



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, DC 20460

April 19, 1996

MEMORANDUM

SUBJECT: Interim Guidance for Performance - Based Reductions of  
NPDES Permit Monitoring Frequencies

FROM: Robert Perciasepe, Assistant Administrator  
Office of Water /s/  
  
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TO: Regional Administrators  
Regional Water Division Directors  
Regional Counsels

We are pleased to transmit for your use this interim guidance for reducing reporting and monitoring under the NPDES permit program.

This interim guidance helps to fulfill one of the main directions in the President's Regulatory Reinvention Initiative for EPA -- reducing unnecessary reporting while at the same time maintaining a high level of environmental protection for the Nation.

NPDES authorities can grant relief to regulated facilities that have a record of good compliance and pollutant discharges at levels below permit requirements. This relief provides incentives for voluntary reductions of pollutant discharges through such means as reuse and recycling.

This interim guidance is the culmination of extensive work among our offices, several Regions and States and consultation with outside stakeholders representing industry, the environmental community, and municipalities. These stakeholders generally favor the approach, which has benefitted considerably from their input.

We encourage you to begin now to implement this interim guidance through the regular NPDES permit issuance process where EPA has permit authority, and to work with your NPDES States to adopt this policy as soon as possible. EPA Region VI will also shortly begin two pilot projects in Oklahoma and Louisiana to assess the strengths and issues associated with the guidance. Based on the results of these pilot projects, we will make revisions to this interim guidance as necessary.

We look forward to working with you on this important endeavor.

cc: Robbi Savage, ASIWPCA  
Robbie Roberts, ECOS

*INTERIM GUIDANCE FOR  
PERFORMANCE-BASED REDUCTION  
OF NPDES PERMIT MONITORING FREQUENCIES*

*April 1996*

This document provides guidance to EPA permit writers and States on how best to implement EPA's National Pollutant Elimination System (NPDES) regulations regarding appropriate monitoring requirements in permits. It also provides guidance to the public and to the regulated community on how EPA intends to exercise its discretion in implementing its regulations. The guidance is designed to implement national policy on these issues. Pretreatment control authorities also may find it helpful in setting monitoring frequency for industrial users of POTWs. The document does not substitute for EPA's regulations, nor is it a regulation itself. Thus, it cannot impose legally binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA may change this guidance in the future, as appropriate.

## ***INTERIM GUIDANCE FOR PERFORMANCE-BASED REDUCTION OF NPDES PERMIT MONITORING FREQUENCIES***

### **Introduction**

The President's Regulatory Reinvention Initiative for the Environmental Protection Agency (EPA) established an interim goal of reducing reporting and monitoring by at least 25%. This goal is also embodied in the Office of Water's Agenda for the Future, which sets forth program priorities for the coming years for EPA and States.

Based on these directions, EPA's Offices of Water and Enforcement & Compliance Assurance developed this Interim Guidance to reduce regulatory burdens associated with reporting and monitoring based on a demonstration of excellent historical performance by facilities subject to NPDES permit requirements. Under this guidance, facilities can demonstrate this historical performance through both compliance and enforcement history and a demonstrated ability to consistently reduce pollutants in their discharge below the levels necessary to meet existing permit requirements. Facilities will also be expected to maintain these performance levels to continue to receive the reductions. Reducing burdens in this manner will also provide incentives for voluntary reductions of pollutant discharges through such means as reuse and recycling.

The approach for determining the degree of burden reduction available to individual facilities is statistically sound and will not reduce the ability of EPA and States to determine non-compliance with permit requirements.

This guidance should also prove useful in setting monitoring frequencies for industrial users of POTWs. EPA has not studied whether the variability of industrial users' effluent is similar to that for NPDES permittees. Pretreatment control authorities may choose to apply this policy to their industrial users with effluent similar to that discussed in this guidance.

Future reductions to NPDES that can be integrated into this burden reduction initiative include ongoing ambient monitoring efforts within the Office of Water.

### **Summary of Decision-Making Process**

The guidance applies to both major and minor individual NPDES permits for direct discharges and will be implemented through the existing NPDES permitting cycle for facilities.

The following steps are to be taken when determining if a particular facility is eligible for reductions, and, if so, the amount of these reductions. These steps are also described in more detail in the next section of the guidance.

