Washington Department of Ecology (WDOE). The Water Permits and Compliances Branch of the Water Division in EPA Region 10 administer's permits for discharges from federal facilities and provides technical assistance to WDOE. The Water Quality Section reviews the permit applications, develops the applicable effluent limitations and monitoring requirements, and then reviews the discharge monitoring reports (DMR) and inspection reports. NPDES permit applications are handled by staff assigned to the following specific industries: coal mining, ore mining, placer mining, oil and gas extraction, seafood processing, pulp and paper, petroleum refineries, metal-finishing, and municipalities. With this categorization by industry, the permits are developed by staff who are knowledgeable of the processes and wastewater characteristics specific to that industry and familiar with the permit requirements for similar discharges.

The current NPDES permitting philosophy is protection of water quality without excessively burdening the discharger. Permits are generally written to require the minimum amount of information which will adequately characterize the effluent. For example, a small municipal waste treatment plant may be required to measure residual chlorine as an index of disinfection with only occasional measurement of fecal coliform. A discharge containing several metals may only be monitored for one metal, the most sensitive indicator, if the metal concentrations are generally proportional to one another. Requirements for an effluent stream with high variability often specify collection of just a composite sample in order to obtain representative pollutant concentrations.

Reviews and revisions are steps included in the current permitting process. After the effluent limits and monitoring requirements are developed, a 30-day comment period begins in which the applicant, other agencies, and concerned parties may provide input to the proposed permit requirements. After permit conditions have been established, formal revisions to the permit can be made if sufficient evidence is presented to warrant more stringent requirements or eliminate unnecessary measurements.

### 3.0 DISCHARGE CHARACTERIZATION

To estimate mass loading from point sources, several types of information about the discharges are required. These include:

- o identification of all contaminant constituents in the discharge
- o determination of the variability of and interrelationships between the discharge flow rate and constituents concentrations
- o distribution of the contaminant between the dissolved and suspended phase

The manner in which this information may be obtained for a given discharge and the way that this information may be used to determine discharge monitoring requirements are discussed below.

#### 3.1 IDENTIFICATION OF DISCHARGE CONSTITUENTS

During the initial phases of permitting, all potential contaminants in the discharge must be identified. As discussed, the case-by-case permit decision process is in place. Historically, however, permit conditions have been specified for only conventional pollutants and occasionally selected organics and metals. This is because detailed analytical techniques required for priority pollutant organics have only become available in relatively recent time. To improve the availability of data required to estimate total contaminant loading to Puget Sound, the case-by-case evaluations simply need to expand the overall emphasis to include other constituents and the 30 priority pollutants of particular interest in Puget Sound.

To effectively establish monitoring requirements that will provide the data to estimate mass loading, the permitting staff need more specific information about the constituents in the applicant's effluent. In addition to the information required on the Standard Form C application, the applicant should be asked to provide more detailed information on

facility operations and waste abatement practices that would affect the composition of the wastewater, and a wastewater characterization based on actual analysis instead of just a best estimate. Permitting staff should become more familiar with recent permit requirements for similar discharges in other regions as well as the data obtained from DMR's and inspection reports. If the necessary constituent information cannot be provided by the applicant or found in EPA's files, then the staff should research other agency files and applicable literature in order to determine what parameters need to be monitored. Most of the above suggestions are being addressed by the Permit Section, but to a limited degree, because most of the staff have multiple assignments and other responsibilities. Therefore, the addition of qualified staff should be seriously considered.

Where there is reason to suspect that any of the priority pollutants will be present in a discharge, limitations and monitoring requirements must be established for these pollutants. In the instances where available information is not sufficient to develop an initial discharge characterization, a priority pollutant scan must be required. This will be the most simple and accurate means to ensure that contaminants in the discharge have been identified.

### 3.2 DETERMINATION OF VARIABILITY AND INTERRELATIONSHIPS

Mass loading is calculated as the product of concentration and volumetric flow. Very accurate measurements of mass loading require that concentrations and volumetric flow rates be measured simultaneously and continuously by automated equipment during all periods of discharge. However, highly accurate estimates are costly to obtain and do not necessarily provide information that is any better suited for determining compliance or estimating mass loadings than somewhat less accurate estimates.

The types of monitoring required to accurately characterize a discharge depend primarily on the variability of the discharge flow rate and/or constituent concentrations. For continuous discharges with fairly consistent constituent concentrations, random samples can be used to obtain average values to characterize the effluent and monitor for compliance.

