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Agency

Office of Water Enforcement
and Permits
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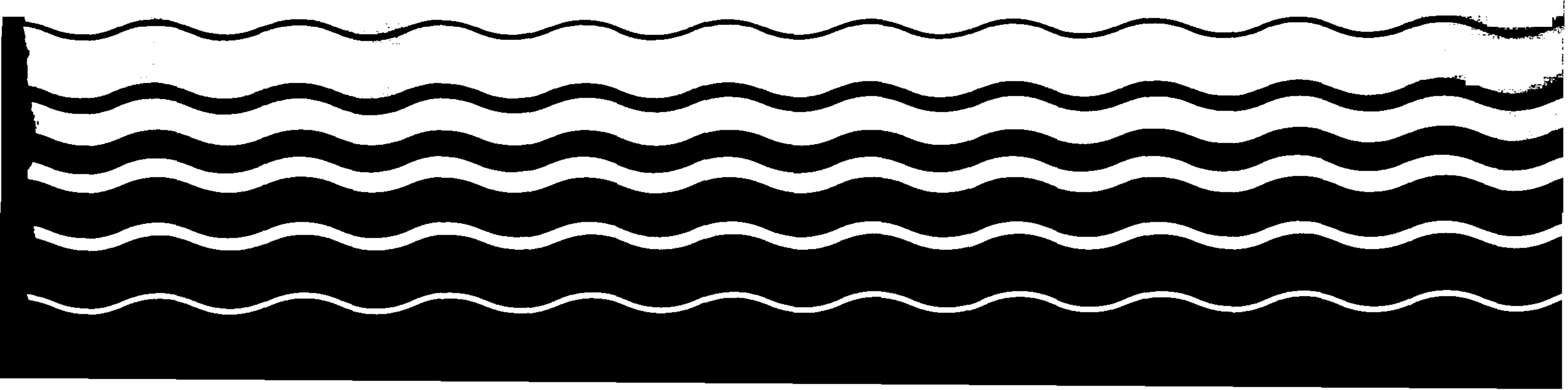
Water

EPA Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program



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

OFFICE OF
WATER

MAR 22 1988

MEMORANDUM

SUBJECT: Pretreatment Program Local Limits Guidance

FROM: James R. Elder, Director
Office of Water Enforcement and Permits

TO: Users of Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program

This manual provides publicly owned treatment works (POTWs) with comprehensive technical guidance on the development and implementation of sound local limits. It fulfills one of the major recommendations of the Pretreatment Implementation Review Task Force (PIRT) and offers detailed information in a number of areas including 1) the legal and regulatory basis for local limits, 2) the relationship of local limits to other pretreatment regulatory controls, 3) approaches to identify pollutants and sources warranting local limits control, 4) sampling and analysis guidance to support local limits development, and 5) several technically-based approaches for local limits development.

EPA's General Pretreatment Regulations require local limits both for POTWs with federally-approved pretreatment programs and for any other POTWs that are experiencing recurring pass-through and interference problems. The Agency's August 5, 1985 local limits policy (see Appendix B of this manual) explains a POTW's general responsibilities: "each POTW must assess all of its industrial discharges and employ sound technical procedures to develop defensible local limits which will assure that the POTW, its personnel, and the environment are adequately protected."

The key to this assessment is a technical evaluation which each POTW must conduct. The elements of this assessment are outlined in the policy and, briefly, include identifying all industrial users, determining the character and volume of pollutants in their discharges, and identifying pollutants of concern through a sampling, monitoring, and analysis program. For each pollutant of concern, the POTW must then determine the maximum allowable headworks loading and implement appropriate local limits to ensure that the maximum loadings are not exceeded. The specific technical approaches and methods of control (i.e., pollutant allocation) are left to the judgement of the POTW.

Occasionally, POTWs may find that loadings of some pollutants of concern are well below the calculated maximum headworks loadings. In these cases, limits may not be necessary to prevent actual exceedances. Nonetheless, EPA encourages POTWs to establish maximim limits for significant dischargers of such pollutants. This will ensure that current loadings cannot be substantially increased without the POTW's granting permission and having the opportunity to assess both increased loadings from other industrial sources as well as the need to provide for future industrial growth.

The local limits guidance manual provides further information on each element of the technical evaluation summarized above. It also builds upon the requirements of the August 1985 policy. In this regard, it is important to note that the manual expands upon the 1985 policy's requirement that headworks analysis be conducted for six metals (cadmium, chromium, copper, lead, nickel and zinc) as well as other pollutants of concern. The attached guidance specifically identifies four additional pollutants (arsenic, cyanide, silver and mercury) that all POTWs should presume to be of concern unless screening of their wastewater and sludge shows that they are not present in significant amounts. Although these additional pollutants are not as widespread in POTW influents as the six metals, they have particularly low biological process inhibition values and/or aquactic toxicity values.

This guidance addresses one of the most critical tasks of the national pretreatment program to develop technically sound and defensible local limits. Its fundamental purpose is to assist you in addressing the difficult challenge of dealing with ever changing conditions at the treatment facility. The scope and level of detail of this manual reflects the complexity of those conditions and the site specific nature of local limits development. I am confident it will help you not only to develop sound and defensible limits, but also to periodically update those limits to assure continued achievement of pretreatment goals.

GUIDANCE MANUAL ON THE DEVELOPMENT AND IMPLEMENTATION OF LOCAL DISCHARGE LIMITATIONS UNDER THE PRETREATMENT PROGRAM

December 1987

U.S. Environmental Protection Agency
Office of Water
Office of Water Enforcement and Permits
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1. INTRODUCTION

1.1 PURPOSE OF THIS MANUAL

This manual provides guidance to municipalities on the development and implementation of local limitations to control conventional, nonconventional, and toxic pollutant discharges from nondomestic industrial users (IUs) to Publicly-Owned Treatment Works (POTWs). This document is principally directed toward POTW personnel responsible for local pretreatment program implementation. In addition, it is intended to assist POTWs which are not required to develop local programs but must develop local limits to prevent recurrence of problems and to ensure compliance with Federal, State and local requirements.

Coverage

This manual presents information on a wide range of issues associated with local limits development and implementation including: (1) the legal and regulatory bases for local limits; (2) the relationship of local limits to other pretreatment regulatory controls; (3) approaches to identify pollutants and sources warranting local limits control; (4) sampling and analysis to support local limits development; and (5) several technically-based approaches for local limits development.

In spite of the breadth of material addressed in this manual, it has one primary objective -- to provide practical assistance to POTW personnel on technically-based approaches for setting local limits. As such, greater emphasis and more detailed information is given on scientific, engineering, and operational issues integral to limits development, than on policy and procedural matters. The reader is referred to several other EPA guidance materials listed in Appendix A for more extensive information on programmatic requirements on related topics such as pretreatment program development and POTW acceptance of hazardous wastes. In addition, Appendix A provides references to important EPA reports which contain further information on technical issues key to local limits development (e.g., POTW removal performance; sampling methodologies, etc.).

Supplementing this and other EPA guidance manuals, EPA has developed a computer program known as PRELIM (for pretreatment limits) which derives local limits based on a POTW's monitoring, operational, and literature data and applicable environmental criteria. The PRELIM program is described in Section 3.5 of this manual. PRELIM (on floppy disk) and its accompanying user's manual are available through EPA Headquarters Office of Water Enforcement and Permits (OWEP).

1.2 BACKGROUND

1.2.1 What are Local Limits and Why are They Important?

As stated, the chief purpose of this manual is to assist POTW personnel to develop and implement technically-based local limits. It may be useful to briefly review what local limits are and why they are important as a pretreatment regulatory control. More detailed statutory/regulatory information is then provided in Section 1.3 of this chapter.

The National Pretreatment Program was established to regulate the introduction of pollutants from nondomestic sources into Publicly-Owned Treatment Works. Discharges targeted for regulation include those which will interfere with the operation of a POTW, including interference with its sludge digestion processes, sludge use or disposal; which will pass through the treatment works; or which are otherwise incompatible with such works. In addition, the program is intended to improve opportunities to reclaim municipal and industrial wastewaters and sludges (see 40 CFR §§403.1 and 403.2). To accomplish these objectives the National Pretreatment Program relies on a pollution control strategy with three elements:

- National Categorical Standards: National technology-based standards developed by EPA Headquarters, setting industry-specific effluent limits
- Prohibited Discharge Standards:
  - General Prohibitions (403.5(a)) - National prohibitions against pollutant discharges from any nondomestic user which cause pass-through or interference

  - Specific Prohibitions (403.5(b)) - National prohibitions against pollutant discharges from any nondomestic user causing: (1) fire or explosion hazard; (2) corrosive structural damage; (3) interference due to flow obstruction; (4) interference due to flow rate or concentration; and (5) interference due to heat.

- Local Limits:

  - Enforceable local requirements developed by POTWs to address Federal standards as well as State and local regulations.

The rationale behind this three-part strategy is, first, that categorical standards provide nationally uniform effluent limits affording a technology-based degree of environmental protection for discharges from particular categories of industry. Second, the prohibited discharge standards recognize the site-specific nature of the problems they are intended to address at sewage treatment works and provide a broader baseline level of control that applies to all IUs discharging to any POTW, whether or not the IUs fall within particular industrial categories. Third, local limits are specific requirements developed and enforced by individual POTWs implementing the general and specific prohibitions, and also going beyond them as necessary to meet State and local regulations.

This approach ensures that site-specific protections necessary to meet pretreatment objectives are developed by those agencies best placed to understand local concerns -- namely POTWs. In this scheme, POTW development and implementation of local limits is the critical link in ensuring that pretreatment standards protecting both the local treatment works and local receiving environment are applied.

1.2.2 Studies Supporting the Need for Local Limits

Several recent studies by EPA underscore the importance of local limits to control site-specific plant and environmental impacts. Results from the Agency's Complex Effluent Toxicity Test Program and State studies indicate that many municipal effluents cause instream toxicity due to industrial discharges to POTWS [52 and 53]. The State of North Carolina, for example, found that 32 percent of POTWs tested had effluents with some degree of acute toxicity, often attributable to industrial discharges of pollutants not regulated by categorical standards.

In a major study to Congress on hazardous waste discharges to POTWs (see Appendix A) EPA found that while categorical standards had been effective in reducing hazardous metals loadings and, to a lesser extent, some toxic organics loadings to sewage treatment plants, significant amounts of hazardous constituents will be discharged to municipalities even after full implementation of Federal categorical pretreatment standards. Documented effects associated with these industrial discharges included adverse water quality impacts, sludge contamination, potential degradation of raw drinking water, air emissions of volatile organic compounds contributing to ozone nonattainment, fires and explosions, sewer corrosion, endangerment of worker health and safety, and loss of life.

Among its major conclusions, the Domestic Sewage Study recommended modification of the prohibited discharge standards to improve control of characteristic hazardous wastes and solvents and improvement/implementation of local limits at the POTW level, particularly to control the discharge of toxic organic constituents.

1.2.3 The Need for EPA Guidance to Support POTW Local Limits Development

Both in local program design and in implementation, POTW adoption of local limits is pivotal to the accomplishment of effective pretreatment controls. The Pretreatment Implementation Review Task Force (PIRT, a work group made up of representatives from municipalities, industries, States, environmental groups and EPA Regions to provide the Agency with recommendations on day-to-day problems faced by POTWs, States, and industries in implementing the Pretreatment Program) found that, "defensible local limits are the cornerstone of an effective POTW Pretreatment Program. Yet some POTW representatives do not understand the relationship between categorical pretreatment standards and local limits, or even how to develop local limits." (p. 5, Pretreatment Implementation Review Task Force, Final Report to the Administrator, January 30, 1985, Office of Water Enforcement and Permits, U.S. EPA.)

PIRT concluded that EPA should issue a policy statement and provide technical guidance to facilitate development of local limits by POTWs. On

August 5, 1985, EPA issued a memorandum clarifying local limits requirements for POTW programs. The full text of the memorandum is provided in Appendix B. As mentioned previously, EPA has also developed the computer model, PRELIM, and a companion user guide to assist localities in local limits calculation. This manual represents the next step in providing municipalities with the requisite technical expertise to develop technically-based local limits.

1.3 LEGAL BASIS FOR LIMITS DEVELOPMENT

In order to provide a clear understanding of local limits, this chapter summarizes the legal and regulatory bases for their development. It also explains the relationship between local limits and federal categorical pretreatment standards in controlling pollutant discharges to POTWs.

1.3.1 Specific Statutory/Regulatory Background

The statutory basis for the development of the National Pretreatment Program is derived from the Federal Water Pollution Control Act of 1972. Section 307 of the Act required EPA to develop pretreatment standards designed to prevent the discharge to POTWs of pollutants "which interfere with, pass through, or are otherwise incompatible with such works." When the Act was amended in 1977, more pretreatment requirements were added in Section 402. At that time, POTWs became responsible for establishing local pretreatment programs to ensure compliance with the pretreatment standards.

1.3.1.1 Pretreatment Regulations

EPA developed the General Pretreatment Regulations (40 CFR Part 403) to implement the requirements of Section 402. As discussed briefly earlier, the General Pretreatment Regulations establish general and specific prohibitions which are implemented through local limits. The regulations relating to each of these elements are set forth below:

A.(i) General Prohibitions

> Section 403.5(a)(1) General prohibitions. A user may not introduce into a POTW any pollutant(s) which cause Pass Through or Interference. These general prohibitions and the specific prohibitions in paragraph (b) of this section apply to each user introducing

pollutants into a POTW whether or not the source is subject to other National Pretreatment Standards or any National, State, or local Pretreatment Requirements.

(ii) Definition of Pass Through

[n] The term "Pass Through" means a Discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit [including an increase in the magnitude or duration of a violation]. Section 403.3(n)

(iii) Definition of Interference

[i] The term "Interference" means a Discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

[1] Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and

[2] Therefore is a cause of a violation of any requirement of the POTW's NPDES permit [including an increase in the magnitude or duration of a violation] or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder [or more stringent State or local regulations]: Section 405 of the Clean Water Act, the Solid Waste Disposal Act [SWDA] [including Title II, more commonly referred to as the Resource Conservation and Recovery Act [RCRA], and including State regulations contained in any State sludge management plan prepared pursuant to Subtitle D of the SWDA], the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act. Section 403.3(i)

B. Specific Prohibitions

Section 403.5(b) Specific prohibitions. In addition, the following pollutants shall not be introduced into a POTW:

[1] Pollutants which create a fire or explosion hazard in the POTW;

[2] Pollutants which will cause corrosive structural damage to the POTW, but in no case Discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such Discharges;

[3] Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in Interference;

[4] Any pollutant,including oxygen demanding pollutants [BOD, etc.] released in a Discharge at a flow rate and/or pollutant concentration which will cause Interference with the POTW.

[5] Heat in amounts which will inhibit biological activity in the POTW resulting in Interference, but in no case heat in such quantities that the temperature at the POTW Treatment Plant exceeds 40°C [104°F] unless the Approval Authority, upon request of the POTW, approves alternate temperature limits.

C. Implementation

Section 403.5(c) of the General Pretreatment Regulations requires the implementation of the General and Specific Prohibitions through the local limits process under two specific circumstances:

1. POTWs with local pretreatment programs "shall develop and enforce specific limits to implement the prohibitions listed in §403.5(a) and (b)."
2. All other POTWs shall, "in cases where pollutants contributed by User(s) result in Interference or Pass Through and such violation is likely to recur, develop and enforce specific effluent limits for Industrial User(s), and all other users, as appropriate, which together with appropriate changes in the POTW Treatment Plant's Facilities or operation, are necessary to ensure renewed or continued compliance with the POTW's NPDES permit or sludge use or disposal practices."

1.3.1.2 Implementation of the General Prohibitions

Pass through and interference occur by regulatory definition when an industrial user is a cause of POTW noncompliance with any conditions of its NPDES permit and/or, in the case of interference, with a POTW's sludge requirements as well. Given this definition, each POTW's Federal or State NPDES permit serves as a very specific legal guide for determining whether there is pass through or interference. Typical municipal permits may contain specific conventional and nonconventional pollutant effluent limitations and, increasingly, water quality-based toxic pollutant limitations, narrative toxicity limitations (e.g., no toxics in toxic amounts) and whole effluent toxicity standards. NPDES permits also usually contain POTW removal efficiency requirements (e.g., 85 percent removal for BOD) as well as conditions requiring that the POTW be well-operated and maintained. Currently, some POTW permits include criteria for sludge use or disposal practices but many do not yet incorporate sludge criteria. Sludge requirements may be contained in State or Federal regulations and/or State-issued sludge use or disposal permits. Section 406 of the Water Quality Amendments of 1987 amended 405(d) of the Clean Water Act to require the EPA Administrator "to impose conditions in permits issued to publicly owned treatment works under section 402 of this Act or take such other measures . . . to protect public health and the environment from any adverse effects which may occur from toxic pollutants in sewage sludge." This permitting of sewage sludge in municipal NPDES permits is to occur prior to promulgation of the sludge technical criteria currently under development by the Office of Water at EPA. Section 406 also provides for implementation of the new sludge standards, once promulgated, through NPDES permits. Thus many municipalities will soon have sludge conditions in their Federal or State NPDES permits, if not already present.

In summary, the effluent limits, water quality and sludge protection conditions, toxicity requirements and O&M objectives found in municipal NPDES permits as well as other applicable sludge requirements establish the objectives that POTWs must meet in order to prevent pass through and interference. To the extent that pass through or interference may occur, either in part or in whole, as a result of inadequately treated industrial discharges from any user, POTWs must develop local limits.

Many cities still only have specific NPDES permit provisions regulating removal efficiencies and concentrations for conventional pollutants (e.g., biological oxygen demand, suspended solids) pH, and fecal coliform. As acknowledged in the Preamble to the interference and pass through definitions, EPA recognizes that the regulatory scheme for achieving water quality goals through effluent limitations in NPDES permits has not yet been fully implemented. Many States do not yet have numerical water quality criteria for toxic or nonconventional pollutants of concern, although all States have a narrative prohibition against the discharge of toxic pollutants in toxic amounts. That standard should be reflected in the POTW's permit either by general or specific limitations. Therefore, a violation of the prohibition on toxics in toxic amounts due to industrial discharges is a strong rationale for POTW local limits development.

EPA expects that increasing numbers of POTW permits will contain limits on toxic pollutants contributed by industrial users in addition to the usual limits on BOD, TSS and pH. In the issuance of third-round permits now underway, EPA has emphasized the application of the "Policy on Water Quality-Based Permit Limits for Toxic Pollutants" (49 FR 9016, March 9, 1984). This policy calls for an integrated strategy to address toxic and nonconventional pollutants through both chemical and biological methods. Where State standards contain numerical criteria for toxic pollutants and the POTW's effluent contains those pollutants, limits to achieve the water quality standards may be required in NPDES permits. Where State numerical criteria are not yet available, NPDES permitting authorities are expected to use a combination of both biological techniques and available data on specific chemical effects to assess toxicity impacts and human health hazards and then develop permit conditions that establish effluent toxicity limits or specific chemical limits as appropriate. POTWs will then be expected to develop local limits to ensure these permit limits will not be violated.

1.3.1.3 Implementation of the Specific Prohibitions

The specific prohibitions forbid the discharge of pollutants which cause fire or explosion hazard, corrosive structural damage, obstruction of flow, interference, or inhibition of biological activity due to excessive heat. Enforcement of these prohibitions is a precondition of pretreatment program approval, and critical prerequisites for meeting permit limits, protecting workers and maintaining a well-operated treatment plant.

POTW sewer use ordinances typically contain either definitions or local limits implementing these specific prohibitions. Definitions may simply consist of the descriptive language from 40 CFR 403.5(b) given above, or may quantitatively define prohibitions, such as by correlating fire/explosion hazard to specific readings on an explosimeter. Such quantitative limits avoid ambiguity and are effective in terms of POTW enforcement and IU compliance.

Whereas the regulations concerning the specific discharge prohibitions address in a general way certain problems which must be prevented, numeric limits are often pollutant-specific and can be more easily implemented and enforced. Section 4.1 outlines the procedures POTWs can follow in establishing specific local limits to define and implement the very important concerns addressed in the specific discharge prohibitions.

1.3.2 Other Considerations Supporting Local Limits Development

The above discussion enumerated Federal regulatory requirements which mandate local limits development. It is important to note that the Federal Clean Water Act and the General Pretreatment Regulations specifically endorse more extensive requirements based on State and/or local law (40 CFR 403.4). POTWs should evaluate their State permits to identify additional State requirements in areas such as solid waste management, worker health and safety, hazardous waste acceptance, and POTW air emissions which may necessitate local limits development.

Two very important concerns that may necessitate local limits development, depending on individual permit and sludge disposal requirements, and State and local regulations are: preventing fume toxicity to workers and reducing POTW air emissions. POTWs have been aware of fume toxicity health problems associated with sewer worker exposure to volatile compounds and have implemented local limits to reduce risks. Cities with air pollution problems might well consider local limits to reduce air emissions both in the collection system and the headworks due to industrial discharges containing volatile organic compounds (VOCs). POTWs that practice sludge incineration may be regulated under the Clean Air Act. Information on developing local limits to address air pollution and fume toxicity problems is contained in later sections of this manual.

Finally, it should be emphasized that local limits should be preventive rather than reactive. Accordingly, EPA recommends that POTWs consider all relevant plant and environmental information in evaluating the need for local limits. Where POTWs can anticipate problems they should set local limits without waiting for problems to occur.

1.3.3 Relationship of Local Limits to Categorical Standards

PIRT suggested in its findings that many POTWs misunderstood the relationship between local limits and categorical standards, thereby hindering effective implementation of pretreatment standards. Categorical standards and local limits are distinct and complementary types of pretreatment standards. Promulgation of a categorical standard by EPA in no way relieves a municipality from its obligations to evaluate the need for, and to develop, local limits to meet the general and specific prohibitions in the General Pretreatment Regulation. As suggested earlier, categorical standards are developed to achieve a nationally-uniform degree of water pollution control for selected industries and pollutants. Local limits are intended to prevent site-specific plant and environmental problems resulting from any nondomestic user.

In many cases POTWs may impose local limits which regulate categorical industries more stringently and/or for more pollutants than are regulated in the applicable categorical standard to afford additional plant or environmental protection. In this case, the local limit supersedes the categorical standard as the applicable pretreatment standard. As a corollary, however, a less stringent local limit does not relieve a categorical industry from its obligation to meet the Federal standard. The central point to be remembered is that the existence of a Federal categorical standard should not deter a city from its obligation to evaluate discharges from all nondomestic users, to identify problem pollutants and to adopt more stringent technically-based local limits, where necessary.

With this understanding in mind, Table 1-1 highlights major differences between categorical standards and local limits. Generalizations that may be drawn from this Table are that local limits are broader in scope, may be more diverse in form, and draw upon POTW discretion and judgment for development.

1.4 POTW DEVELOPMENT OF LOCAL LIMITS

This section provides a brief overview of the steps associated with local limits development. The audience for this discussion includes POTWs with local pretreatment programs and those which, though not required to develop programs, must develop local limits to prevent recurring industry-related problems. Moreover, POTWs using this manual may be at different stages in local limits development -- from first time development, to complete reevaluation and revision, to development of limits for additional pollutants. They likely possess different technical resources at their disposal. As such, this discussion is intended to give a general sense of the local limits process and to serve as a guide for the more detailed technical discussions which follow in subsequent chapters.

1.4.1 Overview of the Local Limits Process

An overview of the local limits development process is presented in Figure 1-1. Local limits development requires a POTW to use site-specific data to identify pollutants of concern which might reasonably be expected to be discharged in quantities sufficient to cause plant or environmental problems. The process for identifying pollutants of concern, through characterizing industrial discharges, monitoring of POTW influent, effluent and sludge, and reviewing pollutant effects on plant operations, and environmental protection criteria, is discussed in detail in Chapter 2.

Once the pollutants of concern and the sources discharging them have been identified, the POTW must select the most effective technical approach for limits development. As is shown in Figure 1-1, several methods are available depending on the nature of the potential problem. Each approach is described briefly below.

- Allowable Headworks Loading Method: In this procedure, a POTW converts environmental and plant protection criteria into maximum allowable headworks loadings that, if received, would still enable the POTW to meet environmental limits and avoid plant interference. Allowable headworks loadings are calculated by the POTW on a pollutant-by-pollutant basis for each plant process and environmental objective relevant to the POTW. For example, the maximum amount of zinc which can safely be received by the plant without inhibiting sludge digestion is calculated, as well as the maximum zinc load which would allow for compliance with the POTW's NPDES permit limits. This procedure is performed for each criteria and the resulting loadings are compared. The lowest value (mass loading) for each pollutant is identified and serves as the basis for identifying the need for a local limit. If the allowable headworks loading for a particular pollutant is well above that loading currently received by a POTW, a local limit may not be necessary. However, if POTW influent loadings

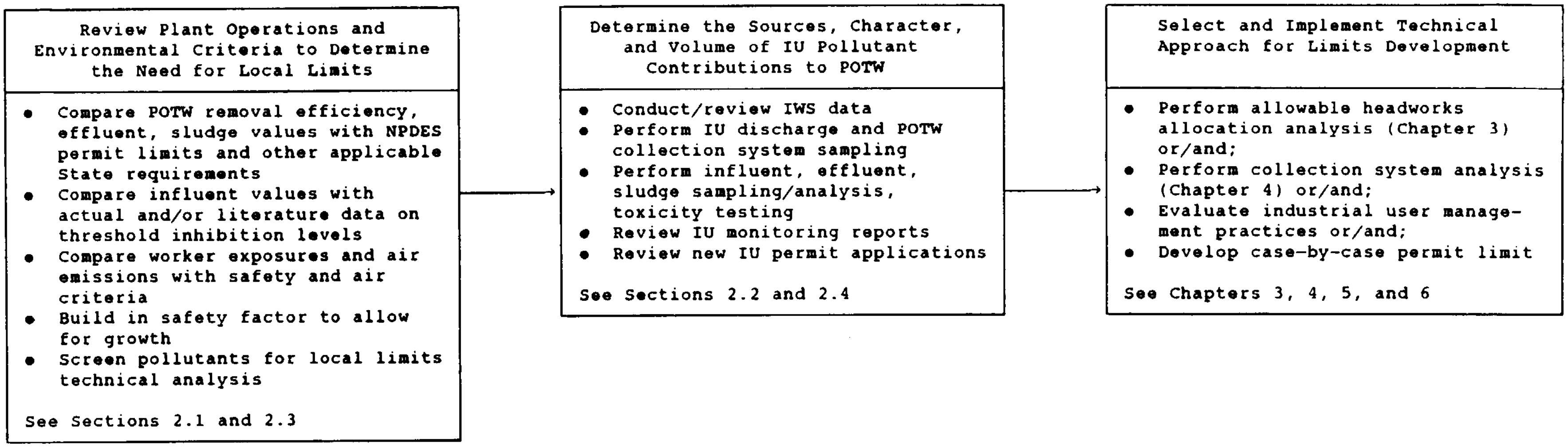

FIGURE 1-1. OVERVIEW OF LOCAL LIMITS PROCESS

approach or exceed the allowable headworks loading, the need for a limit will have been established.

- Collection System Approach: Using this approach, a POTW can identify pollutants which may cause air releases, explosive conditions, or otherwise endanger worker health and safety. These pollutants can then be controlled by numeric local limits and/or industrial user management practice plans. This approach requires system sampling and analysis to identify pollutants present in the collection system. Pollutants detected in the collection system are evaluated to determine their propensity to change from a liquid phase to a gaseous phase. This screening evaluation is performed using the Henry's Law Constant for each pollutant, a measure of the compound's equilibrium in water. For those pollutants shown to volatilize, comparisons are then made with worker health exposure criteria, threshold limiting values (TLVs), and lower explosive limits (LELs) (the minimum concentration in air which will combust or explode). Where threshold limiting values or lower explosive limits are predicted to be exceeded as a result of a pollutant discharge, the need for further monitoring to confirm the problem and, if appropriate, a local limit or management practice plan is indicated. The use of flashpoint limits (the minimum temperature at which the combustion of a compound will propagate away from an ignition source) to prevent the discharge of ignitable wastes is also recommended.

- Industrial User Management Practice Plans: This approach embodies several methods a POTW may use to reduce industrial user pollutant discharges by requiring IUs to develop management practice plans for handling of chemicals and wastes. The methods available are particularly effective for control of episodic or highly variable discharges such as spills, and batch and slug discharges. To accomplish this approach, a POTW takes steps to understand an industrial user's operations by monitoring discharges, inspecting facilities, and reviewing IU reports. Depending on the nature of the discharge problem, the POTW then requires the IU to develop and implement a management plan as an enforceable pretreatment requirement to reduce or eliminate the impacts associated with the discharge. Appropriate management plans may address spill prevention and containment, chemical management practices (e.g., chemical substitution, recycling, and chemical segregation) and best management practices addressing housekeeping practices. A management practice plan requirement can be viewed as a type of narrative local limit. POTWs may include numeric local limits as a part of, or in addition to, industrial user management practices to enhance their effectiveness.

- Case-by-Case Permitting: In this approach a POTW sets numeric local limits based on removals which can be achieved with available technology(ies) which are known to be economically affordable. POTW engineers establish specific limits based on their best professional judgment making use of data on removal efficiencies and economic achievability for pollution control from comparable industries/discharges. This approach is particularly suitable where effects data for specific pollutants is not sufficient to use other approaches, but where a degree of control is indicated as a result of observable effects (e.g., toxicity testing, fishkills, plant inhibition, etc.)

Some of these approaches are suited to specific problems and pollutants (e.g., pass-through is best addressed by the allowable headworks loading method). Others can be used in conjunction with each other (e.g., allowable headworks loading method with industrial user management practices). The technical approach used by a POTW to develop local limits is principally a local decision, provided that the resulting limits are enforceable and scientifically-based.

1.4.2 Planning Considerations in Local Limits Development

The preceding discussion presented an overview of technical bases for the local limits development process, highlighting technical approaches which a POTW may use to establish local limits. In this section, planning issues associated with local limits are introduced. Issues discussed here include: 1) the need to update and revise local limits; 2) institution of an ongoing monitoring program to support local limits development; 3) selection of local limits allocation methods; 4) employment of an effective control mechanism to impose local limits; and 5) ensuring public participation. These topics, while divergent in subject matter, represent critical considerations in planning and implementing local limits. Proper attention to these issues early on in the limits development process may assist POTWs in analyzing options, making effective use of resources and minimizing or eliminating the need for frequent local limits revisions.

1.4.2.1 Updating Local Limits

Local limits development is not a one-time event for POTWs. Local limits should be periodically reviewed and revised as necessary to respond to changes in Federal or State regulations, environmental protection criteria, plant design and operational criteria, and the nature of industrial contributions to POTW influent. To the extent that a POTW can anticipate changes and develop appropriately protective local limits, the need to revise a particular local limit in the future may be reduced. For example, if a POTW knows or can anticipate that economic growth is occurring in its service area, it should factor in a growth margin so that all of the allowable headworks loading is not used up by existing industrial users. Otherwise, additional industrial hook-ups would be prohibited and/or local limits would have to be modified.

Similarly, if a POTW anticipates changing its sludge disposal practices in the near future, the POTW should develop local limits now which are protective of any more restrictive sludge use. By use of foresight, POTWs can extend the validity of their local limits to the projected term of an IU permit (typically one to five years). Effective planning will eliminate frequent local limits modifications which may tax POTW resources and weaken IU compliance efforts.

POTWs, nonetheless, should evaluate the need to update local limits when there are changes in: (1) the limiting criteria on which local limits are based, and/or (2) the flow rate and characteristics of industrial contributions (including connection of additional industrial users). Examples of potential changes that would affect criteria used in deriving local limits include:

- Changes in NPDES permit limits to include additional or more restrictive toxic pollutant limits, including organic pollutants
- Changes in water quality limits including toxicity requirements
- Changes in sludge disposal standards or POTW disposal methods
- Modifications to the treatment plant, causing changes in the process removal efficiencies and tolerance to inhibition from pollutants
- Availability of additional site-specific data pertaining to pollutant removal efficiencies and/or process inhibition.

Potential changes in industrial contributions include:

- Connection to the POTW of new industrial users
- Addition of new processes at existing industrial users
- Shutdown of industrial users or discontinuation of process discharges
- Changes to existing industrial user processes, including chemical substitutions, expected to alter pollutant characteristics and loadings to the POTW
- Alteration of pretreatment operations.

The industrial waste survey should be reviewed periodically to determine if any of the above factors have substantially changed. Upon conducting such a review, the POTW should update its existing local limits as necessary and/or develop new local limits to cover additional pollutants. Any such changes in local limits are considered to be a modification of the POTW's pretreatment program, and as such need to be submitted to, and approved by, the Approval Authority.

EPA encourages POTWs to reevaluate local limits that were adopted without a sound technical basis, particularly if these limits were so poorly justified that they could be unenforceable by the POTW. In some cases, it may be appropriate for a POTW to relax limits that fall into this category. However, the POTW must first demonstrate that the revised limits will satisfy all of the minimum Federal and State requirements and will adequately protect instream water quality and sludge quality. If the analysis does show that local limits can be relaxed, the POTW should determine whether the relaxation will result in new or increased discharges from IUs which will affect the volume or character of the POTW influent or effluent. If so, they must notify the NPDES permitting authority pursuant to 40 CFR 122.42(b). A determination will then be made as to whether the discharge can be allowed, consistent with the State's antidegradation policy, 40 CFR §131.12, and the Clean Water Act §303.

1.4.2.2 Ongoing Monitoring Program

Critical to successful development and updating of local limits is the existence of comprehensive data on IU discharges, conditions in the collection system, and characteristics of the POTW influent, effluent, and sludge. Sections 2.4 and 2.5 of this manual outline basic monitoring requirements necessary to support local limits development. An adequate monitoring program may not be provided by existing POTW efforts. By identifying additional requirements early and phasing in supplemental improvements, POTWs will have sufficient data to update and revise local limits as changes dictate.

1.4.2.3 Selection of Alternative Allocation Methods

POTWs which develop local limits may choose a variety of allocation methods. As will later be discussed in Section 3.3, EPA does not dictate any single specific local limits implementation procedure. Rather, local limits may be allocated and imposed in any number of ways, such as:

- Uniform maximum allowable concentrations based on the total flow from all industrial users
- Concentration limits based on allocation of pollutant loadings to only those industries contributing the pollutant of concern
- Proportionate reduction of the pollutant by each industrial user that discharges the pollutant, based on the industrial user's mass loading
- Technology-based limitations applied selectively to the significant dischargers of a chosen pollutant

The method of control remains the POTW's option, so long as the method selected does not result in an exceedance of the maximum allowable headworks loadings. Choice of a particular allocation method may have consequences in terms of the control mechanism a POTW uses to impose the limit. This is discussed briefly in the following subsection.

1.4.2.4 Use of an Appropriate Control Mechanism

Another planning consideration in local limits development is how the POTW will impose its limits on an industrial user. POTWs have discretion in the selection of a control mechanism through which local limits are applied to industrial users (e.g., ordinance, permit, order, etc.) However, it is highly unlikely that an ordinance-only system would be adequate with any allocation method except the uniform maximum allowable concentration method. An individual control mechanism such as a permit is necessary for effective operation in all but the simplest of IU-POTW relationships. Even in those situations where there is one uniform set of local limits for all IUs, an individual control mechanism is desirable to specify monitoring locations and frequency, special conditions such as solvent management plans or spill prevention plans, applicable categorical standards, reporting requirements and to provide clear notification to IUs as required by 40 CFR §403.8 of the General Pretreatment Regulations.

1.4.2.5 Public Participation

A final planning consideration that POTWs should remember is that Federal regulations require POTWs to provide individual notice and an opportunity to respond to affected persons and groups before final promulgation of a local limit [40 CFR §403.5(c)(3)]. POTWs should allow sufficient time in their limits development process to allow for public participation. In addition, the possibility of technical challenges on the rationale for a particular local limit during public participation argues for thorough documentation and recordkeeping as a part of a POTW's local limits development process.

1.5 ORGANIZATION OF THE MANUAL

As suggested originally, the principal focus of this manual is on technical issues associated with local limits development. Each of the following chapters provides specific information on technical steps for limits development:

- Chapter 2 - Identifying Sources and Pollutants of Concern - details environmental and plant concerns to be addressed; identifies key sources warranting attention and ways to characterize nondomestic discharges; specifies sources of key environmental and plant protection criteria and describes appropriate sampling and analysis, and toxicity testing methods which may be employed.

- Chapter 3 - Local Limits Development by the Allowable Headworks Loading Method - describes allowable headworks loading methods; specifies techniques to prevent pass through and interference; discusses alternative allocation scenarios.

- Chapter 4 - Local Limits Development to Address Collection System Problems - describes techniques to set local limits to prevent fire and explosion, corrosion, flow obstruction, temperature and worker health and safety concerns in POTW collection systems.

- Chapter 5 - Industrial User Management Practices - outlines approaches to control problem pollutants through solvent management, spill prevention and chemical management plans.

- Chapter 6 - Case-by-Case Permitting of Industrial Users - provides an overview of methods to establish technology-based limits for IU discharges on a case-specific basis.

TABLE 1-1. COMPARISON OF FEATURES ASSOCIATED WITH CATEGORICAL STANDARDS AND LOCAL LIMITS

CHARACTERISTIC	CATEGORICAL STANDARDS	LOCAL LIMITS
Agency Responsible for Development	EPA	POTWs (Control Authority)
Potential Sources Regulated	Industries specified in Clean Water Act (CWA) or by EPA	All nondomestic users
Objective	Baseline requirement	Local environmental and plant objectives
Pollutants Regulated	Primarily priority pollutants listed under Section 307 of CWA, although not limited to priority pollutants	All pollutants - priority/non-priority
Basis	Technology (BAT or NSPS) or Management Practice (e.g., solvent management plan)	Any technically-based method including: - Allowable headworks loading method - Toxicity reduction evaluation - Technology-based - Management practice
Applicability	Apply to particular regulated wastestreams within certain industrial subcategories	Apply to all nondomestic users either uniformly or case-by-case
Type of Limit	Several: production-based or concentration-based numerical limits, discharge prohibition, or management practice plan requirements	Several: production-based or concentration-based numerical limits, discharge prohibition, or management practice plan requirements
Point of Application	Usually end of regulated process	Usually at point of discharge to collection system

2. IDENTIFYING SOURCES AND POLLUTANTS OF CONCERN

Activities conducted for the development of local limits consist of identifying areas of concern, gathering requisite data on the sources and pollutants of concern, and calculating local limits. During development of local limits, the POTW:

Step 1 Identifies the concerns it must address through local limits development in order to meet Federal, State and local requirements;

Step 2 Identifies the sources and pollutants which should be limited in order to address those concerns as follows:

- Characterizing industrial discharges
- Review of applicable environmental protection criteria and pollutant effects data
- Monitoring of IU discharges, POTW collection system and treatment plant.

Step 3 Calculates local limits for the identified pollutants of concern.

Section 2.1 of this Chapter identifies the various concerns that may be addressed by local limits. Sections 2.2 through 2.4 discuss the three elements of identifying sources and pollutants of concern. The third step listed above, calculating local limits, is discussed in Chapters 3 through 6.

2.1 CONCERNS TO BE ADDRESSED

A POTW's local limits must, at a minimum, be based on meeting the statutory and regulatory requirements as expressed in the Clean Water Act and General Pretreatment Regulations and any applicable State and local requirements, as stated in Chapter 1. Since individual NPDES permit conditions, sludge disposal practices, and State and local requirements vary from POTW to POTW, there are a variety of concerns which potentially must be addressed through local limits. As part of the process of developing local limits, it will be useful for the POTW at the outset, to list the concerns or objectives that it needs to address. The types of concerns that a POTW is likely to be required to address as a result of Federal, State or local requirements include the following:

- Water quality protection
- Sludge quality protection
- Operational problems
- Worker health and safety
- Air emissions.

This section discusses each of these concerns in some detail. Later sections of the manual provide technical guidance that should be useful in developing local limits to address these concerns.

2.1.2 Water Quality Protection

POTWs are required to prohibit IU discharges in amounts that result in violation of water quality-based NPDES permit limits. These permit limits are often based on specific water quality standards and are generally expressed as numeric standards. Additionally, many NPDES permits include a requirement similar to the following: "All waters shall be maintained free of toxic substances in concentrations that are toxic to or that produce detrimental physiological responses in human, plant, animal, or aquatic life." Thus, based on this narrative toxicity prohibition, POTWs must identify additional pollutants of concern or comply with specific toxicity limitations.

POTWs should utilize toxicity-based approaches and chemical specific approaches involving applicable water quality standards or criteria in order to comply with such requirements. Water quality criteria have been developed by EPA, and implemented as standards by many State agencies. Water quality criteria/standards are often based on stream reach classification, hardness, and other factors. The POTW should obtain receiving stream water quality standards or criteria by contacting the appropriate State agency. Section 3.2.1.2 discusses procedures for developing local limits that are based on water quality standards/criteria.

In addition to developing local limits based on water quality standards/criteria, POTWs may need to develop local limits that are based on reducing aquatic toxicity. A brief discussion of toxicity reduction evaluations is presented in Section 2.6.1.

2.1.3 Sludge Protection

POTWs are required to prohibit IU discharges in amounts that cause violation of applicable sludge disposal or use regulations, or restrict the POTW from using its chosen sludge disposal or use option. The importance of this requirement is underscored by the recent Clean Water Act amendments which require the incorporation of sludge criteria and requirements into all NPDES permits when they are issued or reissued. EPA has prepared interim guidance on what presently must be incorporated into permits to comply with these amendments. In addition, the Agency is developing new regulations that will set forth pollutant-specific criteria relevant to disposal and use practices [see Section 3.2.2.2 for a more detailed discussion of applicable limits]. Thus, POTWs applying sludges to cropland or composting for example, must develop local limits to avoid violations of applicable State and Federal sludge disposal limitations (see definition of interference, Section 1.3.1). When IU discharges render sludge unsuitable for land application and necessitate landfilling, incineration, or additional treatment of sludges, the POTW not only must pay the costs of additional treatment, but may lose the revenue obtained from selling sludge. This is considered interference.

POTWs that normally dispose of sludge through landfilling or incineration may also be adversely affected by certain IU discharges and should develop local limits that assure their method of sludge disposal will not be restricted. POTWs that practice sludge incineration may be regulated by air quality standards (see Section 2.1.6). Sludges and residual ashes resulting from the incineration of sludges, destined for landfills should be tested for EP toxicity (see Section 3.2.2.3). As discussed in Section 3.2.2.3, exceeding EP toxicity concentrations may result in the need to dispose of the residuals in a hazardous waste landfill. The costs of disposal in such landfills greatly exceeds that of disposal in solid waste landfills.

2.1.4 Operational Problems

Receipt of some industrial wastes may interfere with POTW operations, resulting in a violation of NPDES permit conditions calling for specific removal efficiencies to be achieved and for the plant to be well-operated and maintained. Moreover, some discharges of pollutants, while not causing POTW NPDES permit violations or violations of sludge disposal regulations, can nevertheless disrupt POTW operations, increase POTW operation and maintenance costs, and may cause violations of specific prohibitions. For example, IU discharges that inhibit the POTW's biological treatment systems result in reduced POTW efficiency and, as a result, increased operating costs. At worst, process inhibition may necessitate reseeding and stabilization of the treatment unit. In addition, process inhibition or upset may result in the production of sludges that require either special treatment before disposal, or disposal in a manner not generally practiced by the POTW. This would be considered interference.

POTWs may need to develop local limits to resolve these problems. Section 3.2.2.1 discusses procedures POTWs can follow in setting local limits based on biological process inhibition data. Chapter 4 discusses ways to avoid O&M problems in collection systems through local limits.

2.1.5 Worker Health and Safety

Flammable/explosive and/or fume toxic pollutants discharged to POTWs can pose a threat to the health and safety of POTW workers. Local limits can be used to regulate the discharge of flammable/explosive and/or fume toxic pollutants. POTW workers may be susceptible to the inhalation of toxic gases that form or accumulate in collection systems. The vapors of volatile organic compounds (VOCs) are of major concern since they may be both toxic and carcinogenic, and may produce both acute and chronic health effects over various periods of exposure. Also of concern are the hazards associated with the toxic gases produced when certain inorganic discharges mix in the collection system. Acidic discharges, when combined with certain nonvolatile substances such as sulfide and cyanide, can produce toxic gases/vapors that are hazardous to humans (e.g., hydrogen sulfide and hydrogen cyanide gases).

In response to the potential hazards to human health associated with toxic vapors, POTWs may establish local limits based on the maximum recommended VOC levels in air. Section 4.2 provides guidance for developing local limits based on worker health and safety concerns as they relate to the accumulation of toxic gases.

Explosion and fire hazards comprise an additional health and safety concern for POTW workers. Accumulation of volatile substances in the treatment works can produce an influent that ignites or explodes under the proper conditions, potentially injuring POTW workers. Oxygen-activated sludge tanks and confined headworks are examples of areas of concern for fire and explosion hazards in treatment plants. Fire and explosion hazards are regulated under the specific prohibitions of 40 CFR 403.5(b). Development of local limits for those pollutants which pose fire or explosion hazards to POTWs is discussed in Section 4.1.1.

2.1.6 Air Emissions

The General Pretreatment Regulations do not require the adoption of local limits to protect air quality unless there are air quality standards associated with the POTW's sludge use or disposal practice. However, POTWs may choose to adopt local limits for this purpose, or may be required to do so by the State.