## **1) Facility<sup>1</sup> Enforcement History**

Each facility's enforcement history is analyzed to assess eligibility for reductions under the guidance. Criminal convictions under any environmental statute and NPDES civil judicial and administrative enforcement actions are criteria considered in determining eligibility.

## **2) Parameter-by-Parameter Compliance History**

For each eligible facility the compliance history for each parameter controlled in its existing permit is examined for Significant Noncompliance violations and/or effluent violations for critical parameters. These critical parameters are determined at the discretion of the permitting authority and could include pollutants which pose a higher risk to human or environmental health. The results of this examination determine which parameters are eligible for monitoring reductions.

## **3) Parameter-by-Parameter Performance History**

The permitting authority then calculates, for each eligible parameter, the two-year composite average at each outfall. The composite average is compared with the permit limit, and the information in Table 1, which is based on the existing monitoring frequency, to determine the potential monitoring frequency reduction.

## **4) Continued Eligibility for Reductions**

EPA and States would continue to monitor each parameter for significant noncompliance and any effluent violations of critical parameters, failure to submit DMRs, and any new enforcement actions. If violations based on these do occur, the permitting authority may require increased monitoring in accordance with a Section 308 or 309 order (or State equivalent).

## **5) Future Reductions for Ambient Monitoring**

Based on the facility's agreement to participate in an ambient monitoring program, along with other stakeholders in a watershed, additional reductions could be provided, at the discretion of the permitting authority.

## **Timing of Decisions**

Monitoring reductions should be considered during permit reissuance. Reductions based on facility performance may also be considered if the permit is reopened to accommodate other issues. The permitting authority may, at their option, modify the permit solely to reduce monitoring requirements if sufficient resources are available. Monitoring requirements are not

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<sup>1</sup>The term "facility" as used in this document refers to the regulated entity.

considered effluent limitations under section 402(o) of the Clean Water Act, and therefore anti-backsliding prohibitions would not be triggered by reductions in monitoring frequencies.

Permit monitoring requirements may, at the permit issuing authority's option, contain conditions for decreases in monitoring if specified performance conditions are met and/or require increased monitoring if performance levels drop. Although such conditions have sometimes been used in NPDES permits in the past, these conditions cannot now be tracked in the Permits Compliance System (PCS) data base system. If the permitting authority has sufficient resources to manually track changed reporting frequencies, such provisions could be included in the permit when the monitoring frequencies are adjusted based on changed performance. Increased monitoring requirements if performance levels are not maintained will be incorporated through enforcement orders under Sections 308 or 309 of the Clean Water Act (or State equivalent).

## Entry Criteria for Participation

### 1) Facility Enforcement History

#### *Criminal Actions* (all environmental statutes)

- Facilities which have been criminally convicted under any Federal or State environmental statute of falsifying monitoring data or committing violations which presented an imminent and substantial endangerment to public health or welfare *will not receive any reductions at any time in the future*<sup>2</sup>.
- Facilities convicted of any other criminal violation under any Federal or State environmental statute *will not receive any reductions for five years*.
- *Reductions will be available* for those facilities where an individual employed by the permittee, but not the permittee itself, was convicted of a criminal violation under any Federal or State environmental statute, provided the permittee discovered and self-disclosed the violation, and took prompt action to correct the root cause in order to prevent future criminal violations.

#### *Civil Judicial Actions* (Clean Water Act/NPDES related)

- Facilities are eligible for consideration of reductions 1 year after completion of injunctive relief and payment of penalty.

#### *Administrative Actions* (Clean Water Act/NPDES related)

- Facilities are eligible for consideration after the permittee has complied with

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Whenever the permit writer, on a case-by-case basis, determines that there has been a wholesale change in ownership and management, that it may become eligible for consideration under this guidance as a new permittee.

Administrative Penalty Order (APO) or Administrative Order (AO) (including State equivalent) requirements, and payment of any assessed penalty. A permittee that is issued an AO, in conjunction with reissuance of its permit, to extend a compliance schedule, may be eligible if the permittee is in compliance with the interim milestones and schedule in the AO.

For example, in order to comply with a newly promulgated effluent guideline, an industrial sector may be required to install a new technology. Some facilities may not be able to attain the new technology immediately so an AO is issued at the time the facility's permit is reissued. The AO sets a compliance schedule to allow the permittee additional time to install the technology needed to meet the new effluent guideline limitation.