For intermittent discharges, mass loadings can be estimated from averaged pollutant concentrations and the quantity, duration, and frequency information required in items 10 and 11 of the Standard Form C. Monitoring requirements for both compliance and mass loading calculations should be tailored to obtain representative data depending on the discharge volume and occurrence, and whether the pollutant concentrations for each occurrence vary substantially from the average. Where intermittent discharge concentrations are known to be quite variable, measurement of each discharge event may be in order during the initial monitoring period to establish the expected variability; discharges with more consistent concentrations can be characterized by composite samples.

The descriptive information currently required of the applicant for a NPDES permit (daily average, minimum and maximum for flow and constituents) is adequate for continuous or intermittent flows where the contaminant concentrations vary in a consistent manner close to the average. However, if the concentrations fluctuate inconsistently and vary widely about the average or the discharge is variable in both flow and/or constituents, then additional information about the activity producing the discharge, such as process mass balances and chemical inputs, should be required from the applicant. Enough information about the waste abatement practices must be obtained to determine the interrelationships between constituents and flows. Based on this additional knowledge, more effective monitoring requirements can be established such as frequent measurements of instantaneous flow rates and concentrations during specified discharge occurrences. From these measurements, an average instantaneous mass loading value or average concentration and total flow values might be calculated.

In order to estimate an annual mass loading into Puget Sound, one must be able to obtain the total volume discharged on an annual basis for all discharges. Thus, for all except continuous flows, the frequency and duration of flow must be indicated. Specifically, discharge duration in hours per day, days per week, weeks or months per year, and periods of variation must be reported. From the DMR's, average concentrations can be calculated for the total discharge volume or discharge intervals as applicable.

### 3.3 DISTRIBUTION OF CONTAMINANTS BETWEEN THE DISSOLVED AND SUSPENDED PHASE

When the NPDES permitting requirements were developed, environmental concern was focused primarily on the impacts of the discharge on water quality, i.e., concentrations of contaminants in the water column. Accordingly, only total concentration of metals were specified in the water quality criteria. Potential impacts resulting from contaminated sediments are now a recognized concern and environmental awareness has expanded to look at the entire water body and associated ecosystems. In addition, the stability of the contaminant in the marine environment as well as its bioavailability and toxicity have been found to vary widely depending on its chemical and physical form in the discharge. Although no extraction technique has been established which is representative of the actual availability of a contaminant, its distribution between dissolved and suspended phases is useful in understanding the immediate transport.

Contaminant loading estimates for Puget Sound will be most useful if it is possible to differentiate between those contaminants which will remain dissolved in the water column and those in the suspended solid phase which will eventually settle out. The total values reported now are essentially a summation of both the dissolved and suspended values. Therefore, to properly characterize contaminants in the permit application, presentation of both the dissolved and suspended solids

phases should be required. Both phases should also be reported in the early stages of monitoring. After a relationship between the dissolved and total concentrations is established, then the remainder of the DMR's need only present total values.

#### 4.0 STANDARDIZED REPORTING

In order to facilitate data compilation and calculation of contaminant mass loading associated with point sources, the present NPDES format for applications and monitoring reports should be revised. The reporting format and subsequent information currently supplied by the discharger is suitable for checking compliance but are either inadequate or difficult to use for mass loading calculations. The required formats should be expanded to not only include the 30 priority pollutants of primary interest in Puget Sound as applicable, but to also require the flow and concentration data in units conducive to accurate mass loading estimation.

Units of measurements should be standardized for consistency in data compilation and determination of compliance. Concentration units of parts per million (ppm) and parts per billion (ppb) (or the equivalent mg/l and  $\mu\text{g/l}$ , respectively) are common and are useful in calculating mass loading. Trace organic compounds should be expressed in ppb units based on relatively low expected concentrations. Metals, COD, BOD, TKN, TSS and other common water quality parameters should be expressed as ppm.

Flow rates should be measured and reported in standardized units both within a permit application and DMRs and among all discharge permits. Units of cubic meters per second ( $\text{m}^3/\text{s}$ ) may be preferable to cubic feet per second or gallons per day due to the increasingly common use of the metric system. These units will allow simple calculation of mass loading in units of kg/s:

$$(\text{contaminant A}) \text{ kg/s} = [\text{A}]\text{mg/l} \times (\text{flow}) \text{ m}^3/\text{s} \times 1,000$$

$$(\text{contaminant B}) \text{ kg/s} = [\text{B}]\mu\text{g/l} \times (\text{flow}) \text{ m}^3/\text{s} \times 1,000,000$$

Annual estimates of loading may be calculated by multiplying the instantaneous mass loading (kg/s) by the amount of time during the year the discharge occurs in seconds. Annual loading may also be estimated

by multiplying an average concentration by total flow. Flow units of cubic feet per second and gallons per day, although commonly used, require more involved conversions to obtain loading values.