Emissions from sewage sludge management and disposal activities may be regulated under three separate regulatory programs under the Clean Air Act. The first two programs involve Federal standards that limit emissions from sewage sludge incinerators regardless of their location. The third Federal program is comprised of National Ambient Air Quality Standards (NAAQS), and State air pollution control regulations that are imposed on emissions in order to attain NAAQS. These regulations vary from State to State, and according to local air quality conditions. States and localities may also have their own air quality regulations and control requirements in addition to those associated with the Federal rule. Each of the three regulatory programs is discussed in more detail below.

The first rule is the New Source Performance Standard (NSPS) for particulate emissions from sewage sludge incinerators under Section 111 of the Clean Air Act. This standard (40 CFR 60, Subpart O) requires that incinerators constructed after June 11, 1973 emit no more than 0.65 grams of particulates per kilogram of dry sludge input, or 1.30 lb/ton of dry sludge input. In addition, the regulation prohibits the discharge of gases that exhibit 20 percent opacity or greater. EPA is now considering revisions to the standard that would leave the emission limits unchanged, but require additional monitoring and recordkeeping, and more thorough compliance tests. The purpose of the revisions is to help ensure proper operation and maintenance of the incinerator, thereby reducing air emissions through more complete combustion.

As the Section 111 NSPS limitations for particulate matter are not pollutant-specific, and compliance with these limitations is dependent on proper POTW sludge incinerator operations rather than on industrial user pollutant discharge limitations, local limits cannot be based on Section 111 NSPS limitations.

The second set of regulations consists of the two National Emission Standards for Hazardous Air Pollutants (NESHAP) under Section 112 of the Clean Air Act. These two standards limit particulate beryllium and total* mercury emissions from sewage sludge incinerators. If the incinerator was constructed or modified after June 11, 1973, the incinerator must also comply with the NSPS particulate matter limitations as just described. The requirements of all of these air quality standards apply independently. The standard for beryllium (40 CFR 61, Subpart C) limits particulate beryllium emissions from **all** sewage sludge incinerators to 10 grams over a 24-hour period. Alternatively, the plant operators may choose to comply with an ambient concentration limit of 0.01 $\mu g/m^3$ averaged over a 30-day period. The NESHAP for mercury (40 CFR 61, Subpart E) limits total mercury emissions to 3200 grams per 24-hour period.**

The standards under Sections 111 and 112 just described apply regardless of the incinerator's location. Under the third Clean Water Act program, regulatory requirements may vary from State to State, and from location to location within a State. Section 109 of the Clean Air Act directs EPA to set National Ambient Air Quality Standards (NAAQS) that apply to the entire nation. Section 110 provides for the States to develop State Implementation Plans (SIPs) that contain regulatory requirements for specific sources designed to achieve and maintain compliance with EPA's ambient standards (NAAQS).

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* The mercury standard applies to emissions of "mercury in particulates, vapors, aerosols, and compounds" [40 CFR 61.51(a)].

**Compliance with this limitation is determined by analyzing sludge for total mercury, as per analytical procedures detailed in 40 CFR 61, Appendix B, Method 105.

On July 1, 1987, EPA promulgated a final regulation that set a new NAAQS for particulate matter. This particulate matter standard (52 FR 24634-24750, July 1, 1987) applies to particles with an aerodynamic diameter of less than 10 microns, referred to here as PM_{10}. The primary NAAQS for PM_{10} consist of an expected annual arithmetic mean of 50 micrograms per cubic meter ($\mu g/m^3$) with no more than one expected exceedance per year. The primary NAAQS are set at a level necessary to protect human health. The secondary NAAQS for PM_{10} are an annual geometric mean of 60 $\mu g/m^3$ and a maximum 24-hour concentration of 150 $\mu g/m^3$ not to be exceeded more than once a year. Secondary NAAQS are set at a level necessary to prevent welfare effects of air pollution (e.g., materials or crop damage). As EPA and the States implement the new PM_{10} standards, and identify the attainment status of communities, additional control requirements may be established.

Another applicable ambient standard which is perhaps more relevant to the POTW's local limits development program is NAAQS for particulate lead. The particulate lead NAAQS (40 CFR 50, §50.12) is a maximum arithmetic mean of 1.5 micrograms per cubic meter averaged over a calendar quarter.

The State or local regulations that are imposed on sources of particulate matter and particulate lead emissions vary from State to State based on regional air quality conditions and the nature and number of air pollution sources. The regulations that may be imposed on a POTW include additional restrictions on particulate or particulate lead emissions from sewage sludge incinerators, controls on fugitive emissions from sewage sludge piles, or emissions associated with handling of sludge, including the operation of heavy equipment and the particulate emissions that they may cause. The plant owner/operator should contact both the local air quality agency (if one exists) and the State air pollution control agency to determine the source-specific control requirements that may apply to a given POTW. These may include State/local requirements that are not related to Federal regulatory programs. If State or local lead air quality regulations apply to a POTW, the POTW is required to assess the need for lead local limits which will ensure compliance with these air quality regulations.

EPA is also examining POTWs as a source of VOC emissions, and may develop a Control Techniques Guidance (CTG) document for use by the States in controlling industrial discharges of VOC-containing wastewaters to public sewer systems. Volatilization may occur from the sewer system, or at the treatment plant itself. The largest amount of VOC emissions occur at POTWs that have a large number of industrial users that discharge VOC bearing wastewaters to the public sewer system, although some volatilization probably occurs at all plants because of consumer use of solvents and other products, and sewer discharges from small businesses such as machine shops and gasoline stations.

As with particulate matter, VOC emissions are of regulatory concern both because of their contribution to ambient concentrations of a pollutant regulated by an NAAQS (i.e., ozone), and the toxicity of individual compounds. No Federal air quality regulations now exist that control VOC emissions from POTWs. EPA has not developed an NSPS for air emissions from POTWs, nor has EPA developed a hazardous air pollutant standard. EPA has assessed emissions of seven toxic organics and VOC emissions from POTWs (51). EPA plans to continue to assess, and possibly require, some industrial categories to reduce the VOC content of their sewer discharges. These requirements may in turn lead to future requirements for POTWs to establish local limits on VOC discharges.

The NAAQS for ozone (40 CFR 50, §50.9) is currently 0.12 parts per million or 235 $\mu g/m^3$. Many metropolitan areas across the country have not yet attained the ambient standard, and EPA and the States are trying to achieve additional VOC emission reductions. As more pressure is applied to reduce VOC emissions and thereby reduce ozone concentrations, regulatory authorities may begin to emphasize regulation of wastewater treatment facilities. Such regulation, in turn, would likely be the driving force for establishing additional POTW local limits development requirements. EPA is currently considering whether to make the ozone NAAQS more restrictive, which could have the effect of increasing the intensity of the search for new VOC control opportunities.

POTW owner/operators should contact both local and State air quality control agencies to determine whether there are regulatory requirements that apply to their facility.

2.2 CHARACTERIZING INDUSTRIAL DISCHARGES

Once the POTW has identified the concerns that should be addressed by the development of local limits, the specific pollutants of concern should be identified. This identification procedure should begin with an evaluation of industrial users and their discharge characteristics. The following sections deal with data sources available to help characterize IU discharges and also briefly discusses three types of IU discharges which may be of particular concern to POTWs or with which they may be less familiar.

2.2.1 Industrial User Discharges

POTWs cannot make informed decisions concerning potential problem discharges in the absence of a comprehensive data base on industrial contributions to their systems. There are numerous sources that a POTW can draw on to obtain information about its industrial users and the composition and quanitities of their discharges.

Critical to a thorough evaluation of industrial users is the performance and maintenance of a complete industrial waste survey (IWS). The IWS is one of the most effective methods for obtaining comprehensive information about the users of the POTW. All industrial users, including commercial users such as gasoline stations and dry cleaners, should be included in the IWS. A typical IWS may require submission of some or all of the following information from each IU:

- Name
- Address
- Standard Industrial Classification (SIC) Code
- Wastewater flow
- Types and concentrations of pollutants in discharge(s)
- Major products manufactured and/or services rendered
- Locations of discharge points
- Process diagram and/or descriptions
- An inventory of raw feedstocks, including periodically used solvents, surfactants, pesticides, etc.

- Results of inspections, including documentation of spills, compliance history, general practices
- Treatment processes, and management practices such as spill prevention plans and solvent management plans, employed
- Discharge practices, such as batch versus continuous, variability in waste constituent concentrations and types, discharges volume
- Pollutant characteristics data (i.e., carcinogenicity, toxicity, mutagenicity, neurotoxicity, volatility, explosivity, treatability, biodegradability, bioaccumulative tendency).

The IWS should request any additional information that may be useful to the POTW in identifying and assessing the pollutants of concern discharged, or potentially discharged, by the IU. Complete and up-to-date data are invaluable to POTWs in accomplishing the following:

- Identifying previously unknown characteristics of an IU and its discharges
- Evaluating the potential for slug loadings
- Planning a logical monitoring/sampling strategy that will ensure efficient use of POTW resources
- Estimating raw waste loadings of pollutants for which analytical methods are unavailable.

Although most POTWs should have already conducted an IWS, the survey must be periodically updated to be useful. Guidance on conducting an IWS is provided in EPA's Guidance Manual for POTW Pretreatment Program Development.

IWS data may be reviewed in conjunction with the pollutant occurrence matrices provided in Appendix C. The matrices present information on the types of pollutants expected in the discharges from various industrial groups.

In addition to the IWS, the following sources of information will aid the POTW in identifying pollutants of concern:

- The IU's permit application
- EPA Development Documents for Categorical Industries (see Appendix D). Development documents sumarize processes employed at categorical

industries, typical treatment technologies, and priority pollutants detected in discharge from categorical industries. (Available from the National Technical Information Service.)

- EPA Pretreatment Guidance Manuals*. Guidance Manuals provide lists of the priority pollutants characteristic of discharges from various categorical industries. (See Appendix A.)

- Data bases compiled by the North Carolina Department of Natural Resources and Community Development**. These data bases consist of reports of POTW effluent toxicity and the associated discharges of toxics from industrial users. In addition, the data bases contain information that chemical manufacturers have provided on the chemical characteristics (i.e., measured toxicity) of biocidal compounds.

- Michigan Critical Materials Register***. This data base, published by the Michigan Department of Natural Resources, provides information on pollutant properties such as toxicity, carcinogenicity, bioconcentration, mutagenicity, and teratogenicity, as well as information on the types of pollutants used or discharged by various industries. The data base includes both priority and nonpriority pollutants, and is developed from actual sampling data and information supplied by industries.

- State and Regional NPDES permitting authorities. NPDES permitting authorities maintained databases of pollutants detected in direct discharger effluents. POTWs can review the data to identify those pollutants that may be discharged by similar indirect dischargers.

- Industrial Users. POTWs, through a permit or ordinance mechanism, can require IUs to provide toxicity data for pollutants detected in the IU's wastewater. Industries can often obtain such data from the manufacturers of raw feedstocks, solvents, surfactants, pesticides, etc.

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* Currently available manuals: "Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards," U.S. Environmental Protection Agency Effluent Guidelines Division, Washington, D.C., February, 1984. "Guidance Manual for Pulp, Paper, and Paperboard and Builders' Paper and Board Mills Pretreatment Standards," U.S. Environmental Protection Agency Effluent Guidelines Division, Washington, D.C., July, 1984. "Guidance Manual for Iron and Steel Manufacturing Pretreatment Standards," U.S. Environmental Protection Agency Industrial Technology Division, Washington, D.C., September, 1985.

** Information on this data base can be obtained from the North Carolina Division of Environmental Management, Water Quality Section, P.O. Box 27687, Raleigh, NC 27611.

***Available from: Mr. Gray Butterfield, Michigan Department of Natural Resources, Lansing, MI 48909.

- RCRA Form 8700-12. Facilities that generate hazardous waste must submit Form 8700-12 to the appropriate State or Regional agency (see Appendix E). The form contains a description of waste types and volumes generated at the facility, as well as a description of the facility's disposal practices. The RCRA regulations that define a hazardous waste (40 CFR Part 261) list the waste constituents that correspond to the waste codes used on Form 8700-12 and identify specific industrial hazardous wastes and some of their constituents.

Collection and review of existing data sources is an important intitial step in identification of pollutants of concern. It can be used to direct further sampling and analytical work and can identify industrial/commercial soures that may need control.

2.2.2. <u>RCRA Hazardous Wastes</u>

The acceptance of Resource Conservation and Recovery Act (RCRA) defined hazardous wastes by a POTW may require considerable resources for continued compliance with CWA and RCRA requirements. Hazardous wastes may be legally introduced into a POTW by one of two means -- either discharged to the collection system via an industrial facility's normal sewer connection, or transported to the POTW treatment plant (inside the treatment plant property boundary) via truck, rail, or dedicated pipeline.

RCRA hazardous wastes, when mixed with domestic sewage in the POTW's collection system prior to reaching the treatment plant's property boundary, are excluded from regulation under RCRA by the Domestic Sewage Exclusion (DSE). The exclusion applies only after the wastes are mixed. Hazardous wastes are still subject to RCRA until they are discharged to the POTW and mixed with domestic sewage. As RCRA regulations become more restrictive due to the Hazardous and Solid Waste Amendments of 1984, there are increased incentives for industry to take advantage of the DSE. Realizing this fact, municipal officials should identify the industrial activities that generate and discharge hazardous wastes so that they are able to control and manage these wastes. While exempt under RCRA, these wastes are subject to full regulations and control under the Clean Water Act and must meet all applicable categorical and local discharge limitations.

Hazardous wastes may be received directly at a POTW by truck, rail, or dedicated pipe only if the POTW is in compliance with RCRA requirements for treatment, storage, and disposal facilities (TSDFs) [see 40 CFR 270.60]. The responsibilities and liabilities of POTWs accepting wastes by truck, rail or dedicated pipe are explained in summary form in Appendix F, while detailed guidance is available in EPA's Guidance Manual for the Identification of Hazardous Wastes Delivered to POTWs by Truck, Rail or Dedicated Pipeline (February, 1987).

If POTWs are aware of hazardous waste discharges to the sewer, they should determine which pollutants are present and at what concentrations. The fact that a waste is a listed or characteristic hazardous waste under RCRA provides only limited information on its chemical constituents, and none at all on chemical concentration.

2.2.3 CERCLA Wastes

The 888 facilities on (or proposed for) the National Priority List make up only a small portion of the almost 21,000 hazardous sites (including Federal, State and local) that will either require or are in the process of clean-up. Of the sites that are on the National Priority List, it is estimated that approximately 10 percent will ultimately truck some clean-up wastes to sewage treatment plants.

Types and sources of wastewaters resulting from site clean-ups that may be trucked to POTWs include: leachate from landfills, contaminated ground water, aqueous wastes stored in containers, tanks and surface impoundments, treatment sludges from remedial treatment at clean-up sites, and runoff from contaminated soils. Approximately 400 different chemicals have been characterized at NPL[1] sites, with the 10 most common being trichloroethylene, lead, toluene, benzene, PCBs, chloroform, tetrachloroethylene, phenol, arsenic and cadmium. This frequency of occurrence provides no indication of the concentrations at which specific compounds were measured. While many CERCLA wastes are quite dilute, some sites have reported high concentration of metals and organics (chromium at 1758 mg/l, bis(2-chloroethyl) ether at 210 mg/l and chloroform at 200 mg/l).

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[1] Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works. USEPA, EPA/530-SW-86-004, February 1986.

POTWs contemplating the acceptance of CERCLA clean-up wastes should require detailed chemical analyses and treatability testing before any decisions are made regarding actual acceptance of the waste. These data can then be used to determine the presence of pollutants of concern (see Section 2.3).

2.2.4 Hauled Wastes

Many POTWs have historically accepted hauled septage and instituted a charge for the waste accepted. However, in accepting hauled wastes little consideration is generally given to the potential for industrial wastes being discharged along with domestic sewage.

POTWs with Federally-required pretreatment programs must have adequate legal authority to regulate their waste haulers, as 405.1(b) of the General Pretreatment Regulation states that "This regulation applies to pollutants from non-domestic sources covered by Pretreatment Standards which are indirectly discharged into or transported by truck or rail or otherwise introduced into POTWs . . ." Also, Section 403.5 of the Pretreatment Regulations applies Prohibited and Specific Discharge Standards "to all non-domestic sources introducing pollutants into a POTW".

In making or reviewing the decision to accept hauled wastes, municipal officials are confronted with a variety of options and decisions. Major points for consideration are provided below:

- Acceptance of domestic/industrial wastes

  POTWs should consider accepting only domestic wastes from septage haulers, and adjust the language on their sewer use ordinances to reflect this. If industrial wastes are not prohibited, the inspector must determine if categorical wastes are present and require compliance with Federal Standards. If industrial wastes are accepted from haulers, it may also be more difficult to discriminate between illegal discharges of hazardous wastes and legal discharges of industrial wastes. Generally, hauled hazardous wastes can be discharged legally only within the treatment plant property boundary and not to the collection system. The POTW must also meet RCRA requirements for a hazardous waste treatment/storage/disposal facility (see Section 2.2.2). Thus, if hauled wastes are accepted at discharge points in the collection system, increased documentation of the sources of the wastes may be necessary to prevent illegal discharges.

- Discharge Site Selection

  In selecting a site for accepting hauled wastes, officials should consider:

  - Site accessibility for trucks
  - Availability of monitoring facilities
  - Site security
  - Proximity to treatment plant.

- Waste Monitoring

  For the POTW's regulations governing waste haulers to be taken seriously, an enforcement process must exist. Enforcement can take the form of random sampling of the discharge and checking documentation accompanying the wastes. Random sampling frequencies should be adjusted in accordance with the amount of industrial waste expected.

- Documentation of Hauled Wastes

  Municipalities may choose to register or permit haulers and require documentation of the source, volume, and character of each load. This documentation could be easily verified with the generator on a routine basis.

- Penalties

  Since nondomestic wastes may potentially upset plant operations, it is important that adequate penalties exist for improper disposal of wastes, or falsification of information on the nature of the hauled wastes. The city council should be involved in carefully considering this issue.

- Cost Recovery

  Once a system of administration and monitoring is established, the cost of implementation should be recovered through charges to the users.

Additional information is available in EPA's Guidance Manual for the Identification of Hazardous Wastes Delivered to POTWs by Truck, Rail, or Dedicated Pipeline (Office of Water Enforcement and Permits, February 1987).

2.3 REVIEW OF ENVIRONMENTAL PROTECTION CRITERIA AND POLLUTANT EFFECTS DATA

Once a POTW has evaluated its industrial users and has determined the pollutants that its IUs are reasonably expected to be discharging to the POTW, it should design a sampling and monitoring program which is thorough enough to verify the actual concentration levels of pollutants expected to be discharged in significant quantities, and broad enough to detect any problem pollutants which were not uncovered by the industrial waste survey. Before designing the sampling program, the POTW may want to review environmental quality criteria/ effects data for pollutants which are potentially of concern. The review of available environmental quality criteria and effects data will help to design an efficient sampling program.

2.3.1 Environmental Protection Criteria and Pollutant Effects Data

Criteria that can be used to identify potential pollutants of concern are listed below. The available data for each of the following criteria are provided for a number of pollutants in Appendix G, and Tables 3-2 through 3-5.

Criteria for Identifying Pollutants Causing Process Inhibition:

- Activated sludge inhibition threshold data
- Trickling filter inhibition threshold data
- Anaerobic digester inhibition threshold data
- Nitrification inhibition threshold data

Criterion for Identifying Chemically Reactive Pollutants:

- National Fire Protection Association (NFPA) hazardous classification

Criteria for Identifying Pollutants with Potential to Endanger POTW Worker Health and Safety:

- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value - Time Weighted Averages (TLV-TWAs): The maximum concentrations of contaminants in air that will not produce adverse health effects in humans who are exposed 8 hours/day, 40 hours/week.

Criteria for Identifying Pollutants with Potential to Pass Through and Degrade Water Quality:

- National Acute Freshwater Quality Criteria: Nonregulatory maximum contaminant levels experimentally derived to protect aquatic life from acute toxicity. Water quality criteria or State water quality standards can be used as a basis for deriving local limits to prevent instream toxicity.

Criteria for Identifying Pollutants with the Potential to Degrade Sludge Quality:

- Pollutants Under Consideration for Municipal Sludge Regulation: Those pollutants originally considered for regulation by EPA during the regulatory development phase of technical sludge disposal criteria (40 CFR Part 503), and

- Pollutants Proposed for Inclusion into the RCRA TCLP Test: Pollutants proposed for regulation by the RCRA Toxicity Characteristic Leaching Procedure (TCLP) described in the Federal Register (Vol. 51, No. 44, June 13, 1986). The TCLP test is a leachate analysis test for sludges, similar to the EP toxicity test.

2.4 MONITORING OF IU DISCHARGES, COLLECTION SYSTEM, AND TREATMENT PLANT TO DETERMINE POLLUTANTS OF CONCERN

A memorandum issued by the EPA Office of Water Enforcement and Permits (contained in Appendix B) stated that POTWs must use site-specific data to identify pollutants of concern. Pollutants of concern were defined as any pollutants which might reasonably be expected to be discharged to the POTW in quantities which could pass through or interfere with the POTW, contaminate the sludge, or jeopardize POTW worker health or safety. The memorandum identified six pollutants which are potentially of concern to all POTWs because of their widespread occurrence in POTW influents and effluents and their possible adverse effects on POTWs. These are cadmium, chromium, copper, lead, nickel, and zinc. In this guidance, EPA is identifying four additional pollutants that all POTWs should presume to be of concern unless screening of their wastewater and sludge shows that they are not present in significant amounts. These are arsenic, cyanide, silver, and mercury. These pollutants are not as widespread in POTW influents as the six metals, but they have particularly low biological process inhibition values and/or aquatic toxicity values. In the case of cyanide, production of toxic sewer gases is also a concern. POTWs should screen for the presence of all ten pollutants using IU survey data as well as influent, effluent, and sludge sampling.

In addition to these ten pollutants, POTWs should consider the full range of priority, conventional, and nonconventional pollutants (as defined by the Clean Water Act) in identifying pollutants of concern. EPA is particularly interested in the organic priority pollutants and the hazardous constituents listed in RCRA Appendix 9. (See Appendix H of this manual.)

To aid in the identification of additional pollutants of concern, the following step by step approach is provided as guidance. The conceptual approach is presented in Figure 2-1.

In identifying pollutants of concern, a two pronged approach may be adopted, based on chemical specific analyses and/or toxicity testing of wastewaters. The chemical specific approach can be further subdivided into concerns relevant to the collection system, and those relevant to the treatment plant.

In branch A (Chemical Specific Approach) of the figure a suggested approach for identifying additional pollutants of concern based on collection system concerns is presented, as follows:

A1 - Monitoring and Screening - The POTW should monitor IU discharges and various points within the collection system as a preliminary screening to detect potential problem discharges. This could entail the use of lower explosive limit (LEL) meters, flash point testers, sampling of volatiles in sewer headspace, pH measurement devices, and thermometers to determine the presence of dangerous or otherwise undesirable discharges to the sewers. Visual observations might reveal deterioration of the sewerline or blockages.

A2 - Investigative Sampling and Analyses of Problem Discharges - Should the results of the monitoring and screening identify specific discharges that could cause problems within the sewer system, the facility files should be reviewed and the discharge sampled to confirm/determine the exact nature of the problem.

A3 - Institution of Controls - Once the problem industries/discharges are identified, controls should be imposed upon the facility. These may take the form of local discharge limits (see Chapter 4), form of industrial user management practices (Chapter 5), or case-by-case technology-based requirements on the IU (Chapter 6).

Blocks A4 through A7 of the chemical specific approach provide an abbreviated outline for identifying additional pollutants of concern based on treatment plant concerns. (The chemical specific approach for treatment plant concerns is quite involved and is provided in greater detail in Figure 2-2). Plant-related concerns can be identified through:

A4 - Sampling of Industrial Users - Conducting sampling and analyses of discharges allows POTWs to accurately characterize each facility's

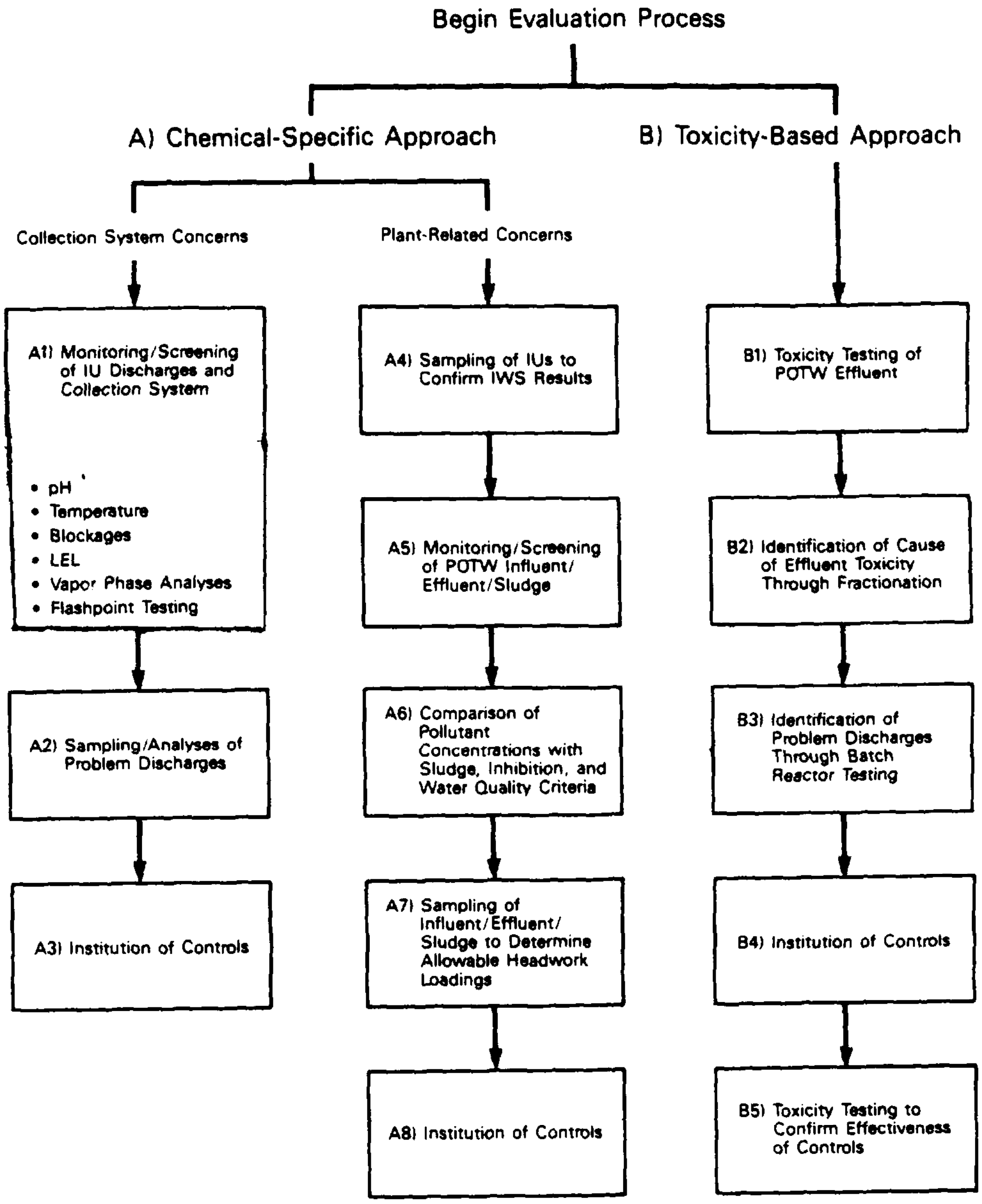

Figure 2-1. A Simplified Conceptual Flow Diagram for Determining Pollutants of Concern

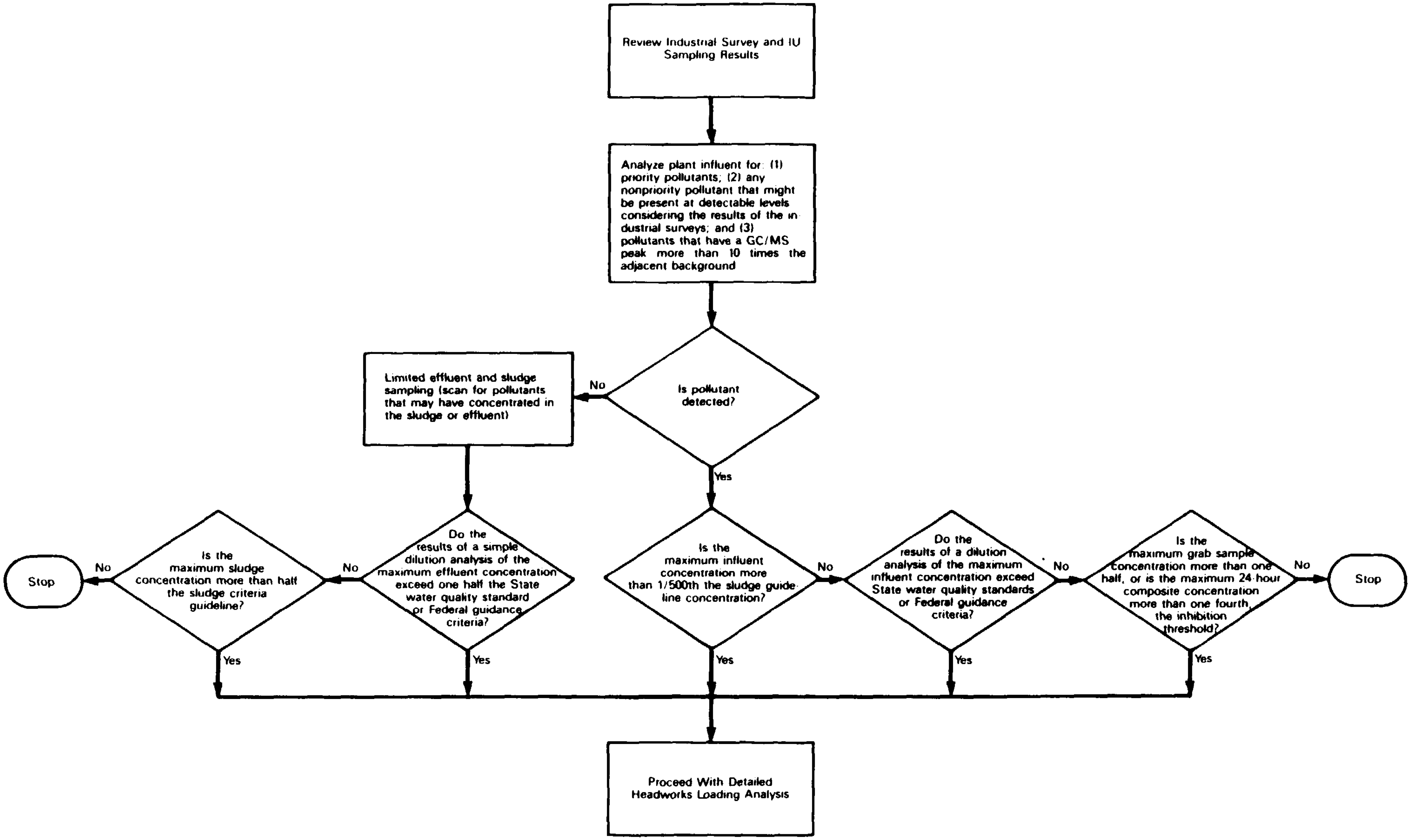

Figure 2-2. Detailed Flow Sheet for a Chemical-Specific Approach to Identifying Pollutants of Concern to Treatment Plant Operations

discharge and confirm the industrial waste survey data. This is especially important where a discharge makes up a large percent of the total industrial pollutant loading to the system, or when pollutants of concern are known or suspected to be discharged in large quantities or concentrations. This data allows for more accurate evaluation of potential impacts on the POTW and allows for greater confidence in any resulting limits.

A5 - Monitoring/Screening of POTW Influent/Effluent/Sludge - The POTW should perform a limited amount of influent, effluent, and sludge sampling to determine what pollutants are detectable and in what concentrations. It should include priority pollutants and any pollutants that might reasonably be expected to be present based on the IWS. Pollutants with GC/MS peaks greater than 10 times the adjacent background should be identified.

A6 - Comparison of Pollutant Concentrations with Criteria Levels - The measured pollutant concentrations should be compared with reference levels based on applicable sludge criteria/guidelines, water quality criteria/standards, and plant process inhibition thresholds (see Figure 2-2 for details on reference levels).

A7 - Sampling of Plant Influent/Effluent/Sludge to Determine the Maximum Allowable Pollutant Headworks Loadings - For those pollutants that are at levels greater than the reference levels, an analysis to determine allowable pollutant loading to the plant headworks should be conducted (see Chapter 3).

A8 - Institute Controls - The allowable loading to the treatment plant should be allocated to the POTW's users and the resulting local discharge limits (and monitoring requirements) enforced.

Branch B of the flow diagram presents a toxicity based approach to identifying additional pollutants of concern.

B1 - Toxicity Testing of the POTW Effluent - Toxicity testing of the POTW effluent may be a NPDES permit requirement. (See Section 2.6.)

B2 - Identification of the Cause of Toxicity Through Fractionation - Should the testing undertaken in B1 reveal that the effluent is toxic, fractionation of the effluent wastewater and subsequent toxicity testing may identify the type of compound responsible for the observed toxicity.

B3 - Identification of Problem Discharges Through Treatability Testing of Industrial Discharges - Use of batch reactors to perform treatability testing of industrial effluents, with toxicity testing before and after the simulated treatment, will help to identify discharges responsible for toxicity in the POTW effluent. (See Section 2.6 below.)

B4 - Institution of Controls - Upon identification of the discharges responsible for the toxicity, controls imposed upon the facility might include discharge limitations or industrial user management practices.

B5 - Toxicity Testing to Confirm the Effectiveness of Controls - Once the source of controls have been instituted by the IU, toxicity testing at the POTW should be performed to confirm the effectiveness of control measures.

As mentioned above, the use of a chemical specific approach to determining pollutants of concern related to treatment plant operations can be an involved process. Figure 2-2 is a detailed flow sheet of one possible approach. This approach is based primarily on analysis of the POTW's influent, with limited effluent and sludge sampling to screen for pollutants which may not be detectable in the influent but which may have concentrated in the effluent or sludge. The flow sheet provides a series of reference levels which POTWs may use in assessing influent wastewater data and determining the need to proceed with a headworks analysis. These reference levels, provided as guidance for each of the protection criteria, are intended to be conservative in order to account for the daily fluctuations in pollutant loadings experienced by POTWs and for the fact that the decisions are usually made based on limited data. The reason for emphasizing the use of influent data in this example approach with only limited effluent and sludge data being used, is to conserve resources during the preliminary screening and allow more resources to be used for the detailed headworks analysis of particular pollutants. The need to proceed with a headworks analysis for particular pollutants is indicated when:

- The maximum concentration of the pollutant in the POTW's effluent is more than one half the allowable effluent concentration required to meet water quality criteria/standards or the maximum sludge concentration is more than one half the applicable sludge criteria guidelines; or
- The maximum concentration of the pollutant in a grab sample from the POTW's influent is more than half the inhibition threshold; or the maximum concentration of the pollutant in a 24-hour composite sample from the POTW's influent is more than one fourth the inhibition threshold.
- The maximum concentration of the pollutant in the POTW's influent is more than 1/500th of the applicable sludge use criteria. (The use of a "1/500" reference level is suggested based on a review of POTW data (Fate of Priority Pollutants in Publicly Owned Treatment Works -

EPA/440/1-82/303) indicating that a 500 fold concentration of pollutants can occur in digested sewage sludges as compared to the wastewater influent to the treatment plant); or

- The concentration of the pollutant in the plant influent exceeds water quality criteria adjusted through a simple dilution analysis.

Decisions as to whether to conduct a detailed headworks loading analysis are represented by the diamonds in Figure 2-2. If a pollutant level exceeds the reference levels, then the POTW should conduct a detailed headworks loading analysis for that pollutant to assess whether a local limit need be established. The headworks loading analysis should be based on comprehensive influent, effluent, and sludge sampling, as discussed in the next section.

2.5 MONITORING TO DETERMINE ALLOWABLE HEADWORKS LOADINGS

Having presented methods for identifying pollutants of concern, this section presents guidance on the types of sampling that should be conducted in order to perform a headworks loading evaluation for those pollutants and derive numeric local limits. While many POTWs derive limits based on reported literature values for such things as pollutant removal efficiencies, industry wastestream and domestic sewage characteristics, it is always preferable for a POTW to utilize actual data. For ease of discussion, three sections are presented: (1) monitoring locations, (2) monitoring frequencies, and (3) sample type, duration and timing.

2.5.1 Sampling Locations at the Treatment Plant

Sampling at the treatment plant will provide data on existing pollutant loadings, removal efficiences across the various processes, and quantities of pollutants partitioning to the sludge and in the plant effluent.

Locations that should be sampled at the treatment plant are listed below. Following the list is a discussion concerning the reasons for sampling at these locations.

- Raw sewage influent to the treatment plant
- Effluent from treatment plant
- Effluent from primary treatment (or influent to secondary treatment)

- Effluent from secondary treatment (or influent to tertiary treatment)
- Waste activated sludge
- Influent to sludge digester
- Sludge disposal point.

Treatment plant influent and effluent sampling would be conducted to obtain loading data for use in calculating overall POTW removal efficiencies. POTW influent sampling should be conducted at the headworks prior to combination with any recirculation flows.

Primary treatment effluent monitoring should be conducted to obtain requisite loading data for calculation of pollutant removal efficiencies across primary treatment. Removal efficiencies across primary treatment are used in local limits calculations to convert secondary treatment (e.g., activated sludge) biological process inhibition data into corresponding headworks loadings. Similarly, for POTWs equipped with tertiary treatment units, secondary treatment effluent monitoring should be conducted to obtain requisite loading data for calculation of pollutant removal efficiencies across secondary treatment. These removal efficiencies are used in local limits calculations to convert tertiary treatment (e.g., nitrification) biological process inhibition data into corresponding headworks loadings.

For those pollutants for which State/Federal sludge disposal criteria/standards and/or sludge digester inhibition threshold data are available/applicable, the POTW should monitor its sludge at two distinct points: at the influent to the sludge digesters and at the point of disposal of the processed sludge. The resulting sludge monitoring data are used to derive digester removal efficiencies and sludge partitioning constants necessary for conversion of sludge disposal criteria/standards and digester inhibition threshold data into corresponding headworks loadings.

2.5.2 Establishing Monitoring Frequencies

Once the POTW has identified all monitoring locations, it must decide on appropriate monitoring frequencies for sampling. An initial sampling program should be designed to collect all data necessary to derive the limits. Once local limits have been established, an ongoing monitoring program should be set up to enable the POTW to periodically re-evaluate the limits. An empirical, case-by-case approach to setting monitoring frequencies is recommended. As a guide, EPA suggests that the initial monitoring program should include at least five consecutive days of sampling for both metals and toxic organics to adequately characterize the wastewater in a minimal time frame. Suggested guidelines for ongoing monitoring are for at least one day of sampling per month for metals and other inorganics, and one day of sampling per year for toxic organics (these include the organic priority pollutants, and depending on the IUs present, may also include organics on RCRA's Appendix 9; see Appendix H of this manual), to assess long-term variations in wastewater composition. These recommended sampling frequencies may be modified based on the following site-specific factors:

- The variability in pollutant loads in wastewaters
- The types and concentrations/loadings of pollutants
- Seasonal variations in wastewater flows and/or pollutant loadings.

The POTW should consider each of these factors when establishing appropriate monitoring frequencies. Each factor is discussed below.

When establishing monitoring frequencies, the POTW should account for the variability of pollutant levels in the wastewaters. If a wastewater to be sampled is known to be highly variable in composition, the POTW should monitor that wastewater more frequently in order to catch peak pollutant levels. The information available to EPA on toxic pollutant concentrations in municipal sewage indicates that, as a general rule, considerable day to day variability occurs. Often, the daily maximum concentration of a composite sample is several times the monthly average. Therefore, monitoring on five consecutive days is recommended for the initial sampling program. As an example of the variability in pollutant loadings to a POTW, Figure 2-3 is a graph depicting the wide swings in toluene loadings experienced by Chattanooga, TN. IU discharges may vary over the course of a day as various process operations occur. As such, it is useful for field personnel to have a good knowledge of IU operations before establishing the sampling regime.

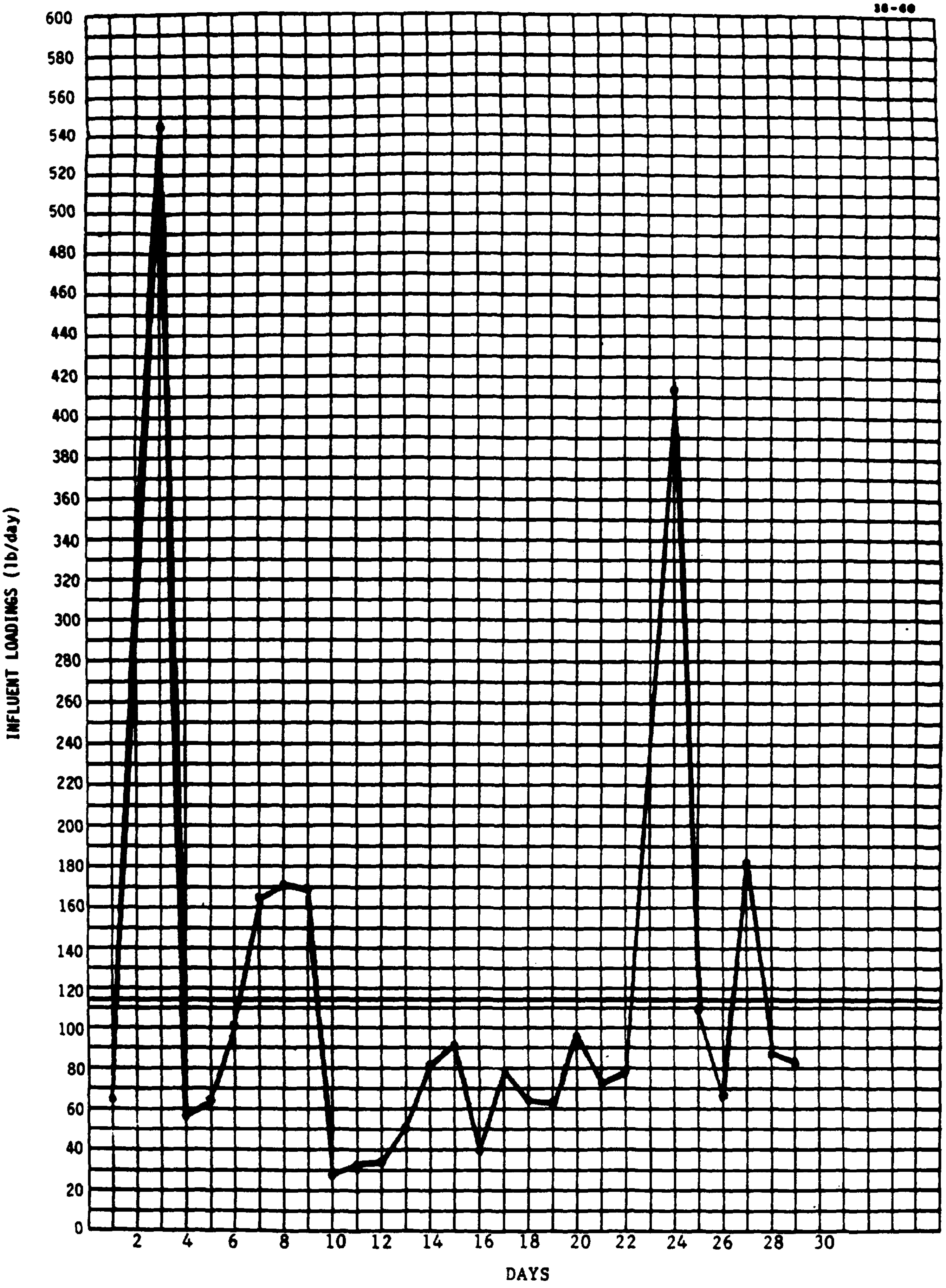

FIGURE 2-3. TOLUENE LOADING TO THE CHATTANOOGA TENNESSEE POTW

Two additional considerations in establishing the required monitoring frequency are the types and concentrations/loadings of pollutants in the wastewaters. Information on types and amounts of pollutants expected to be present in the plant influent will be obtained from the preliminary IU survey and sampling data. If a thorough preliminary evaluation indicates that certain toxic pollutants are not expected to be present in the plant influent at detectable levels, then a limited amount of sampling to confirm this would be sufficient. It is strongly recommended, however, that even POTWs that have few known industrial contributors of toxic pollutants carry out several days of sampling for metals and cyanide and perform more than one influent scan for toxic organics using a gas chromatograph (GC) or a gas chromatograph/mass spectrometer (GC/MS). This is necessary because there may well be unexpected sources of toxics, such as waste haulers, illegal connections, commercial users, cooling water discharges, etc.

POTWs should assess seasonal and other long term variations in its wastewater composition. If seasonal variation is expected to be very significant, the POTW should attempt to address this variation in the initial monitoring program prior to developing local limits. Situations where seasonal variability might be important include cases where major IUs operate seasonally (e.g., canneries) or where combined sewer overflows during wet weather increase the influent loadings of certain pollutants.

An additional consideration in establishing monitoring frequencies is the availability and reliability of resources (i.e., funding, equipment, personnel). The capability and capacity of the POTW's analytical laboratory is particularly critical in assessing available resources and in determining whether to utilize outside commercial analytical services. The POTW should not neglect to consider the impact on the laboratory when establishing a monitoring program in support of local limits development. An adequate initial monitoring program is essential to developing appropriate local limits, even though it may cause additional resource demands for a limited time.