## 2) Parameter-by-Parameter Compliance

The permitting authority will examine each of the following entry criteria:

### *Significant Noncompliance for Parameters under Consideration*

- A facility may not have had any Significant Noncompliance (SNC) violations for the parameters for which monitoring/reporting reductions are being considered during the last two years and,

### *Any Effluent Violations of Selected Parameters*

- A facility may not have had any effluent violations of selected (critical) parameters during the last year. The "selected parameters" can be permit-specific and would be determined at the discretion of the permitting authority. These parameters could include pollutants which pose heightened risks to human or environmental health, such as highly toxic or bioaccumulative compounds.

## 3) Parameter-by-Parameter Performance History

- At a minimum, the two most recent years of monthly average effluent data representative of current operating conditions for the parameter at the particular outfall will be used to calculate the long term average discharge rate for use in Table 1.
- The baseline monitoring frequencies in Table 1 of this guidance will normally be considered the level of monitoring in the existing effective NPDES permit. It is important to recognize that permittees that receive monitoring frequency reductions in accordance with Table 1 or Table 2 are still expected to take all appropriate measures to control both the average level of pollutants of concern in their discharge (mean) as well as the variability of such parameters in the discharge (variance), *regardless* of any reductions in monitoring frequencies granted from the baseline levels. Reliance on monitoring the discharge at a reduced frequency as the sole means of tracking and controlling the discharge could increase the risk of violations.

**Table 1**

**Ratio of Long Term Effluent Average  
to Monthly Average Limit**

Baseline Monitoring	<u>75-66%</u>	<u>65-50%</u>	<u>49-25%</u>	<u>&lt;25%</u>
7/wk	5/wk	4/wk	3/wk	1/wk
6/wk	4/wk	3/wk	2/wk	1/wk
5/wk	4/wk	3/wk	2/wk	1/wk
4/wk	3/wk	2/wk	1/wk	1/wk
3/wk	3/wk	2/wk	1/wk	1/wk
2/wk	2/wk	1/wk	2/mo	1/mo
1/wk	1/wk	1/wk	2/mo	1/2mos
2/month	2/mo	2/mo	2/mo	1/quarter
1/month	1/mo	1/mo	1/quarter	1/6mos

Note: See above eligibility requirements.

- New permittees should go through one permit cycle (5 years) before being eligible for consideration for reduced monitoring.
- Facilities would not normally be considered for reductions in monitoring frequencies below once per quarter, except in unusual circumstances of reliable performance at the requisite levels and outstanding compliance/enforcement histories.
- Facilities which satisfy the entry criteria but are not experiencing discharges of 75% or less of their permitted levels of water quality-based parameters may still be eligible for reductions in monitoring/reporting frequencies at the discretion of the permitting authority. To control an increased risk of undetected violations, monitoring should only be reduced for such parameters if the applicant can demonstrate a very low variation in the concentrations being discharged.

Parameters that show a long-term (2 year) average discharge between the permitted concentration and 76% of a water quality-based permit limit should demonstrate a coefficient of variation (ratio of standard deviation to average) of 20% or less. An additional safeguard should stipulate that parameters which showed any exceedance of the monthly average limitation during the two year averaging period would not be subject to

monitoring reductions. It should be noted that discharges with a long-term average at or near the permit limit have a probability of reporting a violation 50% of the time, regardless of low coefficient of variation or sample size. Reductions may be made as shown in Table 2 below:

**Table 2**  
**Ratio of Long Term Effluent Average to Monthly Average Limit**  
**100-76%**

<u>Baseline Monitoring</u>	<u>Reduced Monitoring</u>
7/wk	6/wk
6/wk	5/wk
5/wk	4/wk
4/wk	4/wk
3/wk	3/wk
2/wk	2/wk
1/wk	1/wk
2/month	2/month
1/month	1/month

**4) Residency Criteria for Continued Participation**

- Permittees are expected to maintain the performance levels that were used as the basis for granting monitoring reductions. To remain eligible for these reductions, the permittee may not have any SNC violations for effluent limitations of the parameters for which reductions have been granted or failure to submit DMRs, or may not be subject to a new formal enforcement action. For facilities that do not maintain performance levels, the permitting authority may require increased monitoring in accordance with a Section 308 or 309 Order (or State equivalent).