The seasonal and time variations of mass loading are also often pertinent. Thus, dates and times of measurements should be reported and included in monitoring databases in order to evaluate time variability of discharges and to quantify loading over desired time intervals. If climate, particularly precipitation, influences the discharge volume or composition, some statement to this effect should be recorded in the DMRs.

Another aspect of data standardization which needs to be considered is the use of different analytical methods and protocols by laboratories. EPA is currently working on this problem through its Water Quality Management Program to develop consensus methods for measuring environmental variables in Puget Sound. The focus of this effort is to encourage all investigations whether for research or permit monitoring to use acceptable and standardized methods. Specifically applicable to wastewater analyses are the following efforts toward uniformity:

- o Clarify the use of internal versus external standards,
- o Reduce the options in QA protocols in reference to blanks, spikes, and duplicates,
- o Establish a standard for rejection of data based on background interference, and
- o Specify an acceptable method for extraction of organics from water samples.

Standardization of acceptable methods and protocols will result in a greater degree of reproducibility and consistency among the laboratory analyses of the 30 priority pollutants of interest in Puget Sound. This will enhance the acceptance of combining databases from different studies and agency files for mass-loading estimates.

## 5.0 COST OF EXPANDING THE NPDES MONITORING REQUIREMENTS

The cost to the discharger to provide the additional information on flows and constituents will consist of costs for sampling, monitoring, reporting, and chemical analyses. The increases in costs due to the first three items should not appreciably exceed those costs under the current program; any cost increases will be associated primarily with labor. The cost of more frequent and extensive chemical analyses for additional constituents will be the controlling factor. The number of parameters required to be analyzed will vary with the discharge characteristics, but costs on a per chemical basis will provide a useful estimate.

The following costs were obtained from AM TEST, Inc. for the chemicals recommended for the Puget Sound mass loading study.

	<u>Cost for Analysis</u>
o Six Priority Pollutant Metals	
- Arsenic, cadmium, copper, and lead	\$ 12.00/ea
- Mercury	\$ 22.00
- Zinc	\$ 7.00
- (Digestion Fee)	\$ 10.00/sample
o Seven Priority Pollutant Organic Compounds or Compound Groups	
- Total PCBs	\$ 80.00
- Total Low Molecular Weight PAHs	\$150.00 - \$400.00
- Total High Molecular Weight PAHs	\$150.00 - \$400.00
- 4 - Methylphenol	\$100.00 - \$150.00
- Phenol	\$100.00 - \$150.00
- Hexachlorobutadiene	\$ 90.00
- DDE and DDD	\$100.00

- o Two Indicator Organic Compounds
  - 2-Methoxyphenol \$100.00 - \$150.00
  - Coprostanol \$100.00 - \$150.00

Costs for individual organics may vary due to preparation techniques, but typically range \$100.00 - \$150.00. In some instances, groups of organic chemicals may be analyzed together, thereby lowering costs. Costs specifically for PAHs vary depending upon the method employed with EPA Method 610 at approximately \$150.00 per scan versus EPA Method 625 at \$400.00 for just a base/neutral scan. Therefore, the total cost of a complete priority pollutant scan can range for \$1000.00 to \$1350.00 depending on the specified detection limits and characteristics of the wastewater.

As a comparison, the costs of testing just for conventional parameters may total less than \$100.00/sample.

o pH	\$ 5.00
o Biochemical Oxygen Demand (BOD <sub>5</sub> )	\$ 23.00
o Chemical Oxygen Demand (COD)	\$ 23.00
o Total Suspended Solids	\$ 10.00
o Specific Conductance	\$ 6.00
o Settleable Matter	<u>\$ 6.00</u>
TOTAL	\$ 73.00

The costs of priority pollutant analyses are such that excessive monitoring frequency could be prohibitive, especially if several organic analyses are required. Therefore, efforts should be made during the application phase to specifically identify priority pollutants of concern as part of the wastewater characterization. In most cases, the complete priority pollutant scan would only be required to characterize a relatively unknown discharge, during the application and/or initial monitoring phase, to recharacterize a discharge after a change in process activities before renewing a permit, or during a Class II

inspection when similar discharges have been found to contain contaminants of concern. Once the priority pollutants of concern have been identified in a discharge, only those specific pollutants or indicator constituents need to be incorporated into subsequent monitoring requirements.