2.5.3 Establishing Sample Type, Duration, and Timing of Sample Collection

In this section, a brief discussion on establishing sample type, sampling duration, and timing of sample collection is provided. More detailed guidance on these topics can be found in the following references:

- NPDES Compliance Sampling Inspection Manual (PB81-153215)
- Code of Federal Regulations (40 CFR Part 136)
- Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA 600/4-82-029).

To ensure valid data, representative measurements of flow rates must be taken at the point and time of sample collection. Flow measurements and sampling can be conducted either manually or with automatic devices. Composite samples should be used by the POTW for most of the sampling conducted for local limits development, particularly in the calculation of removal efficiencies. However, grab samples should be used for pollutants that may undergo chemical/physical transformations (e.g., cyanide, phenol and volatiles) and samples of batch discharges from industrial users, and samples used to detect slug loadings.

Composite samples should be taken over a 24-hour period. For those pollutants which might be expected to undergo chemical/physical transformation during the compositing period, such as cyanide, phenols, and volatile organics, EPA recommends collection of one grab sample every 3 to 4 hours with compositing in the laboratory prior to analysis. EPA recommends the use of composites for the following reasons:

- Receiving stream water quality criteria/standards are based on the highest instream concentration of a toxic pollutant to which aquatic organisms can be exposed for a given duration. Effluent limits based on these criteria are normally developed using a 1-day or 7-day average stream flow and the annual average effluent flow. They are expressed as daily maximum and monthly average concentration limits. In order to meaningfully compare POTW effluent concentrations to these limits, 24-hour composite sampling, rather than grab sampling, of the POTW effluent should be conducted.
- Owing to the nonsteady state conditions within the POTW, it is virtually impossible to calculate a representative removal efficiency

> based on influent/effluent grab samples timed exactly to the POTW's current actual (not design) hydraulic retention time; the effects of nonsteady state conditions on POTW removal efficiencies are dampened out over time through compositing yielding a more representative average removal efficiency.

If a shorter composite sampling duration (e.g., 8 hours) is specified in the POTW's NPDES permit, this shorter sampling duration may be more appropriate for POTW influent/effluent monitoring than the 24-hour composite sampling duration recommended above.

For industrial user sampling, the length of the composite sample should be timed to the facility's operating hours. If an industrial user operates one 8-hour shift and discharges only during these hours, then sampling needs to be conducted only during these hours. However, if the facility operates longer hours or discharges after hours (such as for cleanup), then longer sampling times are necessary.

2.6 TOXICITY TESTING

In the past few years, EPA has placed increased emphasis on controlling ambient toxicity in receiving waters. This emphasis was formalized in the policy statement published in 49 FR 9105 (Policy for the Development of Water Quality-based Permit Limitations for Toxic Pollutants) which described a technical approach for assessing and controlling the discharge of toxic substances to the Nation's waters through the NPDES permit program.

The goal of the program is to control toxic pollutants with an integrated approach consisting of both chemical-specific and biological methods. In order to achieve this goal, EPA will enforce existing specific numerical criteria for toxic pollutants and will use biological techniques and available data to assess toxicity impacts and human health risks.

In the next few years, increasing pressure will arise to control toxic pollutants whether or not they have been incorporated into State standards. The narrative standards that all delegated States have, requiring no discharge of toxics in toxic amounts, provide sufficient legal basis for controlling specific chemicals and/or whole effluent toxicity as appropriate.

Even if there are no identifiable chemicals of concern in a POTW discharge, it is desirable to test effluents for toxicity. The principal advantage of toxicity testing of an effluent is that the test is able to detect and measure the overall toxicity of a complex mixture. Where toxicity is found, steps can be taken to correct the problem either through the identification of causitive toxicants, or through changes in the influent or treatment process itself. Testing can be done by a number of laboratories at reasonable cost using protocols developed by EPA (Methods for Measuring the Acute Toxicity of Effluents to Marine and Freshwater Organisms, EPA/600/4-85-013, and Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA/600/4-85-014). If results of these toxicity tests indicate that an effluent is not toxic, then no further action is necessary. If the effluent is toxic, the methods outlined in the Technical Support Document for Water Quality-Based Toxics Control (September 1985) can be used to determine whether effluent toxicity will cause an exceedance of State standards for instream toxicity. If instream toxicity is greater than these criteria, several steps may be taken to decide whether local limits for toxicity would be appropriate.

2.6.1 Toxicity Reduction Evaluations (TREs)

A toxic POTW effluent can be caused by one or more of several thousand toxic chemicals. This wide range of chemicals presents a practical challenge to determining which of these chemicals might be causing toxicity. For this reason, techniques have been developed that simplify the approach to determining the cause of toxicity. Formal approaches to these techniques are called toxicity reduction evaluations, or TREs.

The purpose of a TRE is to determine the constituents of the POTW effluent that are causing toxicity, and/or to determine the effectiveness of pollution control actions such as local limits or POTW process modifications to reduce the effluent toxicity [52]. Figure 2-4 provides a conceptual flow diagram for performing a TRE at a POTW.

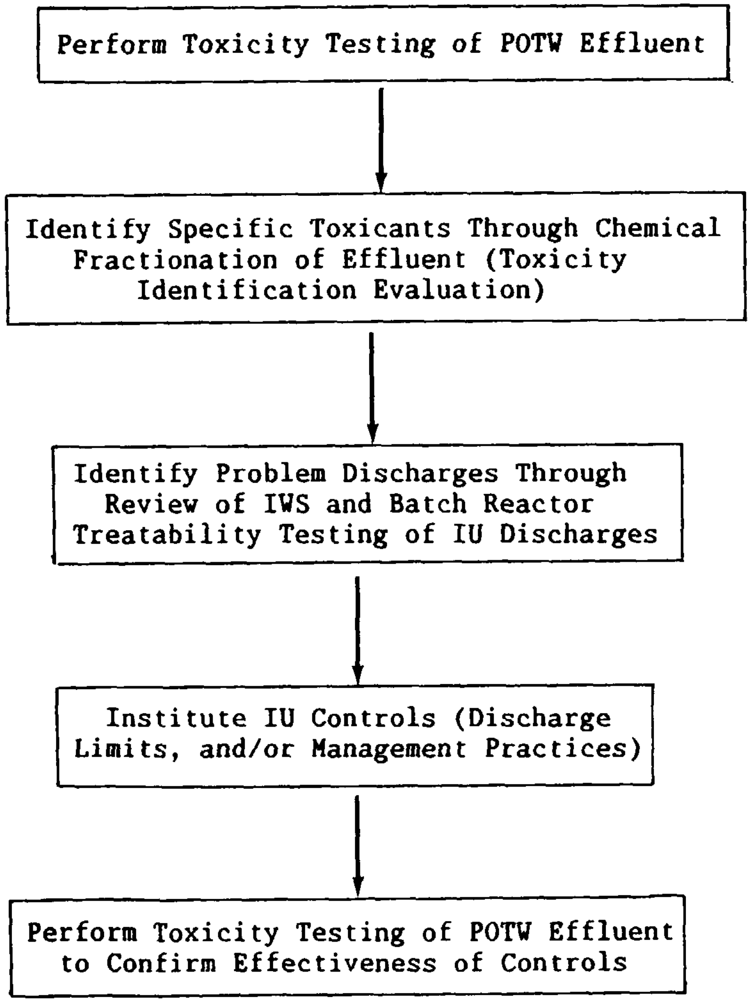

Figure 2-4. Example Approach for a Municipal TRE

Efforts are currently underway by the U.S. EPA Water Engineering Research Laboratory to develop, test, and refine protocols for conducting TREs at both industrial plants and municipal wastewater treatment facilities. The Environmental Research Laboratory in Duluth, Minnesota is researching methods for fractionating wastewaters. In addition, various TREs and TRE development efforts are being carried out by characterizing sources of toxicity in effluents by both industries and contract organization [52]. Because of the variety of research efforts being undertaken by a number of organizations, EPA is still in the process of developing TRE guidance and methods. Therefore this discussion does not present specific protocols, but explains the concept upon which TREs are based. Even though research is still underway, toxicity has been successfully reduced by some POTWs. Successful implementation has usually occurred when expert knowledge of industrial waste characteristics has been coupled with detailed analysis of POTW effluent characteristics.

Toxicity Identification Evaluations

Toxicity identification evaluation (TIE) is one component of a TRE. The process involves sequential treatment or fractionation and analysis of the constituents of the POTW effluent. In this fractionation, the effluent is split into a number of parts. The effluent remaining after removal of each part is tested for toxicity. Hopefully, the removal of one part will reduce toxicity much more than the others, and this part removed can either be further fractionated and tested for toxicity or chemically analyzed to determine potentially toxic chemicals. When the chemicals are identified, likely generators of these chemicals are identified, and their discharges can be analyzed for either the presence of the chemical, toxicity, or both. If an industry is discharging the chemical and has a toxic discharge, then local limits can be applied as discussed in Chapter 4 of this guidance.

Many approaches exist for conducting TIEs. One typical approach entails the following treatments:

- Air stripping--the effluent remaining after air stripping is tested for toxicity. If toxicity is reduced, volatiles have caused toxicity.
- Complexation--a chelating agent is added to the effluent to bind metals in a nontoxic form. If toxicity is reduced in the effluent, metals are probably the cause of the toxicity.

- Resin column stripping--organics are removed from the whole effluent by passing it through a resin exchange column. Chemicals can be stripped from the column in fractions, using serial concentrations of a relatively non-toxic solvent (e.g., methanol). Further chemical analysis is then used to identify toxic constituents in a toxic fraction, if toxicity is found in this effluent fraction.

This series of steps indicates whether toxicants are likely to be inorganic, volatile, organics, or oxidants.

If none of these treatments results in reduced toxicity of the effluent, more inventive approaches must be taken. Usually, however, one or more fractions contain the primary cause of the toxicity, and chemical analyses of that fraction identify the causative agents.

Confirmatory toxicity tests can then be conducted on the isolated compounds to verify that they constitute the toxic agents and that other, unidentified compounds are not contributing substantially to toxicity. With these confirmatory tests, a logical, technically defensible argument is developed that is a strong basis for developing local limits.

However, the general methodology has certain limitations. It has been found at some POTWs that the cause of toxicity varies from day to day, complicating the determination of toxic constituents. Toxicity has also been caused by chemicals in more than one fraction of the effluent. Variability of an IU's discharge may mean that apparent toxicity reduction (or elevation) over time is simply due to variations in concentration of toxicants. Satisfactorily confirming the sources of toxicity in a municipal wastewater effluent will require development of approaches which can recognize factors such as the influence of variability in the source of the toxicity, the slug loading of toxics to the treatment plant, and the relationship of influent toxicity to final effluent toxicity, especially considering the role of biodegradability of compounds through the wastewater treatment system. EPA is currently developing guidance that addresses many of these factors. [53]

Batch Treatability Testing of Industrial Discharges

In general, toxic discharges will contribute to the toxicity of the effluent. However, two apparently anomalous situations can develop. Sometimes an apparently non-toxic discharge can contribute to POTW effluent toxicity. This apparent anomaly arises because some toxic chemicals (for example, metals) may be "bound" to other chemicals and are not toxic in the bound form, but are "released" to solution during treatment. The opposite situation can also arise, where a toxic IU discharge can be greatly reduced in toxicity through biodegradation, volatilization, or settling of toxic constituents in the POTW.

Acknowledging these limitations, POTWs with relatively few industrial dischargers can apply toxicity testing to dischargers suspected of being a source of toxic compounds to determine if any, or all, of the discharges may be toxic.

When a specific industrial/commercial facility is suspected of discharging pollutants causing toxicity the POTW needs to determine whether the toxicants are passing through the treatment plant to contribute to plant effluent toxicity. This can be accomplished through the batch treatment testing of discharges. A variety of approaches to batch treatability testing exist. In general, these include the simulation of the treatment plant operational characteristics (F/M ratio, MLVSS) in reactors, and utilizing varying concentrations of the IU's discharge as the reactor feed. Measurement of the substrate utilization rates in the various reactors, and subsequent testing of the settled supernatants for toxicity, provide information on the relative wastewater strength (and hence pollutant concentration) at which toxicity may occur, and whether pass through of the toxicity to the receiving stream should be a concern. This information may provide the basis for limits development.

3. LOCAL LIMITS DEVELOPMENT BY THE ALLOWABLE HEADWORKS LOADING METHOD

In this chapter, the headworks loading allocation method of deriving local limits is discussed in detail. This method addresses treatment plant, water quality, and sludge impacts only and does not apply to collection system impacts. Chapters 4, 5, and 6 of this manual discuss other methods for the development of local limits, including collection system effects/concerns.

3.1 GENERAL METHODOLOGY

This method allows local limits to be developed based on criteria pertaining to POTW wastewater treatment plant operations and performance, the quality of the POTW's sludge, and the water quality of the POTW's receiving stream. The derivation of these local limits is a two-step procedure, outlined below:

Step 1: Development of Maximum Allowable Headworks Loadings

Site specific treatment plant/environmental criteria pertaining to pollutant pass through, process inhibition/interference, and sludge quality are identified. The criteria used in local limits development include POTW NPDES permit limits, receiving stream water quality standards/criteria, biological process threshold inhibition levels, and sludge quality criteria.

A mass balance (input=output) approach is then used to convert criteria into allowable headworks loadings. This approach traces the routes of each pollutant through the treatment process, taking into account pollutant removals in upstream units. Steady state calculations for conservative pollutants (e.g., total metals) assume that the influent loading to a treatment process equals the sum of the effluent and sludge loadings out of that process. In the case of nonconservative pollutants (e.g., volatile organics, cyanide, dissolved metals), where biodegradation/volatilization and chemical degradation are significant, calculations are modified to take these losses into account.

For each pollutant, the smallest (i.e., the most stringent) of the allowable headworks loadings derived from the above-listed criteria is selected as the pollutant's maximum allowable headworks loading. If the POTW's actual headworks loading is consistently below this maximum allowable loading, compliance with all applicable criteria for the particular pollutant is ensured.

Section 3.2 discusses the development of maximum allowable headworks loadings in detail. Owing to the importance of removal efficiencies in deriving maximum allowable headworks loadings, Section 3.2 concludes (Section 3.2.4) with a discussion of representative removal efficiencies and how they can be derived.

Step 2: Allocation of Maximum Allowable Headworks Loadings

Once maximum allowable headworks loadings have been derived (in Step 1), a portion of this loading (for each pollutant) is subtracted as a safety measure to account for projected industrial loading increases, unanticipated slug loadings, and errors in measurement. Pollutant loadings from domestic/background sources are then subtracted from the allowable headworks loadings. The results of these calculations are the maximum allowable industrial loadings to be allocated to the POTW's industrial users. Local limits are derived from this allocation of allowable industrial loadings.

Section 3.3 discusses procedures for setting safety factors and for allocating maximum allowable headworks loadings to domestic/background and industrial sources. Section 3.3.1 discusses the application of safety factors and Section 3.3.2 discusses the determination of domestic/background pollutant loadings. Finally, Section 3.3.3 details four methods for allocating allowable industrial loadings to industrial users, thereby establishing local limits.

Appendix I presents a comprehensive local limits derivation example, demonstrating this methodology and related calculation techniques.

3.2 DEVELOPMENT OF MAXIMUM ALLOWABLE HEADWORKS LOADINGS

The first step in deriving local limits is to develop maximum allowable headworks loadings based on treatment plant/environmental criteria. These criteria can be classified as either pass through or interference criteria, as follows (see Section 1.3.1 for regulatory definitions of pass through and interference):

- Pass through criteria
  - NPDES permit limits
  - Water quality standards/criteria
- Interference criteria
  - Biological treatment process inhibition data
  - Sludge disposal standards/guidelines
  - EP toxicity limitations
  - Sludge incinerator air emission standards

Section 3.2.1 discusses the development of allowable headworks loadings based on the above-listed pass through criteria, and Section 3.2.2 details the development of allowable headworks loadings based on the interference criteria. Section 3.2.3 discusses the comparisons of allowable headworks loadings for each pollutant to determine the most stringent loading. The most stringent loading for each pollutant constitutes the pollutant's maximum allowable headworks loading, from which a local limit can be derived. Section 3.2.4 discusses the derivation of representative removal efficiencies, which are parameters critical to the calculation of allowable headworks loadings.

3.2.1 Allowable Headworks Loadings Based on Prevention of Pollutant Pass Through

Procedures are provided in this section for the derivation of allowable headworks loadings from treatment plant/environmental criteria pertaining to pollutant pass through. Pollutant pass through has been previously defined in Section 1.3.1 of this manual.

3.2.1.1 Compliance with NPDES Permit Limits

NPDES permit limits are to be used in the derivation of local limits to prevent pollutant pass through. The following equation is used to convert a pollutant-specific concentration-based NPDES permit limit into the corresponding allowable headworks loading of that pollutant.

$$L_{IN} = \frac{(8.34)(C_{CRIT})(Q_{POTW})}{(1-R_{POTW})}$$

Where:

L_{IN} = Allowable influent loading, lbs/d
C_{CRIT} = NPDES permit limit, mg/l
Q_{POTW} = POTW flow, MGD
R_{POTW} = Removal efficiency across POTW, as a decimal

Occasionally, the POTW's NPDES permit specifies whole effluent toxicity limits in conjunction with pollutant-specific concentration-based discharge limits. Effluent toxicity considerations in developing local limits are discussed in Section 2.6.

The POTW's NPDES permit may include a narrative provision requiring POTW compliance with State water quality standards and/or toxicity prohibitions. POTWs possessing NPDES permits with this narrative provision should contact the appropriate State environmental agency to determine their specific responsibilities in deriving water quality-based local limits. These POTWs should inquire as to exactly which State water quality standards or toxicity testing requirements apply to their receiving streams at the points of discharge. The following subsection of this manual provides general guidance on deriving local limits from water quality standards/criteria.

3.2.1.2 Compliance with Water Quality Limits

Water quality limitations for the POTW's receiving stream comprise another local limits development basis.

The following equation is used to derive allowable POTW headworks loadings from water quality standards or criteria.

$$L_{IN} = \frac{(8.34)[C_{CRIT}\ (Q_{STR} + Q_{POTW}) - (C_{STR}\ Q_{STR})]}{(1-R_{POTW})}$$

Where:

L_{IN} = Allowable influent loading, lbs/d
C_{CRIT} = Water quality standard, mg/l
Q_{STR} = Receiving stream (upstream) flow, MGD
Q_{POTW} = POTW flow, MGD
C_{STR} = Receiving stream background level, mg/l
R_{POTW} = Removal efficiency across POTW, as a decimal

The above equation derives an allowable receiving stream pollutant loading based on a water quality standard and then allocates this entire loading to the POTW. The equation does not allow for allocations to other dischargers within the POTW's stream reach. For this reason, the validity of the above equation should be discussed with State environmental agency personnel prior to deriving water quality-based allowable headworks loadings. The State agency may require alternative procedures for derivation of water quality-based allowable headworks loadings.

Two principal sets of water quality limitations have been developed:

- o Individual State water quality standards
- o EPA ambient water quality criteria.

State water quality standards have been developed by various State environmental agencies as maximum allowable pollutant levels in State water bodies. These State agencies conduct wasteload allocation studies based on their State water quality standards, and then set limits for direct dischargers based on the results of these studies. State water quality standards can depend on hardness of the water and the stream reach classification. The POTW should contact the State to obtain the specific water quality standards for the POTW's receiving stream at the point of discharge.

In lieu of State water quality standards, local limits also can be based on EPA ambient water quality criteria. These criteria do not possess the same regulatory basis as State water quality standards; they are merely EPA's recommended maximum contaminant levels for protection of aquatic life in receiving streams. Nevertheless, EPA ambient water quality criteria may provide a sound basis for a POTW in developing local limits for pollutants which have the potential of causing toxicity problems in the receiving stream. A POTW may choose to rely on such local limits as a central component in a control strategy to meet the "no discharge of toxics in toxic amounts" narrative requirements in its permits. This is particularly the case where the POTW needs to establish local limits for toxicants shown to be causing effluent toxicity (through a TRE) and thus preventing the POTW from complying with its toxicity-based permit limit.

Relevant EPA water quality criteria are classified as follows:

- Protection of freshwater aquatic life
- Protection of saltwater aquatic life
- Protection of human health.*

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* Usually application of human health criteria requires that the State make certain judgments about risk and exposure which are rather site-specific. While EPA may need to take action where a State fails to do so, the application of human health criteria generally is beyond the scope of this document. For further information, the POTW may consult its State or EPA permitting authority.

The criteria for protection of freshwater and saltwater aquatic life consist of chronic and acute toxicity criteria. These criteria are presented in Table 3-1 [from Quality Criteria for Water, 1986 ("The Gold Book"), EPA 440/5-86-001, EPA Office of Water Regulations and Standards, Washington, DC, May 1986 (Reference 25 in this manual's reference list)]. Several of the criteria for protection of freshwater aquatic life are hardness dependent. For these pollutants, the levels given in Table 3-1 represent criteria at an assumed hardness of 100 mg/l as $CaCO_3$.*

When calculating allowable headworks loadings based on protection of freshwater and saltwater aquatic life, both chronic and acute toxicity criteria should be used if they exist. The chronic toxicity criteria are designed to protect aquatic organisms against long term effects over the organism's lifetime, as well as across generations of organisms. Acute toxicity criteria are generally designed to protect aquatic organisms against short term lethality.

Chronic criteria should not be used to develop a monthly average local limit, nor should acute criteria be used to develop a daily maximum limit, as is sometimes thought. The following procedure may be followed to develop local limits based on acute and chronic water quality criteria for aquatic life. This procedure is adopted from the EPA guide, Permit Writer's Guide to Water Quality-based Permitting for Toxic Pollutants [63].

- For calculating an allowable headworks loading based on a chronic toxicity criterion, the receiving stream flow rate (Q_{STR}) used in the calculations should be the lowest 7-day average for a 10-year period (referred to as 7Q10). For calculating the corresponding allowable headworks loading based on an acute toxicity criterion, the receiving stream flow rate should be the single lowest one-day flow rate over a 10-year period (1Q10). For each pollutant, the two allowable headworks loadings should be compared (i.e., the loading based on a chronic criterion and the 7Q10 flow vs. the loading based on an acute criterion and the 1Q10 flow) and the smaller loading retained as more stringent [63].

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* Criteria for certain inorganic pollutants (e.g., ammonia) are pH and/or temperature dependent as well. Criteria for these pollutants have not been not presented in Table 3-1.

- The most stringent loading should then be used to derive the daily maximum limitation using the equation on p. 3-4 of this manual. If the POTW wishes to also adopt a monthly average limit, then the simplest approach is to use a "rule of thumb" such as dividing the daily maximum by a factor between one and two, a practice sometimes used by NPDES permit writers. A more technically correct but fairly detailed approach is described in the Permit Writer's Guide, pages 17-21 [63].

- Note that it is not correct to say that daily maximum limits are based on protecting against acute toxicity and monthly average limits are based upon protecting against chronic toxicity [63]. The limits derivation process calculates local limits based on the more stringent of the two allowable headworks loadings.

The POTW should check with the appropriate State environmental agency to see if State-specific guidelines exist regarding alternative stream flows to use. For POTWs discharging to the ocean, saltwater dilution techniques for oceans are described in the Revised Section 301(h) Technical Support Document [64] and the 301(h) publication entitled Initial Mixing Characteristics of Municipal Ocean Discharges [65]. For POTWs with other unique flow situations (e.g., multiple flows, estuaries, etc.), the Technical Support Document and the Permit Writer's Guide should be consulted for guidance.

It should be noted that the allowable headworks loading equation presented on p. 3-4 of this manual requires upstream background pollutant levels for the POTW's receiving stream. Reliable, updated sources of such water quality data may be difficult to find. Also, pollutant level fluctuations in many receiving streams tend to diminish the validity of water quality monitoring data. For guidance on the requisite receiving stream background concentration data to use in local limits calculations, the appropriate State environmental agency should be consulted.

In order to use receiving stream water quality limitations in deriving local limits, the POTW should refer to the equation and procedures outlined above. For each pollutant, the lowest of the maximum allowable headworks loadings based on all of the above criteria should be used when setting local limits.

3.2.2 Allowable Headworks Loadings Based on Prevention of Interference with POTW Operations

In this section of the manual, procedures will be presented for deriving allowable headworks loadings from POTW treatment plant process inhibition/ interference criteria.

The equations presented in this section are based upon generic configurations of major POTW treatment units. The presence and configuration of internal POTW wastestreams, such as sludge digester or gravity thickener supernatant recycle streams, were not considered in the derivation of these equations. The POTW is urged to verify the validity of the equations (and the representativeness of plant sampling locations used for data collection) before attempting to use these equations in deriving local limits.

3.2.2.1 Prevention of Process Inhibition

An appropriate POTW process inhibition/interference criterion measures the capability of the POTW's biological treatment systems to accommodate pollutants and still adequately remove BOD. Threshold inhibition levels provide a measure of this capability of biological treatment systems to accommodate pollutants without adverse effects, and hence provide a sound basis from which to establish local limits.

The following equations are used to derive allowable headworks loadings from secondary and tertiary treatment threshold inhibition levels:

Secondary treatment (e.g., activated sludge) threshold inhibition level

$$L_{IN} = \frac{(8.34)(C_{CRIT})(Q_{POTW})}{(1-R_{PRIM})}$$

Tertiary treatment (e.g., nitrification) threshold inhibition level

$$L_{IN} = \frac{(8.34)(C_{CRIT})(Q_{POTW})}{(1-R_{SEC})}$$

Where:

L_{IN} = Allowable headworks loading, lbs/d

C_{CRIT} = Threshold inhibition level, mg/l

Q_{POTW} = POTW flow, MGD

R_{PRIM} = Removal efficiency across primary treatment, as a decimal

R_{SEC} = Removal efficiency across primary and secondary treatment, as decimal

The R_{PRIM} and R_{SEC} reflect cumulative removal efficiencies through primary and secondary treatment, respectively.

In order to derive local limits that prevent anaerobic digester inhibition/interference, the following mass balance equations can be used to convert anaerobic digester threshold inhibition levels into allowable headworks loadings:

For Conservative Pollutants (Metals):

Sludge digester
threshold inhibition level

$$L_{IN} = \frac{(8.34)(C_{CRIT})(Q_{DIG})}{R_{POTW}}$$

For Nonconservative Pollutants (Organics/Cyanide):

Sludge digester
threshold inhibition level

$$L_{IN} = L_{INF} \text{ X } \left(\frac{C_{CRIT}}{C_{DIG}}\right)$$

Where:

L_{IN} = Allowable headworks loading, lbs/d
C_{CRIT} = Threshold inhibition level, mg/l
Q_{DIG} = Sludge flow to digester, MGD
R_{POTW} = Removal efficiency across POTW, as a decimal
L_{INF} = POTW influent pollutant loading, lbs/d
C_{DIG} = Pollutant level in sludge to digester, mg/l

A distinction is drawn in the above equations between conservative pollutants (not degraded within the POTW or volatilized) such as metals, and nonconservative pollutants such as organics and cyanide. This distinction is necessary because organics and cyanide can be removed by volatilization and biodegradation, as well as through sludge adsorption, whereas the removal of metals is by sludge adsorption alone. Losses through biodegradation and volatilization do not contribute to pollutant loadings in sludge, and the presumption applied to metals, that removed pollutants are transferred entirely to sludge, is not valid for organic pollutants or for cyanide. As can be seen from the above equations, one result of this distinction between conservative and nonconservative pollutants is that sludge monitoring data (i.e., C_{DIG} data) are required to derive the nonconservative pollutant allowable headworks loadings, whereas removal efficiency data are required to derive the conservative pollutant allowable headworks loadings.

Literature data pertaining to pollutant inhibition of the following biological treatment systems are provided in this section:

- Activated sludge units
- Trickling filters
- Nitrification units
- Anaerobic sludge digesters.

In general, it is easier to use total metal, rather than dissolved metal, inhibition levels in deriving local limits based on biological treatment process inhibition. This is because:

- POTW removal efficiency data used in local limits calculations pertain to the removals of total, rather than dissolved metals
- Allowable headworks loadings derived on other bases, such as NPDES permit limits, water quality standards, etc., are generally based on treatment plant/environmental criteria expressed as total, rather than dissolved metal.

Table 3-2 presents literature data on activated sludge inhibition for metals, nonmetal inorganics, and organics. As can be seen from Table 3-2, inhibition data are often presented in the literature both as ranges and as single inhibition levels. Without additional site-specific information regarding POTW performance in accommodating these pollutants, the minimum reported inhibition thresholds presented in Table 3-2 should be used in deriving local limits.

The literature provides minimal inhibition data for trickling filter units. Table 3-3 presents available literature inhibition data for trivalent chromium and cyanide in trickling filters. More extensive literature data are available pertaining to inhibition of nitrification. Table 3-4 documents nitrification threshold inhibition data for various metals, nonmetal inorganics and organics.

Table 3-5 presents inhibition threshold data for anaerobic sludge digesters. The inhibition threshold data presented in Table 3-5 are based on total rather than dissolved pollutant, unless otherwise noted. For reasons mentioned above, inhibition levels for total pollutant are preferable for use in deriving local limits.

3.2.2.2 Protection of Sludge Quality

One of the principal motivations for establishing local limits is to prevent restriction of the POTW's sludge disposal options. EPA and State agencies have established limitations on the land application of sludge. The following equations can be used to convert these limits into allowable headworks loadings.

Conservative Pollutants (Metals):

Sludge Disposal Criterion $$L_{IN} = \frac{(8.34)(C_{SLCRIT})(PS/100)(Q_{SLDG})}{R_{POTW}}$$

Nonconservative Pollutants (Organics/Cyanide):

Sludge Disposal Criterion $$L_{IN} = L_{INF} \text{ X } \left(\frac{C_{SLCRIT}}{C_{SLDG}}\right)$$

Where:

L_{IN} = Allowable influent loading, lbs/d
C_{SLCRIT} = Sludge disposal criterion, mg/kg dry sludge
PS = Percent solids of sludge to disposal
Q_{SLDG} = Sludge flow to disposal, MGD
R_{POTW} = Removal efficiency across POTW, as a decimal
L_{INF} = POTW influent pollutant loading, lbs/d
C_{SLDG} = Pollutant level in sludge to disposal, mg/kg dry sludge

As with the derivation of organic pollutant allowable headworks loadings from anaerobic digester inhibition data (see Section 3.2.2.1), the distinction is drawn between conservative pollutants, which are neither degraded nor volatilized within the POTW, and nonconservative pollutants. As noted in Section 3.2.2.1, the rationale for drawing this distinction is that losses due to degradation and volatilization do not contribute to pollutant loadings in the sludge. It should be noted from the above equations that sludge monitoring data (i.e., C_{SLDG} data) are required to derive the allowable headworks loadings for nonconservative pollutants, whereas removal efficiency data are required to derive the allowable headworks loadings for conservative pollutants.

Table 3-6 presents Federal and selected State sludge disposal limitations for metals and organics in land-applied sludge. The table illustrates that some State sludge disposal limitations have the force of State regulation behind them, others are merely guidelines for land application of sludge. POTWs should be sure to base their local limits on regulations/guidelines provided for <u>their own</u> State only. Other States' sludge disposal limitations are <u>not applicable</u>. Updated and considerably more detailed tables presenting State sludge management practices and limitations will be available soon in a manual to be published by EPA titled "Guidance for Writing Interim Case-by-Case Permit Requirements for Sludge" [U.S. EPA Office of Water, Permits Division, 1987, Draft].

Table 3-6 presents three different sludge limitations for each pollutant:

- Pollutant concentration limit in sludge, mg/kg dry sludge
- Pollutant application rate limit on an annual basis, lbs/acre/year
- Cumulative pollutant application rate limit, lbs/acre over the site life.

Thus, up to three different starting points may be available from which to derive allowable headworks loadings. For each pollutant the lowest (i.e., most stringent) criterion is to be used in the headworks loading calculations. In order to compare the three types of sludge limitations presented in Table 3-6, the three limitations must be expressed in consistent units. The most logical choice of units is milligrams pollutant per kilogram of dry sludge, as these units are required by the headworks loading equations presented above. Table 3-6 shows that the pollutant limits in sludge already are expressed in these units; only the annual and cumulative application rate limits need to be converted.

The following equations can be used to convert these two application rate limits to milligram per kilogram sludge limits:

$$C_{LIM(A)} = \frac{(AAR)(SA)}{(Q_{SLDG})(PS/100)(3046)} \text{ mg/kg dry sludge}$$

$$C_{LIM(C)} = \frac{(CAR)(SA)}{(SL)(Q_{SLDG})(PS/100)(3046)} \text{ mg/kg dry sludge}$$

where:

$C_{LIM(A)}$ = Sludge disposal limit based on annual application rate limit, mg/kg dry sludge

$C_{LIM(C)}$ = Sludge disposal limit based on cumulative application rate limit, mg/kg dry sludge

AAR = Annual application rate limit, lbs/acre/year

CAR = Cumulative application rate limit, lbs/acre over the site life

SA = Site area, acres

SL = Site life, years

Q_{SLDG} = Sludge flow to disposal, MGD

PS = Percent solids of sludge to disposal (as a percent, not as a decimal)

3046 = Unit conversion factor

For each pollutant, the two sludge disposal limits calculated from the above equations should be compared with the appropriate pollutant limit in sludge from the fourth column of Table 3-6. The lowest limit should be selected as most stringent.

All POTWs which land apply sludge must use the Federal sludge disposal limitations for cadmium presented in Table 3-6, if these limitations are more stringent than State limitations for cadmium. The POTW should also contact the State environmental agency directly to obtain a copy of the State's sludge disposal regulations/guidelines.

The POTW should also keep abreast of the current status of Federal EPA sludge disposal regulatory activities. In this regard, the EPA is currently considering the development of sludge disposal regulations for a variety of pollutants. These pollutants are presented in Column 4 of Table G-3, in Appendix G.

3.2.2.3 EP Toxicity Limitations

The EP toxicity test determines if a solid waste is hazardous under the Resource Conservation and Recovery Act (RCRA). Sludge disposed by a POTW must not exceed the EP toxicity test limitations or it must be disposed as a hazardous waste in accordance with RCRA.

The EP toxicity test (40 CFR 261, Appendix II provides a detailed description of test procedures) entails the extraction of pollutants from sludge through the addition of a dilute acid. Table 3-7 presents analytical limits that must not be exceeded if the sludge is to be classified as non-hazardous.

While POTWs will generally not have sewage sludge that fails the EP toxicity test, the costs and liabilities associated with the management and disposal of a hazardous sludge are such that it is in a municipality's best interest to test their sludge, and closely monitor any trends reflected in the test results. Significant changes may be brought about with changes in the industrial community, or changes in the treatment plant operations.

POTWs should routinely monitor sludge metals levels (mg/dry kg) and the corresponding EP toxicity levels to determine: (1) whether their sludge leachate from the EP toxicity test is approaching regulatory levels; and (2) whether there is a relationship between sludge metals concentration and measured leachate metals concentation (not necessarily a linear relationship). Based on its monitoring data the POTW can then determine the dry weight metals concentration that would be protective against EP toxic sludge, and use this in equations presented in Section 3.2.2.2 to derive allowable headworks loadings.

Although most POTWs would not normally be expected to generate hazardous sludges, the EP toxicity testing requirements should be of special note to POTWs using aerated lagoons, since lagoon sludge is often contaminated with exceptionally high levels of metals. EPA is presently evaluating the Toxicity Characteristic Leaching Procedure (TCLP) as a replacement for the EP toxicity test. The TCLP test includes 38 additional organic constituents; these pollutants are listed in Column 5, Table G-3 of Appendix G. EPA recently tested six municipal sludges to determine if they would be hazardous under the proposed TCLP test. The results showed that while none of the six tested sludges would exceed the proposed TCLP limits, two sludges approached failure for chloroform and benzene. In light of this study, EPA is currently continuing to evaluate the proposed TCLP test.

3.2.2.4 Reduction of Incinerator Emissions

As discussed in Section 2.1.6, POTWs with sludge incinerators must ensure that incinerator air emissions comply with NESHAP limits for particulate beryllium and total* mercury, as well as the NAAQS limit for particulate lead (the numeric limits for these pollutants are specified in Section 2.1.6). In accordance with the regulatory definition of interference (See Section 1.3.1), these POTWs are further required to prohibit through local limits pollutant discharges in amounts sufficient to cause incinerator emissions to violate Clean Air Act standards such as the NESHAP and NAAQS limits. In this section, the development of maximum allowable headworks loadings based on incinerator emission standards such as NESHAP and NAAQS limits is discussed.

As guidance in deriving maximum allowable headworks loadings based on sludge incinerator air emissions for lead, mercury, or beryllium (or for any pollutant not destroyed by incineration, e.g., total metals) the following equation is provided:

$$L_{IN} = \frac{L_{STD}}{R_{INC}\ R_{POTW}} \times 0.0022046 \text{ lbs/g}$$

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* The mercury standard applies to emissions of "mercury in particulates, vapors, aerosols, and compounds" (40 CFR 61.51(a)).

Where: L_{IN} = Allowable headworks loading, lbs/day

L_{STD} = Emission standard, g/day

R_{INC} = Incinerator removal efficiency, as a fraction:

$$\frac{\text{Loading in input sludge - loading in output ash}}{\text{loading in input sludge}}$$

R_{POTW} = Removal efficiency across POTW, as a fraction:

$$\frac{\text{loading in POTW influent - loading in POTW effluent}}{\text{loading in POTW influent}}$$

These steady state equations assume that metals in sludge fed to an incinerator are either emitted to the atmosphere or remain behind in incinerator sludge ash. For pollutants regulated on a particulate basis (e.g., lead, beryllium), these equations further assume that metal emissions from the sludge incinerator entirely consist of particulate (i.e., regulated) metal.

3.2.3 Comparison of Allowable Headworks Loadings

The result of the calculations described in Sections 3.2.1 and 3.2.2 will be a number of allowable headworks loadings for each pollutant, each allowable headworks loading having been derived from an applicable criterion or standard. For each pollutant, these allowable headworks loadings should be compared, and the smallest loading for each pollutant should be selected as most stringent. If the POTW's actual headworks loading of a particular pollutant is consistently below this loading, compliance with all applicable criteria for the particular pollutant will be ensured. This loading is designated the "maximum allowable headworks loading" for the particular pollutant. It is the maximum allowable headworks loading for each pollutant which is allocated to domestic/background and industrial sources (and to which a safety factor is applied), thereby deriving local limits. Allocation of maximum allowable headworks loadings is discussed in detail in Section 3.3.

3.2.4 Representative Removal Efficiency Data

It is evident from the allowable headworks loading equations presented in Sections 3.2.1 and 3.2.2 that the derivation of representative removal efficiencies, for both the entire wastewater treatment plant and across each level of treatment or process, is a critical aspect of local limits development. Decisions must be made concerning data manipulation, to ensure that derived removal efficiencies reflect representative treatment plant performance. In this section, recommended procedures for the derivation of representative removal efficiencies are discussed.

The removal efficiency across a wastewater treatment plant, or a specific treatment unit within the treatment plant, is defined as the fraction (or percent) of the influent pollutant loading which is removed from the wastestream. The general equation for the instantaneous removal efficiency is:

$$R_{EFF} = \left(\frac{L_{INF} - L_{EFF}}{L_{INF}} \right) (100)$$

where: R_{EFF} = Removal efficiency, percent

L_{INF} = Influent pollutant loading, lbs/d

L_{EFF} = Effluent pollutant loading, lbs/d

However, for purposes of calculating local limits, instantaneous removal efficiency should not be used, but rather a representative removal efficiency such as a mean value or a value that is achieved at least a certain percentage of the time. This is because instantaneous, or even daily, removal efficiencies can be highly variable. They are affected by both wastewater characteristics (e.g., influent load) and by factors influencing performance (ambient temperature, operational variables, etc.). The development of a representative removal efficiency data base requires numerous influent/effluent monitoring events. EPA recommends that typical removal efficiencies be based on at least 1 year of monitoring data to account for variability. If one year of data are not available, however, EPA recommends 5 consecutive days of monitoring data as a minimum. Once the data set has been obtained, a single removal efficiency representative of the entire data set needs to be derived for use in local limits calculations. Several methods exist by which this single removal efficiency can be derived; two methods will be described in the following subsections. Both methods involve the use of influent/effluent loading data as opposed to concentration data. This is recommended because of flow reduction that can occur in the treatment plant and, secondly, because seasonal changes in flow can be quite significant.

3.2.4.1 Representative Removal Efficiencies Based on Mean Influent/Effluent Data

A single removal efficiency can be calculated from the mean influent and mean effluent values using the following equation.

$$R_{eff} = \frac{\bar{I} - \bar{E}}{\bar{I}} \quad (100)$$

where: R_{eff} = Removal efficiency, percent

$\bar{I}$ = Mean influent loading, lbs/d

$\bar{E}$ = Mean effluent loading, lbs/d

The main disadvantage to the removal efficiency based on influent and effluent means is that it is not apparent how often the derived removal efficiency was achieved. However, this disadvantage can be circumvented by the alternative approach of selecting representative removal efficiencies corresponding to specific deciles.

3.2.4.2 Representative Removal Efficiencies Based on Deciles

A decile is similar to a data set median. A median divides an ordered data set into two equal parts; half of the data set values are less than the median and half of the data set values exceed the median. Deciles are similar, except that they divide an ordered data set into <u>ten</u> equal parts. Thus, ten percent of the data set values are less than the first decile, twenty percent of the data set values are less than the second decile, and so on. The <u>fifth</u> decile is equivalent to the data set median.

In order to demonstrate the derivation of removal efficiency deciles, the following hypothetical monthly removal efficiency data will be assumed (already sorted from smallest to greatest):

$R_1 = 10\%$
$R_2 = 22\%$
$R_3 = 27\%$
$R_4 = 37\%$
$R_5 = 45\%$
$R_6 = 62\%$
$R_7 = 67\%$
$R_8 = 87\%$
$R_9 = 89\%$
$R_{10} = 91\%$
$R_{11} = 92\%$
$R_{12} = 94\%$

- Deciles consist of the nine (N+1)/10th values of a sorted data set. Thus, if the removal efficiency data set consists of 12 monthly removal efficiencies, every (12+1)/10 = 1.3rd removal efficiency is sought.

- The first decile is the 1.3rd removal efficiency in the above list. This removal efficiency lies three-tenths of the distance between the first (10%) and second (22%) removal efficiencies in the above list. Thus,

  First decile = $D_1 = 10 + (0.3)\ (22 - 10) = 13.6\%$

- The second decile is the 2 x 1.3 = 2.6th removal efficiency in the above list. The second decile lies six-tenths of the distance between the second (22%) and third (27%) removal efficiencies in the above list:

  Second decile = $D_2 = 22 + (0.6)\ (27 - 22) = 25\%$

- The third decile is the 3 x 1.3 = 3.9th removal efficiency in the above list. The third decile lies nine-tenths of the distance between the third (27%) and fourth (37%) removal efficiencies in the above list:

  Third decile = $D_3 = 27 + (0.9)\ (37 - 27) = 36\%$

- In this same manner, all nine deciles can be derived:

D_1	13.6%
D_2	25%
D_3	36%
D_4	48.4%

D_5	64.5% (median)
D_6	83%
D_7	89.2%
D_8	91.4%
D_9	93.4%

This distribution (not a normal distribution) is illustrated in Figure 3-1. The hypothetical POTW described by the above performance data achieved a median removal efficiency of 64.5 percent. For much of the year, however, the POTW achieved considerably poorer removals; for instance, the POTW achieved less than 30 percent removal for three entire months. POTW personnel might be concerned that local limits based on the median removal efficiency of 64.5 percent may not protect the POTW from interference/pass-through during these three months. In such a situation, the POTW might consider selecting a particular decile in lieu of the data set median, as more demonstrative of a "worst-case" scenario of POTW performance.

For example, the POTW may choose to derive local limits from pass-through criteria using the removal efficiency corresponding to the second decile (25 percent), basing this decision on the fact that the historical data show that the POTW achieves poorer removals only 20 percent of the time. The resultant allowable headworks loading would be about 50 percent more stringent than if the median removal efficiency had been used.

Similarly, the hypothetical POTW may wish to derive local limits from sludge quality criteria. In this event, the POTW should select a removal efficiency corresponding to a decile higher than the median. For example, the eighth decile (91.4 percent) might be selected. The resulting headworks loading would then be about 30 percent more stringent then if the median removal efficiency had been used.