**Special Considerations**

**Discontinuous data:** Monitoring should not be reduced using the methodology described above if effluent data have not been continuously reported over the period of time being considered. Effluent averages from interrupted or discontinuous data sets may not be representative of long-term performance. Monitoring frequencies for discharges that are intermittent or short-term, such as seasonal discharges and highly variable batch processes, should not be assessed or reduced using the methods described in this guidance and would need to be considered on a case-by-case

basis.

**Independent/Dependent Control Parameters:** The procedures for reductions described in this guidance are intended for effluent parameters which are normally independently controlled by the permittee. That is, for each parameter limited in the permit there should be significantly different control mechanisms/factors--either in the permittee's treatment, pretreatment, or process operations. In situations where there are several parameters, each of which could be used to measure the performance of a given system, it will generally be appropriate to primarily monitor only the best indicator parameter. For example, if a biological treatment system can be evaluated by either BOD, CBOD, COD, or TOC measurements; it would be normally appropriate to require monitoring of only one of these oxygen demanding parameters.

The permitting authority should, therefore, examine the parameters being monitored from each facility during the permit issuance process to establish which parameters are independently controlled and/or which can be used to determine the proper operation of a facility. Monitoring of other parameters can be either eliminated or reduced to a minimum frequency.

**Monitoring Frequency "Floor":** Current federal NPDES regulations do not establish a monitoring frequency "floor" but do establish a reporting frequency floor of once/per year. The monitoring frequency from which reductions could be made in this guidance is considered to be the level of the monitoring in the existing effective NPDES permit. It is important to recognize that the guidance given in Table 1 does not advocate any reductions in statistical confidence in the ability of a permitting authority to determine whether or not a permit limit is being violated at reduced monitoring frequencies. The guidance also does not advocate any reductions for parameters that are currently monitored only once/quarter.

The permitting authority may, however, consider other factors specific to the State or facility. For example, a State policy may establish the baseline. If a facility has already been given monitoring reductions due to superior performance, the baseline may be a previous permit. As a point of reference, Federal regulations do not stipulate minimum monitoring frequencies but do require that reporting cannot be less than once per year. Future national guidance may also be used to establish a baseline for monitoring.

**Exceptions:** The permitting authority may elect to maintain higher monitoring levels in individual situations where there may be a particular interest in human health, endangered species, or a sensitive aquatic environment. An example would be where a permitting authority has assessed water quality problems in a watershed and determined which point and nonpoint sources are particularly critical from the standpoint of protection of aquatic resources (e.g., endangered species) and human health (e.g., drinking water source). The permitting authority may well decide not to reduce monitoring of critical point sources in these instances, while continuing to monitor the overall situation.

**Applicability to Minor Facilities:** Minor facilities are fully eligible for reductions under this guidance, even though they are not automatically tracked for SNC in the Permits Compliance

System Database. (Avoidance of SNC is one of the minimum criteria that should be met for participation in this program.) However, permitting authorities may apply the SNC criteria on a case-by-case basis to minor facilities in order to allow them to participate in this program based on permit-specific effluent compliance.

**Implementation of Guidance:** Where EPA is the permitting authority, it would apply this guidance upon permit reissuance, and consider at that time, whether reductions in monitoring and reporting frequencies were appropriate based upon the compliance/enforcement and performance history of the facility. EPA does not possess adequate resources to routinely reopen, modify, and reissue currently effective permits to revise monitoring frequencies. However, individual permitting authorities may elect to reopen and modify permits to reduce monitoring frequencies consistent with this guidance if resources permit.

**Limits below Levels of Detection:** This guidance does not recommend reductions in monitoring frequencies in cases where stringent water-quality based limits (WQBELs) are below levels of quantitation (the level at which a constituent present in a wastewater sample can be reliably detected and quantified). Permittees with these types of limits will normally be deemed to be in compliance when monitored levels are below the level of quantitation; however, by definition, it is not scientifically possible (until analytical methods improve) to certify that the WQBELs are actually being achieved. Thus, EPA feels it would be inappropriate to develop national guidance establishing reductions from established monitoring frequencies for these types of limits. However, individual permitting authorities may still use their discretion in considering reductions on a case-by-case basis.