3.2.4.3 Potential Problems in Calculating Removal Efficiencies

In attempting to analyze POTW influent, effluent, and sludge monitoring data for the purpose of deriving removal efficiencies, the POTW may have to resolve various data inconsistencies/anomalies, including:

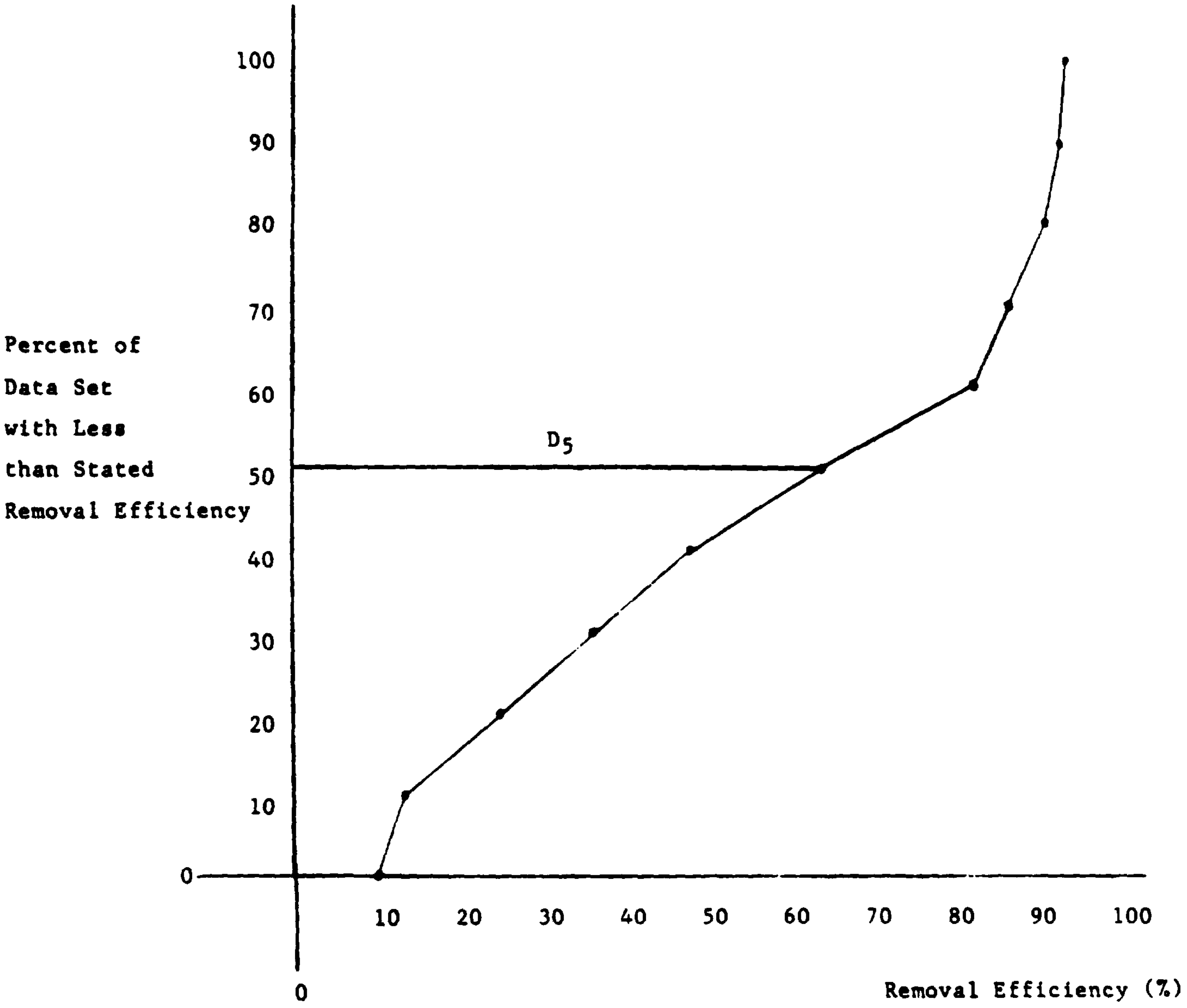

FIGURE 3-1. EXAMPLE DISTRIBUTION PLOT OF REMOVAL EFFICIENCY DATA

- Influent, effluent, and/or sludge levels are below analytical detection
- Effluent pollutant levels exceed influent pollutant levels
- The pollutant is detected in effluent and/or sludge but is not detected in influent.

As an actual example of these anomalous conditions, Table 3-9 documents the results of ten consecutive days of nickel monitoring at the Chattanooga, Tennessee Wastewater Treatment Plant [from Fate of Priority Pollutants in Publicly Owned Treatment Works - 30 Day Study EPA 440/1-82/302]. It can be seen from Table 3-8 that for only four of the ten days influent, effluent, and sludge levels of nickel simultaneously exceeded the analytical detection limit, permitting direct calculation of removal efficiencies. For three days, the effluent levels of nickel were below analytical detection and the corresponding influent levels were above detection. For two days, the influent levels of nickel were below detection and the corresponding effluent levels were above detection. On one day, both influent and effluent levels of nickel were below detection.

The Chattanooga POTW data highlight two data analysis issues to be resolved: (1) selection of surrogate values to replace pollutant levels reported as below detection, and (2) interpretation of negative removal efficiencies. In deriving removal efficiencies from the Table 3-8 data, the POTW may elect to substitute a surrogate for influent and effluent levels reported as below detection. Three surrogates are commonly used for this purpose: the detection limit itself; zero; and one half of the detection limit. Selection of a surrogate equal to the detection limit constitutes the assumption of a pollutant level which is always higher than the actual value. Conversely, selection of a surrogate equal to zero constitutes the assumption of a pollutant level which is always lower than the actual value. Selection of a surrogate equal to one half of the detection limit is an attempt to improve data set accuracy by establishing a compromise between these two extremes.

The following guidance is provided on the selection of surrogate values and the subsequent derivation of removal efficiencies:

- When only a few data values are reported near or below the detection limit, a surrogate should be substituted and all available data used in the derivation of representative removal efficiencies.
- When the majority of data values are reported at or near the detection limit, the data set should not be used to derive representative removal efficiencies. This recommendation is made because the resultant representative removal efficiencies derived from such data will be greatly influenced by the choice of the surrogate value. Alternatives that can be used if the pollutant is of concern, even though its concentrations are near or below the detection level, include sampling to check for the occurrence of additional higher concentrations, performance of spiked pilot studies, or use of representative data from the literature.

In addition to Chattanooga POTW influent and effluent monitoring data, Table 3-9 also presents POTW sludge monitoring data for nickel. For conservative pollutants such as nickel, sludge monitoring data can be used in deriving POTW removal efficiences, by means of the following equation:

$$R_{EFF} = \frac{L_{SLDG}}{L_{INF}} (100) = \frac{Q_{SLDG}\ C_{SLDG}}{Q_{INF}\ C_{INF}} (100)$$

where: R_{EFF} = Removal efficiency, percent
L_{SLDG} = Pollutant loading in sludge to disposal, lbs/d
L_{INF} = POTW influent pollutant loading, lbs/d
Q_{SLDG} = Sludge flow to disposal, MGD
Q_{INF} = POTW influent flow, MGD
C_{SLDG} = Pollutant level in sludge to disposal, mg/l
C_{INF} = POTW influent pollutant level, mg/l

By basing conservative pollutant removal efficiencies on sludge monitoring data, the above equation allows the POTW to circumvent the need for establishing surrogate values for POTW influent and effluent levels reported as below detection. The above equation does not apply to nonconservative pollutants, such as organics and cyanide.

The second data analysis issue highlighted by the Chattanooga POTW data (Table 3-9) concerns the interpretation of negative removal efficiencies. Negative removal efficiencies are in part attributable to the fact that POTWs do not actually operate at steady state. Deviation from steady state operation is brought about by a number of factors including:

- Variability in POTW influent concentrations
- Variability in POTW treatment performance
- Accumulation of pollutants in POTW sludge
- Variability in POTW effluent concentrations, due to the effect of concentrated recycle streams within the POTW (e.g., recycled digester supernatant)
- Incidental generation of pollutants by POTW operations, such as the generation of chlorinated organics (e.g., chloroform) as a result of disinfection by chlorination.

It should be emphasized that the above factors can contribute to the actual occurrence of short term negative removal efficiencies across the POTW, and that such negative removal efficiencies should not be dismissed as uncharacteristic of the POTW's operating condition at any given time. The following guidance is provided regarding negative removal efficiencies:

- If removal efficiencies vary greatly from sampling to sampling, the decile approach (see Section 3.2.4.2) to removal efficiency derivation should be used. Negative removal efficiencies should be excluded from this type of data analysis.
- If removal efficiencies are fairly consistent from sampling to sampling, the mean influent/mean effluent approach (see Section 3.2.4.1) to removal efficiency derivation should be used. Influent/effluent data indicating negative removal efficiencies can and should be included in this type of analysis.

The above guidance concerning negative removal efficiencies, as well as guidance concerning data surrogates presented earlier in this section, should be reviewed by the POTW and judiciously applied as warranted on a case-by-case basis.

3.2.4.4 Literature Removal Efficiency Data

As removal efficiencies are largely based on site-specific conditions, such as climate, POTW operation and maintenance, sewage characteristics, etc., removal efficiencies are not readily generalized for inclusion in this type of guidance manual. To derive truly representative removal efficiencies, a site-specific monitoring data base is required. Section 2.5 provides details for establishing such a data base. The removal efficiencies presented in this section are not an accurate substitute for site-specific removal efficiencies obtained through POTW in-plant monitoring programs.

Table 3-9 presents typical primary removal efficiencies for metals, nonmetal inorganics, and priority pollutant organics. These data were obtained from the document Fate of Priority Pollutants in Publicly Owned Treatment Works, commonly referred to as the 40 POTW Study. The study involved sampling and analysis of influent, effluent, sludge, and internal wastestreams of 40 representative wastewater treatment plants. The table presents the median removal efficiencies for primary treatment units, derived as part of the 40 POTW Study. Representative primary removal efficiencies are necessary for calculating maximum allowable headworks loadings based on secondary treatment threshold inhibition levels (see Section 3.2.2.1).

Tables 3-10 and 3-11 present removal efficiency data for metals, nonmetal inorganics, and priority pollutant organics in activated sludge and trickling filter treatment plants, respectively. The data are based on an analysis of removal efficiency data presented in the 40 POTW Study. The tables provide second and eighth decile removal efficiencies, as well as median removal efficiencies, for the listed pollutants. The definition and use of removal efficiency deciles have been detailed in Section 3.2.4.2 above. Representative secondary removal efficiencies are necessary for calculating maximum allowable headworks loadings based on NPDES permit limits, water quality standards/ criteria, sludge digester inhibition data, and sludge disposal standards/ criteria for secondary treatment plants, as well as tertiary treatment inhibition data for tertiary treatment plants (see Sections 3.2.1 and 3.2.2).

Table 3-12 presents second decile, eighth decile, and median removal efficiencies for metals, nonmetal inorganics, and priority pollutant organics in tertiary treatment plants. Again, the data are based on an analysis of removal efficiency data presented in the 40 POTW Study. Tertiary removal efficiencies are used in calculating maximum allowable headworks loadings based on NPDES permit limits, water quality standards/criteria, sludge digester inhibition data, and sludge disposal standards/criteria for tertiary treatment plants (see Sections 3.2.1 and 3.2.2).

The removal efficiency data presented in Tables 3-9 to 3-12 are intended as supplementary guidance to removal efficiency data and documentation provided elsewhere (e.g., the PRELIM program, EPA's Guidance Manual for Pretreatment Program Development, etc.). As noted previously, literature removal efficiency data should only be used when site-specific removal efficiencies obtained from POTW in-plant monitoring programs cannot be obtained.

3.3 PROCEDURE FOR ALLOCATING MAXIMUM ALLOWABLE HEADWORKS LOADINGS

In this, the second step of local limits development, maximum allowable headworks loadings, derived as detailed in Section 3.2 above, are converted into local limits. A portion of the maximum allowable headworks loading for each pollutant is allocated to:

- Safety factor
- Domestic sources
- Industrial sources.

Allowable headworks loading allocations can be carried out by following a number of procedures. The selection of an appropriate allocation procedure for a specific POTW should be an integral aspect of that POTW's local limits planning and decision-making process. The POTW may select any allocation method, so long as the selected method results in a system of local limits that is enforceable and that meets minimum objectives (prevention of pass-through, interference, compliance with specific prohibitions and other State and local requirements). When choosing an allocation method, the POTW may wish to consider: (1) how easily the derived local limits can be implemented and enforced, and (2) the relative compliance burdens the derived local limits will impose on each IU. The POTW may also wish to consider whether to incorporate a safety factor to hold part of the allowable pollutant loadings in reserve for future growth or to compensate for possible slug loadings.

Finally, POTWs may need to take a hard look at "domestic" sources of pollutants, to see if any might actually be better classified as nondomestic sources with reducible pollutant loadings. This practice is recommended for those POTWs for which background loading allocations use up nearly all of the allowable loadings of some pollutants.

In this section of the manual, local limits issues and POTW options in identifying and accounting for domestic/pollutant pollutant contributions to the POTW, in incorporating a safety factor during the limits setting process, and in allocating allowable industrial pollutant loadings to individual industrial users will be discussed.

3.3.1 Building in Safety Factors

The POTW should consider allocating only a portion of the maximum allowable headworks loading for each pollutant to the POTW's current industrial and domestic users. The remaining portion of the maximum allowable headworks loading for each pollutant is held in reserve as a safety factor. This safety factor should be designed to account for and accommodate the various uncertainties inherent in the local limits development process. These uncertainties include:

- Potential future industrial growth, resulting in new and/or increased industrial discharges to the POTW.
- Potential slug loadings (e.g., as a result of chemical spills) of pollutants which might affect POTW operation/performance.
- Variability and measurement error associated with POTW design/performance parameters used in deriving local limits (e.g., removal efficiencies, POTW flow data, domestic/background pollutant levels, etc.).

The determination of an appropriate safety factor is a site-specific issue dependent upon local conditions. As noted above, a significant consideration in the selection of an appropriate safety factor is the expected local industrial growth rate and the expected impact this growth rate will have on the POTW. Thus the POTW should endeavor to keep informed of proposed local industrial construction projects which might result in future increases in pollutant loadings to the POTW. In the absence of more specific industrial growth rate data, the POTW may wish to consider the following trends indicative of industrial growth:

- Trend analysis of POTW influent flows and pollutant loadings over the past several years
- Trend analysis of community water consumption records over the past several years
- Known/projected increases in the number of industrial building permits issued
- Known/projected increases in community revenues obtained through local taxes

As a general rule, a minimum safety factor of ten percent of the maximum allowable headworks loading is usually necessary to adequately address the safety factor issues delineated in this section. As noted previously, the requisite magnitude of the safety factor above this recommended minimum is a site-specific issue; however, the POTW should recognize that selection of a high safety factor does not constitute an appropriate substitute for periodic review and updating of local limits. As local conditions change, the POTW needs to periodically review and revise its local limits as necessary.

3.3.2 Domestic/Background Contributions

Maximum allowable headworks loadings are allocated to total domestic/background sources and to individual industrial/commercial users during the limits setting process. For each pollutant the estimated total loading currently received at the POTW from all domestic/background sources is subtracted from the pollutant's allowable headworks loading. The resulting allowable industrial/commercial loading can then be allocated to the individual industrial users and local limits subsequently derived.

Domestic pollutant loadings for use in local limits calculations must be obtained through site-specific monitoring. Such monitoring should be conducted at sewer trunk lines which receive wastewater solely from domestic sources. Domestic pollutant concentrations obtained as a result of this monitoring program are multiplied by the POTW's total domestic flow [as well as the appropriate conversion factor], to derive the POTW's total domestic loadings. These total domestic loadings are presumed to constitute background loadings and are not typically controlled by local limits.

Table 3-13 presents typical domestic/background wastewater levels for metals and nonmetal inorganics. These data were extracted from the 40 POTW Study and a similar study of four cities. The Table 3-13 data provide only a rough indication of the expected magnitude of site-specific domestic/background wastewater pollutant levels. Actual site-specific data should be used in the derivation of the above-described domestic/background pollutant loadings whenever possible. The POTW is strongly urged to obtain site-specific data by instituting an appropriate collection system monitoring program.

Occasionally, in deriving local limits for a particular pollutant, a POTW may find that the total domestic/background loading of that pollutant approaches or exceeds the maximum allowable headworks loading. In such an event, little or no portion of the maximum allowable headworks loading would be available to allocate to industrial users. Such a situation may be attributable in part to nondomestic facilities such as gasoline stations, radiator shops, car washes, and automobile maintenance shops, which often discharge at surprisingly high pollutant levels. These facilities are often overlooked by POTWs, owing to their small size and low discharge flows, but their discharges are controllable and should not be overlooked.

Tap water discharged to the city sewers contains background levels of certain pollutants (e.g., chloroform, copper, zinc). These pollutants sometimes originate from corroding water pipes or municipal water treatment practices and can sometimes be controlled. These background levels contribute to the POTW's total domestic pollutant loadings. In addition, household wastes, such as household pesticides, solvents, and spent oil, discarded into the city sewer will likewise contribute to the POTW's total domestic/background pollutant loadings.

When the total domestic/background loading of a pollutant exceeds the pollutant's maximum allowable headworks loading, the POTW should:

- Ensure that all significant industrial and commercial dischargers of the pollutant have been identified.

- Consider public education to reduce household discharges of used oil and hazardous wastes.

- Substitute actual sewer trunk line monitoring data for any literature data used in deriving total domestic pollutant loadings to the POTW.

- Substitute POTW removal efficiencies obtained as a result of in-plant monitoring for any literature removal efficiencies used in deriving maximum allowable headworks loadings.

- Verify applicability of POTW plant and environmental protection criteria (e.g., ensure that water quality criteria are appropriate for the stream use classification of the POTW's receiving stream).

- If the POTW's biological treatment units have never experienced inhibition/upsets, compare inhibition-based maximum allowable headworks loadings derived from literature inhibition data with the POTW's current headworks loadings. If the current headworks loadings are less stringent, but can be verified as having never inhibited or upset the POTW's treatment processes, these loadings may constitute a more appropriate local limits basis than the more stringent headworks loadings derived from literature inhibition data.

By pursuing the problem in a logical manner, the POTW should be able to develop reasonable local limits for pollutants with elevated total domestic/background loadings.

3.3.3 Alternative Allocation Methods

Once the POTW has derived the maximum allowable industrial loadings of the various pollutants, these loadings should be allocated to the POTW's industrial users. A variety of procedures exist for conducting these loading allocations. In this section of the manual, four of the most commonly employed allocation methods - the uniform concentration method based on total industrial flow, the concentration limit method based on industrial contributory flow, the mass proportion method, and the selected industrial reduction method - will be described. In the following two subsections, the principal considerations in applying these loading allocation methods to derive local limits for conservative pollutants and nonconservative pollutants, respectively, will be presented. Conservative pollutants are defined as pollutants which are presumed not to be destroyed, biodegraded, chemically transformed, or volatilized within the POTW. Conservative pollutants introduced to a POTW ultimately exit that POTW solely through the POTW's discharge streams (e.g., POTW effluent, sludge). Nonconservative pollutants are defined as pollutants which are, to some degree, changed within the POTW by these mechanisms.

3.3.3.1 Conservative Pollutants

As suggested above, the uniform concentration method based on total industrial flow, the concentration limit method based on industrial contributory flow, the mass proportion method, and the selected industrial reduction method are all commonly used to allocate maximum allowable industrial loadings and to subsequently derive local limits for conservative pollutants. The uniform concentration method based on total industrial flow yields one set of limits that apply to all IUs, while the other three methods can be termed "IU-specific", meaning that different limits apply to different IUs. Each of the four methods is described below; equations for application of these methods are provided in Figure 3-2:

1) Uniform concentration limit for all industrial users - For each pollutant, the maximum allowable industrial loading to the POTW is divided by the total flow from all industrial users, even those that do not discharge the pollutant. This allocation method results in a single discharge concentration limit for each pollutant that is the same for all users. Mathematically, this method is the same as the "flow proportion allocation method" described in earlier guidance (Guidance Manual for POTW Pretreatment Program Development, U.S. EPA Office of Water Enforcement and Permits, Washington, DC, October, 1983, Appendix L.)

2) Concentration limits based on industrial contributory flow - This is similar to the uniform concentration limit allocation method except that the flow from only those users that actually have the pollutant in their raw wastewaters at greater than background levels is used to derive a concentration limit for the pollutant. The limit for the pollutant applies only to those identified users.

3) Mass proportion - For each pollutant, the maximum allowable industrial loading to the POTW is allocated individually to each IU in proportion to the IU's current loading. The limits are derived by determining the ratio of the allowable headworks loading to the current headworks loading, and then multiplying this ratio by each IU's current loading.

4) Selected industrial reduction - The POTW selects the pollutant loading reductions which each IU will be required to effect. Typically, the POTW selects pollutant loading reductions on the basis of treatability.

	Equation
Uniform Concentration Method Based on Total Industrial Flow:	$C_{LIM} = \frac{L_{ALL}}{(8.34)(Q_{IND})}$
Concentration Limit Method Based on Industrial Contributory Flow:	$C_{LIM} = \frac{L_{ALL}}{(8.34)(Q_{CONT})}$
Mass Proportion Method:	$L_{ALL(X)} = \frac{L_{CURR(X)}}{L_{CURR(T)}} \times L_{ALL}$ $C_{LIM(X)} = \frac{L_{ALL(X)}}{(8.34)(Q_{(X)})}$
Selected Industrial Reduction Method:	$L_{ALL(X)} = L_{CURR(X)} \times (1-R_{(X)})$ $C_{LIM(X)} = \frac{L_{ALL(X)}}{(8.34)(Q_{(X)})}$

C_{LIM} = Uniform concentration limit, mg/l

L_{ALL} = Maximum allowable industrial loading to the POTW, lbs/day

Q_{IND} = Total industrial flow, MGD

Q_{CONT} = Industrial contributory flow, MGD

$L_{ALL(X)}$ = Allowable loading allocated to industrial user X, lbs/day

$L_{CURR(X)}$ = Current loading from industrial user X, lbs/day

$L_{CURR(T)}$ = Total current industrial loading to the POTW, lbs/day

L_{ALL} = Maximum allowable industrial loading to the POTW, lbs/day

$C_{LIM(X)}$ = Discharge limit for industrial user X, mg/l

$Q_{(X)}$ = Discharge flow from industrial user X, MGD

$R_{(X)}$ = POTW-selected pollutant removal efficiency for industrial user X, as a decimal

FIGURE 3-2. COMMONLY USED METHODS TO ALLOCATE MAXIMUM ALLOWABLE INDUSTRIAL LOADINGS

The Appendix I local limits derivation example demonstrates the application of each of these pollutant loading allocation techniques.

The relative advantages and disadvantages of each technique are a matter of perception and philosophy as well as a matter of technical merit. A brief discussion of the relative advantages and disadvantages of each technique is provided below. This manual updates the material presented in Appendix L of the EPA document, Guidance Manual for POTW Pretreatment Program Development (October 1983).

Uniform Concentration Limits for All Industrial Users

This is the traditional method for deriving local limits. It is the only method that results in local limits that are the same for all IUs. This is because the total industrial flow is used in the calculations, not just the flow from industries discharging the pollutant. Since uniform concentration limits apply to all industrial users, these limits can be incorporated directly into the POTW ordinance. Enforcement of the limits solely through the ordinance without an independent control mechanism may be acceptable for smaller POTWs with few IUs. However, an individual control document for each IU is still desirable to specify monitoring locations and frequency, reporting requirements, special conditions, applicable categorical standards, and to provide clear notification to IUs as required by 40 CFR 403.8.

The relative ease of calculation and perceived ease of application are cited as major advantages of the uniform concentration approach. However, this method also has several drawbacks which should be understood before a decision is made to establish one target for all users.

The total industrial flow is used in the calculations. This has the effect of allowing all nondomestic sources to discharge all limited pollutants at levels up to the uniform concentration limits. All nondomestic sources generally do not discharge measurable quantities of all limited pollutants; however, the uniform concentration allocation method nevertheless provides every IU with a flow proportioned pollutant loading allocation for every limited pollutant. This practice may be acceptable if there is sufficient excess capacity at the POTW. But this method can result in overly restrictive limits on IUs if the POTW discharges to a low-flow stream, operates a sensitive process such as nitrification, or is faced with stringent sludge disposal requirements. If the ability of the POTW to accept industrial pollutant loadings is limited, adopting an allocation method that yields IU-specific local limits may be the better course to pursue. Following are several approaches to IU-specific local limits.

Concentration Limits Based on Industrial Contributory Flow

Discharge standards can also be developed for those specific IUs which actually discharge a given pollutant. Under this scenario, a common discharge limit would be established for all IUs identified as discharging a given pollutant.

Under this method, whether the flow from the classification of a particular discharger is considered as either part of the domestic/background flow or as part of the industrial contributory flow will depend on the particular pollutant being considered. For example, if an industrial or commercial user does not discharge cadmium or discharges only at background levels, then that user's flow would be considered in the domestic portion of total POTW flow. However, if a limit is being calculated for zinc and the same user discharges zinc, then the user's flow is considered part of the industrial flow portion.

Some POTWs may have developed limits using this method and applied the limits uniformly in the local ordinance without individual IU control documents. This approach should be avoided because ordinance limits normally apply to <u>all</u> industrial users, not just those IUs identified as discharging the particular pollutant. If additional IUs, outside of those IUs whose flows were incorporated into the loading allocation process, were to begin discharging at pollutant levels up to the ordinance limit, then the POTW's allowable headworks loading could potentially be exceeded, even though all IUs would be discharging in compliance with the city's ordinance limits. In order to ensure that this does not happen, a control mechanism should be used which clearly notifies those IUs that they are expected to discharge at only their current level, or the level assumed in the allocation process.

A similar issue concerning this allocation method pertains to IUs that have a pollutant present at significant concentrations in their raw wastewater but at only background concentrations in their pretreated wastewater. These IUs are often considered part of the domestic/background flow rather than the industrial flow. This practice should be avoided unless the IU's control document requires the discharge to remain at or below the current or background level. Again, the concern is that if the IU were to increase its discharge up to the ordinance limit, perhaps due to poor operation of pretreatment equipment, the POTW's allowable headworks loading could be exceeded.

When used properly, the allocation method has advantages in that the POTW's allowable loading is apportioned only to those IUs that actually discharge a pollutant. A possible disadvantage of this approach is that it requires detailed knowledge of each IU's current raw wastewater composition.

Mass Proportion Limits

These are limits developed on the basis of the ratio of allowable headworks loading to current headworks loading for a particular pollutant. This ratio is multiplied by the current loading for each IU, generating the IU's local limit for that pollutant. When the current headworks loading exceeds the maximum allowed, the requisite pollutant loading reductions are imposed on all IUs. This method is particularly useful when the fate of the pollutant within the collection system is not easily quantified. However, this method requires a fairly detailed understanding of each user's effluent quality and may penalize IUs which are presently pretreating their wastes when others are not.

The mass proportion allocation method is an IU specific method; for each pollutant, a different concentration limit is derived for each IU discharging the particular pollutant. As local limits derived by the mass proportion method are IU specific, these limits are most effectively implemented through individual IU control documents.

Selected Industrial Reduction Limits

Selected industrial reduction limits are based on POTW-selected pollutant loading reductions which certain IUs will be required to effect. The POTW generally bases these removals on wastewater treatability information. Technology-based limitations are developed by considering the potential wastewater treatment systems that are best suited to that IU's wastewater. Development of limits requires information about current IU loadings and information on applicable industrial waste treatment and waste minimization technologies. (See Chapters 5 and 6.)

This method seeks to cost-effectively reduce pollutant loadings by imposing needed reductions on only the significant dischargers of a pollutant on a case-by-case basis. Significance can be defined in terms of size, raw waste loadings or concentrations, or potential to impact the POTW. Less significant dischargers of the pollutant do not have to bear as much of the pollutant reduction burden.

An advantage of this method is that it enables a POTW to focus its local limits strategy for a particular pollutant on those specific industries for which available technology will bring about the greatest POTW influent loading reductions. This approach may bring about the greatest pollution abatement for the least amount of money. IUs that are in direct competition or are in the same type of industry can be categorized and required to achieve the same levels of pretreatment, which provides some equity and uniformity. However, since uniform requirements are not imposed on all IUs, the POTW's decisions will be subject to close examination and involvement by IUs.

The selected industrial reduction allocation method is IU specific, establishing different concentration limits for different IUs. As with other IU specific methods (i.e., industrial contributory flow and mass proportion methods), local limits derived by the selected industrial reduction method are most effectively implemented through individual IU control documents.

The selected industrial reduction method can be effectively used to set local limits for nonconservative pollutants. Other pollutant loading allocation methods (e.g., uniform concentration method) involve the assumption that pollutants are not lost through biodegradation/volatilization in the collection system. The selected industrial reduction methodology circumvents this assumption by setting IU-specific local limits on the basis of expected IU treatment technology performance.

3.3.3.2 Nonconservative Pollutants

The allocation of allowable pollutant headworks loadings for nonconservative pollutants presents unique challenges that are not encountered with conventional pollutants. These challenges result from the fact that there will be losses of nonconventional pollutants in the collection system, through biodegradation and/or volatilization, losses which could be quite substantial. As a result, any mass balance based approach to pollutant allocation is complicated by losses through the collection system.

Because of these difficulties, it is recommended that POTWs adopt a more empirical approach to establishing the discharge limits. This would involve the following process:

- Step One - Estimate the portions of nonconservative pollutants contributed by controllable and noncontrollable sources. This characterization will be difficult for nonconservative pollutants since the total domestic loading is difficult to determine and thus the fraction lost in the sewers through volatilization and biodegradation may be very difficult to determine. Of necessity, the assessment must be based on a site specific consideration of all available monitoring and sampling data as well as sewer system configuration.
- Step Two - Determine the percent pollutant reduction desired at the plant headworks by comparing the maximum allowable nonconservative pollutant headworks loading to the existing loading.
- Step Three - Require reduction in the industrial user discharges of the nonconservative pollutant of concern at a minimum by the above determined percentage. These minimum industrial reductions may need to be increased further to account for the uncontrolled loading from domestic/background sources if the assessment called for in Step 1 suggests that those loadings may be significant.
- Step Four - These limits, as with all local limits, should be reassessed during the routine evaluation of local limit effectiveness. If subsequent evaluation of the actual influent loading indicates insufficient reduction has been achieved, the POTW should consider whether the industrial reductions called for in Step 3 need to be increased.

A demonstration of this pollutant loading allocation procedure is provided in the local limits derivation example presented in Appendix I.

Potential collection system effects, such as flammability/explosivity and fume toxicity, constitute additional bases for the development and implementation of local limits for volatile organics. These local limits bases are discussed in detail in Chapter 4.

3.4 REVIEWING TECHNOLOGICAL ACHIEVABILITY

Once the POTW has derived its local limits in accordance with the procedures presented in this Chapter, the POTW should determine whether the limits are achievable through the installation of pretreatment technologies. One result of a technological achievability assessment might be the decision to rework the local limits calculations via an alternative allocation procedure. One allocation procedure (selected industrial reduction) incorporates technological achievability data into the allocation process. The technological achievability assessment might also provide the POTW with an indication of the stringency of its selected safety factor. Chapter 6 presents more detailed discussions of technological achievability and local limits.

3.5 PRELIM

PRELIM (an acronym for "pretreatment limits") is an EPA computer program that derives local limits for metals and cyanide, using the steady state equations discussed in this chapter. PRELIM requires the user to enter site-specific industrial user and POTW monitoring data as well as pertinent in-plant criteria from which to base local limits. If site-specific data are not available, PRELIM allows the user to access literature data for many parameters.

It should be emphasized that PRELIM is merely a tool for POTWs to use in deriving sound technical local limits on a site-specific basis. PRELIM, like any other computer program, is not an appropriate substitute for sound judgment on the part of its users, in assessing the site-specific validity of its data outputs.

TABLE 3-1. EPA AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF AQUATIC LIFE

	Maximum Allowable Levels for Protection of Aquatic Life, μg/l[+]			
	Freshwater Aquatic Life		Saltwater Aquatic Life	
Pollutant	Chronic	Acute	Chronic	Acute
Metals/Nonmetal Inorganics:				
Antimony	1600	9000	-	-
Arsenic	190	360	69	36
Beryllium	5.3	130	-	-
Cadmium*	1.1*	3.9*	9.3	43
Chromium (hex)	11	16	50	1100
Chromium (tri)	210*	1700*	-	10,300
Copper	12*	18*	-	2.9
Cyanide	5.2	22	-	1
Lead	3.2*	82	5.6	140
Mercury	0.012	2.4	.025	2.1
Nickel	160*	1400*	8.3	75

[+] from Reference [25]

*at 100 mg/l hardness as $CaCO_3$

TABLE 3-1. EPA AMBIENT WATER QUALITY CRITERIA FOR FOR PROTECTION OF AQUATIC LIFE (Continued)

	Maximum Allowable Levels for Protection of Aquatic Life, μg/l			
	Freshwater Aquatic Life		Saltwater Aquatic Life	
Pollutant	Chronic	Acute	Chronic	Acute
Selenium	35	260	54	410
Silver	0.12	4.1	-	2.3
Thallium	40	1400	-	2,130
Zinc	110*	120*	86	95
Organics:				
Acenaphthene	520	1700	710	970
Acrylonitrile	2600	7550	-	-
Aldrin	-	3	-	1.3
Benzene	-	5,300	700	5,100
Carbon Tetrachloride	-	35200	-	50000
Chlordane	0.0043	2.4	0.004	0.09
Chlorinated Benzenes	50	250	129	160
1,1,1-Trichloroethane	-	18000	-	31200
1,1,2-Trichloroethane	9400	18000	-	-
Hexachloroethane	540	980	-	940

TABLE 3-1. EPA AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF AQUATIC LIFE (Continued)

	Maximum Allowable Levels for Protection of Aquatic Life, μg/l			
	Freshwater Aquatic Life		Saltwater Aquatic Life	
Pollutant	Chronic	Acute	Chronic	Acute
Pentachloroethane	1100	7240	281	390
1,1,2,2-Tetrachloroethane	2400	9320	-	9020
1,1,1,2-Tetrachloroethane	-	9320	-	-
Chlorinated Naphthalenes	-	1600	-	7.5
2,4,6-Trichlorophenol	970	-	-	-
Chloroform	1240	28900	-	-
2-Chlorophenol	2000	4380	-	-
DDT	0.0010	1.1	0.0010	0.13
Dichlorobenzenes	763	1120	-	1970
Dichloroethylenes	-	11600	-	224000
2,4-Dichlorophenol	365	2020	-	-
Dichloropropanes	5700	23000	3040	10300
Dichloropropenes	244	6060	-	790
Dieldrin	0.0019	2.5	0.0019	0.71
2,4-Dimethyl Phenol	-	2120	-	-

TABLE 3-1. EPA AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF AQUATIC LIFE (Continued)

	Maximum Allowable Levels for Protection of Aquatic Life, µg/l			
	Freshwater Aquatic Life		Saltwater Aquatic Life	
Pollutant	Chronic	Acute	Chronic	Acute
2.4-Dinitrotoluene	230	330	370	590
Endosulfan	0.056	0.22	0.0087	0.034
Endrin	0.0023	0.18	0.0023	0.037
Ethyl Benzene	-	32000	-	430
Fluoranthene	-	3980	16	40
Heptachlor	0.0038	0.52	0.0036	0.053
Hexachlorobenzene	-	-	-	-
Hexachlorobutadiene	9.3	90	-	32
Hexachlorocylohexane	0.080	2.0	-	0.16
Isophorone	-	117000	-	12900
Malathion	0.1	-	0.1	-
Methoxychlor	-	0.03	-	0.03
Naphthalene	620	2300	-	2350
Nitrobenzene	-	27000	-	6680
Nitrophenols	150	230	-	4850

TABLE 3-1. EPA AMBIENT WATER QUALITY CRITERIA FOR PROTECTION OF AQUATIC LIFE (Continued)

	Maximum Allowable Levels for Protection of Aquatic Life, μg/l			
	Freshwater Aquatic Life		Saltwater Aquatic Life	
Pollutant	Chronic	Acute	Chronic	Acute
Pentachlorophenol	13	20	7.9	13
Phenol	2560	10200	-	5800
Polychlorinated Biphenyls	0.014	2.0	0.030	10
Tetrachloroethylene	840	5280	450	10200
Toluene	-	17500	5000	6300
Toxaphene	0.0002	0.73	0.0002	0.21
Trichloroethylene	21900	45000	-	2000

Reference [25]: U.S. EPA-Quality Criteria for Water 1986, EPA 440/5-86-001 May 1, 1986.

TABLE 3-2. ACTIVATED SLUDGE INHIBITION THRESHOLD LEVELS

Pollutant	Minimum Reported Inhibition Threshold mg/l	Reported Range of Inhibition Threshold Level, mg/l	Laboratory, Pilot, or Full-scale	References*
Metals/Nonmetal Inorganics				
Cadmium	1	1 - 10	Unknown	(29), (32)
Chromium (Total)	1	1 - 100	Pilot	(28)
Chromium (III)	10	10 - 50	Unknown	(29), (32)
Chromium (VI)	1	1	Unknown	(29), (32)
Copper	1	1	Pilot	(29), (28), (32)
Lead	0.1	0.1 - 5.0	Unknown	(32)
		10 - 100	Lab	(28)
Nickel	1	1.0 - 2.5	Unknown	(29), (32)
		5	Pilot	(28)
Zinc	0.08	0.08 - 5	Unknown	(32)
		5 - 10	Pilot	(28)
Arsenic	0.1	0.1	Unknown	(28), (29), (32)
Mercury	0.1	0.1 - 1	Unknown	(29), (32)
		2.5 as Hg (II)	Lab	(28)
Silver	0.25	0.25-5	Unknown	(29), (32)
Cyanide	0.1	0.1 - 5	Unknown	(28), (29), (32)
		5	Full	(28)
Ammonia	480	480	Unknown	(46)
Iodine	10	10	Unknown	(46)
Sulfide	25	25 - 30	Unknown	(46)
Organics:				
Anthracene	500	500	Lab	(28)
Benzene	100	100 - 500	Unknown	(32)
		125 - 500	Laboratory	(28)

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*References did not distinguish between total or dissolved pollutant inhibition levels.

TABLE 3-2. ACTIVATED SLUDGE INHIBITION THRESHOLD LEVELS (Continued)

Pollutant	Minimum Reported Inhibition Threshold mg/l	Reported Range of Inhibition Threshold Level, mg/l	Laboratory, Pilot, or Full-scale	References*
2-Chlorophenol	5	5	Unknown	(29)
		20 - 200	Unknown	(32)
1,2 Dichlorobenzene	5	5	Unknown	(29)
1,3 Dichlorobenzene	5	5	Unknown	(29)
1,4 Dichlorobenzene	5	5	Unknown	(29)
2,4-Dichlorophenol	64	64	Unknown	(32)
2,4 Dimethylphenol	50	40 - 200	Unknown	(32)
2,4-Dinitrotoluene	5	5	Unknown	(29)
1,2-Diphenylhydrazine	5	5	Unknown	(29)
Ethylbenzene	200	200	Unknown	(32)
Hexachlorobenzene	5	5	Unknown	(29)
Naphthalene	500	500	Lab	(28)
		500	Unknown	(29)
		500	Unknown	(32)
Nitrobenzene	30	30 - 500	Unknown	(32)
		500	Lab	(28)
		500	Unknown	(29)
Pentachlorophenol	0.95	0.95	Unknown	(29)
		50	Unknown	(32)
		75 - 150	Lab	(28)
Phenathrene	500	500	Lab	(28)
		500	Unknown	(29)
Phenol	50	50 - 200	Unknown	(32)
		200	Unknown	(29)
		200	Unknown	(28)
Toluene	200	200	Unknown	(32)
2,4,6 Trichlorophenol	50	50 - 100	Lab	(28)
Surfactants	100	100 - 500	Unknown	(46)

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*References did not distinguish between total or dissolved pollutant inhibition levels.

TABLE 3-3. TRICKLING FILTER INHIBITION THRESHOLD LEVELS

Pollutant	Minimum Reported Inhibition Threshold mg/l	Reported Range of Inhibition Threshold Levels, mg/l	Laboratory, Pilot, or Full-scale	References*
Chromium (III)	3.5	3.5 - 67.6	Full	(28)
Cyanide	30	30	Full	(28)

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*Reference did not distinguish between total or dissolved pollutant inhibition levels

TABLE 3-4. NITRIFICATION INHIBITION THRESHOLD LEVELS

Pollutant	Minimum Reported Inhibition Threshold mg/l	Reported Range of Inhibition Threshold Levels, mg/l	Laboratory, Pilot, or Full-scale	References*
Metals/Nonmetal Inorganics				
Cadmium	5.2	5.2	Laboratory	(28), (29)
Chromium (T)	0.25	0.25 - 1.9 1 - 100 (trickling filter)	Unknown Unknown	(28), (29), (32) (28)
Chromium (VI)	1	1 - 10	(as CrO_4^{2-})	Unknown (28
Copper	0.05	0.05 - 0.48	Unknown	(29), (32)
Lead	0.5	0.5	Unknown	(29), (32)
Nickel	0.25	0.25 - 0.5 5	Unknown Pilot	(29), (32) (28)
Zinc	0.08	0.08 - 0.5	Unknown	(29), (32)
Arsenic		1.5	Unknown	(29)
Cyanide	0.34	0.34 - 0.5	Unknown	(29), (32)
Chloride		180	Unknown	(46)
Organics:				
Chloroform	10	10	Unknown	(29)
2,4-Dichlorophenol	64	64	Unknown	(32)
2,4-Dinitrophenol	150	150	Unknown	(29)
Phenol	4	4 4 - 10	Unknown Unknown	(29) (32)

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*References did not distinguish between total or dissolved pollutant inhibition levels

TABLE 3-5. ANAEROBIC DIGESTION THRESHOLD INHIBITION LEVELS

Pollutant	Recommended Inhibition Threshold* (mg/l)	Reported Range of Inhibition Threshold* Level, mg/l	Laboratory, Pilot, or Full-scale	References
Metals/Nonmetal Inorganics				
Cadmium	20	20	Unknown	(32)
Chromium (VI)	110	110	Unknown	(32)
Chromium (III)	130	130	Unknown	(32)
Copper	40	40	Unknown	(32)
Lead	340	340	Unknown	(32)
Nickel	10	10	Unknown	(29), (32)
		136	Unknown	(28)
Zinc	400	400	Unknown	(32)
Arsenic	1.6	1.6	Unknown	(28)
Silver	13**	13-65**	Unknown	(32)
Cyanide	4	4-100	Unknown	(28)
	4	1-4	Unknown	(29), (32)
Ammonia	1500	1500 - 8000	Unknown	(46)
Sulfate	500	500 - 1000	Unknown	(46)
Sulfide	50	50 - 100	Unknown	(46)
Organics:				
Acrylonitrile	5	5	Unknown	(32)
		5	Unknown	(29)
Carbon Tetrachloride	2.9	2.9 - 159.4	Lab	(28)
		10 - 20	Unknown	(32)
		2.0	Unknown	(29)
Chlorobenzene	0.96	0.96 - 3	Lab	(28)
		0.96	Unknown	(29)

TABLE 3-5. ANAEROBIC DIGESTION THRESHOLD INHIBITION LEVELS (Continued)

Pollutant	Recommended Inhibition Threshold (mg/l)	Reported Range of Inhibition Threshold Level, mg/l	Laboratory, Pilot, or Full-scale	References
Chloroform	1	1	Unknown	(29)
		5 - 16	Lab	(28)
		10 - 16	Unknown	(32)
1,2-Dichlorobenzene	0.23	0.23 - 3.8	Lab	(28)
		0.23	Unknown	(29)
1,4-Dichlorobenzene	1.4	1.4 - 5.3	Lab	(28)
		1.4	Unknown	(29)
Methylchloride	3.3	3.3 - 536.4	Pilot	(28)
		100	Unknown	(29)
Pentachlorophenol	0.2	0.2	Unknown	(29)
		0.2 - 1.8	Lab	(28)
Tetrachloroethylene	20	20	Unknown	(29)
Trichloroethylene	1	1 - 20	Lab	(28)
		20	Unknown	(29)
		20	Unknown	(32)
Trichlorofluoromethane			Unknown	(29)

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*Total pollutant inhibition levels, unless otherwise indicated
**Dissolved metal inhibition levels

TABLE 3-6. FEDERAL AND SELECTED STATE SLUDGE DISPOSAL REGULATIONS AND GUIDELINES FOR METALS AND ORGANICS

					Cumulative Application Limits, lbs/acre		
State	Regulation or Guideline	Pollutant	Sludge Limit, mg/kg dry wt.	Annual Application Limit, lbs/acre	Soil CEC* <5 meq/100g	Soil CEC 5-15 meq/100g	Soil CEC >15 meq/100g
Federal	Regulation	Cd	-	0.45	(pH<6.5) 4.46	4.46	4.46
(40 CFR 257.3-5)					(pH>6.5) 4.46	8.92	17.84
(Federal Register, June 1976)**	Guideline	Cd	-	0.45	(pH>6.5) 4.46	8.92	17.84
		Cu	-	-	(pH>6.5) 111.5	223.1	446.1
		Pb	-	-	(pH>6.5) 446.1	892.2	1784.4
		Ni	-	-	(pH>6.5) 44.6	89.2	178.4
		Zn	-	-	(pH>6.5) 223.1	446.1	892.2
New Jersey	Guideline	Cd	-	-	4.4	8.9	17.8
		Cu	-	-	125	250	500
		Pb	-	-	500	1,000	2,000
		Ni	-	-	125	250	500
		Zn	-	-	250	500	1,000
	Contamination Indicator	Aldrin	0.10				
		Chlordine	0.20				
		Endrin	0.10				
		DDT	0.25				
		PCBs	0.50				
New York	Guideline	Cd	25	0.45	4.46	4.46	4.46
		Cr	1,000				
		Cu	1,000		111.5	111.5	111.5
		Pb	1,000		446.1	446.1	446.1
		Ni	200		44.6	44.6	44.6
		Hg	10				
		Zn	2,500		223	223	223

*CEC = Cation Exchange Capacity of the site's soil; if not known, contact the local Soil Conservation Service.

**From "Municipal Sludge Management - Environmental Factors." Federal Register, 41, NO. 108, pp. 22531, 22543. June 1976

TABLE 3-6. FEDERAL AND SELECTED STATE SLUDGE DISPOSAL REGULATIONS AND GUIDELINES FOR METALS AND ORGANICS (Continued)

State	Regulation or Guideline	Pollutant	Sludge Limit, mg/kg dry wt.	Annual Application Limit, lbs/acre	Cumulative Application Limits, lbs/acre Soil CEC <5 meq/100g	 Soil CEC 5-15 meq/100g	 Soil CEC >15 meq/100g
Minnesota	Regulation	Cd	-	0.5 (2 for application to crops not for human consumption)	5	10	20
		Cu	-	-	125	250	500
		Pb	-	-	500	1,000	2,000
		Ni	-	-	50	100	200
		Zn	-	-	250	500	1,000
Ohio	Guideline	Cd		0.4	(pH<6.5) 4.5	4.5	4.5
					(pH>6.5) 4.5	8.9	17.8
		Cu			125	250	500
		Pb			500	1000	2000
		Ni			125	250	500
		Zn			250	500	1000
Texas	Regulation	Cd	25 (Class I & II)				
		Cu	1,000 (Class I)				
		Pb	500 (Class I)				
			1,000 (Class II)				
		Ni	200 (Class I)				
		Zn	2,000 (Class I)				
		PCBs	10 (Class I & II)				
Colorado	Regulation	Cd	-	(pH=4-6.5) 0.25	5	5	5
				(pH>6.5) 0.5	5	10	20
			625 (Class I)*		(pH=4-6.5) 125	125	125
		Cu	1,650 (Class II)*	-	(pH>6.5) 125	250	500
			3,125 (Class III)*				
			250 (Class I)*		(pH=4-6.5) 50	50	50
		Ni	650 (Class II)*	-	(pH>6.5) 50	100	200
			1,250 (Class III)*				
				1,250 (Class I)*		(pH=4-6.5) 250	250 250

TABLE 3-6. FEDERAL AND SELECTED STATE SLUDGE DISPOSAL REGULATIONS AND GUIDELINES FOR METALS AND ORGANICS (Continued)

					Cumulative Application Limits, lbs/acre		
State	Regulation or Guideline	Pollutant	Sludge Limit, mg/kg dry wt.	Annual Application Limit, lbs/acre	Soil CEC <5 meq/100g	Soil CEC 5-15 meq/100g	Soil CEC >15 meq/100g
		Zn	3,325 (Class II)*	-	(pH>6.5) 250	500	1,000
			6,250 (Class III)*				
		Pb	-	-	(pH=5-6.5) 500	500	500
					(pH>6.5) 500	1,000	2,000
		PCBs	5 (Class I)*				
			10 (Class II & III)*				
California		PCBs	5				

*Class I Sludge = Application to private lawns, gardens
*Class II Sludge = Controlled use in agricultural setting
*Class III Sludge = Application to nonfoodchain crops only

TABLE 3-7. EP TOXICITY LIMITATIONS*

Pollutant	Maximum Concentration, mg/l
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Endrin	0.02
Lindane	0.4
Methoxychlor	10.0
Toxaphene	0.5
2,4-D	10.0
2,4,5-TP	1.0

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* 40 CFR Section 261.24 (1986)

TABLE 3-8. NICKEL LEVELS IN CHATTANOOGA POTW INFLUENT, EFFLUENT, AND SLUDGE (2/11-2/20/80)*

Date	Influent Level, µg/l	Effluent Level, µg/l	Sludge Levels, µg/l	
			Primary	Secondary
2/11/80	BDL**	87	2700	580
2/12/80	190	BDL	6600	480
2/13/80	76	BDL	3600	740
2/14/80	100	77	4100	840
2/15/80	66	58	2200	810
2/16/80	BDL	170	2700	710
2/17/80	58	BDL	4700	800
2/18/80	BDL	BDL	2700	930
2/19/80	200	95	9300	1300
2/20/80	120	58	17000	1200

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*Samples collected were 24-hour composites for ten consecutive days.

**BDL = Below 50 µg/l detection limit.

TABLE 3-9. PRIORITY POLLUTANT REMOVAL EFFICIENCIES THROUGH PRIMARY TREATMENT*

Metal/Nonmetal Inorganics	Median	No. of POTWs with Removal Data**
Cadmium	15	6 of 40
Chromium	27	12 of 40
Copper	22	12 of 40
Lead	57	1 of 40
Nickel	14	9 of 40
Zinc	27	12 of 40
Mercury	10	8 of 40
Silver	20	4 of 40
Cyanide	27	12 of 40
Organics		
Benzene	25	8 of 40
Chloroform	14	11 of 40
1,2-trans-Dichloroethylene	36	9 of 40
Ethylbenzene	13	12 of 40
Tetrachloroethylene	4	12 of 40
1,1,1-Trichloroethane	40	10 of 40
Trichloroethylene	20	12 of 40
Butyl benzyl phthalate	62	4 of 40
Di-n-butyl phthalate	36	3 of 40
Diethyl phthalate	56	1 of 40
Naphthalene	44	4 of 40
Phenol	8	11 of 40

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*Pollutant removals between POTW influent and primary effluent. From Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume I (EPA 440/1-82/303), U.S. Environmental Protection Agency, Washington, D.C., September 1982, p. 61.

**Median removal efficiencies from a data base of removal efficiencies for 40 POTWs. Only POTWs with average influent concentrations exceeding three times each pollutant's detection limit were considered.

TABLE 3-10. PRIORITY POLLUTANT REMOVAL EFFICIENCIES THROUGH ACTIVATED SLUDGE TREATMENT*

Metals/Nonmetal Inorganics**	Range	Second Decile	Median	Eighth Decile	No. of POTWs with Removal Data
Cadmium	25-99	33	67	91	19 of 26
Chromium	25-97	68	82	91	25 of 26
Copper	2-99	67	86	95	26 of 26
Lead	1-92	39	61	76	23 of 26
Nickel	2-99	25	42	62	23 of 26
Zinc	23-99	64	79	88	26 of 26
Arsenic	11-78	31	45	53	5 of 26
Mercury	1-95	50	60	79	20 of 26
Selenium	25-89	33	50	67	4 of 26
Silver	17-95	50	75	88	24 of 26
Cyanide	3-99	41	69	84	25 of 26
Organics**					
Benzene	25-99	50	80	96	18 of 26
Chloroform	17-99	50	67	83	24 of 26
1,2-trans-Dichloroethylene	17-99	50	67	91	17 of 26
Ethylbenzene	25-99	67	86	97	25 of 26
Methylene chloride	2-99	36	62	77	26 of 26
Tetrachloroethylene	15-99	50	80	93	26 of 26
Toluene	25-99	80	93	98	26 of 26
1,1,1-Trichloroethane	18-99	75	85	94	23 of 26
Trichloroethylene	20-99	75	89	98	25 of 26
Anthracene	29-99	44	67	91	5 of 26
Bis (2-ethylhexyl) phthalate	17-99	47	72	87	25 of 26
Butyl benzyl phthalate	25-99	50	67	92	16 of 26
Di-n-butyl phthalate	11-97	39	64	87	19 of 26
Diethyl phthalate	17-98	39	62	90	15 of 26
Napthalene	25-98	40	78	90	16 of 26
Phenanthrene	29-99	37	68	86	6 of 26
Phenol	3-99	75	90	98	19 of 26
Pyrene	73-95	76	86	95	2 of 26

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*Pollutant removals between POTW influent and secondary effluent (including secondary clarification). Based on a computer analysis of POTW removal efficiency data, (derived from actual POTW influent and effluent sampling data) provided in Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume II, (EPA 440/1-82/303), U.S. Environmental Protection Agency, Washington, D.C., September 1982.

**For the purpose of deriving removal efficiencies, effluent levels reported as below detection were set equal to the reported detection limits. All secondary activated sludge treatment plants sampled as part of the study were considered.

TABLE 3-11. PRIORITY POLLUTANT REMOVAL EFFICIENCIES THROUGH TRICKLING FILTER TREATMENT*

Metals/Nonmetal Inorganics**	Range	Second Decile	Median	Eighth Decile	No. of POTWs with Removal Data
Cadmium	33-96	33	68	93	6 of 11
Chromium	5-92	34	55	71	9 of 11
Copper	12-97	32	61	89	9 of 11
Lead	4-84	25	55	70	6 of 11
Nickel	7-72	11	29	57	9 of 11
Zinc	14-90	34	67	81	9 of 11
Mercury	14-80	33	50	62	9 of 11
Silver	11-93	38	66	86	8 of 11
Cyanide	7-88	33	59	79	8 of 11
Organics**					
Benzene	5-98	50	75	93	7 of 11
Chloroform	21-94	50	73	84	9 of 11
1,2-trans-Dichloroethylene	14-99	50	50	96	7 of 11
Ethylebenzene	45-97	50	80	91	10 of 11
Methylene chloride	5-98	28	70	85	10 of 11
Tetrachloroethylene	26-99	53	80	93	10 of 11
Toluene	17-99	80	93	97	10 of 11
1,1,1-Trichloroethane	23-99	75	89	97	10 of 11
Trichloroethylene	50-99	67	94	98	10 of 11
Bis (2-ethylhexyl) phthalate	4-98	21	58	81	10 of 11
Butyl benzyl phthalate	25-90	37	60	77	9 of 11
Di-n-butyl phthalate	29-97	41	60	82	10 of 11
Diethyl phthalate	17-75	40	57	67	8 of 11
Naphthalene	33-93	40	71	87	6 of 11
Phenol	50-99	75	84	96	8 of 11

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*Pollutant removals between POTW influent and secondary effluent (including secondary clarification). Based on a computer analysis of POTW removal efficiency data, (derived from actual POTW influent and effluent sampling data) provided in Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume II, (EPA 440/1-82/303), U.S. Environmental Protection Agency, Washington, D.C., September 1982.

**For the purpose of deriving removal efficiencies, effluent levels reported as below detection were set equal to the reported detection limits. All secondary trickling filter plants sampled as part of the study were considered.

TABLE 3-12. PRIORITY POLLUTANT REMOVAL EFFICIENCIES THROUGH TERTIARY TREATMENT*

Metals/Nonmetal Inorganics**	Range	Second Decile	Median	Eighth Decile	No. of POTWs with Removal Data
Cadmium	33-81	50	50	73	3 of 4
Chromium	22-93	62	72	89	4 of 4
Copper	8-99	58	85	98	4 of 4
Lead	4-86	9	52	77	3 of 4
Nickel	4-78	17	17	57	3 of 4
Zinc	1-90	50	78	88	4 of 4
Mercury	33-79	43	67	75	4 of 4
Silver	27-87	55	62	82	3 of 4
Cyanide	20-93	32	66	83	4 of 4
Organics**					
Benzene	5-67	40	50	54	2 of 4
Chloroform	16-75	32	53	64	3 of 4
1,2-trans-Dichloroethylene	50-96	50	83	93	2 of 4
Ethylbenzene	65-95	80	89	94	3 of 4
Methylene Chloride	11-96	31	57	78	4 of 4
Tetrachloroethylene	67-98	80	91	97	4 of 4
Toluene	50-99	83	94	97	4 of 4
1,1,1-Trichloroethane	50-98	79	94	97	4 of 4
Trichloroethylene	50-99	62	93	98	4 of 4
Bis (2-ethylhexyl) phthalate	45-98	59	76	94	4 of 4
Butyl benzyl phthalate	25-94	50	63	85	4 of 4
Di-n-butyl phthalate	14-84	27	50	70	4 of 4
Diethyl phthalate	20-57	29	38	50	3 of 4
Naphthalene	25-94	33	73	86	3 of 4
Phenol	33-98	80	88	96	4 of 4

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*Pollutant removals between POTW influent and tertiary effluent (including final clarification). Based on a computer analysis of POTW removal efficiency data, (derived from actual POTW influent and effluent sampling data) provided in Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume II, (EPA 440/1-82/303), U.S. Environmental Protection Agency, Washington, D.C., September 1982.

Tertiary treatment was taken to include POTWs with effluent microscreening, mixed media filtration, post aeration, and/or nitrification/denitrification.

**For the purpose of deriving removal efficiencies, effluent levels reported as below detection were set equal to the reported detection limits. All tertiary treatment plants sampled as part of the study were considered.

TABLE 3-13. TYPICAL DOMESTIC WASTEWATER LEVELS*

Pollutant	Concentration, mg/l
Cadmium	0.003
Chromium	0.05
Copper	0.061
Lead	0.049
Nickel	0.021
Zinc	0.175
Arsenic	0.003
Mercury	0.0003
Silver	0.005
Cyanide	0.041

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*From "Assessment of the Impacts of Industrial Discharges on Publicly Owned Treatment Works, Appendices," prepared by JRB Associates for the U.S. Environmental Protection Agency, November 1981, p. C-38.

4. LOCAL LIMITS DEVELOPMENT TO ADDRESS COLLECTION SYSTEM PROBLEMS

In this chapter, considerations in developing local limits based on collection system effects are discussed. These collection system effects include:

- Fire/explosion
- Corrosion
- Flow obstruction
- Heat effects
- Fume toxicity.

Each of the above effects, and the development of local limits based on appropriate effects criteria, are discussed in the following sections.

4.1 IMPLEMENTATION OF SPECIFIC PROHIBITIONS

The specific prohibitions of the General Pretreatment Regulations [40 CFR 403.5(b)] forbid the discharge of pollutants which cause fire or explosion hazards, corrosive structural damage, obstruction of flow, inhibition of biological activity due to excessive heat, or interference with POTW operations. The following sections outline methods for establishing local limits for those pollutants which can cause violations of these prohibitions.

4.1.1 Fire and Explosion

In order to comply with the specific discharge prohibitions, and to protect the POTW and its workers from explosion or fire in the collection system or treatment works, POTWs must develop a strategy for screening against discharges which will cause flammable/explosive conditions. This strategy should incorporate both field monitoring activities and review of data from industry surveys and permit application forms. Where problem discharges are identified, the POTW must impose local discharge limitations or other source controls to mitigate the danger.

The following procedures for establishing flammable/explosive pollutant discharge limits and source control requirements are discussed in this section:

- Lower explosive limit (LEL) monitoring
- Sample headspace monitoring
- Flash point limitations
- Industrial user management practice plans.

An LEL-based screening technique for identifying potential problem discharges is also presented.

4.1.1.1 Lower Explosive Limit (LEL) Monitoring

The lower explosive limit (LEL) of a compound is the minimum concentration of that compound, as a gas or vapor in air, which will explode or burn in the presence of an ignition source. As part of their strategies for detecting flammable/explosive discharges, many POTWs are currently conducting routine explosimeter screening of LEL levels (i.e., measured vapor levels of a pollutant expressed as a percentage of the pollutant's LEL) at key sewer locations. These monitoring programs consist of routine screening of manholes and/or continuous monitoring of pump stations, IU sewer connections, etc. These monitoring programs provide an ongoing source of data that may serve as the basis for more comprehensive programs of sampling and analyses to positively identify the offending industries.

In implementing these programs, it is important that the POTW is aware of the limitations to the LEL data that are collected. For instance, if detected LEL levels are found to be high directly downstream from an industrial discharge, and background levels (upstream) are lower, this does not *necessarily* mean that the contributing industry is the cause of the measured increase. Complicating factors in this analysis might include the turbulence of the wastewater at each monitoring point, the method by which LEL measurements were made (whether the reading was taken immediately after removal of a manhole lid, or time allowed to elapse), and the degree of ventilation (air exchange rate) at each point. Realizing these potentially complicating factors, the sampling crews would be well advised to also sample the IU discharge and perform an analysis for the volatile constituents. Collectively, these data would provide convincing evidence in support of any IU controls that the POTW should choose to require.

In addition to ongoing LEL monitoring programs, POTW workers should always test sewer atmospheres for flammable/explosive conditions as a safety precaution immediately prior to monitoring of the sewer. Section 4.2.4 discusses this and other POTW worker safety issues in more detail.

4.1.1.2 Sample Headspace Monitoring

There are a variety of methods for setting local limits to control the discharge of flammable/explosive pollutants to POTWs. This section describes one innovative approach, which has been successfully implemented by the Cincinnati Metropolitan Sanitary District (MSD).

The MSD has established a volatile organic pollutant local limit, based on a sample headspace monitoring technique. This headspace monitoring technique consists of:

- Collection of an IU discharge sample in accordance with proper volatile organic sampling techniques (e.g., zero headspace, etc.)
- Withdrawal of 50 percent of the sample (by volume), followed by injection of nitrogen gas (to maintain one atmosphere total pressure)
- Equilibration of sample
- GC analysis of sample headspace gas.

The details of this sample headspace monitoring technique are provided in Appendix J. The MSD requires total volatile organic levels in the sample headspace gases to be below a 300 ppm hexane equivalent limit. This limit was deemed sufficient to protect the collection system from fires/explosions and to provide POTW workers minimal protection from pollutant fume toxicity (a more stringent consideration). Worker health and safety issues associated with the development of the MSD volatile organic pollutant local limit are discussed in detail in Section 4.2.1.

4.1.1.3 Flashpoint Limitation

Another local limits option for control of flammable/explosive pollutant discharges is a flashpoint limitation imposed upon discharges to POTWs. Such a prohibition would state that no discharge to a POTW shall possess a flashpoint below a stated value. This flashpoint prohibition would apply to <u>all</u> wastes received at the POTW, including IU discharges, as well as wastes received from waste haulers. A flashpoint screening of waste haulers' loads would enable the POTW to readily ascertain whether ignitable wastes had been accepted by the haulers.

The flashpoint is the minimum temperature at which vapor combustion will propagate away from its source of ignition. At temperatures below the flashpoint, combustion of the vapor immediately above the liquid will either not occur at all, or will occur only at the exact point of ignition. Temperatures above the flashpoint are required for combustion to spread. Thus, a flashpoint limitation ensures that no discharge to a POTW will independently result in the propagation of self-sustained combustion.

It is important to emphasize that a flashpoint prohibition will not necessarily account for the flammability of mixtures of multiple industrial user discharges when combined in sewers. Owing to the effect of dilution within the sewer system, however, it is generally reasonable to assume that the concentrations of combustible constituents in sewer wastewaters will be well below the concentrations required for flammability/explosivity, provided that all industrial users are in compliance with the flashpoint prohibition.

A 140°F closed cup flashpoint is recommended as the appropriate limit for the flashpoint prohibition. The 140°F closed cup flashpoint limit is proposed for the following reasons:

- Ambient temperatures are not likely to meet or exceed 140°F, either at the point of discharge or within the sewer system
- Typical industrial wastewater temperatures are usually below 140°F
- The closed cup flashpoint test is recommended because this test is based upon the ignition of confined vapors, and thus simulates potential sewer conditions
- To aid cities in minimizing RCRA liabilities concerning the acceptance of ignitable characteristic hazardous wastes.

Although the 140°F flashpoint prohibition would be imposed upon wastewater discharges and not wastewater constituents, a comparison of the relative flashpoints of typical organic wastewater constituents would provide a rough guide as to the stringency of the flashpoint prohibition. Table 4-1 cites the closed cup flashpoints of several organic chemicals. It can be seen from this table that wastewater discharges would have to be at least as nonflammable as (pure) furfural or benzaldehyde to meet the flashpoint prohibition. Table 4-1 also demonstrates that a flashpoint prohibition would not permit the undiluted discharge of volatiles such as gasoline or ethyl alcohol.

In order to measure the flashpoint of a wastewater sample, a flashpoint tester must be obtained. A flashpoint tester is used to slowly heat the sample, and at periodic intervals, a test flame is applied to the vapor space above the liquid. The flashpoint is the temperature at which a flash of flame is visible upon application of the test flame.

The Tagliabue (Tag) closed cup flashpoint tester is suggested as the appropriate flashpoint tester for wastewater samples. The Tag tester is designed to accommodate nonviscous, nonfilm-forming liquid samples with flashpoints below 200°F. The American Society for Testing and Materials (ASTM) states that Tag closed cup testers cost $1,000-$1,500 and are available through laboratory instrumentation supply firms. Tag closed cup flashpoint test methodologies have been established by, and are available through, ASTM as ASTM Methodology D-56. Operation of Tag testers requires no further expertise beyond that of a competent laboratory chemist.

4.1.1.4 Industrial User Management Practice Plans

In addition to establishing a numeric local limit on the discharge of flammable/explosive pollutants, the POTW can often require IUs to submit management practice plans. These plans document IU procedures for handling process chemicals and controlling chemical spills. The documented procedures also detail IU measures taken to prevent flammable/explosive pollutant discharges to the POTW. IU implementation of proper chemical handling and spill control procedures above can often effectively eliminate the possibility of flammable/explosive pollutant discharges, thereby obviating the need for further control measures. Chapter 5 discusses industrial user management practice plans in more detail.

4.1.1.5 Screening Technique for Identifying Flammable/Explosive Pollutant Discharges

In order to identify IU discharges which could potentially generate flammable/explosive conditions in sewer atmospheres, an IU discharge screening procedure should be established. This screening procedure would identify flammable/explosive pollutant discharges warranting control through the imposition of local limits and/or other IU requirements.

A variety of screening procedures to identify flammable/explosive pollutant discharges have been developed. This section describes one approach, which entails:

(1) Conversion of LEL data into corresponding IU discharge screening levels, and

(2) Comparison of these screening levels with actual IU discharge levels. Exceedances may warrant further investigation by the POTW, perhaps involving the flammable/explosive pollutant discharge control measures discussed in Sections 4.1.1.1 to 4.1.1.4 above.

The calculation of LEL-based screening levels is a five-step process:

1. Determine the LEL of the pollutant of concern. LEL values are typically expressed as percent (volume/volume)-in-air concentrations. LEL values for several volatile organics are presented in the second column of Table 4-2. Appendix G, as well as the LEL data sources referenced in Appendix G, present LEL data for many additional pollutants.

2. Convert the compound's LEL concentration (percent) to a vapor phase concentration (C_{VAP}) expressed in mol/m^3 (third column of Table 4-2):

$$C_{VAP} = LEL \times \frac{P}{(R)(T)} \times 10 \quad mol/m^3 \tag{1}$$

where

C_{VAP} = LEL expressed as a vapor phase concentration, mol/m^3
LEL = Lower explosive limit, percent (volume/volume)
P = Total pressure, 1 atm (assumed)
R = Ideal gas constant, 0.08206 atm L/mol °K
T = Temperature, 298.15 °K (assumed).

3. Determine the Henry's Law Constant for the pollutant of concern. Since the screening level is to be expressed as a concentration in water and the LEL is a vapor phase concentration, a partitioning constant is needed to convert LEL values to corresponding water phase discharge levels. The Henry's Law constant serves this function for pollutants present in low concentrations, as are normally encountered in IU discharges. Table 4-3 presents Henry's Law Constants (in various units) for several of the organics listed in Appendix G. Henry's Law Constants for additional pollutants are provided in Appendix G, as well as in the literature sources referenced in Table 4-3.

4. Convert the Henry's Law Constant to the appropriate units. The Henry's Law Constants presented in Table 4-3 are expressed in terms of three different units:

   - (atm m^3)/mol
   - (mol/m^3)/(mg/L)
   - (mg/m^3)/(mg/L).

   In the literature, Henry's Law Constants are most commonly expressed in terms of pressure (atm m^3/mol). To derive LEL-based screening levels, however, the Henry's Law Constant must be expressed in terms of (mol/m^3)/(mg/L). The following equation should be used to convert the Henry's Law Constant expressed in units of (atm m^3/mol) to the equivalent constant expressed in (mol/m^3)/(mg/L):

   $$H_B = H_A \times \frac{1 \times 10^3}{(MW)(R)(T)} \quad (\text{mol/m}^3)/(\text{mg/L})$$

   where: H_B = Henry's Law Constant, (mol/m^3)/(mg/L)

   H_A = Henry's Law Constant, atm m^3/mol

   MW = Molecular weight, g/mol

   R = Ideal gas constant, 0.08206 atm L/mol °K

   T = Temperature corresponding to vapor pressure* used to derive H_A (see Table 4-3), °K

   Henry's Law Constants expressed as (mol/m^3)/(mg/L) are presented for several volatile organics in the fourth column of Table 4-2.

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*Assume T = 298.15 °K if data not available.

5. Calculate the IU discharge screening level using the Henry's Law expression (fifth column of Table 4-2):

$$C_{LVL} = \frac{C_{VAP}}{H} \tag{2}$$

where

C_{LVL} = Discharge screening level, mg/L

C_{VAP} = LEL expressed as a vapor phase concentration, mol/m^3

H = Henry's Law Constant (mol/m^3)/(mg/L)

Screening levels derived by this equation should be compared with actual IU discharge levels measured at the IU's sewer connection. This method for deriving screening levels assumes instantaneous volatilization of pollutant to the sewer atmosphere (i.e., instantaneous attainment of equilibrium, see assumptions delineated below) and does not take into account dilution of IU wastewater within the collection system.

Table 4-2 presents LEL-based screening levels, calculated using the method described above, for several pollutants selected from the list of pollutants presented in Appendix G. The screening levels vary over a considerable range (from 11 mg/L for chloromethane to 24,848 mg/L for methyl ethyl ketone), and are influenced significantly by the magnitude of the Henry's Law Constant, such that:

- Compounds with relatively lower Henry's Law Constants, such as methyl ethyl ketone, possess higher screening levels, and
- Compounds with relatively high Henry's Law constants, such as chloromethane, possess lower screening levels.

The following assumptions are made when adopting the Henry's Law expression for calculation of LEL-based screening levels:

- Temperature dependency of the Henry's Law Constant - The Henry's Law Constant is typically calculated as the ratio of a compound's vapor pressure (in atmospheres) to its solubility (in mol/m^3). Because both vapor pressure and solubility are temperature dependent, the Henry's Law Constant is also temperature dependent. Table 4-3 presents the temperatures at which the solubilities and vapor pressures used to calculate the Henry's Law Constants were measured. For the purpose of calculating screening levels, a sewer atmosphere temperature of approximately 25°C is assumed.

- Steady state system - The collection system at the point of each IU's discharge is presumed to constitute a steady state system in which (1) thermodynamic equilibrium between the water and vapor phases is established immediately upon discharge, and (2) pollutant concentrations in the vapor and water phases do not change with time. In reality, instantaneous attainment of equilibrium is only an approximation as sufficient time may not exist at the point of discharge for equilibrium to be established between the liquid and vapor phases. In addition, constant air flow through the sewer that tends to lower concentrations of pollutants in the vapor phase below equilibrium values, and fluctuations in pollutant discharge levels will upset both steady state and equilibrium conditions.

- Solubility effects caused by organic compounds (e.g., oil and grease) and dissolved salts - Solubility values reported in the literature, and used to calculate Henry's Law Constants, assume distilled, deionized water as a solvent. In practice, however, various organic compounds are generally present in the IU wastestream and/or in the collection system wastewater at the point of discharge. The presence of these compounds will generally tend to increase pollutant solubilities above their corresponding pure aqueous solubilities. In addition, pollutant solubilities may be lowered below pure aqueous solubilities by the presence of significant concentrations of dissolved salts. In either case, changing the solubility of the pollutant of concern affects the value of the Henry's Law Constant; however, the influence of organic compounds and/or dissolved salts on pollutant solubility, and consequently, on the Henry's Law Constant, is not readily quantified. Therefore, variations in pollutant solubility due to the presence of organic compounds and/or dissolved salts in the wastestream are not considered.

Screening levels should be used to identify flammable/explosive pollutants for control. In developing local limits based on pollutant flammability/explosivity, careful consideration should be given to the above assumptions and site specific data should be relied upon where available.

4.1.2 Corrosion

The specific prohibitions of the General Pretreatment Regulations (40 CFR 403.5(B)(2)) forbid IUs from discharging "pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges." Thus in order to protect POTWs from corrosive discharges, the specific prohibitions explicitly forbid IU discharges with pH less than 5, unless the POTW is specially designed to accept such wastes. In addition to implementing the specific prohibitions against discharges with low pH, POTWs should consider developing local limits to restrict discharges that are corrosive because they have a high pH and/or high concentrations of one or more of the following substances:

- Sulfides
- Chlorides
- Sulfates
- Nitrates
- Chlorine
- Dissolved salts
- Suspended solids
- Organic compounds.

The concerns associated with each of these properties/constituents, as well as options for local limits development, are identified below. The information on corrosion presented below is based on reviews by DeBarry, et al. (47); Patterson (48); and Singley, et al. (49).

Upper pH Discharge Limits

Although their corrosivity has not been completely explored, substances with high pH are capable of producing a variety of undesired effects on sewer system materials. Researchers have established that as the pH of solutions increase beyond 13, there is generally a slight increase in the corrosion rates of iron and steel. The lower corrosion rates in basic waters as compared to acidic waters is due to the fact that basic waters support the formation of inorganic films and precipitates that act as coatings to protect the walls of pipes transporting water. The effects of pH on other construction materials used in sewers, such as asbestos-cement, concrete, clay, and PVC; and materials used in linings, joints, and gaskets, such as zinc, bituminous materials, epoxy resins, paints, polyurethane, cement mortar, and neoprene, are not completely understood. Concrete, asbestos-cement, and cement mortar are known to be strongly affected by acidic solutions that dissolve calcium compounds. Concrete and cement are also somewhat susceptible to dissolution in low-calcium neutral and basic solutions. Although important, the role of pH in increasing the corrosive properties of certain chemicals is not well known.

Should the POTW identify corrosion damage attributable to high pH discharges, an upper pH local limit should be established and enforced. There are many techniques by which the POTW can establish an upper pH local limit. POTWs can perform field inspections of IUs and monitor IU discharges in support of developing IU-specific upper pH local limits. In addition, POTWs may wish to rely on the available literature to support data gathered by field inspections and/or through corrosivity testing. Another method for establishing an upper pH limit is to perform corrosivity tests on the various construction materials to which wastewaters are exposed in the collection system and treatment works. Such tests would allow the POTW to develop a local limit for upper pH that is specific to the POTW's own particular structural materials. The drawback of this procedure is that it requires considerable funding in addition to the investment of time.

Other Pollutants of Concern

POTWs should consider developing local limits for any additional pollutants that have the potential for contributing to corrosive damage to sewers, including:

- Sulfides, discharged either directly into the sewer system, or generated through the reduction of sulfates by anaerobic bacteria, are a major cause of corrosion. In neutral and basic waters, the protective films and precipitates that form on the walls of pipes are susceptible to deterioration and replacement by metal sulfides. In addition, metal sulfides may also corrode iron directly, and dissolved hydrogen sulfide (HS^- and S^{-2}) may be associated with increased corrosion. Above the water line, hydrogen sulfide contained in condensed water vapor is biologically oxidized to sulfuric acid. Sulfuric acid is known to corrode iron, steel, concrete, asbestos-cement, and cement mortar.

- Chloride is known to adversely affect the protective inorganic films and precipitates that form on sewer walls (e.g., iron oxide). Chloride not only can decay and penetrate the coatings, but can prevent them from developing by forming more soluble metal chlorides instead.

- Chlorine acts to increase the corrosion of iron and steel by aiding in the formation of hydrochloric and hypochlorous acids that decrease the pH of the discharge.
- Nitrates contribute to iron and steel corrosion through preferential reduction at cathodic areas.
- Suspended particles in discharges act to erode and abrade sewer walls.
- Solvent properties of organic compounds promote dissolution of rubber/plastic linings, gaskets, etc.
- Dissolved salts, particularly sulfates, can cause corrosion of concrete, asbestos-cement, and cement mortar. The electrolytic action of dissolved salts promotes the corrosion of metals.

4.1.3 Flow Obstruction

The specific discharge prohibitions of the General Pretreatment Regulations (40 CFR 403.5(b)(3)) forbid IUs from discharging "solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference." In order to implement this prohibition, POTWs should conduct periodic inspections of the collection system and of IU discharges to ensure that wastewater flows are not impeded. POTWs should require IUs to clean their grease traps on a frequent basis. As a reasonable control measure, POTWs might require IU discharge solids to be small enough to pass through a three-eighths inch mesh screen.

4.1.4 Temperature

The specific discharge prohibitions forbid IUs from discharging "heat in amounts which will inhibit biological activity in the POTW resulting in Interference, but in no case heat in such quantities that the temperature at the POTW Treatment Plant exceeds 40°C (104°F)," unless other temperature limits are approved. Collection system dilution of heated industrial wastewaters usually ensures compliance with this prohibition. Generally, of more immediate concern to the POTW is the temperature of the IU discharge at the IU's sewer connection. Heated industrial wastewaters pose a hazard to POTW workers who must enter the sewer at manholes immediately downstream of the IU's discharge point. Should POTW workers encounter an IU discharge which is hot enough to restrict or prevent sewer entry, the POTW should require the IU to reduce the temperature of its discharge. To this end, the POTW can require the IU to institute appropriate wastewater discharge management practices (e.g., holding the wastewater long enough for it to cool) and/or to install requisite temperature control technologies (e.g., heat exchange equipment).

The POTW should be aware that exothermic chemical reactions between the IU discharge and the receiving sewage may result in elevated temperatures. In addition, heats of dilution and solution accompanying the discharge of certain concentrated wastes can also cause temperature increases. The POTW may need to investigate these sources of heat and develop local limits that restrict the substances causing elevated temperatures.

4.2 WORKER HEALTH AND SAFETY

Industrial discharges to sewers may create conditions that endanger the health and safety of POTW workers. Two major hazards encountered by POTW workers are exposure to toxic fumes and injury from explosion or fire. Local limits based on fire and explosion concerns have been discussed in Section 4.1.1. The following section will discuss local limits based on fume toxicity. It should be understood that the setting of local limits based on fume toxicity is not a substitute for good safety precautions. Section 4.2.4 provides a general discussion of safety precautions in order to emphasize their importance. Development of local limits to prevent specific problems is a supplement to a good safety program.

The following two procedures for establishing fume toxic pollutant discharge limits and source control requirements are discussed in this section:

- Headspace monitoring
- Industrial user management practice plans.

A screening technique for identifying potential problem discharges is also presented.

4.2.1 Headspace Monitoring

There are a variety of methods for setting local limits to control the discharge of fume toxic pollutants to POTWs. Vapor phase monitoring of the headspace in the sewer or in an equilibrated wastewater sample is a direct approach for quantifying specific substances in order to determine if there is a danger to worker health and safety. As discussed in Section 4.1.1.2, one innovative approach to local limits for both flammable/explosive and fume toxic pollutants has been developed and implemented by the Cincinnati Metropolitan Sanitary District (MSD). Control of fume toxic discharges by the MSD's local limits approach is further detailed in this section.

As described in Section 4.1.1.2, the MSD has established a volatile organic pollutant local limit, based on the sample headspace monitoring technique presented in Appendix J. The local limit consists of a 300 ppm hexane equivalent limit on total volatile organics in headspace gases accumulated over an equilibrated wastewater sample (See Appendix J for the detailed analytical procedure). The 300 ppm hexane equivalent limit was developed by MSD in consultation with the National Institute for Occupational Safety and Health (NIOSH) and was designed to provide POTW workers exposed to sewer atmospheres at least minimal protection from pollutant fume toxicity.

NIOSH and MSD concluded that below the 300 ppm hexane equivalent limit, carbon filters would, in general, provide POTW workers with adequate protection [55]. EPA's Technology Assessment Branch, Wastewater Research Division, reviewed NIOSH/MSD documentation and observed that the limit is not chemical-specific, and therefore does not ensure that Occupational Safety and Health Administration (OSHA) permissible exposure levels (PELs) of individual volatile organics will be met in sewer atmospheres [55]. The EPA review, however, also concluded that the 300 ppm hexane equivalent limit should prevent concentrations of volatile organics from exceeding the Immediately Dangerous to Life and Health (IDLH) level in sewer atmospheres and should essentially eliminate public exposure to dangerous levels of volatile organics through sewer air exchanges [55].

The EPA review of the MSD's 300 ppm hexane equivalent limit concluded with the caution that implementation of this volatile organic limit, or for that matter, any volatile organic limit, will not alter the fact that toxic vapors from spills, hydrogen sulfide and methane gas generation in sewers, and vapor purging of oxygen from sewers represent significant health hazards. Sewer workers should not be allowed in sewers or confined spaces without portable explosimeters and appropriate breathing devices [55]. Section 4.2.4 discusses these POTW worker safety issues in more detail.

4.2.2 Industrial User Management Practice Plans

In addition to establishing a numeric local limit on the discharge of fume toxic pollutants, the POTW can often require IUs to submit management practice plans. These plans document IU procedures for handling process chemicals and controlling chemical spills. The documented procedures also detail IU measures taken to prevent toxic pollutant discharges to the POTW. IU implementation of proper chemical handling and spill control procedures alone can often effectively eliminate the possibility of toxic pollutant discharges, thereby obviating the need for further control measures. Chapter 5 discusses industrial user management practice plans in more detail.

4.2.3 Screening Technique for Identifying Fume Toxic Pollutant Discharges

In order to identify IU discharges which could potentially generate fume toxic conditions in sewer atmospheres, an IU discharge screening procedure should be established. This screening procedure would identify fume toxic pollutant discharges warranting control through the imposition of local limits and/or other IU requirements.

One such technique for identifying fume toxic pollutant discharges entails 1) conversion of fume toxicity criteria into corresponding IU discharge screening levels, and 2) comparison of these screening levels with actual IU discharge levels. Exceedances may warrant further investigation by the POTW, perhaps involving the control measures discussed in Sections 4.2.1 and 4.2.2 above.

The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value-time weighted averages (TLV-TWAs) serve as a measure of fume toxicity from which IU discharge screening levels can be calculated. The ACGIH TLV-TWA fume toxicity levels are the vapor phase concentrations of volatile organic compounds to which nearly all workers may be repeatedly exposed, over an eight hour workday and a 40-hour work week, without adverse effect. In general, POTW workers are not exposed for extended period of time to sewer atmospheres contaminated with volatile compounds, and the use of TLV-TWA concentrations as a basis for developing IU discharge screening levels can be considered a conservative practice.

The calculation of screening levels that are based on fume toxicity involves the following four steps:

1. Determine the ACGIH TLV-TWA concentration of the pollutant of concern. ACGIH TLV-TWA concentrations (mg/m^3) for several representative organic pollutants from the Appendix G list are presented in the second column of Table 4-4. Appendix G, as well as the ACGIH document referenced in Table 4-4, present ACGIH TLV-TWA data for many additional pollutants.

2. Determine the Henry's Law Constant for the pollutant of concern. Table 4-3 presents the Henry's Law Constants for several volatile organics.

3. Convert the Henry's Law Constant to the appropriate units. In order to calculate screening levels based on ACGIH TLV-TWA concentrations, the Henry's Law Constant must be expressed in terms of $(mg/m^3)/(mg/L)$. The following equation should be used to convert the Henry's Law Constant expressed in units of atm m^3/mol to the equivalent constant expressed in $(mg/m^3)/(mg/L)$:

   $$H_c = H_A \times \frac{1 \times 10^6}{(R)(T)} \quad (mg/m^3)/(mg/L)$$

   where:
   H_c = Henry's Law Constant, $(mg/m^3)/(mg/L)$
   H_A = Henry's Law Constant, (atm m^3/mol)
   R = Ideal gas constant, 0.08206 (atm L/mol °K)
   T = Temperature corresponding to vapor pressure* used to derive H_A, K (See Table 4-3)

   Henry's Law Constants expressed in $(mg/m^3)/(mg/L)$ are presented for several volatile organics in the third column of Table 4-4.

4. Calculate the IU discharge screening level from the Henry's Law expression:

   $$C_{LVL} = \frac{C_{VAP}}{H}$$

   where

   C_{LVL} = Discharge screening level, mg/L
   C_{VAP} = ACGIH TLV-TWA, mg/m^3
   H = Henry's Law Constant, $(mg/m^3)/(mg/L)$

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*Assume T = 298.15 °K if data are not available.

> Screening levels derived by this equation should be compared with actual IU discharge levels measured at the IU's sewer connection. This method for deriving screening levels assumes instantaneous volatilization of pollutant to the sewer atmosphere (i.e., instantaneous attainment of equilibrium, see assumptions delineated in Section 4.1.1.5) and does not take into account dilution of IU wastewater within the collection system.

Screening levels should be used to identify fume toxic pollutants for control. In developing local limits to address fume toxicity, the techniques presented in Section 4.2.1 and 4.2.2 may be useful. As with chemical specific limits for flammable/explosive pollutants, careful consideration should be given to the assumptions delineated in Section 4.1.1.5 and site specific data should be relied upon where available.

The fourth column of Table 4-4 presents ACGIH TLV-TWA-based screening levels calculated for several volatile organics. Several observations can be made from the data:

- Screening levels based on TLV-TWA fume toxicity data are more stringent than screening levels based on explosivity (LEL) data (Tables 4-2 and 4-4).
- The only screening level presented in Table 4-4 which exceeds 5 mg/L is the screening level for methyl ethyl ketone (249 mg/L). The particularly high screening level for this pollutant is at least in part due to its low Henry's Law Constant (2.37 $mg/m^3/mg/L$), which indicates that methyl ethyl ketone is not as volatile as the other compounds listed in Table 4-4.
- The lowest screening level presented in Table 4-4 is for hexachloro-1,3-butadiene (0.2 µg/L). This stringent screening level is attributable to the fact that hexachloro-1,3-butadiene is highly fume toxic (its TLV-TWA of 0.24 mg/m^3 is the lowest presented in Table 4-4), and also highly volatile (Henry's Law Constant = 1064 $mg/m^3/mg/L$).

Screening levels calculated from ACGIH TLV-TWA data address only the toxicities of individual compounds. The screening levels presented in Table 4-4 do not address the generation of toxic concentrations of gases that are produced from the mixture of chemicals in the wastestream. The following procedure allows the POTW to predict the potential vapor toxicity associated with the discharge of a mixture of volatile organic compounds:

1. Analyze the industrial user's wastewater discharge for volatile organics. The following are hypothetical monitoring data:

Pollutant	Discharge Level, mg/L
Benzene	0.1
Toluene	0.9
Chlorobenzene	2.2
1,2-Dichlorobenzene	3.57
1,4-Dichlorobenzene	3.39

Although these discharge levels are all below the corresponding screening levels presented in Table 4-4, the POTW should determine whether the simultaneous discharge of the five pollutants could result in a fume toxic mixture within the sewer.

2. Use Henry's Law to calculate the equilibrium vapor phase concentration of each pollutant:

$$C_{VAPOR} = H \times C_{DISCHARGE}$$

where

C_{VAPOR} = Vapor phase concentration, mg/m^3
H = Henry's Law Constant, $(mg/m^3/mg/L)$
$C_{DISCHARGE}$ = Discharge level, mg/L,

Pollutant	Discharge Level, mg/L	Henry's Law Constant, $(mg/m^3)/(mg/L)$	Equilibrium Vapor Phase Concentration, mg/m^3
Benzene	0.1	225	22.5
Toluene	0.9	277	249.3
Chlorobenzene	2.2	149	327.8
1,2-Dichlorobenzene	3.57	80.2	286.3
1,4-Dichlorobenzene	3.39	127	430.5

3. Express the equilibrium vapor phase concentrations (above) as fractions of the corresponding TLV-TWAs:

Pollutant	Equilibrium Vapor Phase Concentration, mg/m^3	TLV-TWA mg/m^3	Fraction of TLV-TWA
Benzene	22.5	30	0.75
Toluene	249.3	375	0.66
Chlorobenzene	327.8	350	0.94
Chlorobenzene	327.8	350	0.94
1,2-Dichlorobenzene	286.3	300	0.95
1,4-dichlorobenzene	430.5	450	0.96
			4.26

4. Sum the fractions of the TLV-TWAs. In the example above, the sum of the TLV-TWA fractions equals 4.26.

   If the compounds in question are assumed to possess additive fume toxicities when mixed, then if the sum of the TLV-TWA fractions is greater than 1.00, a potentially fume toxic condition exists.

5. If the sum of the TLV-TWA fractions is greater than 1.00, calculate the percentage by which the concentrations of the compounds need to be reduced in order to avoid a potentially fume toxic condition. Using the example values:

$$\left(1 - \frac{1}{4.26}\right) \times 100 = 77\%$$

reduction of the discharge of all five pollutants to alleviate the potentially fume toxic condition. (assuming additive toxicities and the applicability of the Henry's Law Constants)

4.2.4 POTW Worker Safety

Local limits based upon explosivity and/or fume toxicity do not obviate the need for POTW safety programs and the proper use of safety procedures by POTW workers when entering sewer manholes. Even if reasonably sound local limits and/or source controls have been instituted, these controls/limits may occasionally be violated, either accidentally or intentionally. A major discharge violation, even if only for a short duration, could result in harmful pollutant levels in sewer atmospheres. Local limits and source controls therefore, are merely precautionary; no local limit could ever substitute for sound safety precautions and the use of sound judgment by field personnel before manhole entry.

In August, 1981, NIOSH prepared a Health Hazard Evaluation Report (HETA 81-207-945) for the Cincinnati Metropolitan Sanitary District (MSD) [56]. The following recommendations concerning POTW worker safety were presented at the conclusion of this report [56]:

- Overall:

  Protection of sewer workers from incidents involves vigorous enforcement of wastewater regulations, adequate industrial hygiene measurement of potentially dangerous sewer atmospheres prior to sewer entry, provision of proper sewer ventilation, proper use of adequate personal protection equipment while working in or near sewers, and adequate medical surveillance to enable early detection of illness associated with exposure to toxic chemicals in the sewer environment.

- Instrumentation and Training:

  Before entering the sewers, POTW personnel should test the atmosphere with rugged, portable, direct-reading instruments such as explosimeters, oxygen detectors, and supplemented if appropriate by organic vapor detectors, and colorimetric indicator tubes.