**Use of Daily Maximum Values:** This guidance does not provide a specific methodology for considering daily maximum permit values when considering monitoring/reporting reductions. However, EPA is in the process of implementing a revised definition of SNC that accounts for daily maximum violations. The new definition will be included in the entry criteria of this proposal. In the interim, permitting authorities should consider such situations on a case-by-case basis. There may be concerns over instances where, for example, there are acutely toxic conditions in a receiving water due to violations of daily maximum permit limitations. In such cases, the permitting authority may elect to maintain higher monitoring levels. In addition, it is important to recognize that dischargers who frequently violate daily maximum permit limitations will likely be unable to achieve high levels of performance in monthly average limits and effectively would not be eligible to participate in this program on that basis. In addition, such facilities may also trigger one of the various compliance/enforcement-based entry criteria.

**Applicability of this program to indirect users of POTWs:** Many elements of the national Pretreatment program parallel the NPDES permit program. In general, therefore, the same overall logic embodied in this guidance may be extended to industrial users of POTWs (IUs), where appropriate. However, EPA has not investigated whether monitoring data of industrial users of POTWs (IUs) can be characterized with similar coefficients of variation. (Tables 3, 4, and 5 were generated for facilities with coefficients of variation of 20%, 60%, and 80%, respectively.)

Where monitoring frequencies are already near the minimum required by regulation (e.g., twice per year for significant industrial users), the reductions in this guidance would not apply. EPA has begun a dialogue among State and EPA Regional Pretreatment Coordinators to more fully discuss possible pilot projects and statistical analyses.

**Incentives for Ambient Monitoring:** This interim guidance focuses primarily on criteria for reducing reporting and monitoring used for determining compliance with NPDES permit requirements. It is our intention to reduce burdens associated with these activities where good compliance and permitting performance can be demonstrated and maintained. Another important policy direction for EPA and State water programs is the need to focus our resources more effectively on the problems facing individual places. This Community Based Environmental Protection (CBEP) strategy is embodied through our watershed protection approach. One of the most important aspects of a successful watershed protection approach is to get the best possible monitoring information on the conditions, causes and sources of impairment, and relative impact of these sources on the overall health of a watershed and the effectiveness of our control actions in a watershed. The approach described below for obtaining ambient monitoring information from point sources will also help provide important linkages among other important activities such as more comprehensive of our waters under Section 305(b), effluent trading in watersheds, and improved Total Maximum Daily Load (TMDL) analyses.

This information needs to be gathered and used, where available, from a variety of sources, including municipal and industrial point source dischargers. These point sources could provide a great deal of valuable ambient monitoring information that could be very helpful in making better watershed-based decisions. While certain information may be unique to an individual watershed, there needs to be a core group of environmental indicators, such as attainment of designated uses in State water quality standards and fish consumption advisories, that each watershed will need to measure. NPDES dischargers could often provide valuable information to help measure these core indicators of the overall health of the watershed.

Therefore, in order to encourage NPDES dischargers to voluntarily provide this information or collect additional ambient monitoring information, permitting authorities may consider granting additional reductions in compliance reporting and monitoring, over and above the reductions granted based on good performance if permittees agree to collect or provide additional ambient monitoring information. Prior to granting these additional reductions, permitting authorities should reach agreements with the dischargers on how this information will be provided or collected and how it will be used to give all key stakeholders a better picture of the overall health of the affected watershed. The amount of additional reduction will be at the discretion of the permitting authority who should work collaboratively with State and watershed agencies who design and implement monitoring programs to support environmentally based decisions. This closer integration of ambient and compliance monitoring may also be included in EPA/State agreements to support the National Environmental Performance Partnership System (NEPPS).

Finally, any additional reductions provided should be done so in a manner consistent with the

framework and other criteria described in this guidance.

## **Future Actions**

The burden reductions recommended under this guidance will be available immediately. Over the next 12-18 months, EPA will also conduct detailed pilot studies in two States, Louisiana, and Oklahoma, to closely monitor implementation of the guidance. Based on information from these pilot studies and other information, EPA will consider modifications to this interim guidance as appropriate.

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## Supporting Statistical Study

### Effect of Sample Size on Probability of Violation

EPA has done a statistical analysis on the effect of sampling frequency on compliance assessment. The basic premise underlying a performance-based reduction approach is that maintaining a low average discharge relative to the permit limit results in a low probability of the occurrence of a violation for a wide range of sampling frequencies.

The probability of the occurrence of a violation of a monthly average permit limit was calculated. Tables 3, 4 and 5 display the percentage of time that a monthly average permit violation will be reported given sample size and a long-term average to permit ratio. This probability is dependent on the true long-term average of the discharge, the permit limit, and the monthly sampling frequency. The variables of long-term average and permit limit are both reflected in the tables by expressing these as a ratio. Tables 3, 4, and 5 assume a normal distribution of monthly averages and show the effect of altering the assumed coefficient of variation, using 20%, 60%, and 80%, respectively.

Obviously, the best estimate of the true monthly average discharge is obtained by daily sampling. One can assess the true violation rate of a discharge by looking at the probability calculated assuming sampling was done daily (30 times per month). In order to maintain compliance with a permit limit, the long term average level of the discharge must be controlled at a level less than the permit limit. Reducing the sample size, while increasing the probability that a violation will be reported, does not change the underlying probability of reporting a violation associated with a baseline estimate of the monthly average calculated with 30 samples. With a constant performance, the probabilities of reporting a permit violation increase as the sample size is reduced from daily sampling because the variance of the average is inversely proportional to the sample size.

Looking at the true violation rate of a facility sampling daily and operating at 75% of their permit limit, these tables show that the probability of a violation in a given month is 1% or less. If the long-term average discharge is 65% of the permit limit, the true percentage of violation is less than 1%. As sample size decreases for a given discharge/limit ratio, the expected percentage of time that the average of the samples collected during the month will exceed the permit limit increases. For example, Table 5 demonstrates that at a ratio of 65%, the expected violation rate is effectively zero. If a subsample of 8 samples per month is taken instead of 30, the facility has a 3% chance of reporting a violation. If only one sample per month is taken, the chances of reporting a violation increase to 25%. The facility performance (true monthly average discharge) has not changed, thus "missed" monthly average violations are not an issue. The probabilities calculated for very low sampling frequencies reflects the risk assumed by the discharge operator that monthly average violations will be reported when in fact the process average is under permit limit. If facility performance degrades during the permit term and sampling has been reduced, it can be seen that the facility will have probability of reporting violations at a higher rate, even if the long-term average is still below the permit limit. An example will illustrate this point. Table 5 shows that if a facility was judged to be at 75% of their permit limit and reduced sampling from 16 to 12 times per month, the probability of violation would change from approximately 5% to

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7%. If the long-term average performance degraded to 90% of the permit limit, the 12 monthly samples would yield expected monthly average permit violations 32% of the time instead of 29% of the time if 16 samples were collected.

Table 5 shows probabilities calculated using a more conservative assumption of 80% coefficient of variation. The results show that facilities with a long term average of less than or equal to 75% have essentially no chance of violating a monthly average limit, hence facilities with this performance would be good candidates for performance-based monitoring reductions. The reductions in Table 1 were designed to maintain approximately the same level of reported violations as that experienced with their current (baseline) sampling.

**Table 3**

**Probability of Reporting Monthly Average Permit Violations at 20% Effluent Variability (CV = 0.20; Normal Distribution)**

<sup>1</sup> LTA/Permit	Monthly Sample Size									
	30	28	24	20	16	12	8	4	2	1
<b>100%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>
95%	7%	8%	10%	12%	15%	18%	23%	30%	35%	40%
90%	0%	0%	0%	1%	1%	3%	6%	13%	22%	29%
85%	0%	0%	0%	0%	0%	0%	1%	4%	11%	19%
80%	0%	0%	0%	0%	0%	0%	0%	1%	4%	11%
75%	0%	0%	0%	0%	0%	0%	0%	0%	1%	5%
70%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%
65%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
60%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
55%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
40%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
30%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

<sup>1</sup> Ratio of calculated average of at least 2 years of effluent data to monthly average permit limit.

**Table 4**

**Probability of Reporting Monthly Average Permit Violations at 60% Effluent Variability (CV = 0.60; Normal Distribution)**

<sup>1</sup> LTA/Permit	Monthly Sample Size									
	30	28	24	20	16	12	8	4	2	1
<b>100%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>
95%	32%	32%	33%	35%	36%	38%	40%	43%	45%	47%
90%	16%	16%	18%	20%	23%	26%	30%	36%	40%	43%
85%	5%	6%	7%	9%	12%	15%	20%	28%	34%	38%
80%	1%	1%	2%	3%	5%	7%	12%	20%	28%	34%
75%	0%	0%	0%	1%	1%	3%	6%	13%	22%	29%
70%	0%	0%	0%	0%	0%	1%	2%	8%	16%	24%
65%	0%	0%	0%	0%	0%	0%	1%	4%	10%	18%
60%	0%	0%	0%	0%	0%	0%	0%	1%	6%	13%
55%	0%	0%	0%	0%	0%	0%	0%	0%	3%	9%
50%	0%	0%	0%	0%	0%	0%	0%	0%	1%	5%
40%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
30%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

<sup>1</sup> Ratio of calculated average of at least 2 years of effluent data to monthly average permit limit.