  Training of POTW personnel in the use of direct-reading instruments should be conducted before POTW personnel use equipment at a work site.

- Respiratory
  Because of the chemical composition of the sewer's atmosphere and its potential to change rapidly and without notice, particularly in industrial sections which receive both commercial and industrial sewage, the underground personnel should use open-circuit air-line supplied respirators when direct-reading instruments indicate the presence of toxic substances in concentrations immediately dangerous to health or life. At lower concentrations, NIOSH-approved full- or half-face chemical cartridge respirators should be worn by personnel entering industrial sewers.

  A respiratory protection program should be established and enforced by POTW management.

- Engineering Controls:

  Forced-air ventilation should be used whenever possible when working in sewers, especially industrial sewers.

  The jet exhaust venturi blower (air horn) connected to the end of the compressor air hose (with organic filter) and used to aspirate fresh air into the workspace should be kept at street level. The air intake should be away from automobile or diesel exhaust emissions. A flexible elephant duct should be attached to the blower and extended to the work area to bring fresh air from the surface.

- Medical Surveillance:

  A system should be developed for reporting symptoms following exposure to chemical contaminants in sewers. A log of such reports should be maintained. In combination with results of such medical tests as deemed necessary, such a log will enable the POTW and its medical consultant to determine any adverse trends in exposure incidents.

- Safety

  Each underground worker should be provided with arm wristlets, safety lines, and harnesses for rapid removal from the sewer.

- Other:

  The City Fire Department's Emergency Response Team should be alerted whenever POTW workers are entering a sewer environment that may be hazardous to the worker.

- Sewer permits for industrial users should regulate the discharge of potentially volatile compounds which may be present in sewer vapor spaces.

The above recommendations should be implemented as an integral part of every POTW's worker health and safety program.

TABLE 4-1. CLOSED CUP FLASHPOINTS OF SELECTED ORGANIC CHEMICALS

Compound	Flashpoint, °F
Gasoline	-50
Hexane	-7
Acetone	0
Benzene	12
Ethyl alcohol	55
Methyl isobutyl ketone	73
Isobutyl alcohol	82
Acetic acid	104
Furfural	140
Benzaldehyde	148
Naphthalene	174
Propylene glycol	210
Stearic acid	385

Source: Hazards Evaluation and Risk Control Services Bulletin HE-120A, compiled and printed by the Hercules Corporation.

The Merck Index, Merck and Company, Inc., 1976. Rahway, NJ. Ninth Edition.

TABLE 4-2. DISCHARGE SCREENING LEVELS BASED ON EXPLOSIVITY

Compound	LEL, %	C_{VAP} (mol/m^3)*	H^1 (mol/m^3)/(mg/L)	C_{LVL} (mg/L)
Acrylonitrile	3.0 (31)	1.23	6.83×10^{-5}	17954
Benzene	1.4 (31)	0.57	2.88×1^{-3}	199
Bromomethane	10.0 (3)	4.09	8.62×10^{-2}	47
Carbon disulfide	1.0 (31)	0.41	6.44×10^{-3}	63
Chlorobenzene	1.3 (31)	0.53	1.32×10^{-3}	403
Chloroethane	3.8 (8)	1.55	9.54×10^{-2}	16
Chloromethane	8.1 (5)	3.31	3.08×10^{-1}	11
1,2-Dichlorobenzene	2.2 (31)	0.90	5.46×10^{-4}	1647
1,3-Dichlorobenzene	2.2 (31)	0.90	1.00×10^{-3}	899
1,4-Dichlorobenzene	2.2 (31)	0.90	8.62×10^{-4}	1043
1,1-Dichloroethane	5.6 (3)	2.29	1.79×10^{-3}	1279
trans-1,2-Dichloroethylene	9.7 (31)	3.97	2.87×10^{-2}	138
1,2-Dichloropropane	3.4 (8)	1.39	8.50×10^{-4}	1635
1,3-Dichloropropene	5.3 (50)	2.17	4.98×10^{-4}	4357
Ethyl benzene	1.0 (31)	0.41	2.58×10^{-3}	158
Ethylene dichloride	6.2 (3)	2.53	3.84×10^{-4}	6589
Formaldehyde	7.0 (50)	2.86	6.94×10^{-4}	4121
Methylene Chloride	14.0 (50)	5.72	9.93×10^{-4}	5760
Methyl Ethyl Ketone	2.0 (31)	0.82	3.29×10^{-5}	24848
Toluene	1.27 (31)	0.52	3.01×10^{-3}	173
1,2,4-Trichlorobenzene	2.5 (50)	1.02	5.18×10^{-4}	1969
1,1,1-Trichloroethane	7.5 (50)	3.07	9.19×10^{-3}	334
Trichloroethylene	8.0 (50)	3.27	2.88×10^{-3}	1135
Vinyl chloride	3.6 (31)	1.47	5.32×10^{-2}	28
Vinylidene chloride	6.5 (50)	2.66	8.01×10^{-2}	33

*Vapor phase concentration calculated from LEL, assuming temperature = 25°C.

[1] Henry's Law Constants (mol/m^3)/(mg/L) taken from Table 4-3.

TABLE 4-3. HENRY'S LAW CONSTANTS EXPRESSED IN ALTERNATE UNITS

	Henry's Law Constant			Temperature, °C	
Compound	$\frac{\text{atm m}^3}{\text{mol}}$	$\frac{\text{mol/m}^3}{\text{mg/L}}$	$\frac{\text{mg/m}^3}{\text{mg/L}}$	Vapor Pressure	Solubility
Acenaphthylene	1.45×10^{-3}(33)	3.96×10^{-4}	60.3	20	25
Acrylonitrile	8.80×10^{-5}(33)	6.83×10^{-5}	3.62	22.8	25
Anthracene	1.25×10^{-3}(33)	2.87×10^{-4}	51.1	25	25
Benzene	5.50×10^{-3}(33)	2.88×10^{-3}	225	25	25
Bromomethane	1.97×10^{-1}(12)	8.62×10^{-2}	8189	20	20
Carbon disulfide	1.20×10^{-2}(19)	6.44×10^{-3}*	490*	--	--
Carbon tetrachloride	2.30×10^{-2}(33)	6.21×10^{-3}	956	20	20
Chlorobenzene	3.58×10^{-3}(33)	1.32×10^{-3}	149	20	25
Chloroethane	1.48×10^{-1}(12)	9.54×10^{-2}	6152	20	20
Chloroform	2.88×10^{-3}(33)	1.00×10^{-3}	120	20	20
Chloromethane	3.80×10^{-1}(19)	3.08×10^{-1}*	15532*	--	--
1,2-Dichlorobenzene	1.93×10^{-3}(33)(12)	5.46×10^{-4}	80.2	20	20
1,3-Dichlorobenzene	3.61×10^{-3}(33)(12)	1.00×10^{-3}	148	25	25
1,4-Dichlorobenzene	3.10×10^{-3}(33)(12)	8.62×10^{-4}	127	25	25
Dichlorodifluoromethane	2.98×10^{0}(12)	1.01×10^{0}	121801	25	25
1,1-Dichloroethane	4.26×10^{-3}(12)	1.79×10^{-3}	177	20	20
trans-1,2-Dichloroethylene	6.70×10^{-2}(12)	2.87×10^{-2}	2785	20	20
1,2-Dichloropropane	2.31×10^{-3}(12)	8.50×10^{-4}	96.0	20	20
1,3-Dichloropropene	1.33×10^{-3}(12)	4.98×10^{-4}	55.3	20	25
Ethyl benzene	6.60×10^{-3}(33)(12)	2.58×10^{-3}	274	20	20
Ethylene dichloride	9.14×10^{-4}(33)	3.84×10^{-4}	38.0	20	20
Formaldehyde	5.10×10^{-4} (54)	6.94×10^{-4}*	20.8	--	--

TABLE 4-3. HENRY'S LAW CONSTANTS EXPRESSED IN ALTERNATE UNITS (Continued)

	Henry's Law Constant			Temperature, °C	
Compound	$\frac{atm\ m^3}{mol}$	$\frac{mol/m^3}{mg/L}$	$\frac{mg/m^3}{mg/L}$	Vapor Pressure	Solubility
Heptachlor	4.00 x 10^{-3}(33)	4.38 x 10^{-4}	163	25	25
Hexachloro-1,3-butadiene	2.56 x 10^{-2}(33)	4.08 x 10^{-3}	1064	20	20
Hexachloroethane	2.49 x 10^{-3}(33)	4.37 x 10^{-4}	104	20	22
Methyl Ethyl Ketone	5.80 x 10^{-5}(19)	3.29 x 10^{-5}*	2.37*	--	--
Methylene chloride	2.03 x 10^{-3}(33)	9.93 x 10^{-4}	84.4	20	25
Pentachloroethane	2.17 x 10^{-3}(19)	4.38 x 10^{-4}*	88.7*	--	--
1,1,1,2-Tetrachloroethane	1.10 x 10^{-2}(33)	2.68 x 10^{-3}*	450*	--	--
Tetrachloroethylene	1.53 x 10^{-2}(12)	3.83 x 10^{-3}	636	20	20
Toluene	6.66 x 10^{-3}(33)	3.01 x 10^{-3}	277	20	25
1,2,4-Trichlorobenzene	2.30 x 10^{-3}(12)	5.18 x 10^{-4}	94.0	25	25
1,1,1-Trichloroethane	3.00 x 10^{-2}(33)	9.19 x 10^{-3}	1226	25	25
Trichloroethylene	9.10 x 10^{-3}(33)	2.88 x 10^{-3}	378	20	20
Trichlorofluoromethane	1.10 x 10^{-1}(12)	3.33 x 10^{-2}	4573	20	20
Vinyl chloride	8.14 x 10^{-2}(33)(12)	5.32 x 10^{-2}	3327	25	25
Vinylidene chloride	1.90 x 10^{-1}(12)	8.01 x 10^{-2}	7766	25	20
Aroclor 1242	1.98 x 10^{-3}(12)	3.14 x 10^{-4}**	80.9	25	25
Aroclor 1248	3.60 x 10^{-3}(12)	5.04 x 10^{-4}**	147	25	25
Aroclor 1254	2.60 x 10^{-3}(12)	3.26 x 10^{-4}**	106	25	25
Aroclor 1260	7.40 x 10^{-1}(12)	8.38 x 10^{-2}**	30246	25	25

*A temperature of 25°C was assumed in Henry's Law calculations.

**The molecular weights of the following compounds were used to represent the molecular weights of Aroclor mixtures in Henry's Law calculations:

Aroclor 1242	Trichlorobiphenyl
Aroclor 1248	Tetrachlorobiphenyl
Aroclor 1254	Pentachlorobiphenyl
Aroclor 1260	Hexachlorobiphenyl

TABLE 4-4. DISCHARGE SCREENING LEVELS BASED UPON FUME TOXICITY

Compound	ACGIH TLV-TWA, mg/m^3 (30)	Henry's Law Constant,* (mg/m^3)/(mg/L)	Screening Level, mg/L
Acrylonitrile	4.5	3.62	1.24
Benzene	30.0	225	0.13
Bromomethane	20.0	8189	0.002
Carbon disulfide	30.0	490	0.06
Carbon tetrachloride	30.0	956	0.03
Chlorobenzene	350.0	149	2.35
Chloroethane	2600.0	6152	0.42
Chloroform	50.0	120	0.42
Chloromethane	105.0	15532	0.007
1,2-Dichlorobenzene	300.0	80.2	3.74
1,4-Dichlorobenzene	450.0	127	3.54
Dichlorodifluoromethane	4950.0	121801	0.04
1,1-Dichloroethane	810.0	177	4.58
trans-1,2-Dichloroethylene	790.0	2785	0.28
1,2-Dichloropropane	350.0	96.0	3.65
1,3-Dichloropropene	5.0	55.3	0.09
Ethyl benzene	435.0	274	1.59
Ethylene dichloride	40.0	38.0	1.05
Formaldehyde	1.5	20.8	0.07
Heptachlor	0.5	163	0.003
Hexachloro-1,3-butadiene	0.24	1064	0.0002
Hexachloroethane	100.0	104	0.96
Methyl ethyl ketone	590.0	2.37	249
Methylene chloride	350.0	84.4	4.15
Tetrachloroethylene	335.0	636	0.53
Toluene	375.0	277	1.35
1,2,4-Trichlorobenzene	40.0	94.0	0.43
1,1,1-Trichloroethane	1900.0	1226	1.55
Trichloroethylene	270.0	378	0.71
Trichlorofluoromethane	5600.0	4573	1.22
Vinyl chloride	10.0	3327	0.003

TABLE 4-4. DISCHARGE SCREENING LEVELS BASED UPON FUME TOXICITY (Continued)

Compound	ACGIH TLV-TWA, mg/m^3 (30)	Henry's Law Constant,* $(mg/m^3)/(mg/L)$	Screening Level, mg/L
Vinylidene chloride	20.0	7766	0.003
Aroclor 1242	1.0	80.9	0.01
Aroclor 1254	0.5	106	0.005

*Henry's Law Constant $(mg/m^3)/(mg/L)$ taken from Table 4-3.

5. INDUSTRIAL USER MANAGEMENT PRACTICES

5.1 INTRODUCTION

The development and implementation of numeric local limits is not always the only appropriate or practical method for preventing pollutant pass through and interference, or for protecting POTW worker health and safety. Control of chemical spills and slug discharges to the POTW through formal chemical or waste management plans can go a long way toward preventing problems. A local requirement for an IU to develop and submit such a plan can be considered as a type of narrative local limit and can be a useful supplement to numeric limits.

The basic philosophy of instituting management practices is to minimize the discharge of toxic or hazardous pollutants to the sewer, or at least to reduce the impact of toxic/hazardous pollutant discharges by avoiding short-term, high concentration discharges. Management practice plans generally are developed to prevent or control the discharge of hazardous or toxic materials, such as acids, solvents, paints, oils, fuels and explosives by means of appropriate handling procedures, possibly in addition to pretreatment. Slug discharges of process wastewater (including high BOD/COD wastes) can also be effectively controlled through the use of management practices.

In the NPDES permitting program for direct dischargers, industries can be required under 40 CFR Part 125, Subpart K to implement best management practices (BMPs) to minimize the discharge of toxicants to surface waters. These plans are meant to address:

- Toxic and hazardous chemical spills and leaks
- Plant site run-off
- Sludge and waste disposal
- Drainage from material storage areas
- Other "good housekeeping" practices.

While direct discharger BMPs address only activities which are ancillary to manufacturing or treatment processes, IU management practices under a local pretreatment program can also include:

- Solvent management plans
- Batch discharge policies
- Waste recycling
- Waste minimization.

The first step a POTW must take in implementing its program is to be certain that the POTW has the requisite legal authority. This involves ensuring that proper language regarding IU management practices are contained in the sewer use ordinance (at a minimum) and in IU permits. The sewer use ordinances or regulations of most POTWs may already include provisions for requiring IUs to develop management practice plans.

When evaluating the need for IU management plans, POTWs may follow the following steps:

- Evaluation of the potential for toxic and hazardous chemicals onsite to reach the sewer system
- Assessing the adequacy of any industry management plans and practices already in place, and requiring revisions to these as necessary.

1. Evaluation of the Potential for Toxic and Hazardous Chemicals Onsite to Reach the Sewer System. The primary concern on the part of the POTW when evaluating the adequacy of IU management practices is the likelihood of slugs/spills of chemicals reaching the sewer system. Inspectors need to focus on: (1) the types of and quantities of chemicals that are handled (e.g., transferred), stored, or disposed onsite; and (2) the location(s) of all chemical handling, storage and disposal activities with respect to sewer access. The chemicals managed in areas of highest risk of being discharged to the sewers (through spills, slug loading, or accidents) should be of the highest priority to be addressed in management plans.

2. Assessing the Adequacy of Existing Management Plans and Practices. POTW officials should carefully evaluate any existing industry management plans. Receiving particular scrutiny should be:

- The practices that are proposed (and whether they are currently being followed)

- Whether the plan is reflective of current operations at the industry
- Whether the plan was designed to prevent discharges to the sewers
- Whether plant personnel are required to follow the plan
- The familiarity of personnel with the plan
- Any conditions that must be met before a response/corrective action can be taken
- Whether all toxic chemicals managed in areas with access to sewers are addressed.

If deficiencies are found in the existing plans, the IU should be required to correct them before submitting a revised plan to the POTW for approval. Further details of recommended plan specifics are discussed later in this section.

The following sections of this chapter outline the elements of three types of industry management practice plans; chemical management plans, spill contingency, and best management practices plans. POTWs should be aware that hybrids of the plans presented may be appropriate for a particular situation and that some overlap of management practice requirements exists. Key to each of these plans is the continued training of staff and proper implementation.

5.2 CHEMICAL MANAGEMENT PLANS

Chemical management plans differ from the other two types of management plans introduced above because they target specific chemicals or groups of chemicals that are considered to be of concern. One example of a chemical management plan that is widespread is the solvent management plan required of metal finishers by federal categorical standards.

POTWs may wish to pay special attention to certain groups of chemicals that have historically caused management problems. Examples of such chemical groups are:

Strong acids (e.g., hydrochloric acid, sulfuric acid, nitric acid, and chromic acid)

Strong bases (e.g., caustic soda, lye, ammonia, lime, etc.)

Noxious/fuming chemicals (e.g., phosphorus pentachloride, hydrofluoric acid, benzene, chloroform)

Flammable chemicals (e.g., acetone, naptha, hexane, cyclohexane)

Explosive chemicals (e.g., nitroglycerine, metallic sodium, picric acid, and lead azide)

Oxidants (e.g., chlorine dioxide, phosphorus pentoxide, potassium permanganate, sodium chlorate)

Reductants (e.g., sodium borohydride, phosphine, methyl hydrazine)

Oils and fuels (e.g., diesel oil, gasoline, bunker fuel oil)

Toxic wastes (e.g., pesticides)

Solvents

Radioactive materials

Foaming Materials (e.g., surfactants).

It is impossible to present an all encompassing list of chemicals that might suitably be addressed under chemical management plans as the needs and concerns of any specific POTW and its industries will be different. However, much attention has recently been paid to one particular group of chemicals, the frequently used solvents. Table 5-1 presents a list of frequently used solvents and their regulatory status. In presenting this table, it is not the intention to suggest that the solvents on this list will always be a problem. Rather, this list is a recognition of the fact that solvents are ubiquitous to sewer systems and can make up a large portion of the usually uncontrolled organic loadings to treatment plants. Concerns regarding these chemicals may be less familiar to POTW personnel than concerns regarding other chemicals such as acids and bases.

As part of the assessment of an industry's chemical management plan, the POTW must first determine the following: the nature of chemical usage at the IU, chemical handling practices, specific process streams containing the chemical, and locations where the chemicals might (intentionally or unintentionally) enter the sewers. An analysis of the chemical's concentration at potential as well as known release points should be obtained as part of this data gathering effort. These data should be gathered through onsite inspections whenever possible. Once this basic information is compiled, its accuracy should be verified with the IU and should subsequently provide the basis for assessing the need for, and adequacy of, chemical management plans submitted by the industry. Elements of the industry's chemical management plan should address each of the potential release points. Whenever possible, the industry should be provided with specific language indicating the acceptable levels of the chemical in the sewer so that a clear yardstick is established against which the success or failure of the management plan can be measured. An example of this is again provided by the metal finishing industry's solvent management plans which attempt to achieve a total toxic organic (TTO) pollutant limit of 2.13 mg/l.

Examples of plan components that would target specific release points are: prevent access through floor drains to sewers in areas of possible chemical spillage; the installation of sumps in floor drains providing a capacity that exceeds the largest projected potential spill volume by a safety margin of perhaps 10 percent; and the education of plant workers handling the chemicals of concern in areas with access to sewers.

POTW staff could also discuss the feasibility of possible chemical substitution, process modifications, and/or waste segregation as means of source control.

- Chemical substitution may be possible if there are other compounds that will fulfill the same function demanded of the chemical of concern; assuming that the substitute itself does not exhibit any properties with the potential to cause problems for the POTW. Key factors in the feasibility of this option will be the cost and availability of the substitute chemical; the chemical and physical properties of the substitute and whether these properties will have a substantive effect on the manufacturing process or subsequent wastes handling operations/liabilities.

- Process modifications that would reduce or eliminate the presence of the chemicals of concern would be an attractive option if feasible. It is likely that industry officials will have a better understanding of the limitations to such modifications than POTW personnel, but this should not inhibit inspectors from raising this option as a possibility. Examples of process modification are the use of different, more effective polymers during wastewater treatment, resulting in an improved removal efficiency for the target pollutant; and changing the degreasing procedures utilized in cleaning product components, possibly from immersion in solvent baths and subsequent rinsing with water, to the wiping of the components manually with the solvent, and air drying under a vacuum hood.

- Waste segregation may be an effective means for improving wastewater treatment efficiency. If the presence of more than one wastewater component acts to limit the efficiency of a treatment process, it may be possible to undertake some form of waste segregation (possibly by distillation) that would separate the components sufficiently to allow for efficient subsequent treatment.

In some instances the institution of formal procedures for the handling, transfer, and storage of chemicals will be useful. For example, if a specific chemical is only used in the manufacturing process in small quantities, the dispensing of the chemical in bulk quantities could be discouraged. This action would reduce the quantities potentially spilled during transfer and also reduce the quantity of "left-over" chemicals that might be carelessly discarded. In some instances the centralized storage of chemicals could improve the logistics of chemical use supervision and provide a principle point of focus for chemical management efforts.

The chemical management plan for each facility should be endorsed by a responsible official at the facility and include a written commitment that the practices described will be followed as a matter of company policy. In instances where industries appear reluctant to implement the procedures delineated in the management plans, POTWs may wish to withhold formal approval of the management plan until a trial period illustrates that the procedures are indeed being implemented.

5.3 SPILL CONTINGENCY PLANS

Many industries with large storage tanks onsite may already have spill contingency plans in place, sometimes as a matter of company policy. This kind of familiarity with planning and response procedures is a definite plus from the POTW's point of view. However, existing spill plans may address only a portion of the potential pollutant sources of concern to the POTW and may not be as sensitive to protection of the sewer system as needed. Also, the quantity and types of materials spilled that would initiate a spill response under existing contingency plans may be inconsistent with pretreatment concerns and needs. With this in mind, POTW inspectors should carefully review any existing plans for their adequacy as opposed to accepting them at face value. The items which should be focused upon in reviewing a spill contingency plan are the same as those considered in the design of a new plan and include:

- Identification of high risk chemicals
- Identification of high risk handling and storage procedures and plant locations
- Identification and mapping of potential release points relative to sewer access points
- Identification of and preparation for possible spill containment and/or countermeasures
- Identification of individuals responsible for implementation of the spill plan, individuals with the authority to commit additional resources to a response action, if necessary; and designation of a predetermined chain of command for coordinating spill response activities--depending on the type of spill
- Documentation of the entire spill contingency plan, including:
    - Maps of key area
    - Equipment lists, and equipment storage and in-plant staging locations
    - Names and functions of all plant officials with a role in spill contingency planning and implementation
    - Names and phone numbers of POTW officials who should be contacted in the event of a spill (the industry may choose to also include local fire department, police, and emergency rescue information)
    - A commitment to provide the POTW with a written notification or report within a short period (3 days) following an incident, explaining the cause of the spill, and steps that are being taken to prevent recurrence
    - An endorsement of the spill plan by responsible industry officials, including a commitment to implement the plan as per the facility's permit requirement
    - An indication as to the date when the plan was last updated, and a commitment to update the plan periodically, or following a spill incident.

Inspectors should carefully review all the details of the plan and be satisfied that it is adequate from the POTW's perspective before recommending formal approval. Additional information on spill contingency plans may be found in "EPA Region X Guidance Manual for the Development of Accidental Spill Prevention Programs," U.S. EPA Region X, Seattle, WA, February 1986. An example is also provided in Appendix K. In addition, EPA is currently developing a guidance manual to help identify the need and methods for developing slug control plans.

5.4 BEST MANAGEMENT PRACTICES PLANS

The concept of best management practices plans (BMPs) is well accepted in the NPDES program, and many of the same principles apply equally well to indirect dischargers. In this section, the types of requirements that could be required of an IU under the provisions of a BMP are discussed. As in the case of the other types of management plans, the actual requirement imposed on any particular industry will vary depending on site-specific needs.

Much of the focus of BMPs is on good housekeeping and proper operation and maintenance measures. While these items may at first seem obvious or trivial, experience has shown that the documentation of proper procedures and a requirement that the procedures be followed are very effective in reducing the number of (preventable) breakdowns in equipment, and miscommunication that can lead to unwanted discharges to the sewers. In considering the need for BMPs and in reviewing the design of BMPs proposed by industry, the following should be considered:

- Equipment O & M. While most facilities will make every effort to take care of the equipment that they have purchased and installed for waste management purposes, this cannot be assumed to always be the case. Where equipment is at a level of sophistication that is beyond the comprehension of its operators, or when the equipment is simply old, attention paid to operation and maintenance practices becomes all the more important. In such cases, BMP requirements should be directed at ensuring that necessary routine maintenance is performed and that equipment failures are not due to neglect. Where sophisticated electronics are a part of a treatment system the manufacturers of such equipment frequently provide either technical training or the option of equipment maintenance contracts. These services should be encouraged by POTW staff wherever appropriate.

- Reduction of contaminated runoff. The potential exists for contaminated runoff from any process operation, chemical transfer area, or raw materials, product, or waste storage area that is exposed to rainfall. Walk through inspections of a facility may reveal telltale stains on the ground in problem areas. Depending on the nature of the contamination, this type of runoff may be of concern. If the contaminated runoff is readily treated by the IU's pretreatment processes and does not contribute to hydraulic overloading of the system, then it may be of little consequence. However, if pollutants (or the flow) resulting from runoff appear to be a problem, then some form of mitigation should be considered by the IU. After discussing the problems and possible solutions with industry staff, the POTW inspectors should leave the selection of remedial measures to industry management. Mitigative measures might include the construction of berms and/or diversion structures, the shifting of operations to covered areas, recontouring of surfaces, or even the modification of pretreatment systems onsite. The ongoing maintenance and implementation of runoff control measures are appropriately contained in the facility's BMP.

- Segregation of wastes for reclamation. In some instances, opportunities will exist to segregate wastes within a facility for the purpose of reclamation. This practice also reduces the quantities of possibly hazardous waste that must be disposed and may even reduce pollutant loadings in the wastewater. Contaminated oils and spent solvents are examples of wastes for which a substantial reclamation market exists.

- Routine cleaning operations. Many industries will schedule routine cleaning of plant areas and equipment. This may come at the end of every few shifts, on specified days of the week, or possibly at the end of seasonal operations. While these cleaning activities are necessary for the continued efficient (and perhaps sanitary) nature of plant operations, the use of large quantities of detergents and solvents, and the pollutants carried by these chemicals, can be of concern. In some instances, it is possible for industries to reduce the loadings to the sewers through the substitution of dry methods of cleaning or modification of cleaning procedures. For instance, it is often possible to achieve highly efficient cleaning of surfaces while reducing chemical usage by using high pressure application wands. This type of chemical application also allows for more direct application and more efficient chemical usage. When reviewing routine cleaning operations, POTWs should also endeavor to ensure that required cleaning of grease traps are indeed conducted with necessary frequency. Once again, the use of formal procedures, and perhaps even operations log books could be of help.

- Chemical storage practices. A walk through of a facility's process operations may reveal that chemicals and fuels are being stored adjacent to, and perhaps directly over floor drains (so that leaks and drips do not make a mess). This kind of practice should be discouraged and is perhaps the simplest type of preventive measure. Also, if a facility acknowledges routine amounts of chemical spillage and leaks (perhaps during dispensing chemicals) with the use of drip pans, it is probably worth inquiring as to the frequency with which these pans are emptied, whose responsibility it is, and where and how the spilled substances are disposed.

5.5 LEGAL AUTHORITY CONSIDERATIONS

All POTWs must have the minimum legal authority required by 40 CFR 403.8(f)(i), to deny or condition discharges of pollutants that could violate local or Federal pretreatment standards and requirements. The goals of management practice requirements are the same as those of numerical local limits -- to prevent pass through, interference, and violations of the specific prohibitions. However, the imposition of the management plans described in this chapter may or may not be within the scope and authority of some local ordinances. Therefore, it is suggested that each POTW specifically evaluate its legal ability to impose these requirements. Once verified or obtained, specific requirements for industrial users to submit a management plan should be included in the user's control mechanism (i.e., industrial user permit).

5.6 APPROVAL OF INDUSTRIAL USER MANAGEMENT PLANS

Once the need for a chemical management plan, spill prevention plan or BMP is determined, the POTW may require the plan(s) to be submitted in conjunction with the industrial user's permit application and approved in conjunction with issuance of the permit. The industrial user permit should be reissued to include the requirements of the management plan if necessary. Satisfactory implementation of the plans should then be verified during the periodic industrial inspections by the POTW.

TABLE 5-1. LIST OF COMMONLY USED SOLVENTS

Solvent	RCRA Ignitability	RCRA Toxicity	Proposed TCLP	CWA Priority Pollutant
Acetone	Yes	No	No	No
Benzene	Yes	Yes	Yes	Yes
n-Butyl alcohol	Yes	No	No	No
Carbon disulfide	Yes	Yes	Yes	No
Carbon tetrachloride	No	Yes	Yes	Yes
Chlorobenzene	No	Yes	Yes	Yes
Cresols (o-m-p isomers)	No	Yes	Yes	No
Cyclohexanone	Yes	No	No	No
1,2-Dichlorobenzene	No	Yes	Yes	Yes
Dichlorodifluoromethane	No	Yes	No	No
2-Ethoxyethanol	Yes	Yes	No	No
Ethyl acetate	Yes	No	No	No
Ethyl benzene	Yes	No	No	Yes
Ethyl ether	Yes	No	No	No
Isobutanol	Yes	Yes	Yes	No
Methanol	Yes	No	No	No
Methylene chloride	No	Yes	Yes	Yes
Methyl ethyl ketone	Yes	Yes	Yes	No
Methyl isobutyl ketone	Yes	No	No	No
Nitrobenzene	No	Yes	Yes	Yes
2-Nitropropane	Yes	Yes	No	No
Pyridine	Yes	Yes	Yes	No
Tetrachloroethylene	No	Yes	Yes	Yes
Toluene	Yes	Yes	Yes	Yes
1,1,1-Trichloroethane	No	Yes	Yes	Yes
1,1,2-Trichloroethane	No	Yes	Yes	Yes
Trichloroethylene	No	Yes	Yes	Yes
Trichlorofluoromethane	No	Yes	No	No
1,1,2-Trichloro-1,2,2-trifluoroethane	No	Yes	No	No
Xylene (o-m-p isomers)	Yes	No	No	No

6. CASE BY CASE PERMITS - BEST PROFESSIONAL JUDGMENT (BPJ)

6.1 INTRODUCTION

This section of the guidance manual is devoted to developing permit limits on a case-by-case, IU-specific basis. The limits are for pollutants of concern for which local limits have not been developed by any of the other methods already described in this manual. This section explains the procedures that can be used to develop the actual wastewater discharge permit limits. Many of the concepts and procedures used in the NPDES program have applicability to the pretreatment program and therefore will be discussed. For NPDES direct dischargers, permit limits for these types of facilities are referred to as Best Professional Judgment (BPJ) permit limits. BPJ is defined as the permit writer's best judgment, reflected in permit limits, as to the most effective control techniques available, after consideration of all reasonable available and pertinent data or information which forms the basis for the terms and conditions of a permit. POTWs should take information submitted by their IUs into consideration when applying BPJ. Working closely with IUs to develop BPJ local limits will often identify additional practical considerations and result in better limits.

6.2 APPLICATIONS OF BPJ

In this section some of the appropriate applications of BPJ to local limits derivation are discussed. In every case, the local limits which are developed must, at a minimum, prevent violation of State and local requirements as well as pass through, interference, and violations of any of the specific prohibitions in the General Pretreatment Regulations.

(1) BPJ can be used to allocate maximum allowable headworks loadings by the selected industrial reduction method discussed previously in Section 3.3.3.1. This allocation method generally involves a BPJ evaluation of treatment performance data in order to establish expected IU pollutant removals through pretreatment.

(2) BPJ can be used to establish pretreatment requirements when there are insufficient data/criteria to do a headworks loading analysis for a pollutant of concern. For example, the pollutant could be a new toxic chemical, a suspected carcinogen for which the long-term health effects are unknown, a bioaccumulative pollutant, a pollutant which concentrates in sediments, or a chemical for which analytical methods are unavailable. In these cases the POTW may be uncertain as to safe quantities of the chemicals involved, and therefore will

attempt to minimize the discharges of these chemicals by making a BPJ determination of the best available treament technology (or chemical management practice). The POTW would then develop case-by-case permit limits for IUs based on the expected treatment performance.

(3) It can be used when biomonitoring tests have shown toxicity of the whole POTW effluent, but the toxicity cannot be traced definitely to one or a few specific causes. Through the toxicity reduction evaluation techniques described in Section 2.5, the general class of contaminants causing the toxicity may be identifiable (such as metals, acids, filterable materials, volatiles, polar or nonpolar organics, etc.). The POTW can then determine who is discharging these materials and use BPJ to determine what type of pretreatment would be effective in reducing them.

(4) It can be used to further the basic goal of the Clean Water Act, which is to minimize the release of pollutants and prohibit dilution. Although a discharge may not be causing an apparent problem at a POTW, if an industrial user is discharging small quantities of highly concentrated toxic wastes to the sewer untreated and relying on dilution to hide the problem, the POTW will want to regulate the discharge. This can be done through technology-based limits or chemical management practice requirements. The exception would be if the POTW can demonstrate that its own treatment processes consistently reduce the pollutant as effectively as pretreatment alternatives.

(5) It can be used to control discharges from centralized hazardous waste treaters and other dischargers of highly variable wastes. Centralized hazardous waste treatment facilities are becoming more common throughout the country as RCRA regulations become more stringent. They accept wastes that used to be hauled to hazardous waste landfills from diverse generators. The waste is complex and varying in quality. It may be difficult for the POTW to evaluate individual pollutants on a water quality/sludge/POTW effects basis. The POTW will want to be assured of adequate treatment and reliable operation of pretreatment facilities. It may choose to use BPJ to establish a total toxic organic (TTO) limit plus individual technology-based limits for certain pollutants.

6.3 APPROACHES TO BPJ

Several BPJ approaches are discussed in this section. Based on this discussion of BPJ methods it will be evident that BPJ allows the permit writer a great deal of flexibility in establishing permit limits. Inherent in this flexibility, however, is the burden on the permit writer to show that his/her BPJ is based on sound engineering analysis. The methods set forth in this document are aimed at illustrating several common approaches to a solution.

It is important to remember that the technical basis for the limits should be clearly defined and well documented.

The following approaches will be discussed:

- Existing permit limits for comparable industrial facilities
- The demonstrated performance of the permittee's currently installed treatment technologies (performance-based limits)
- The performance of treatment technologies as documented in engineering literature (treatability)
- Adapting Federal standards that regulate similar wastestreams (transfer of regulations)
- Economic achievability considerations in permit limits development.

Examples are provided at the end of this section.

6.3.1 Existing Permit Limits for Comparable Industrial Facilities

One straightforward method for establishing BPJ permit limits is to identify and use existing permit limits for comparable industrial facilities. One way to obtain information about comparable facilities is to contact NPDES permit writers at the State or EPA Regional offices. In addition, there is an EPA document, Abstracts of Industrial NPDES Permits, which presents abstracted data from the NPDES permits of 500 industrial dischargers to surface waters (not to POTWs). The document is available by request from the Permits Division (EN-336), EPA Headquarters, Office of Water Enforcement and Permits. Within each permit abstract, the following information is presented:

- Industrial facility name
- Description of products and manufacturing processes
- Identification of wastewater discharges
- Description of wastewater treatment
- A statement of permit limits and a discussion of the basis for the permit limits.

To use this document effectively, the permit writer must first identify industrial facilities similar to the facility to be permitted. The permit writer should select facilities with regard to the following characteristics:

- Manufacturing processes
- Pollutants
- Process wastewater sources and flows
- Nonprocess wastewater (e.g., cooling water) flows
- Treatment technologies and practices.

Once permit abstracts of similar industrial facilities have been identified, the permit writer should review the permit limits for each, and examine the basis behind them. The permit writer then should assess the applicability of these permit limits to the industrial discharge to be permitted. The permit writer should compare the wastewater treatment system at his particular industrial user to the direct discharger's system. If the two wastewater treatment systems are comparable, then the permit writer may want to consider establishing similar permit limits. Prior to establishing similar limits, the permit writer should also consider the effectiveness of the POTW itself in removing the pollutants of concern and avoid redundant treatment. If the POTW consistently reduces the pollutants of concern as effectively as pretreatment alternatives, then pretreatment may be unnecessary. However, POTWs are generally not designed to treat toxic or hazardous industrial wastes and whatever removal is incidentally achieved may be highly inconsistent from day-to-day.

Another consideration in using the NPDES permit to establish BPJ limits is that NPDES permit limits are frequently based on water quality considerations. Water quality based limits are usually developed from an in-stream water quality standard and back-calculated from the amount of dilution provided by the receiving stream to arrive at the permit limit for a particular discharger. The permit writer should determine if the permit limits are water quality based. In such a case, even if the wastewater treatment technologies are similar, the numerical NPDES permit limit is probably not transferable to an industrial user of a POTW. Example 1 demonstrates this approach.

6.3.2 Demonstrated Performance of the Industrial User's Treatment System

The permit writer can base permit limitations for an industrial user on the performance of the user's existing treatment system. Such permit limits are referred to as performance-based limits. In employing this practice, the permit writer must adequately assess the influence of the user's operational characteristics on the performance of the treatment system. In particular, the variabilities of the industrial user's production rates and their relationship to raw waste loadings and treatment efficiency, must be considered.

Permit limits based on poor treatment system performance are not allowable and for this reason before a permit writer can develop performance-based permit limits, it must be determined that the wastewater treatment system is operating properly and efficiently. To do this, the permit writer should visit the industrial user's facility and treatment system. During the site visit, one should look for obvious indications of poor performance such as high solids going over the clarifier weir, poor maintenance, and other signs. The writer should obtain design data (i.e., volumes of tanks, unit processes, overflow rates, etc.), operational data (flows, analytical data, daily operating time for batch and intermittent operations, etc.), production data and monitoring data. These data can be used to determine if the wastewater treatment system is overloaded and if the proper treatment processes are employed.

Only after the permit writer has determined that the performance of the treatment system is adequate, can he/she develop performance-based permit limits using the monitoring data for the industrial user's discharge. The limits can be set at a level so that if the treatment system maintains the desired level of performance, the probability of exceeding the limits is very low (less than 0.05). Since effluent quality will vary over time, statistics are used to describe the effluent characteristics and treatment performance. Normally, a permit writer relies on at least two years of raw discharge data for each pollutant. Two years of data, provided the data are at least monthly, are recommended to obtain a sufficient number of data points to use a statistical method to determine the performance-based permit limits. The two years of data can be the most recent two years or the two years of highest production during the last five years. Before using the highest production years, the permit writer should check to see that the treatment system was not overloaded during the high production periods. Using the raw data, the permit writer should first calculate the mean and standard deviation for each pollutant of concern and with these values, derive the permit limits (equations found in Example 2). It should be noted, however, that treated effluent data are lognormally distributed and require additional statistical procedures than those given in Example 2. The permit writer is directed to the Technical Support Document for Water Quality-Based Toxics for the more detailed technical information.

Monthly average values should not be used in place of the raw data when developing performance-based permit limits. These values are averages and consequently much of the day-to-day variability in a pollutant will be smoothed out. The loss of variability can result in permit limits which are too stringent for the treatment system to meet and could result in excessive and unnecessary violations. Example 2 illustrates how to calculate performance-based permit limits and the effect of using monthly averages rather than raw data.

6.3.3 Performance of Treatment Technologies as Documented in Engineering Literature (Treatability)

Another method for establishing BPJ permit limits for a given industrial discharge is based on the performance of various treatment technologies for the removal of specific pollutants. The practice will assist the permit writer in understanding what level of treatment is possible. From this information the permit writer can compare the available technologies and treatment level to those at the industrial user in question. Developing BPJ limits from the documented treatability data can be approached in two distinct ways:

- Limits for a facility can be based on the performance of treatment technologies installed at other facilities performing similar processing operations
- Limits on a facility's discharge can be based on the performance of treatment technologies in removing specific pollutants from wastestreams with similar characteristics and pollutant levels, but discharged by industrial facilities performing completely different process operations.

In general, the considerations involved in using treatability data to set BPJ limits are the same for both of the above approaches. Major considerations are:

- Performance data should be based on the removal of identical or chemically similar pollutants to those found in the discharge to be permitted
- Performance data should pertain to the treatability of wastewaters containing approximately the same pollutant levels as those found in the discharge to be permitted
- Compositional differences between the discharge to be permitted and the discharge for which treatability data are available should be noted
- The variability in pollutant levels in the discharge to be permitted will affect treatability.

The permit writer should note major differences between the average flow of the discharge for which treatability data exist and the average flow of the discharge to be permitted.

In order to assess wastewater treatability, available performance data should be obtained that documents the efficiency of existing treatment technologies in removing identical, or at least chemically similar, pollutants. The rationale for this consideration is that treatment technologies remove similar pollutants with similar efficiencies. Treatment technologies usually are geared toward the removal of specific pollutants (e.g., air stripping units remove volatile organics, precipitation units remove metals, etc.).

A second consideration is that performance data should be obtained that reflect the treatability of wastewaters containing approximately the same pollutant levels as the discharge to be permitted. The permit writer might find this consideration particularly important when available performance data pertaining to the treatability of wastestreams generated by industrial processes are dissimilar from the data of the industrial facility to be permitted.

A third consideration in applying technology transfer is that compositional differences between the wastewaters for which performance data are available and the wastewater discharge to be permitted should be identified and expected influences on treatability should be determined. For example, suppose a permit writer is to develop a permit limit for copper and performance data for an analogous wastestream indicate high removals can be achieved through precipitation techniques. Before applying a high copper removal efficiency to the industrial discharge to be permitted, however, the permit writer should be careful to note whether high levels of ammonia also are present in the discharge. Ammonia tends to form complexes with copper, which conceivably could affect the treatability of the wastewater. In such a case, the permit writer may wish to set discharge limits based on stripping of the ammonia prior to precipitation of the copper, or alternatively, set a less stringent limit on copper to allow for some pass through due to complexation.

The following list (by no means exhaustive) provides examples of pollutants that commonly cause interference with the performance of treatment technologies, and consequently, pollutants that the permit writer should try to identify:

- Ammonia - As noted above, ammonia can form chemical complexes with metals, and consequently, lower metals removal efficiencies.
- Iron - Iron tends to form complexes with cyanide, and consequently, reduce cyanide treatability.
- Surfactants - The foaming action of surfactants can reduce volatiles removal by air stripping. Emulsification of insoluble organics by surfactants might reduce the removal of these pollutants by absorption onto activated carbon.
- Oil and grease - Oil and grease tends to saturate treatment systems that rely on beds, such as activated carbon and ion exchange. Oil and grease saturation could drop removal efficiencies in these units to zero.
- pH - pH affects the operation and efficiency of many treatment technologies. For example, organic acids are removed better in activated carbon columns at low pHs than at neutral or high pHs. Chemical dosing rates in neutralization and/or precipitation systems depend on pH, floc formation, and other factors.

In addition to the considerations cited above, the permit writer should be aware of the variability of pollutant levels in the discharge to be permitted. Removal efficiencies of treatment technologies tend to vary greatly with wide fluctuations in influent level; therefore, removal efficiencies based on the operation of technologies treating wastewaters with uniform, invariant pollutant levels may not adequately reflect the performance of the same technologies in treating highly variable pollutant discharges. The permit writer should be aware of the variabilities in the pollutant discharges, and should take these variabilities into account when assessing the applicability of performance data in developing permit limits.

Finally, the permit writer also should consider the magnitudes of the wastewater discharges. Even though a particular treatment technology performs well on a small discharge, the permit writer may find that it is technically and/or economically infeasible to install the particular technology on the larger scale necessary for treatment of greater discharges. Major considerations concerning treatment scale-up include:

- Requisite land area for the treatment facility
- Cost of treatment media (e.g., activated carbon, resin beds, etc.)
- Cost of treatment chemicals
- Energy requirements for operation of the treatment facility.

The engineering literature provides a wealth of information concerning the performance of treatment technologies and treatability of specific pollutants. Probably the documents of most value to a permit writer are EPA's Treatability Manual [59] and the Development Documents (see Appendix D of this manual for a list of those currently available).

EPA Development Documents present industry and wastewater characterization data, as well as both actual and theoretical treatment technology performance data, for numerous categories of industrial facilities. The documents have been prepared by EPA's Industrial Technology Division to support the development of technology-based discharge limitations. Specifically, each Development Document contains the following information for an industrial category:

- Description of the industrial category, number and size of manufacturing sites, production characteristics, and age and geographic distribution of facilities.
- Characterization of water use and wastewater generation within the industrial category. Sampling data for both treated and untreated wastewaters from representative facilities within the industrial category.
- Discussions of alternative treatment technology options, as well as presentation of removal efficiency data for actual and theoretical treatment systems.

EPA's Treatability Manual is a five-volume document pertaining to the effectiveness of treatment technologies in removing pollutants from industrial wastewaters. The first volume of the manual presents physical/chemical property data, industrial wastewater occurrence data, treatment removal efficiencies, typical industrial effluent concentrations, and water quality criteria for specific pollutants.