**Table 5**

**Probability of Reporting Monthly Average Permit Violations at 80% Effluent Variability (CV = 0.80; Normal Distribution)**

<sup>1</sup> LTA/Permit	Monthly Sample Size									
	30	28	24	20	16	12	8	4	2	1
<b>100%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>	<b>50%</b>
95%	36%	36%	37%	38%	40%	41%	43%	45%	46%	47%
90%	22%	23%	25%	27%	29%	32%	35%	39%	42%	44%
85%	11%	12%	14%	16%	19%	22%	27%	33%	38%	41%
80%	4%	5%	6%	8%	11%	14%	19%	27%	33%	38%
75%	1%	1%	2%	3%	5%	7%	12%	20%	28%	34%
70%	0%	0%	0%	1%	2%	3%	6%	14%	22%	30%
65%	0%	0%	0%	0%	0%	1%	3%	9%	17%	25%
60%	0%	0%	0%	0%	0%	0%	1%	5%	12%	20%
55%	0%	0%	0%	0%	0%	0%	0%	2%	7%	15%
50%	0%	0%	0%	0%	0%	0%	0%	1%	4%	11%
40%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%
30%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

<sup>1</sup> Ratio of calculated average of at least 2 years of effluent data to monthly average permit limit.

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## Detailed Protocol for Calculating Probability of Reporting Permit Violations

### Calculation of probabilities for Tables 3-5

Probability distributions may be used to model effluent data and assess the probability of permit violations. The models provide a logical and consistent methodological framework for using observed performance data to assess permit limitations in an objective manner. The goal of the limitations is to establish performance levels that enforce good treatment and ensure that water quality objectives are met. In deriving limitations, sufficient allowance for variation in treatment performance is provided such that a well-operated treatment system should be capable of compliance with the limitations at all times. In using probability models as the basis for limits, it is necessary to select a percentile value such that, within the context of the model, any meaningful limit will have a non-zero probability of being exceeded.

The results shown in the tables here are derived from probability distribution functions that may be used to model effluent data. That is, the processes are assumed to operate over time in a manner that is consistent with past performance. No intervention to change the process or exert more or less control over the discharge is assumed.

Calculation of the probability that a reported permit violation will occur depends upon: the number of individual samples taken during the month, the long-term discharge level, the variance of the discharge concentrations, the probability distribution of the individual samples during the month, and the permit limit. There are two probability distributions commonly used to model effluent data: the lognormal distribution and the normal distribution. The lognormal distribution usually provides a good fit to data sets comprised of individual effluent measurements because such data typically have two critical lognormal characteristics: they are positive valued and positively skewed. Positive skewness means that the data are characterized by a tendency for a preponderance of measurements in the lower range of possible values with relatively fewer measurements stretched out over a wider range of possible upper values. The lognormal also has the property that the logarithms (natural or base 10) of the data are normally distributed. The normal distribution has the well-known "bell shape" and is mathematically straightforward so that working with the logarithms of effluent data is relatively uncomplicated.

The asymptotic distribution of sample averages is normally distributed. That is, the average of a sample of individual measurements will have a distribution that is approximately normally distributed regardless of the distribution of the individual measurements. The quality of the approximation depends on several factors including the number of individual measurements being averaged and the form of the underlying distribution. Although individual effluent measurements are rarely normally distributed, it is reasonable in many situations to approximate the distribution of the averages of effluent measurements with a normal distribution and thus the normal approximation is used in many cases as a model for monthly average effluent limitations. The results in Tables 3-5 are based on the assumption of a normal distribution for the averages of effluent measurements. Extensive discussion on the statistical modelling of effluent data and methodology for setting effluent limitations are contained in EPA's 1991 Technical Support Document for Water Quality-based Toxics Control (TSD).