The second volume provides descriptions of industrial facilities and wastewaters, which will be valuable in assessing the applicability of various treatment technologies. The third volume discusses treatment technologies and presents performance information. The fourth volume presents data on treatment technology cost estimating. The permit writer could use these data to assess the economical feasibility of the treatment technology options. The fifth volume of the Treatability Manual is a summary volume.

Example 3 is an example of the use of treatability data from the literature in setting BPJ permit limits.

6.3.4 Adapting Federal Discharge Standards

Another potential basis for the development of BPJ discharge limits is the use of existing technology-based Federal discharge standards for similar industries and/or wastestreams. The rationale for the use of existing Federal standards is that compliance with such standards is predicated upon the installation of appropriate pollution control technologies; if the permit writer adopts technology-based standards for inclusion in a permit, the permitted industry similarly will have to install the appropriate pollution control technologies to comply.

The permit writer should identify an industrial category or categories regulated by national categorical standards that is relevant to the facility to be permitted. The permit writer should consult the Federal Register at this point to determine if the specific technology-based discharge limitations can be applied reasonably to the discharge to be permitted.

EPA has noted that many permit writers have used electroplating and metal finishing standards (40 CFR 413 and 433) in developing BPJ permit limits for metals dischargers other than electroplaters/metal finishers. It must be realized that the metal finishing standards only reflect the wastewater characteristics and treatability of electroplating/metal finishing wastewaters, and that these standards may not be appropriate for BPJ permit limits for other categories of metals dischargers, such as copper formers.

In order to provide a more representative data base of all metal discharging industries, EPA established the combined metals data base. The combined metals data base consists of effluent data for metal finishing, copper forming, battery manufacturing, and coil coating industries, as well as other industries that discharge metals and use similar metals removal treatment technologies. Table 6-1 presents mean effluent data from the combined metals data base, as well as monthly and daily variability data. Table 6-1 also presents corresponding monthly average and daily maximum "discharge limits" as guidance for the permit writer in setting BPJ permit limits. Also presented are metal finishing effluent discharge limit data for comparison.[1] Permit writers should use their own judgment in selecting which of these data bases to employ.

Example 4 demonstrates the use of technology-based discharge standards for similar wastestreams in setting BPJ permit limits.

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[1] The monthly average and daily maximum metal finishing limits in Table 6-1 are the categorical pretreatment standards for existing sources (PSES). The long-term arithmetic mean data in the table represent the long-term performance which was found to be attainable by the technology EPA assessed. If a plant intends to consistently comply with the regulatory limit, it should use the long-term mean as a guide for design.

6.4 REGULATORY CONSIDERATIONS FOR DEVELOPING BPJ LOCAL LIMITS

The Federal Pretreatment Regulations (40 CFR Part 403) do not include regulatory constraints on a POTW's development of BPJ permit limits for indirect dischargers. The permit writer has considerable latitude in establishing case-by-case permit limits for indirect dischargers, but must, as a minimum, assess the potential impacts of pollutant discharges on the operation of the POTW and develop limits as necessary to prevent pass through, interference, and violations of any of the specific prohibitions contained in the General Pretreatment Regulations. The permit writer also may wish to consider the requirements delineated by Federal regulations for direct discharger permits. These are discussed briefly below.

In developing BPJ permit limits for direct dischargers (NPDES pemit limits), the permit writer is required by Federal Regulations [40 CFR Part 125.3(C)3] to consider the following:

- The age of wastewater treatment equipment and facilities
- The nature of the wastewater treatment process employed
- Engineering aspects of the application of various treatment technologies
- Requisite process changes in order to comply with the permit limit(s)
- Nonwater quality environmental impacts associated with treatment technologies
- The cost of achieving effluent reductions.

Clearly, the age of wastewater treatment equipment will affect the equipment's expected performance. Reasonable permit limits should take into account factors relating to the the expected actual performance of currently installed treatment units, such as age and type of equipment, as long as the technology is appropriate for the type of wastewater.

The permit writer also should account for the engineering aspects of the application of various treatment technologies. Permit limits should not be predicated on the application of technologies that are impossible to install from an engineering standpoint. For example, the permit writer should not develop a permit limit based on the installation and proper operation of a treatment technology which occupies three-eighths of an acre if the entire industrial facility consist of only one-quarter of an acre.

The permit writer should consider all industrial process changes that must be affected in order to comply with the permit limit. In particular, the permit writer should determine whether requisite changes in operational procedures, management practices, etc., alone will be sufficient to achieve compliance with the new permit limits, or whether installation of treatment technologies will be necessary. Also, the permit writer should assess the technical and economic feasibility of all process modifications required for compliance with the permit limit.

Additionally, the permit writer should consider all nonwater quality environmental impacts associated with the requisite treatment technologies. Nonwater quality impacts include the following:

- Air pollution impacts (e.g., discharge of volatiles to the air by air stripping treatment technologies)
- Hazardous waste generation (e.g., metals-bearing sludges generated by precipitation treatment technologies)
- Energy requirements associated with the treatment technologies (less energy intensive treatment technologies should be preferentially considered).

A final factor that the permit writer should consider when establishing case-by-case permit limits for direct dischargers is the cost of the requisite treatment technologies. This consideration is discussed in detail in Volume IV of the Treatability Manual [59]. Where economic achievability may be an issue, the permit writer may wish to consult a manual entitled Protocol for Determining Economic Achievability for NPDES Permits [65].

Finally, Federal regulations [40 CFR Part 122.44(1)] require that renewal permits issued to direct dischargers must contain permit limits at least as stringent as those in the dischargers' previous permits. Thus, the permit writer cannot establish case-by-case permit limits for a direct discharger that are less stringent than those with which the direct discharger must already comply. The only exceptions allowed under 40 CFR Part 122.44(1) are cases for which the old permit limits are more stringent than subsequently promulgated Federal limitations, and:

- Previously installed technology is deemed inadequate to ensure compliance with the old permit limits
- Material and substantial changes to the facility have occurred, making compliance with the old permit infeasible
- Increased production drastically reduces treatment efficiency
- Operation and maintenance costs for the installed treatment technology are considerably greater than costs considered in promulgating the Federal limitation.

TABLE 6-1. COMPARISON OF COMBINED METALS DATA BASE WITH METAL FINISHING DATA BASE

Parameter	Long-Term Arithmetic Mean	Monthly (10-day) Ave.		Daily Maximum	
		Variability	Limit (mg/)l	Variability	Limit (mg/l)
METAL FINISHING:					
Total Chromium	0.572	2.98	1.71	4.85	2.77
Copper	0.815	2.54	2.07	4.15	3.38
Lead	0.197	2.19	0.43	3.52	0.69
Zinc	0.549	2.70	1.48	4.75	2.61
Cadmium	0.130	2.02	0.26	5.31	0.69
Nickel	0.942	2.53	2.38	4.22	3.98
Total Cyanide	0.180	3.61	0.65	6.68	1.20
Hexavalent Chromium	0.032	3.05	0.10	5.04	0.16
Cyanide, amenable	0.060	5.31	0.32	14.31	0.86
TSS	16.8	1.85	31.0	3.59	60.0
COMBINED METALS DATA BASE:					
Total Chromium	0.084	2.14	0.18	5.24	0.44
Copper	0.58	1.26	0.73	3.28	1.90
Lead	0.12	1.08	0.13	1.25	0.15
Zinc	0.33	1.85	0.61	4.42	1.46
Cadmium	0.079	1.90	0.15	4.30	0.34
Nickel	0.74	1.72	1.27	2.59	1.92
TSS	12.0	1.67	20.0	3.42	41.0

EXAMPLE 1 APPLICATION OF THE COMPARABLE FACILITIES APPROACH

A manufacturer (ABC Corporation) of organic chemicals discharges an average of 0.200 MGD of process wastewater to a POTW. This wastewater is from the production of alkyd resins, urea resins and polyester resins. The wastewater is pretreated by neutralization, an aerated lagoon and a polishing pond prior to discharge. The plant manager has indicated that lead or cadmium are used as catalysts and phenol is an additive in the polyester resin process. No other priority pollutants are used. Upon scanning the EPA document, Abstracts of Industrial NPDES Permits, the permit writer may identify the following citation concerning the permit for another organic chemicals manufacturing facility:

> XYZ Corporation is a manufacturer of formaldehyde and synthetic resins including urea-formaldehyde, phenol-formaldehyde, polyester and alkyl resins and discharges to the Clear River. The facility's process outfall consists of 0.135 MGD of process wastewater which is treated by equalization, neutralization, activated sludge treatment, clarification, lagoon stabilization and sand filtration.
>
> There are no National Effluent Guidelines promulgated for this industry and consequently effluent limitations have been developed using BPJ and water quality standards. The basis for the BPJ limitation is BCT = 95 percent reduction in raw BOD_5, TSS and COD. Ammonia and total phenols are limited at demonstrated treatment plant performance levels per BAT/BPJ and water quality standards. Styrene and xylene are limited at 3.0 mg/l (instantaneous maximum) based on water quality criteria. Zinc is limited at 2.0 mg/l per State Hazardous Metals Policy (i.e., five times the single reported value). Formaldehyde, also a hazardous compound but not a priority pollutant, is not limited because BOD and COD are considered to be indicator parameters. The NPDES permit limits are summarized in the table on the following page.

The permit writer for the POTW notes that with the exception of formaldehyde production, the production processes at the two facilities are similar. The permit writer decides that 95 percent removal of BOD_5, TSS and COD is beyond the capabilities of the ABC Corporation's pretreatment system after reviewing the performance data. Because ABC Corporation is discharging to a POTW rather than directly to surface waters, the permit writer elects to

XYZ Corporation
Effluent Limits for Process Wastewater Outfall

Pollutants	Avg/Max. Limits and Units	Monitoring
Flow	NL	continuous, recorded
BOD_5	9.1/18.1 Kg/d (18/25 mg/l)	2/week
COD	152/227 Kg/d (298/444 mg/l)	2/week
TSS	18/36 Kg/d (35/70 mg/l)	2/week
Ammonia-N	2.3/4.6 Kg/d (4.5/9.0 mg/l)	2/week
Total phenols	0.02/0.04 Kg/d (0.04/0.08 mg/l)	2/week
Styrene	3.0 mg/l inst. max.	1/month
Xylene	3.0 mg/l inst. max.	1/month
Zinc	2.0 mg/l inst. max.	1/month
pH	6.0-9.0	continuous

develop BOD_5, COD and TSS permit limits based on 80 percent removal. These methods would result in BOD_5 limits of 93/117 mg/l which are within the range of the raw domestic sewage concentrations received by the POTW. In XYZ Corporation's NPDES permit, the ammonia-N and total phenols limits were based on treatment plant performance and water quality standards. Because the industrial user is discharging to a POTW, water quality-based limits are not necessary unless the industrial user contributes a pollutant which causes the POTW to violate water quality standards in the receiving stream. Upon reviewing the industrial user's discharge data, the permit writer finds that the concentration limits for ammonia-N in the XYZ Company's permit are achievable by the industrial user; however, the total phenol limits are not. The permit writer elects to limit ammonia-N at the same concentration as XYZ Corporation and to base the total phenols limits on the performance of the industrial user's pretreatment system. The limits for both pollutants are sufficient to protect the water quality in the receiving stream after the industrial discharge receives further treatment at the POTW.

Since the styrene and xylene limitations in XYZ Corporation's permit were based on water quality but the receiving stream to which the POTW discharges has no water quality criteria standards or criteria for these pollutants, and since these pollutants have not been detected at the POTW, they are not included in the industrial user's permit. Zinc, like ammonia-N and total phenols, has a water quality standard in the POTW's receiving stream in addition to being a priority pollutant. The industrial user's discharge data indicates a low zinc concentration so it is not limited. The industrial user indicated that lead and cadmium are used as catalysts in production, and phenol (Priority Pollutant No. 065) is an additive. Since lead and cadmium are used as catalysts, very little is expected to be discharged in the process wastewater and this is confirmed by the industrial user's discharge data. The permit writer decides to require monitoring rather than limits for these since they are priority pollutants and are known to be used at the facility. Phenol is included in the total phenols analysis and limit, so the permit writer does not require a separate limit for the priority pollutant itself.

EXAMPLE 2 PERFORMANCE-BASED PERMIT LIMITS

Jones Mining Company operates a molybdenum mine and mill producing less than 5,000 metric tons of ore per year. The wastewater (mine drainage) from this small facility is discharged to a POTW. Molybdenum ore mining and dressing is regulated under Subpart J of 40 CFR Part 440, but no categorical pretreatment standards have been promulgated for the industry. The permit writer has considered applying the appropriate BPT and BAT limitations for direct dischargers to this facility. However, he has decided to calculate performance-based limits to see how comparable they are to the BPT/BAT limits. Using the raw data below (assumed to be normally distributed) and Equations 1-4 below, the permit writer calculates the following for zinc and TSS:

	Zinc	TSS	Zinc (using monthly averages)
Mean (X)	1.30	66	1.30
Standard deviation (s)	1.74	7.44	1.56

All values are in mg/l. The permit writer estimates the daily maximum and monthly average limits using Equations 3 and 4 and establishes sampling frequencies of twice per month for zinc and once per month for TSS.

	Zinc	TSS	Zinc (using monthly averages)
Daily Maximum Limit (mg/l)	4.15	78.	3.87
Monthly Average Limit (mg/l)	3.31	78.	3.11

The resulting performance-based limits are not as stringent as the corresponding BPT/BAT limits for direct dischargers. The permit writer also notices that when the sampling frequency is once per month, the monthly average limit is the same as the daily maximum; the more frequent the sampling, the more stringent the limit. Using the monthly average values instead of raw data to calculate performance-based limits results in more stringent limits because the variability as reflected in the standard deviation is smoothed out somewhat.

$$\bar{X} = \frac{\Sigma x_i}{n} \qquad \text{Equation 1}$$

where: $\bar{X}$ = mean of the data points
x_i = the individual data points
n = the number of data points upon which the mean is based.

$$s = \left(\frac{\Sigma (x_i - \bar{x})^2}{n-1} \right)^{\frac{1}{2}} \qquad \text{Equation 2}$$

where: s = standard deviation.

$$\text{Daily Maximum Limit} = \bar{X} + Zs \qquad \text{Equation 3}$$

where Z = 1.645 for the 95th percentile.

$$\text{Monthly Average Limit} = \bar{X} + \frac{Zs}{\sqrt{N}} \qquad \text{Equation 4}$$

where N = the number of samples to be taken per month.

RAW DATA PERFORMANCE-BASED PERMIT LIMITS

	Raw Data		Monthly Average
Month	Zinc (mg/l)	TSS (mg/l)	Zinc (mg/l)
Jan.	0.43	54	
	0.77		2.82
	3.90		
	6.20		
Feb.	5.50	68	
	5.80		5.02
	4.30		
	4.50		
Mar.	4.80	69	3.34
	3.70		
	0.55		
	4.30		
Apr.	0.40	66	
	0.33		0.33
	0.35		
	0.25		
May	0.18	64	
	0.25		0.23
	0.23		
	0.25		
June	0.82	83	
	2.10		1.18
	1.00		
	0.78		
July	0.68	72	
	0.33		0.40
	0.27		
	0.32		
Aug.	0.95	70	
	0.27		0.45
	0.32		
	0.25		
Sept.	0.20	57	
	0.40		0.28
	0.28		
	0.22		
Oct.	0.25	65	
	0.033		0.22
	0.30		
	0.28		
Nov.	0.87	61	
	1.10		0.65
	0.17		
	0.45		
Dec.	0.75	66	
	0.85		0.73
	1.00		
	0.77		
	0.28		
$\bar{X}$	1.30	66	1.30
s	1.74	7.44	1.56

Note: For illustrative purposes, only one year of data was used rather than the recommended two years of data.

EXAMPLE 3 APPLICATION OF LITERATURE TREATABILITY DATA

An industrial user discharging treated process wastewater from the manufacturing of trinitrotoluene (TNT) is to be permitted. EPA issued a Notice of Interim Final Rulemaking on March 9, 1976 (40 CFR Part 457, 41 FR 10180), for best practicable control technology (BPT) for Subcategories A (the manufacture of explosives) and C (the loading, assembling, and packing of explosives) of the industry. Best available technology (BAT) and Pretreatment Standards for Existing Sources (PSES) regulations, however, have been deferred by EPA.

The literature was reviewed to compare the performance of this industrial facility's activated carbon system to other facilities for removal of TNT. This information is summarized below. The carbon system was determined to experience influent levels and loading rates comparable to other facilities. The reported effluent TNT concentrations and percent removal fall within the ranges reported for other facilities. The data show a removal rate of approximately 98 percent for TNT wastewaters. The wastewaters are composed of TNT (trinitrotoluene), 2,4-dinitrotoluene and 2,6-dinitrotoluene. Using the influent data for the facility, the permit writer calculated limits for trinitrotoluene, 2,4-dinitrotoluene and 2,6-dinitrotoluene equivalent to 98 percent removal.

COMPARISON OF ACTIVATED CARBON REMOVAL DATA FOR TNT WASTEWATERS

Reference	Influent TNT mg/l	Effluent TNT mg/l	Percent Removal
1	1,000	1	99.9
2	54	1	98.1
3	118	2.6	97.8
4	423	2.7	98.0

References:

1. Demek, Mary M., et al., Studies on the Regeneration of Active Carbon for Removal of L-TNT from Wastewaters, Edgewood Arsenal Technical Report. EC-TR-74008 (May 1974).

2. Schulte, G. R., Robert C. Hoehn, and Clifford W. Randall, "The Treatability of a Munitions Manufacturing Waste with Activated Carbon," pp. 150-162 in Proceedings of the 28th Purdue Industrial Waste Conference, Lafayette, IN, May 1-3, 1973, edited by Bell, Purdue University Engineering Extension Series No. 14, Lafayette, IN, 1973.

3. Heck, Robert P. III, "Munitions Plant Adsorption in Wastewater Treatment," Industrial Waste, Vol. 24 (2), 35-39 (March/April).

4. EPA, State-of-the-Art: Military Explosives and Propellants Production Industry: Volume III Wastewater Treatment. EPA-600/2-76-213c.

EXAMPLE 4 APPLICATION OF TECHNOLOGY-BASED STANDARDS

All cooling tower blowdown from an organic chemical facility is discharged to the local POTW. To prevent scaling of the condensers during recirculation of the cooling water, the facility uses chemical additives which include chromium, zinc and possibly some priority pollutants. The blowdown stream which contains these toxic pollutants has been determined to require a discharge permit.

Cooling tower blowdown in the Steam Electric Power Generating category is regulated by BAT and PSES limits for chromium, zinc and the 126 priority pollutants (40 CFR 423.13 and 423.16). These limits are judged to be applicable to the organic chemical manufacturing facility's discharge because the practices and technologies of cooling tower maintenance at steam electric power generating facilities and at organic chemicals manufacturing facilities are similar.

APPENDIX A

REFERENCES TO DOCUMENTS WHICH PROVIDE GUIDANCE TO POTWs IN DEVELOPING TECHNICALLY BASED LOCAL LIMITS

APPENDIX A

EPA GUIDANCE MANUALS PROVIDING ASSISTANCE TO POTWs IN DEVELOPING TECHNICALLY BASED LOCAL LIMITS

Local Limits Development Procedures

1) Guidance Manual for POTW Pretreatment Program Development, USEPA Office of Water Enforcement and Permits, October 1983.

2) PRELIM Users Guide: Documentation for the EPA Computer Program/Model for Developing Local Limits for Industrial Pretreatment Programs at Publicly Owned Treatment Works - Version 3.0, USEPA Office of Water Enforcement and Permits, January 1987.

Comparison of Local Limits with Categorical Standards

1) Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula, USEPA Permits and Effluent Guidelines Divisions, September 1985.

2) Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards, USEPA Permits and Effluent Guidelines Divisions, February 1984.

POTW Removal Efficiency and POTW Performance

1) Fate of Priority Pollutants in Publicly Owned Treatment Works - 30 Day Study, (EPA 440/1-82/302), USEPA Effluent Guidelines Division, July 1982.

2) Fate of Priority Pollutants in Publicly Owned Treatment Works, Volumes I and II, (EPA 440/1-82/303), USEPA Effluent Guidelines Division, September 1982.

3) Guidance Manual for Preventing Interference at POTWs, USEPA Office of Water Enforcement and Permits, July 1987.

Monitoring Methods

1) Handbook for Sampling and Sample Preservation of Water and Wastewater, (EPA 600/4-82/089), USEPA, September 1982 (NTIS Order No. PB83-124503).

POTW Acceptance of Hazardous Wastes

1) RCRA Information on Hazardous Wastes for Publicly Owned Treatment Works, USEPA Office of Water Enforcement and Permits, September, 1985.

2) Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works, (EPA 530-SW-86-004), USEPA Office of Water Regulations and Standards, February, 1986.

3) Guidance Manual for the Identification of Hazardous Wastes Delivered to POTWs by Truck, Rail, or Dedicated Pipeline, USEPA Office of Water Enforcement and Permits, July 1987.

Spill and Slug Loading Prevention and Solvent Management Plans

1) EPA Region X Guidance Manual for the Development of an Accidental Spill Prevention Program, USEPA - Region X, Seattle, WA, February 1986.

2) Guidance Manual for Implementing Total Toxic Organics (TTO) Pretreatment Standards, USEPA Office of Water Enforcement and Permits, Permits Division, September 1985.

Toxicity Testing and Toxicity Reduction Evaluations

1) Technical Support Document for Water Quality-based Toxics Control, USEPA Office of water, September, 1985.

2) Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms (Third Edition), (EPA 600/4-85/013), USEPA Environmental Monitoring and Support Laboratory, Cincinnati, OH, March, 1985.

3) Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, (EPA 600/4-85/014), USEPA Environmental Monitoring and Support Laboratory, Cincinnati, OH, December, 1985.

4) Technological Approaches to Toxicity Reduction in Municipal and Industrial Wastewaters, Perry W. Lankford, W. Wesley Eckenfelder, and Kevin D. Torrens. Presented at 1987 Annual Meeting of Virginia Water Pollution Control Association, Norfolk, VA, April 29, 1987.

5) Draft Toxicity Reduction Evaluation Methods, Phase I: Characterization of Effluent Toxicity, USEPA Office of Water Enforcement and Permits, January 1987.

APPENDIX B

AUGUST 5, 1985 EPA GUIDANCE MEMO ON LOCAL LIMITS REQUIREMENTS FOR POTW PRETREATMENT PROGRAMS

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

AUG 5 1985

OFFICE OF
WATER

MEMORANDUM

SUBJECT: Local Limits Requirements for POTW
Pretreatment Programs

FROM: Rebecca W. Hanmer, Director
Office of Water Enforcement and Permits (EN-335)

TO: Regional Water Management Division Directors
NPDES State Directors

I. Background

The Pretreatment Implementation Review Task Force (PIRT), in its Final Report of January 30, 1985, stated that some POTWs which are required to implement pretreatment programs "do not understand the relationship between categorical standards and local limits or even how to develop local limits." This memo reviews the Agency's minimum local limits requirements for POTWs which must develop and implement industrial pretreatment programs. More detailed technical guidance for developing local limits is available in the Guidance Manual for POTW Pretreatment Program Development. Comprehensive technical guidance on local limits is under development and will be published in FY 86.

Section 403.5(c) of the General Pretreatment Regulations provides that POTWs required to establish local pretreatment programs must develop and enforce specific limits to implement the general prohibitions against pass-through and interference [§403.5(a)] and the specific prohibitions listed in §403.5(b). This requirement is discussed in the preamble to the 1981 General Pretreatment Regulations:

> "These limits are developed initially as a prerequisite to POTW pretreatment program approval and are updated thereafter as necessary to reflect changing conditions at the POTW. The limits may be developed on a pollutant or industry basis and may be included in a municipal ordinance which is applied to the affected classes. In

addition, or alternatively, the POTW may develop specific limits for each individual facility and incorporate these limits in the facility's municipally-issued permit or contract. By translating the regulations' general prohibitions into specific limits for Industrial Users, the POTW will ensure that the users are given a clear standard to which they are to conform."

The categorical pretreatment standards, applicable to broad classes of industries, are technology-based minimum requirements which do not necessarily address all industrial discharge problems which might occur at a given POTW. To prevent these site-specific problems, each POTW must assess all of its industrial discharges and employ sound technical procedures to develop defensible local limits which will assure that the POTW, its personnel, and the environment are adequately protected. This memorandum clarifies EPA's minimum requirements for the development of local limits to control the discharges of industrial users and discusses the application of those requirements to POTWs in different stages of local pretreatment program development and implementation.

II. Minimum Requirements for Local Limits

The General Pretreatment Regulations require every POTW developing a pretreatment program to conduct an industrial waste survey to locate and identify all industrial users which might be subject to the POTW pretreatment program. This procedure is a prerequisite to pretreatment program approval. In addition, the POTW must determine the character and volume of pollutants contributed to the POTW by these industrial users. Based on the information obtained from the industrial waste survey and other sources, including influent, effluent and sludge sampling, the POTW must determine which of these pollutants (if any) have a reasonable potential for pass-through, interference or sludge contamination. For each of these pollutants of concern, the POTW must determine, using the best information available, the maximum loading which can be accepted by the treatment facility without the occurrence of pass-through, interference or sludge contamination. A procedure for performing this analysis is provided in the Guidance Manual for POTW Pretreatment Program Development. As a minimum, each POTW must conduct this technical evaluation to determine the maximum allowable treatment plant headworks (influent) loading for the following pollutants:

cadmium
chromium
copper

lead
nickel
zinc

These six toxic metals are listed because of their widespread occurrence in POTW influents and effluents in concentrations that warrant concern. Also, since they are usually associated with the suspended solids in the waste stream, their presence often prohibits the beneficial reuse of municipal sewage sludge and reduces POTW options for safe sludge disposal. In addition, based on site-specific information, the POTW and/or the Approval Authority must identify other pollutants of concern which might reasonably be expected to be discharged to the POTW in quantities which could pass through or interfere with the POTW, contaminate the sludge, or jeopardize POTW worker health or safety. Once maximum allowable headworks loadings are determined for each of the pollutants of concern, the POTW must implement a system of local limits to assure that these loadings will not be exceeded. The POTW may choose to implement its local limits in any of a number of ways, such as uniform maximum allowable concentrations applied to all significant industrial dischargers, or maximum mass discharge limits on certain major dischargers. The method of control is the option of the POTW, so long as the method selected accomplishes the required objectives. There is no single method of setting local limits which is best in all situations. The Guidance Manual for POTW Pretreatment Program Development discusses several alternative methods which a POTW might use to allocate the acceptable pollutant load to industrial users. The manual also provides an example of the calculations a typical POTW would use to determine the maximum allowable headworks loadings for a pollutant and to allocate that load to significant industrial users. POTWs are strongly encouraged to apply a safety factor to the calculated maximum allowable loadings and to reserve some capacity for industrial expansion when setting local limits.

Some POTWs may find that loading levels of at least some of the pollutants of concern are far below the calculated maximum allowable headworks loadings. In these cases, the POTW should continue to monitor all industrial users discharging significant quantities of these pollutants. It may also be appropriate for the POTW to limit each significant industrial user to a maximum loading which cannot be exceeded without POTW approval. This process of limiting increases in discharges of pollutants of concern provides POTWs with a control mechanism without imposing unnecessarily stringent limits on industries which expand or change production processes. Industries approaching their limits could petition the POTW for an increased allowance. Upon receipt of such request, the POTW would update its headworks loading analysis to determine the effect of the proposed increase. The analysis would enable the POTW to make a sound technical decision on the request.

Because they are based on the specific requirements of the POTW, sound local limits can significantly enhance the enforceability of a POTW's local pretreatment program. A POTW that proposes to rely solely upon the application of the specific prohibitions listed in §403.5(b) and categorical pretreatment standards in lieu of numerical local limits should demonstrate in its program submission that (1) it has determined the capability of the treatment facility to accept the industrial pollutants of concern, (2) it has adequate resources and procedures for monitoring and enforcing compliance with these requirements, and (3) full compliance with the applicable categorical standards will meet the objectives of the pretreatment program.

III. Application of the Minimum Local Limits Requirement

A. Unapproved Programs

All POTWs required to develop pretreatment programs must comply with the regulatory local limits requirements described above. However, EPA recognizes that there has been a need for clarification of these requirements and that some Approval Authorities have not applied this requirement in accordance with the principles in this memorandum when approving local pretreatment programs in the past. Some POTWs with local programs now under development or review were given direction by their Approval Authority that may have failed to reflect all of the requirements for local limits that are discussed herein. Withholding approval for these POTWs until they have adopted all necessary local limits would delay availability of the considerable local POTW resources needed to enforce categorical pretreatment standards and other pretreatment requirements. Therefore, where POTWs have not previously been advised of the need to complete the analysis described herein and to adopt local limits prior to program approval, and where imposing such a requirement would make approval by September 30, 1985 infeasible, POTW pretreatment program submissions meeting all other regulatory requirements may be approved. However, in any such case, the POTW permit must be modified to require that the POTW expeditiously determine the maximum allowable headworks loading for all pollutants of concern as described above and adopt those local limits required to prevent pass-through, interference, and sludge contamination. To ensure that this condition is enforceable, the Approval Authority must assure that this requirement is promptly incorporated into the POTW's NPDES permit and require that the appropriate local limits be adopted as soon as possible, but in no case later than one year after approval. Noncompliance with this permit requirement on the part of the POTW will be considered grounds for bringing an enforcement action for failure to implement a required pretreatment program.

B. Approved Programs

If any POTW program has already been approved without the analysis of the impact of the pollutants of concern and adoption of local limits, the Approval Authority should immediately require the POTW to initiate an analysis as described above and adopt appropriate local limits. This requirement should be incorporated in the POTW's NPDES permit as soon as feasible. Where a POTW has previously adopted local limits but has not demonstrated that those limits are based on sound technical analysis, the Approval

Authority should require the POTW to demonstrate that the local limits are sufficiently stringent to protect against pass-through, interference and sludge contamination. POTWs which cannot demonstrate that their limits provide adequate protection should be required to revise those limits within a specific time set forth in a permit modification.

IV. Local Limits to Control Additional Toxic Pollutants

To date, where POTWs have evaluated their industrial discharges and adopted local limits as needed based on that evaluation, the pollutants most often controlled are toxic metals, cyanide and phenol. Few POTWs now control the discharge of toxic organic compounds through local limits. Recent studies, including the Agency's Complex Effluent Toxicity Testing Program, indicate that these substances are often responsible for toxicity problems in receiving streams. Furthermore, many of the volatile organic compounds in POTW influents may be released to the atmosphere during conveyance or treatment, potentially causing health or safety hazards or aggravating air quality problems. Compounds causing these problems are not necessarily among those in the statutory list of 126 priority toxic pollutants and may not be addressed by existing or proposed categorical standards. If monitoring efforts are not sufficiently comprehensive, these adverse impacts may go undiscovered, or their root causes may not be identified.

After a POTW's pretreatment program has been approved, Approval Authorities should continue to evaluate each POTW to determine the need for additional measures to control toxic discharges from industrial users. This is in keeping with the Agency's policy on water quality-based permit limits for toxic pollutants (49 FR 9016, March 9, 1984). Utilizing the authority provided by Section 308 of the Clean Water Act (or comparable State authority), the Approval Authority should consider requiring both chemical-specific and biological testing of POTW influent, effluent and sludge to evaluate the need for additional local limits. Where test results indicate a need for greater industrial user control, POTWs should be required to determine the sources of the toxic discharges through additional testing and to adopt appropriate local limits which will prevent interference and pass-through.

Not every POTW required to have a local pretreatment program will need to perform this additional testing, but since toxic chemicals are utilized by many non-categorical industries, this requirement should not be limited to those POTWs with large contributions from categorical industries. For example, there is at least one documented instance of an FDA-approved food additive, discharged by a food processor to a POTW, causing receiving stream toxicity problems. OWEP has been working closely with EPA researchers and will provide whatever assistance we can to Approval Authorities faced with complex toxicity problems associated with POTW discharges.

V. Local Limits Requirements for POTWs covered by §403.10(e): State-run Pretreatment Programs

In accordance with §403.10(e) of the General Pretreatment Regulations, some States have assumed responsibility for implementing State-wide pretreatment programs in lieu of requiring POTWs to develop individual local programs. In these States, the NPDES permits of POTWs which otherwise would have been required to develop local pretreatment programs may need to be modified to require the local limits development procedures described above. Alternatively, the State can perform the required analyses and implement the appropriate local limits necessary to assure that the goals of the program are achieved. These limits would then be enforced in the same manner as other pretreatment requirements, in accordance with procedures included in the approved State-run program. Where States assume POTW responsibility for carrying out pretreatment program requirements, Regional Offices must monitor all aspects of the State-run pretreatment program, including local limits, to assure that the national program requirements are met.

VI. Control of Conventional Pollutants

Although the National Pretreatment Program is usually associated with the control of toxic industrial wastes, the discharge of excessive conventional pollutants has been the most commonly documented industry-related cause of POTW effluent limit violations. Generally, POTWs are required to construct, operate and maintain their own treatment facilities at efficiencies adequate to prevent pass-through and interference from conventional pollutants. However, where a POTW chooses instead to limit its influent or where limits on the influent concentrations are necessary to assure that unexpectedly high influent concentrations do not occur, the POTW pretreatment program submission should demonstrate that local limits adequately address conventional pollutant loadings from industry. Most POTWs have already determined the capacity of their treatment facilities to accommodate conventional pollutants. Where local limits for these pollutants are needed, the limit-setting process is rather straightforward. At a minimum, Approval Authorities should encourage all POTWs to consider setting appropriate local limits on conventional pollutants in order to prevent pass-through and interference where problems have occurred in the past or can be anticipated in the future due to local growth or increases in industry discharges.

VII. Deadline for Industrial User Compliance with Local Limits

POTWs adopting local limits should require industrial users to comply with those limits as soon as is reasonable, but in no case more than three years from the date of adoption. Where an industrial user is allowed more than one year to comply, the POTW should evaluate the industrial user's operation and set interim limits to minimize discharge of the pollutants of concern prior to full compliance with the local limit. The POTW should also establish enforceable increments of progress for industrial users with compliance schedules longer than one year and require the users to submit incremental progress reports at least annually to assure proper tracking of actions needed to accomplish compliance.

Where an industrial discharge has been identified as a contributing factor in a POTW's violation of an NPDES permit limit, water quality standard, or other environmental requirement, the POTW must take immediate enforcement action, employing all means necessary to assure that the Industrial User is brought into compliance in the shortest possible time.

VIII. Conclusion

This memorandum has summarized the Agency's minimum requirements for the establishment of local limits by POTWs implementing pretreatment programs. Because local limits address site-specific needs, Approval Authorities should apply these requirements with sensitivity to local conditions, recognizing that the diversity among POTWs requires a case-by-case consideration of local limits. In many cases, there will be a clear need to aggressively attack toxicity or interference problems with extensive analysis and local regulation. In others, only a few local limits will be needed, if only to insure that present loadings do not increase. This flexibility, however, does not mean that local limits are optional under the National Pretreatment Program. All POTWs implementing pretreatment programs must evaluate the need for local limits. Where the evaluation so indicates, the POTW must promptly adopt and enforce local limits which will protect against interference, pass-through and sludge contamination.

As EPA and State permit writers establish more comprehensive water quality-based municipal permit limits (including toxics), POTWs will have more definitive information available as a basis for establishing the need for and the stringency of local limits to prevent pass-through. Similarly, the forthcoming sludge disposal and reuse regulations should enable States to establish more comprehensive sludge quality requirements, which will in turn provide a solid technical basis for local limits to prevent sludge contamination. The Office of Water Enforcement and Permits is also working with the Agency's Office of Research and Development to obtain better information on the impact of toxic substances on municipal treatment processes. These efforts are proceeding as fast as available resources permit and should produce results, in the form of guidance documents, in FY 86.

Although these activities will help POTWs refine local limits in the future, adequate information is available today to proceed with the specific local limits requirements set forth in this memorandum. The Agency has recently developed a computer program, PRELIM, which is intended to greatly reduce the time required to calculate the maximum allowable headworks loading. The program also calculates industrial user limits using a number of optional allocation methods, using data provided by the POTW. The program is designed for use by POTW personnel but can also be used by Approval Authorities to verify the adequacy of POTW local limits. OWEP is now scheduling PRELIM training workshops for Approval Authority personnel, who can, in turn, train POTW personnel in its use. Additional information on PRELIM will be distributed in the near future.

If you have any questions or comments concerning local limits requirements, please contact Jim Gallup (FTS) 755-0750 or Pete Eagen (FTS) 426-4793.

APPENDIX C

MATRIX OF POLLUTANT OCCURRENCE IN INDUSTRIAL WASTESTREAMS

	ADHESIVES	ALUMINUM FORMING	AUTO & OTHER LAUNDRIES	BATTERY MANUFACTURING	COAL MINING	COIL COATING	COPPER FORMING	DYE MANUFACTURING	ELECTRICAL AND ELECTRONIC COMPONENTS	ELECTROPLATING/METAL FINISHING	EXPLOSIVES MANUFACTURING	FOUNDRIES	GUM AND WOOD CHEMICALS	HOSPITALS	INORGANIC CHEMICALS	IRON AND STEEL	LABORATORIES	LEATHER TANNING & FINISHING	MECHANICAL PRODUCTS	NON-FERROUS METALS	ORE MINING & DRESSING	ORGANIC CHEMICALS	PAINT & INK	PESTICIDES	PETROLEUM REFINING	PHARMACEUTICALS	PHOTOGRAPHIC SUPPLIES	PLASTICS & SYNTHETICS	PLASTICS PROCESSING	PORCELAIN ENAMELING	PRINTING & PUBLISHING	PULP, PAPER, & FIBERBOARD	RUBBER MANUFACTURING	SOAPS & DETERGENTS	STEAM ELECTRIC	STONE, CLAY, GLASS, & CONCRETE PRODUCTS	TEXTILE MILLS	TIMBER PRODUCTS
Acenaphthene																				●		●			●													●
Acenaphthylene																●																			●			●
Acrylonitrile																						●		●				●									●	
Aldrin																								●														
Anthracene			●		●				●		●					●			●	●	●	●			●							●						●
Antimony	●			●	●			●			●			●	●	●	●	●		●							●						●			●	●	
Arsenic					●				●					●	●		●	●		●			●	●	●	●		●									●	●
Barium							●				●									●			●					●				●	●			●		
Benz(a)anthracene																●			●						●													●
Benzene					●			●	●				●	●			●		●	●		●	●		●	●	●	●			●		●	●				●
Benzo(b)fluroanthene																									●													
Benzo(k)fluoranthene																●																						●
Benzo(a)pyrene																				●					●													
Benzo(g,h,i)perylene																																						
Beryllium									●		●									●																●		
Bis(2-chloroethoxy)methane																			●														●					
Bis(2-ethylhexyl)phthalate	●	●			●							●						●	●	●		●		●				●				●	●		●		●	
Bromoform																																						
Bromomethane (methyl bromide)																						●		●														
Butyl Benzyl phthalate	●											●							●	●		●						●				●						
Cadmium		●		●			●	●	●	●		●			●				●	●		●				●	●	●	●	●							●	
Carbon disulfide									●													●		●		●		●										
Carbon tetrachloride	●																		●			●	●															
Chlordane																								●														
p-Chloro-m-cresol																																						●
Chlorobenzene					●				●													●		●														
Chlorodibromomethane																												●										
Chloroethane (ethyl chloride)									●					●			●					●		●	●													

	ADHESIVES	ALUMINUM FORMING	AUTO & OTHER LAUNDRIES	BATTERY MANUFACTURING	COAL MINING	COIL COATING	COPPER FORMING	DYE MANUFACTURING	ELECTRICAL AND ELECTRONIC COMPONENTS	ELECTROPLATING/METAL FINISHING	EXPLOSIVES MANUFACTURING	FOUNDRIES	GUM AND WOOD CHEMICALS	HOSPITALS	INORGANIC CHEMICALS	IRON AND STEEL	LABORATORIES	LEATHER TANNING & FINISHING	MECHANICAL PRODUCTS	NON-FERROUS METALS	ORE MINING & DRESSING	ORGANIC CHEMICALS	PAINT & INK	PESTICIDES	PETROLEUM REFINING	PHARMACEUTICALS	PHOTOGRAPHIC SUPPLIES	PLASTICS & SYNTHETICS	PLASTICS PROCESSING	PORCELAIN ENAMELING	PRINTING & PUBLISHING	PULP, PAPER, & FIBERBOARD	RUBBER MANUFACTURING	SOAPS & DETERGENTS	STEAM ELECTRIC	STONE, CLAY, GLASS, & CONCRETE PRODUCTS	TEXTILE MILLS	TIMBER PRODUCTS
Chloroform	●	●			●				●								●	●				●		●		●		●	●			●	●					
Chloromethane (methyl chloride)									●					●			●					●		●				●					●		●			
2-Chlorophenol								●	●					●	●							●				●												
Chromium	●	●			●	●	●	●	●	●		●	●		●	●		●	●	●		●	●		●	●	●	●		●				●			●	●
Cobalt																																						
Copper	●	●	●		●		●		●	●		●	●		●			●	●	●	●	●	●					●	●	●				●	●		●	●
Cyanide	●					●				●					●	●		●		●	●			●	●	●	●										●	
DDE (Dichlorodiphenyl dichloroethylene)																								●														
DDT (Dichlorodiphenyl trichloroethane)																								●														
Di-n-Butyl Phthalate	●	●	●		●				●	●										●		●	●								●	●			●			
Di-n-Octyl Phthalate																				●		●							●									
Dibromomethane (Methylene bromide)																						●																
1,2-Dichlorobenzene								●	●	●				●	●			●				●		●													●	
1,3-Dichlorobenzene									●									●																				
1,4-Dichlorobenzene									●						●			●				●																
Dichlorobromomethane																				●		●																
Dichlorodifluoromethane									●																			●										
1,1-Dichloroethane																			●	●		●																
trans-1,2-Dichloroethylene					●														●																			
2,4-Dichlorophenol														●								●		●								●	●					
2,4-Dichlorophenoxyacetic acid (2,4-D)																								●									●					
1,2-Dichloropropane																																						
1,3-Dichloropropene																						●		●														
Dieldrin																								●														
Diethyl phthalate	●				●										●				●	●								●				●						
Dimethyl phthalate	●																						●					●										
2,4-Dimethylphenol (2,4-xylenol)																●						●			●								●					
2,4-Dinitrotoluene								●			●				●							●																

	ADHESIVES	ALUMINUM FORMING	AUTO & OTHER LAUNDRIES	BATTERY MANUFACTURING	COAL MINING	COIL COATING	COPPER FORMING	DYE MANUFACTURING	ELECTRICAL AND ELECTRONIC COMPONENTS	ELECTROPLATING/METAL FINISHING	EXPLOSIVES MANUFACTURING	FOUNDRIES	GUM AND WOOD CHEMICALS	HOSPITALS	INORGANIC CHEMICALS	IRON AND STEEL	LABORATORIES	LEATHER TANNING & FINISHING	MECHANICAL PRODUCTS	NON-FERROUS METALS	ORE MINING & DRESSING	ORGANIC CHEMICALS	PAINT & INK	PESTICIDES	PETROLEUM REFINING	PHARMACEUTICALS	PHOTOGRAPHIC SUPPLIES	PLASTICS & SYNTHETICS	PLASTICS PROCESSING	PORCELAIN ENAMELING	PRINTING & PUBLISHING	PULP, PAPER, & FIBERBOARD	RUBBER MANUFACTURING	SOAPS & DETERGENTS	STEAM ELECTRIC	STONE, CLAY, GLASS, & CONCRETE PRODUCTS	TEXTILE MILLS	TIMBER PRODUCTS
1,2-Diphenylhydrazine																																						
Endosulfan																								●														
Endrin																								●														
Ethyl Benzene	●		●		●				●				●		●			●	●			●	●		●			●				●	●				●	●
Ethylene dibromide (EDB)																						●		●	●													
Ethylene dichloride																																						
Fluoranthene																●			●	●		●			●													●
Fluorene																●				●		●			●													●
Heptachlor																								●														
Heptachlor Epoxide																								●														
Hexachloro-1,3-butadiene									●															●	●													
Hexachlorobenzene																				●		●		●														
Hexachlorocyclohexane (Lindane)																								●														
Hexachloroethane											●			●								●		●				●					●					
Indeno (1,2,3-cd)pyrene																									●													
Isobutyl alcohol																	●					●	●					●										
Isophorone																							●	●				●										
Lead	●	●	●	●	●		●		●	●	●			●	●	●		●	●	●	●	●	●		●	●	●	●	●	●			●	●			●	
Malathion																								●														
Mercury	●			●	●				●	●				●	●		●			●		●	●			●	●								●		●	
Methoxychlor																								●														
Methyl Ethyl Ketone																						●						●			●					●		
Methylene chloride	●	●			●				●									●		●		●	●			●	●	●										
4,4-Methylenebis(2-chloroaniline)																												●										
Naphthalene			●		●				●		●	●			●	●		●	●	●	●	●	●		●							●	●					●
Nickel		●		●	●				●	●			●		●	●		●	●	●			●			●	●	●		●				●	●		●	
Nitrobenzene															●							●			●									●				
2-Nitrophenol									●													●					●											

	ADHESIVES	ALUMINUM FORMING	AUTO & OTHER LAUNDRIES	BATTERY MANUFACTURING	COAL MINING	COIL COATING	COPPER FORMING	DYE MANUFACTURING	ELECTRICAL AND ELECTRONIC COMPONENTS	ELECTROPLATING/METAL FINISHING	EXPLOSIVES MANUFACTURING	FOUNDRIES	GUM AND WOOD CHEMICALS	HOSPITALS	INORGANIC CHEMICALS	IRON AND STEEL	LABORATORIES	LEATHER TANNING & FINISHING	MECHANICAL PRODUCTS	NON-FERROUS METALS	ORE MINING & DRESSING	ORGANIC CHEMICALS	PAINT & INK	PESTICIDES	PETROLEUM REFINING	PHARMACEUTICALS	PHOTOGRAPHIC SUPPLIES	PLASTICS & SYNTHETICS	PLASTICS PROCESSING	PORCELAIN ENAMELING	PRINTING & PUBLISHING	PULP, PAPER, & FIBERBOARD	RUBBER MANUFACTURING	SOAPS & DETERGENTS	STEAM ELECTRIC	STONE, CLAY, GLASS, & CONCRETE PRODUCTS	TEXTILE MILLS	TIMBER PRODUCTS
PCB (Polychlorinated biphenyls)																				●									●				●					
Pentachloroethane					●																																	
Pentachlorophenol	●																	●	●			●	●	●													●	●
Phenanthrene					●			●	●		●			●		●				●		●	●		●	●						●						●
Phenol	●	●	●						●			●	●			●		●	●	●	●	●	●	●	●	●	●	●				●					●	●
Pyrene														●		●			●	●		●										●						
Pyridine								●						●	●							●		●		●							●					●
Selenium							●		●						●	●				●							●						●			●	●	
Silver				●					●	●				●	●		●		●	●							●										●	
1,1,1,2-Tetrachloroethane									●						●							●																
1,1,2,2-Tetrachloroethane																						●	●				●	●										
Tetrachloroethylene (Perchlorethylene)			●		●		●											●	●	●		●	●	●	●			●			●	●	●	●			●	●
Tetrachlorophenol									●										●			●	●	●														
Thallium					●				●						●					●				●												●		
Toluene			●		●			●	●		●		●		●			●	●			●	●		●	●	●	●	●				●				●	
Toxaphene																								●														
1,2,4-Trichlorobenzene								●	●											●		●		●							●						●	
1,1,1-Trichloroethane					●				●										●					●								●					●	
1,1,2-Trichloroethane																			●			●						●										
Trichloroethylene	●	●	●											●								●	●	●		●											●	
Trichlorofluoromethane					●			●						●								●																
2,4,5-Trichlorophenol									●						●			●				●		●								●						
2,4,6-Trichlorophenol																		●			●	●		●														
Trichlorophenoxy-2-propionic acid																								●														
Vinyl chloride (chloroethylene)																						●						●										
Vinylidene chloride																			●																			
Zinc	●	●	●	●	●	●	●		●	●		●	●		●	●		●	●	●	●		●	●	●	●	●	●		●			●	●	●		●	

APPENDIX D

CURRENTLY AVAILABLE EPA DEVELOPMENT DOCUMENTS

INDUSTRIAL TECHNOLOGY DIVISION
PUBLICATIONS ORDERING INFORMATION

Copies of all Development Documents published by the Industrial Technology Division (formerly the Effluent Guidelines Division) are made available for review at the following EPA Offices:

ENVIRONMENTAL PROTECTION AGENCY
Public Information Reference Unit
Waterside Mall, Room 2922
401 M Street, S.W.
Washington, D.C. 20460

or

Any Environmental Protection Agency
Regional Office Library

Publications available directly from Industrial Technology Division (Part I) can be ordered by submitting your written request to:

ENVIRONMENTAL PROTECTION AGENCY
Effluent Guidelines Division
ATTN: Distribution Officer WH-552
401 M Street, S.W.
Washington, D.C. 20460
Phone Number: 202/382-7112

Other publications (Part II) can be obtained by purchasing from the following sources:

GOVERNMENT PRINTING OFFICE (GPO)
ATTN: Superintendent of Document
North Capitol Street, N.W.
Washington, D.C. 20402
Order Desk Phone Number: 202/783-3238

NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)
5285 Port Royal Road
Springfield, VA 22061
Order Desk Phone Number: 703/487-4650
(NTIS Accession Number is required when ordering)

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION (DEVELOPMENT DOCUMENTS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER
407	Fruits & Vegetables	a) Fruits & Vegetables Specialties	EPA 440/1-75/046
410	Textile Mills	*a) Textile Mills	EPA 440/1-74/022-a
412	Feedlots	*a) Feedlots (Draft)	EPA 440/1-74/004-a
414	Organic Chemicals	a) Segment of Organic Chemicals	EPA 440/1-75/045
415	Inorganic Chemicals Manufacturing	a) Inorganic (Phase I) Proposed	EPA 440/1-79/007-b
		b) Inorganic Chemicals - Phase II (Final)	EPA 440/1-84/007
416	Plastic & Synthetics	*a) Synthetic Resins	EPA 440/1-74/036-a
		*b) Synthetic Polymers	EPA 440/1-74/036
419	Petroleum Refining	a) Petroleum (Draft)	EPA 440/1-76/083-a
420	Iron & Steel	a) Iron and Steel Vols I, III, IV & V (Final)	EPA 440/1-82/024

*Also available from Government Printing Office (GPO) and/or National Technical Information Service (NTIS). See Attachment B.