The results of calculating probability of a reported violation of a monthly average permit limit are shown in Tables 3 through 5 under different conditions. The purpose of these tables is to provide some insight into the effects of changing monitoring requirements. The probability of exceeding the monthly limit when the long-term average of the discharge is at the desired value can be thought of as the Type I error rate (alpha-level) of the monitoring program. When the long-term average exceeds the desired limit, the probability of exceeding the monthly limit is now the monitoring program's ability to detect violation increases if the long-term average increases over the desired level. It should be understood that if permit limits are held constant and performance measures such as long term average discharge and variability of treatment do not change, then reducing the number of monitoring measurements used to calculate the monthly average causes the probability of a violation to increase for all values of the long term average less than the monthly average permit limit. This has a two-fold effect: 1) the chances of reporting a violation even when the long term average is less than the desired level (the Type I error rate) go up 2) the sensitivity (ability to detect violations) of the program increases. The Tables also show that if the average discharge level is held well below the monthly average limit, the chances of a violation are small. The three tables reflect three different levels of variation in the underlying daily data as measured by the coefficient of variation. The coefficient of variation (CV) is the ratio of the standard deviation of the distribution to the mean and is often expressed as a percentage. The CV is a convenient measure for summarizing the relative variability in a data set. The results in Tables 3,4, and 5 use CVs of 20%, 60% and 80% respectively. A coefficient of variation of 60% was used in the TSD to describe a typical level of variation for lognormally distributed effluent data. CVs of 80% and 20% were used to show the effects of higher and lower levels of variability.

The probability distribution of the average of N daily measurements taken during a month,  $M_N$ , is given by the following normal probability density function:

where  $\mu$  is the mean or long term average, and  $\sigma$  is the standard deviation of the daily discharges. If  $\mu_1$  is the maximum monthly average allowed by the permit, then the probability that the monthly average exceeds the permit maximum is given by  $P(M_N > \mu_1)$ . Using simple algebra this probability can be rewritten as:

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where  $\Phi(\cdot)$  is the standard normal cumulative probability function (the Microsoft®Excel built-in function NORMDIST).

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Since

where  $C$  is the coefficient of variation, then the probability of a monthly average exceeding the maximum allowable can be calculated using  $C$ ,  $N$ , and the ratio of the long-term average to the maximum allowable monthly average using NORMDIST. This is how the values in Tables 3, 4, and 5 were calculated.

#### **Alternate approaches to**

#### **probability calculations:**

The probabilities in Tables 3-5 were calculated with the assumption that the distribution of the sample means is normal. Individual sample values are generally best fit to a lognormal distribution. As discussed in the TSD, the mean of small samples from a lognormal distribution is in most cases approximately lognormal. Probabilities can be calculated assuming a lognormal distribution by two different methods, a Monte Carlo technique and the Microsoft Excel built-in function LOGNORMDIST. The resulting probabilities will be very close to those in the normal distribution table for the sample sizes and discharge levels under consideration for monitoring reductions, although the probabilities calculated from these two distributions may not be comparable for all sample sizes and all discharge levels.

The statistical evaluations used in this analysis are intended for use only to illustrate the effect and benefits of this strategy, alternative statistical techniques and approaches may be utilized in other situations.

## NPDES Burden Reduction Analysis

The analysis to estimate the NPDES burden reduction used the SAS Language and data from the Permit Compliance System (PCS) database. The procedure, assumptions, and results are summarized below:

- The universe for this study was all major facilities with measurement data in PCS (6,477) for the two-year evaluation period of 1/93 to 12/94. This evaluation period was chosen in order to have as large a universe as possible since the Commonwealth of Virginia and the State of California have not entered measurement data into PCS for 1995.
- The facility entry criteria for enforcement history were approximated by eliminating permittees for consideration that have effluent violations for either an active formal judicial action or an active formal administrative order (AO) for 1995.
- The parameter entry criterion, evaluated per outfall, was the elimination of parameters for consideration that have had any Significant Non-Compliance (SNC) violations during the two-year evaluation period.
- For each parameter eligible for burden reduction, the long-term average (LTA) for the two-year period was calculated and compared to the monthly average limit.
- The amount of burden reduction was calculated to be the ratio of the difference between the monthly average limit and the LTA divided by the monthly average limit. This approximates the reduction presented in Table 1 of the guidance for LTA to monthly average limit ratios up to 75%.
- No reduction for parameters not meeting the 75% ratio threshold.

**Table 6**

	Burden Reduction
Municipal	27%
Non-municipal	24%
<b>Total</b>	<b>26%</b>