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION
(DEVELOPMENT DOCUMENT)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER
421	Nonferrous Metals Manufacturing	a) Secondary Aluminum	EPA 440/1-76/081-c
422	Phosphate	a) Non-Fertilizer	EPA 440/1-75/043
		b) Non-Fertilizer (Proposed)	EPA 440/1-75/043-a
423	Steam Electric Powerplants	*a) Steam Electric (Proposed)	EPA 440/1-80/029-b
		b) Steam Electric (Final)	EPA 440/1-82/029
425	Leather Tanning	a) Leather Tanning (Final)	EPA 440/1-82/016
426	Glass Manufacturing	*a) Insulation Fiberglass	EPA 440/1-74/001-b
		b) Pressed Blown Glass	EPA 440/1-74/034
429	Timber Products	a) Plywood & Wood (Draft)	EPA 440/1-74/023-a
		*b) Timber Products (Final)	EPA 440/1-81/023

*Also available from Government Printing Office (GPO) and/or National Technical Information Service (NTIS)
See Attachment B.

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION (DEVELOPMENT DOCUMENTS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER
430	Pulp, Paper and Paperboard	a) Builders Paper & Roofing Felt Segment of the Builders and Paper & Board Mills	EPA 440/1-74/026-a
		b) Pulp & Paper Segment	EPA 440/1-76/047-a
		*c) Pulp & Paper & Paper-Board and Builders' Paper & Board Mills (Proposed)	EPA 440/1-80/025-b
		d) Pulp & Paper (Final)	EPA 440/1-82/025
433	Metal Finishing	*a) Metal Finishing (Final)	EPA 440/1-83/091
435	Oil & Gas	a) Oil & Gas Extraction	EPA 440/1-76/055-a
		b) Oil & Gas Extraction Offshore (Proposed)	EPA 440/1-85/055-b

*Also available from Government Printing Office (GPO) and/or National Technical Information Service (NTIS) See Attachment B.

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION
(DEVELOPMENT DOCUMENTS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER
439	Pharmaceutical	a) Pharmaceutical (Draft)	EPA 440/1-75/060
		b) Pharmaceutical (Proposed)	EPA 440/1-82/084
		c) Pharmaceutical (Phase II) (Proposed)	EPA 440/1-83/084-b
		d) Pharmaceutical (Phase II) (Final)	EPA 440/1-83/084
440	Ore Mining and Dressing	*a) Volume I	EPA 440/1-78/061-d
		*b) Volume II	EPA 440/1-78/061-e
		*c) Ore Mining & Dressing (Proposed)	EPA 440/1-82/061-b
		d) Ore Mining & Dressing (Final)	EPA 440/1-82/061
454	Gum and Wood	a) Gum and Wood (Proposed)	EPA 440/1-79/078-b
455	Pesticide	a) Pesticide Chemical (Final)	EPA 440/1-85/079

*Also available from Government Printing Office (GPO) and/or National Technical Information Service (NTIS). See Attachment B.

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION
(DEVELOPMENT DOCUMENTS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER
461	Battery Manufacturing	a) Battery Manuf. (Proposed)	EPA 440/1-82/067-b1 & b2
		*b) Battery Manuf. (Final) Volume I (only)	EPA 440/1-84/067-b1
464	Foundries	a) Metal Molding (Proposed)	EPA 440/1-82/070-b1 & b2
		b) Metal Molding (Final)	EPA 440/1-85/070
465	Coil Coating	a) Coil Coating (Proposed) Phase I	EPA 440/1-81/071-b
		b) Coil Coating (Final) Phase I	EPA 440/1-82/071
		c) Coil Coating (Prop.) Ph.II (Canmaking)	EPA 440/1-83/071-b
466	Porcelain Enameling	*a) Porcelain Enameling (Proposed)	EPA 440/1-81/072-b
		*b) Porcelain Enameling (Final)	EPA 440/1-82/072

*Also available from Government Printing Office (GPO) and/or National Technical Information Service (NTIS). See Attachment B.

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION
(DEVELOPMENT DOCUMENTS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER
467	Aluminum Forming	a) Aluminum (Draft)	EPA 440/1-80/073-a
468	Copper Forming	a) Copper Forming (Proposed)	EPA 440/1-82/074-b
469	Electronics	a) Electrical & Electronic Components (Phase I) Draft	EPA 440/1-80/075-a
		b) Electrical & Electronic Components (Phase I) (Final)	EPA 440/1-83/075
		c) Electrical & Electronic Components (Phase II) (Proposed)	EPA 440/1-83/075-b

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION (SUMMARIES, TECHNICAL SUPPORT AND POTW STUDIES)

Fate of Priority Pollutants in Publicly Owned Treatment Works - Volume I and II	EPA 440/1-82/303
Summary of Available Information on the Levels and Control of Toxic Pollutants Discharges in the Printing and Publishing Point Source Category	EPA 440/1-83/400
Paragraph 4(c) Summary Report (1984)	-
Selected Summary of Information in Support of the Organic Chemicals Plastic and Synthetic Fibers (1985)	-
Assessment of Environmental Fate & Effects of Discharges from Offshore Oil and Gas Operation	EPA 440/4-85/002
Report to Congress in the Discharges of Hazardous Wastes to Publicly Owned Treatment Works	EPA 530-SW-86-004
Multimedia Technical Support Document for Ethanol for Fuel Industry	EPA 440/1-86/093

PUBLICATIONS AVAILABLE FROM THE INDUSTRIAL TECHNOLOGY DIVISION
(GUIDANCE MANUALS/PRETREATMENT STANDARDS)

Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards	February 1984
Guidance Manual for Pulp, Paper, amd Paperboard and Builders' Paper and Board Mills Pretreatment Standards	July 1984
Guidance Manual for Iron and Steel Manufacturing Pretreatment Standards	September 1985
Guidance Manual for Implementing Total Toxic Organic (TTO) Pretreatment Standards	September 1985
Guidance Manual for the Use of Production-Base Pretreatment Standards and the Combined Wastestream Formula	Septemebr 1985

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
405	Dairy Products Processing	a) Dairy Products Processing (Draft)	EPA 440/1-74/021-a	5501-00898	PB238835/AS
406	Grain Mills	a) Grain Processing (Draft)	EPA 440/1-74/028-a	5501-00844	PB238316/AS
		b) Animal Feed, Breakfast Cereal & Wheat (Draft)	EPA 440/1-74/039-a	5501-01007	PB240861/AS
407	Canned & Preserved Fruits & Vegetables Processing	a) Citrus, Apple & Potatoes (Draft)	EPA 440/1-74/027-a	5501-00790	PB238649/AS
408	Canned & Preserved Seafood Processing	a) Catfish, Crab, Shrimp (Draft)	EPA 440/1-74/020-a	5501-00920	PB238614/AS
		b) Report to Congress, Section 74 Seafood Processing Executive Summary - (Volumes I-III)	EPA 440/1-80/020	---	PB81-182354
409	Sugar Processing	a) Beet (Final)	EPA 440/1-74/002-b	5501-00117	PB238462/AS
		b) Cane	EPA 440/1-74/002-c	5501-00826	PB238147/AS

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY		ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
410	Textile Mills	*a)	Textile Mills	EPA 440/1-74/022-a	5501-00903	PB238832/AS
		b)	Textile Mills (Final)	EPA 440/1-82/022	---	PB83-116871
411	Cement Manufacturing	a)	Cement Manufacturing (Draft)	EPA 440/1-74/005-a	5501-00866	PB238610/AS
412	Feedlots	a)	Feedlots (Draft)	EPA 440/1-74/001-a	5501-00842	PB238651/AS
413	Electroplating	a)	Copper, Nickel, Chrome and Zinc (Draft)	EPA 440/1-74/003-a	5501-00816	PB238834/AS
		*b)	Electroplating Pretreatment (Final)	EPA 440/1-79/003	---	PB80-196488
414	Organic Chemicals Manufacturing	a)	Major Organic Products (Draft)	EPA 440/1-74/009-a	5001-008812	PB241905/AS
		b)	Organic Chemicals & Plastics & Synthetic Fibers (Proposed)	EPA 440/1-83/009-b	---	PB83-205625

* Also available from Industrial Technology Division

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
415	Inorganic Chemicals Manufacturing	a) Major Inorganic Chemical Products (Draft)	EPA 440/1-74/007-a	5502-00121	PB238611/AS
		*b) Inorganic Chemicals (Proposed)	EPA 440/1-80/007-b	---	PB81-122632
		*c) Inorganic Chemicals (Final) Phase I	EPA 440/1-82/007	---	PB82-265612
		d) Inorganic Chemicals (Final) Phase II	EPA 440/1-84/007	---	PB85-156446/AS
416	Plastic & Synthetic	a) Synthetic Resins (Draft)	EPA 440/1-74/010-a	5501-00815	PB82-3924/AS
		*b) Synthetic Polymers	EPA 440/1-74/036	5501-01012	PB240862/AS
		c) Organic Chemicals/ Plastic & Synthetic Fibers (Proposed)	EPA 440/1-83/009-b	---	PB83-205625
417	Soaps & Detergents Manufacturing	a) Soaps & Detergents (Draft)	EPA 440/1-74/018-a	5501-00867	PB238613/AS
418	Fertilizer Manufacturing	a) Basic Fertilizer Chemicals (Draft)	EPA 440/1-74/011-a	5501-00868	PB238652/AS
		b) Formulated Fertilizer (Draft)	EPA 440/1-75/042-a	5501-01006	PB240863/AS

* Also available from Industrial Technology Division.

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
419	Petroleum Refining	a) Petroleum Refining (Draft)	EPA 440/1-74/014-a	5501-00912	PB238612/AS
		b) Petroleum Refining (Proposed)	EPA 440/1-79/014-b	---	PB81-118413
		c) Petroleum Refining (Final)	EPA 440/1-82/014	---	PB83-172569
420	Iron & Steel	a) Steel Making (Draft)	EPA 440/1-74/024-a	5501-00906	PB238837/AS
		*b) Iron & Steel Volumes I thru VI (Proposed)	EPA 440/1-80/024-a	---	PB81-184384
		*c) Iron & Steel (Final)	EPA 440/1-82/024	---	
		Volume I			PB82-240425
		Volume II			PB82-240433
		Volume III			PB82-240441
		Volume IV			PB82-240458
		Volume V			PB82-240466
		Volume VI			PB82-240474

* Also available from Industrial Technology Division.

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
421	Nonferrous Metals Manufacturing	a) Bauxite Refining	EPA 440/1-74/091-c	5501-00116	PB128463/AS
		b) Primary Aluminum Smelting	EPA 440/1-74/019-d	5501-00817	PB234859/AS
		c) Secondary Aluminum Smelting	EPA 440/1-74/019-e	5501-00819	PB238464/AS
422	Phosphate Manufacturing	a) Phosphorus Derived Chemicals (Draft)	EPA 440/1-74/006-a	5503-00078	PB241018/AS
423	Steam Electric Powerplants	a) Steam Electric Power (Draft)	EPA 440/1-74/029-a	5501-01001	PB230853/AS
		*b) Steam Electric (Proposed)	EPA 440/1-80/029-b	---	PB81-119075
424	Ferroalloy	a) Smelting & Slag Processing (Draft)	EPA 440/1-74/008-a	5501-00780	PB238650/AS
425	Leather Tanning	a) Leather Tanning (Draft)	EPA 440/1-74/016-a	5501-00818	PB238648/AS
		*b) Leather Tanning (Final)	EPA 440/1-82/016	---	PB83-172593

* Also available from Industrial Technology Division

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
426	Glass Manufacturing	a) Pressed & Blown Glass	EPA 440/1-75/034-a	5501-01036	---
		*b) Insulation Fiberglass	EPA 440/1-74/001-b	5501-00781	PB128078/AS
		*c) Flat Glass	EPA 440/1-74/001-c	5501-00814	---
427	Asbestos Manufacturing	a) Building, Construction and Paper (Draft)	EPA 440/1-74/017-a	5501-00827	PB238320/AS
428	Rubber Processing	a) Tire & Synthetic	EPA 440/1-74/013-a	5501-00885	PB238609/AS
		b) Fabricated & Reclaimed Rubber	EPA 440/1-74/030-a	5501-01016	PB241916/AS
429	Timber Products Processing	*a) Plywood & Wood (Draft)	EPA 440/1-74/023-a	5501-00853	PB240811/AS
		*b) Timber Products (Final)	EPA 440/1-81/023	---	PB81-22728

* Also available from Industrial Technology Division

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
430	Pulp, Paper and Paperboard	a) Unbleached Kraft and Semi-chemical Pulp (Draft)	EPA 440/1-74/025-a	---	PB238833/AS
		*b) Pulp & Paper & Paper-Board and Builders' Paper & Board Mills (Proposed)	EPA 440/1-80/025-b		PB81-201535
		*c) Pulp, Paper & Paper-board and Builders' Paper & Board Mills (Final)	EPA 440/1-82/025	---	PB83-163949
431	Builders Paper & Board Mills	*a) Builders Paper & Roofing (Draft)	EPA 440/1-74/026-a	5501-00909	PB238076/AS
		*b) Pulp, Paper & Paper-Board and Builders' Paper & Board Mills (Final)	EPA 440/1-82/025	---	PB83-163949
	Meat Products and Rendering	a) Red Meat Processing	EPA 440/1-74/012-a	5501-00843	PB238076/AS
		b) Renderer	EPA 440/1-74/031	---	PB238836/AS
433	Metal Finishing	*a) Metal Finishing (Proposed)	EPA 440/1-82/091-b	---	PB83-102004
		*b) Metal Finishing (Final)	EPA 440/1-83/091		PB84-115989

*Also available from Industrial Technology Division

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
434	Coal Mining	a) Coal Mining (Proposed)	EPA 440/1-81/057-b	---	PB81-119296
		b) Coal Mining (Final)	EPA 440/1-82/057	---	PB83/180422
435	Oil & Gas	a) Oil & Gas Extraction Offshore (Proposed)	EPA 440/1-055-b	---	PB86/114949/AS
436	Mineral Mining & Processing	a) Report to Congress The Effects of Discharges from Limestone Quarries on Water Quality and Aquatic Biota	EPA 440/1-82/059	---	PB82-242207
439	Pharmaceuticals	a) Pharmaceutical (Final)	EPA 440/1-83/084	---	PB84-180066
440	Ore Mining and Dressing	*a) Volume I	EPA 440/1-78/061-d	---	PB286520/AS
		*b) Volume II	EPA 440/1-78/061-e	---	PB286521/AS
		*c) Ore Mining & Dressing (Proposed)	EPA 440/1-82/061-b	---	PB82-250952

*Also available from Industrial Technology Division

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO) AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES		SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
455	Pesticides	a)	Pesticides	EPA 440/1-76/060-e	---	PB285480/AS
		b)	Pesticides (Proposed)	EPA 440/1-82/079-b		PB83-153171
		c)	Test Methods for Non-Conventional Pesticides Chemical Analysis of Industrial & Municipal Wastewater	EPA 440/1-82/079-c	---	PB83-176636
		d)	Pesticides (Final)	EPA 440/1-85/079		PB86-1500427/AS
461	Battery Manufacturing	*a)	Battery Manuf. (Proposed)	EPA 440/1-82/067-b	---	PB83-197921
		*b)	Battery Manuf. (Final)	EPA 440/1-84/067 Vol. I Vol. II		PB85-121507 PB85-121515
463	Plastic Processing	a)	Plastic Molding & Forming (Proposed)	EPA 440/1-84/069-b		PB84-171578
		b)	Plastic Molding & Forming (Final)	EPA 440/1-84/069		PB84-186823
464	Metal Molding & Casting (Foundries)	a)	Metal Molding & Casting (Foundries) (Final)	EPA 440/1-85/070		PB86-161452/AS

* Also available from Industrial Technology Division.

PUBLICATIONS AVAILABLE FROM THE GOVERNMENT PRINTING OFFICE (GPO)
AND/OR THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

CFR PART NUMBER	CATEGORY OF ITD INDUSTRIAL STUDIES	SUBCATEGORY	ITD DOCUMENT NUMBER	GPO STOCK NUMBER	NTIS ACCESSION NUMBER
465	Coil Coating	a) Coil Coating (Final)	EPA 440/1-82/071	---	PB83-205542
		b) Coil Coating Canmaking (Final)	EPA 440/1-83/071	---	PB84-198647
466	Porcelain	*a) Porcelain (Proposed)	EPA 440/1-80/072-b	---	PB81-201527
467	Aluminum Forming	*a) Aluminum (Final)	EPA 440/1-84/073	---	PB84-244425
468	Copper Forming	a) Copper (Final)	EPA 440/1-84/074	---	PB84-192459
469	Electronics	*a) Electrical & Electronic Components (Phrase I) (Proposed)	EPA 440/1-82/075-b	---	PB82-249673

* Also available from Industrial Technology Division

PUBLICATIONS AVAILABLE FROM THE THE NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)
(SUMMARIES, TECHNICAL SUPPORT AND POTW STUDIES)

Fate of Priority Pollutants in Publicly Owned Treatment Works	EPA 440/1-82/303	Vol. I Vol. II	PB83-122788 PB83-122796
Combined Sewer Overflow Toxic Pollutant Study	EPA 440/1-84/304	---	PB84-207687
Assessment of Environmental Fate & Effects of Discharges from Offshore Oil and Gas Operation	EPA 440/4-85/002		PB86/114964/AS
Multimedia Technical Support Document for the Ethanol for Fuel Industry	EPA 440/1-86/093		PB86/177557/AS
Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works	EPA 530/SW-86/004		PB86/184017/AS

APPENDIX E

NOTIFICATION OF HAZARDOUS WASTE ACTIVITY, RCRA FORM 8700-12

Appendix—Form—Notification of Hazardous Waste Activity

EPA Form 8700-12 (Revised 11/85)

Form Approved OMB No 2050 0028 Expires 9 30 88
GSA No 0248 EPA OT

Please print or type with ELITE type (12 characters per inch) in the unshaded areas only

United States Environmental Protection Agency
Washington, DC 20460

EPA Notification of Hazardous Waste Activity

Please refer to the Instructions for Filing Notification before completing this form. The information requested here is required by law (Section 3010 of the Resource Conservation and Recovery Act)

For Official Use Only

Comments

C C

Installation's EPA ID Number | Approved | Date Received *(yr mo. day)*

C F T/A C 1

I. Name of Installation

II. Installation Mailing Address

Street or P.O. Box

C 3

City or Town | State | ZIP Code

C 4

III. Location of Installation

Street or Route Number

C 5

City or Town | State | ZIP Code

C 6

IV. Installation Contact

Name and Title *(last, first, and job title)* | Phone Number *(area code and number)*

C 2

V. Ownership

A. Name of Installation's Legal Owner | B. Type of Ownership *(enter code)*

C 8

VI. Type of Regulated Waste Activity *(Mark 'X' in the appropriate boxes. Refer to instructions.)*

A. Hazardous Waste Activity

☐ 1a. Generator ☐ 1b. Less than 1,000 kg/mo.
☐ 2. Transporter
☐ 3. Treater/Storer/Disposer
☐ 4. Underground Injection
☐ 5. Market or Burn Hazardous Waste Fuel
(enter 'X' and mark appropriate boxes below)
  ☐ a. Generator Marketing to Burner
  ☐ b. Other Marketer
  ☐ c. Burner

B. Used Oil Fuel Activities

☐ 6. Off-Specification Used Oil Fuel
(enter 'X' and mark appropriate boxes below)
  ☐ a. Generator Marketing to Burner
  ☐ b. Other Marketer
  ☐ c. Burner
☐ 7. Specification Used Oil Fuel Marketer (Or On-Site Burner) Who First Claims the Oil Meets the Specification.

VII. Waste Fuel Burning: Type of Combustion Device *(enter 'X' in all appropriate boxes to indicate type of combustion device(s) in which hazardous waste fuel or off-specification used oil fuel is burned. See instructions for definitions of combustion devices.)*

☐ A. Utility Boiler ☐ B. Industrial Boiler ☐ C. Industrial Furnace

VIII. Mode of Transportation *(transporters only — enter 'X' in the appropriate box(es))*

☐ A. Air ☐ B. Rail ☐ C. Highway ☐ D. Water ☐ E. Other *(specify)*

IX. First or Subsequent Notification

Mark 'X' in the appropriate box to indicate whether this is your installation's first notification of hazardous waste activity or a subsequent notification. If this is not your first notification, enter your installation's EPA ID Number in the space provided below.

☐ A. First Notification ☐ B. Subsequent Notification *(complete item C)*

C. Installation's EPA ID Number

EPA Form 8700-12 (Rev. 11-85) Previous edition is obsolete.

Continue on reverse

ID — For Official Use Only														
C													T/A	C
W														1

IX. Description of Hazardous Wastes *(continued from front)*

A. Hazardous Wastes from Nonspecific Sources. Enter the four-digit number from 40 *CFR* Part 261.31 for each listed hazardous waste from nonspecific sources your installation handles. Use additional sheets if necessary.

1	2	3	4	5	6
7	8	9	10	11	12

B. Hazardous Wastes from Specific Sources. Enter the four-digit number from 40 *CFR* Part 261.32 for each listed hazardous waste from specific sources your installation handles. Use additional sheets if necessary.

13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30

C. Commercial Chemical Product Hazardous Wastes. Enter the four-digit number from 40 *CFR* Part 261.33 for each chemical substance your installation handles which may be a hazardous waste. Use additional sheets if necessary.

31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48

D. Listed Infectious Wastes. Enter the four-digit number from 40 *CFR* Part 261.34 for each hazardous waste from hospitals, veterinary hospitals, or medical and research laboratories your installation handles. Use additional sheets if necessary.

49	50	51	52	53	54

E. Characteristics of Nonlisted Hazardous Wastes. Mark 'X' in the boxes corresponding to the characteristics of nonlisted hazardous wastes your installation handles. *(See 40 CFR Parts 261.21 — 261.24)*

☐ 1. Ignitable *(D001)*
☐ 2. Corrosive *(D002)*
☐ 3. Reactive *(D003)*
☐ 4. Toxic *(D000)*

X. Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature	Name and Official Title *(type or print)*	Date Signed

EPA Form 8700-12 (Rev. 11-85) Reverse

[Editor's note]

APPENDIX F

A SUMMARY OF POTW RESPONSIBILITIES UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

(This Appendix presents abbreviated excerpts from the EPA document Guidance Manual for the Identification of Hazardous Wastes Delivered to Publicly Owned Treatment Works by Truck, Rail, or Dedicated Pipeline.)

1.0 RCRA HAZARDOUS WASTES

The acceptance of Resource Conservation and Recovery Act (RCRA) defined hazardous wastes by a POTW may require considerable resources for continued compliance with CWA and RCRA requirements. Planning for the acceptance of hazardous wastes by a POTW should include: (1) allocation of personnel and resources to carry out RCRA reporting responsibilities, (2) changes in facility operations and local limits to ensure continued NPDES permit compliance, and (3) allocation of fiscal resources necessary to cover corrective action requirements.

The Resource Conservation and Recovery Act (RCRA) established a comprehensive program for managing the handling of hazardous wastes from the time they are generated until their ultimate disposal. Hazardous wastes may be legally introduced into a POTW by one of two means--either discharged to the collection system via an industrial facility's normal sewer connection, or transported to the treatment plant (inside the treatment plant property boundary) via truck, rail, or dedicated pipeline (TRDP).

RCRA hazardous wastes, when mixed with domestic sewage in the POTW collection system prior to reaching the treatment plant property boundary, are excluded from regulation under RCRA by the Domestic Sewage Exclusion (DSE). The exclusion applies only after the wastes are mixed. Hazardous wastes are still subject to RCRA until they are discharged and mixed with domestic sewage. As RCRA regulations become more restrictive due to the Hazardous and Solid Waste Amendments of 1984, there are increased incentives for industry to take advantage of the DSE. Realizing this fact, municipal officials should identify the industrial activities that generate and discharge hazardous wastes so that they are able to control and manage these wastes. While exempt under RCRA, these wastes are subject to full regulation and control under the CWA, and must meet applicable categorical and local discharge limitations.

Hazardous wastes may only be received by truck, rail, or dedicated pipeline if the POTW is in compliance with RCRA requirements for treatment, storage, and disposal facilities (TSDFs). The responsibilities and liabilities of POTWs accepting TRDP wastes is explained in Section 2.1.3.1 below. It is important that POTWs fully understand the regulatory requirements and potential consequences of accepting hazardous wastes.

1.1 DEFINITION OF HAZARDOUS WASTE

As a first step, municipal officials should understand exactly what is meant by a hazardous waste. As defined in Section 1004(5) of RCRA, "the term 'hazardous waste' means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may --

(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

There are four steps for determining whether a solid waste is regulated as a hazardous waste under federal law:

- First, determine if the waste is <u>exempted</u> from regulation as a solid or a hazardous waste.
- Second, check to see if it is <u>listed</u> as a hazardous waste in Subpart D of 40 CFR 261. Listed wastes are regulated as hazardous wastes unless they have been specifically delisted.
- If the waste has not been listed as a hazardous waste, determine if it exhibits, on analysis, any of the <u>characteristics</u> of a hazardous waste, cited in Subpart C of 40 CFR 261.
- Lastly, determine if the waste is a <u>mixture</u>. A mixture of a listed waste and a nonhazardous solid waste is considered hazardous unless it has been specifically excluded under 40 CFR Part 261.3. A mixture of a characteristic waste and a nonhazardous solid waste is only considered hazardous if it still exhibits one or more of the hazardous waste characteristics.

Municipal officials should note that the definition of a hazardous waste provided here is the Federal definition. States may have a more stringent or different definition of a hazardous waste.

2.0 RESPONSIBILITIES OF POTWS ACCEPTING HAZARDOUS WASTES BY TRUCK, RAIL, OR DEDICATED PIPE

POTWs may choose to accept hazardous wastes delivered by truck, rail, or dedicated pipeline. POTWs accepting these wastes are considered to be hazardous waste TSDFs and are subject to applicable RCRA regulations. However, in an effort to streamline the permitting process and to avoid redundancy with respect to the CWA, RCRA exempts these POTWs from individual RCRA permits incorporating all of the standards of 40 CFR Part 264. Instead, these POTWs are deemed to be subject to RCRA permit by rule provisions which contain the following conditions:

- The POTW owner or operator must have a NPDES permit, issued by EPA or a NPDES delegated State
- The POTW must be in compliance with its NPDES permit
- The hazardous waste received must meet all Federal, State, and local pretreatment requirements (e.g., categorical standards, prohibited discharges, and local limits)
- The POTW must comply with the following RCRA provisions:
    - Identification number (40 CFR 264.11)
    - Use of manifest system (40 CFR 264.71)
    - Manifest discrepancy reporting (40 CFR 264.22)
    - Unmanifested waste report (40 CFR 264.76)
    - Operating records [40 CFR 264.73(a) and (b)(1)]
    - Biennial report (40 CFR 264.75)
    - Corrective action if the NPDES permit was issued after November 8, 1984 (40 CFR 264.101) or if permit by rule coverage first occurs after November 8, 1984.

POTWs that do not comply with these requirements may not accept hazardous wastes for treatment, storage, or disposal. Receipt of hazardous wastes by a

POTW not in compliance with permit by rule requirements constitutes a violation of Subtitle C of RCRA.

Each of the various permit by rule requirements is discussed below.

2.1 COMPLIANCE WITH NPDES PERMIT CONDITIONS

The requirement of "in compliance with an NPDES permit" is an ongoing obligation. Consequently, noncompliance with any NPDES permit condition could result in RCRA 3008(a) enforcement actions for receipt of hazardous wastes in violation of the permit by rule, as well as CWA enforcement actions.

As part of the 40 CFR Part 270.60(c) permit conditions of a permit by rule, the hazardous waste received from an industrial user by a POTW must meet all applicable pretreatment standards (i.e., Federal, State, and/or local). Therefore, it is the responsibility of the POTW to ensure that any hazardous wastes received by truck, rail, or dedicated pipeline also meet applicable pretreatment standards and requirements before discharge is allowed.

2.2 COMPLIANCE WITH RCRA PROCEDURAL REQUIREMENTS

POTWs must comply with the procedural provisions cited in 40 CFR Part 270.60(c) of the RCRA regulations to operate under a permit by rule. These provisions are discussed below.

EPA Identification Number

All facilities that treat, store, or dispose hazardous wastes are required to file a notification of activity and receive an EPA identification number (40 CFR Part 264.11). POTWs may obtain this identification number by applying to EPA using EPA Form 8700-12.

Manifest System

Tracking of hazardous wastes under RCRA is accomplished through use of the Uniform Hazardous Waste Manifest or an equivalent State form. Permit by rule conditions require POTWs to comply with the manifest regulations for TSDFs (40 CFR Part 264.71-264.72). The manifest system is originated by the generator, continued by the transporter, and completed by the POTW. At each step, the appropriate sections of the manifest must be completed with a copy going to all parties involved in the transaction. To complete the circle, the POTW must return a copy of the completed manifest to the generator, while retaining a copy for its records.

Upon receipt of a hazardous waste, the POTW owner or operator must:

- Sign and date the manifest
- Note any significant discrepancies in the manifest on each copy of the manifest (discussed in detail below)
- Immediately give the transporter a copy of the signed manifest
- Send a copy of the manifest to the generator within 30 days after the delivery
- Retain a copy of the manifest at the facility for at least 3 years after the date received.

The POTW is required to note any significant manifest discrepancies on each copy of the manifest. Manifest discrepancies are differences between the type and/or amount of hazardous waste designated on the manifest and that received by the facility. A significant discrepancy is defined as:

- A difference in weight of greater than 10 percent for bulk shipments
- Any variation in the piece count for batch deliveries
- Any obvious difference in waste type that can be discovered by inspection or waste analysis.

If a discrepancy is found either prior to or after waste analysis, the owner or operator must attempt to reconcile the discrepancy with the generator or transporter. If the discrepancy is not resolved within 15 days after the date of delivery, the TSDF must send a letter to the Regional Administrator that includes a description of the discrepancy, the attempts to reconcile it, and a copy of the manifest.

POTWs subject to a permit by rule are required to file an unmanifested waste report if hazardous waste is accepted from an offsite source that is not accompanied by a manifest or shipping paper and is not excluded from the manifest requirement by the small quantity generator regulations.

Operating Record

Under the permit by rule conditions, the POTW owner or operator is required to maintain operating records. The operating record must contain the following information as it becomes available, until the POTW ceases to engage in the treatment, storage, or disposal of hazardous waste:

- A description of the type and quantity of each hazardous waste received
- The method and dates of its treatment, storage, or disposal at the facility, as per Appendix I of the RCRA regulations.

Appendix I of Part 264 requires each hazardous waste to be described in the operating record by its common name and, if the waste is listed, by its EPA Hazardous Waste Number(s) (from Part 261, Subpart D). If the waste is not listed, the description must include the production process. The record also must describe the waste's physical form (i.e., liquid, sludge, solid, or contained gas); the estimated or manifest-reported weight, or volume and density, where applicable (specified in Table 1 of Part 264 Appendix I); and the method(s) of treatment by handling code(s) (specified in Table 2 of Part 264 Appendix I).

Biennial Report

POTWs with permits by rule must submit biennial reports to the EPA Regional Waste Management Division or the appropriate State agency by March 1 of each even-numbered year. The report, to be filled out using EPA Form 8700-13B, details the facility's treatment, storage, and disposal activities of the previous odd-numbered year.

3.0 CORRECTIVE ACTION

The November 1984 Amendments to RCRA included a provision [RCRA Section 3004(u)] that requires:

> . . . corrective action for all releases of hazardous waste or constituents from any solid waste management unit at a treatment, storage or disposal facility seeking a permit under this subtitle, regardless of the time at which waste was placed in the unit. Permits issued under section 3005 shall contain schedules of compliance for such corrective action (where such corrective action cannot be completed prior to issuance of the permit) and assurances of financial responsibility for completing such corrective action.

Under this new requirement, POTWs subject to permit by rule (see p. E-3), with NPDES permits that are issued after November 8, 1984, or that are first covered by a permit by rule after November 8, 1984, are subject to RCRA corrective action requirements [270.60(c)(3)(7)]. Unlike the other permit by rule requirements, the corrective action requirement may result in a POTW being subject to substantial costs associated with treating, storing, and disposing of hazardous waste. Corrective action, under RCRA, encompasses corrective measures to clean up any release of hazardous waste or hazardous constituents from a solid waste management unit that may result in hazards to human health or the environment. Moreover, the requirement is not triggered by whether or not the facility is in compliance with RCRA and CWA regulations. Even a complying facility is subject to the initial stages of corrective action requirements. The term corrective action refers not only to actual cleanup measures, but any actions that may need to be taken prior to actual cleanup. Potential corrective action activities include: initial investigations of the nature and extent of any releases, (e.g., drilling of monitoring wells and sampling and analysis); interim measures to control the contamination; necessary corrective measures (e.g., ground-water extraction); and post-corrective measure monitoring and assessment.

APPENDIX G

PHYSICAL/CHEMICAL CHARACTERISTICS OF TOXIC POLLUTANTS

GLOSSARY OF TERMS

Biodegradability: The relative tendency of a pollutant to be chemically altered by microorganisms.

Explosivity: The lower explosive limit (LEL) is defined as the minimum vapor concentration of a compound needed to support combustion. The LEL is a weak function of temperature. The lower explosive limit is an indication of the potential for fire and/or explosion (i.e., the lower LEL, the lower the vapor concentration necessary to produce a fire/explosion). LELs can be used in conjunction with Henry's Law Constants to develop limits to prevent fires/explosions in POTW collection systems.

Fume Toxicity: The time weighted average threshold limit value (TWA-TLV) is the concentration that, if exposed to 8 hours/day, 40 hours/week will not produce adverse health effects. The fume toxicity level indicates the likelihood of adverse health effects, when approached or exceeded. The TLVs can be used, in conjunction with Henry's Law Constants, to develop limits to protect worker health.

Henry's Law Constant: The equilibrium ratio of a compound's partial pressure to its liquid phase concentration. The Henry's Law Constant is a measure of a compound's tendency to volatilize out of solution. The Henry's Law Constant can generally be estimated by the vapor pressure divided by the solubility. The Henry's Law Constant can be used to estimate the transfer of pollutants from wastewater to air. Thus, it is an important component in deriving local limits to prevent fires/explosions or worker health problems.

National Fire Protection Association (NFPA) Hazard Classifications: A numeric scoring system developed by the NFPA to rank the relative health, flammability, and chemical reactivity hazards associated with various chemicals. The NFPA scoring system is detailed in the subsequent section of this Glossary.

Pollutants Proposed for Inclusion into RCRA TCLP Test: Pollutants proposed to be regulated by the RCRA Toxicity Characteristic Leaching Procedure (TCLP) described in the Federal Register, Vol. 51, No. 114, June 13, 1986. The TCLP test is a leachate analysis test for sludges, similar to the EP toxicity test. The TCLP test, and its implementation under RCRA, has been proposed in the Federal Register and is currently being evaluated.

Pollutants under consideration for municipal sludge regulation: Those pollutants originally considered for regulation by EPA during the regulatory development phase of technical sludge disposal criteria (40 CFR 503).

SDWA Maximum Contaminant Levels: Regulatory standards that must be met by all water supply systems that have at least 15 service connections and serve 25 individuals.

Water Quality Criteria: Nonregulatory guidelines for protection of aquatic life from acute and/or chronic toxicity. Water quality criteria have been experimentally derived.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) CLASSIFICATION SCHEME (45)

Health, flammability, and chemical reactivity hazards associated with various chemicals are ranked by the NFPA from 0-4, depending on the severity of the hazard. The criteria used to assign these scores are as follows:

Health Hazards

4 A few whiffs of the gas or vapor could cause death; or the gas, vapor, or liquid could be fatal on penetrating the fire fighters' normal full protective clothing which is designed for resistance to heat. For most chemicals having a Health 4 rating, the normal full protective clothing available to the average fire department will not provide adequate protection against skin contact with these materials. Only special protective clothing designed to protect against the specific hazard should be worn.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing, including self-contained breathing apparatus, rubber gloves, boots and bands around legs, arms and waist should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health. It may be desirable to wear self-contained breathing apparatus.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Flammability Hazards

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air. Shut off flow of gas or liquid and keep cooling water streams on exposed tanks or containers. Use water spray carefully in the vicinity of dusts so as not to create dust clouds.

3 Liquids which can be ignited under almost all normal temperature conditions. Water may be ineffective on these liquids because of their low flash points. Solids which form coarse dusts, solids in shredded or fibrous form that create flash fires, solids that burn rapidly, usually because they contain their own oxygen, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors. Water spray may be used to extinguish the fire because the material can be cooled to below its flash point.

1 Materials that must be preheated before ignition can occur. Water may cause frothing of liquids with this flammability rating number if it gets below the surface of the liquid and turns to steam. However, water spray gently applied to the surface will cause a frothing which will extinguish the fire. Most combustible solids have a flammability rating of 1.

0 Materials that will not burn.

<u>Reactivity Hazards</u>

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock. If a chemical with this hazard rating is in an advanced or massive fire, the area should be evacuated.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement. Fire fighting should be done from an explosion-resistant location.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures or which can undergo violent chemical change at elevated temperatures and pressures. Also includes those materials which may react violently with water or which may form potentially explosive mixtures with water. In advanced or massive fires, fire fighting should be done from a protected location.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently. Caution must be used in approaching the fire and applying water.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used.

TABLE G-1. HAZARD CLASSIFICATIONS AND VAPOR PHASE EFFECTS*

	NFPA Hazard Classifications(45)**	Explosivity (LEL, % v/v)	Fume Toxicity (TWA mg/m^3)	Henry's Law Constant ATM - M^3/Mole
Acenaphthene				9.1×10^{-5} (12)
Acenaphthylene				1.45×10^{-3} (33)
Acrylonitrile	432	3.0% (31)	4.5 (30)	8.8×10^{-5} (33)
Aldrin	200		0.25 (30)	1.6×10^{-5} (12)
Anthracene	01-			1.25×10^{-3} (33)
Antimony			0.5 (30)	
Arsenic			0.2 (30)	
Barium			0.5 (30)	
Benz(a)anthracene				1×10^{-6} (33)(12)
Benzene	230	1.4% (31)	30 (30)	5.5×10^{-3} (33)
Benzo(b)fluoranthene				1.22×10^{-5} (12)
Benzo(k)fluoranthene				3.87×10^{-5} (12)
Benzo[a]pyrene				4.9×10^{-7} (33)
Benzo(g,h,i)perylene				1.44×10^{-7} (12)
Beryllium	411			
Bis(2-chloroethoxy)methane				2.8×10^{-7} (12)
Bis(2-ethylhexyl)phthalate				3×10^{-7} (33)
Bromoform			5 (30)	

TABLE G-1. HAZARD CLASSIFICATIONS AND VAPOR PHASE EFFECTS* (Continued)

	NFPA Hazard Classifications(45)**	Explosivity (LEL, % v/v)	Fume Toxicity (TWA mg/m^3)	Henry's Law Constant ATM - M^3/Mole
Bromomethane (methyl bromide)	310	10.0% (3)		1.97×10^{-1} (12)
Butyl benzyl phthalate	110			8.3×10^{-6} (33)
Cadmium			0.05 (30)	
Carbon disulfide	230	1.0% (31)	30 (30)	1.2×10^{-2} (19)
Carbon tetrachloride	300		30 (30)	2.30×10^{-2} (33)
Chlordane			0.5 (30)	9.4×10^{-5} (33)
p-Chloro-m-cresol			3 (30)	2.5×10^{-6} (12)
Chlorobenzene	230	1.3% (31)	350 (30)	3.58×10^{-3} (33)
Chlorodibromomethane				9.9×10^{-4} (12)
Chloroethane (ethyl chloride)	240	3.8% (8)		1.48×10^{-1} (12)
Chloroform	200		50 (30)	2.88×10^{-3} (33)
Chloromethane (methyl chloride)	240			3.8×10^{-1} (19)
2-Chlorophenol				1.03×10^{-5} (12)
Chromium				
Cobalt			0.1 (30)	
Copper				
Cyanide	442			
DDE			0.2 (30)	
DDT (Dichlorodiphenyltrichloroethane)			1 (30)	1.58×10^{-5} (12)
Di-n-Butyl Phthalate				2.8×10^{-7} (19)

TABLE G-1. HAZARD CLASSIFICATIONS AND VAPOR PHASE EFFECTS* (Continued)

	NFPA Hazard Classifications(45)**	Explosivity (LEL, % v/v)	Fume Toxicity (TWA mg/m^3)	Henry's Law Constant ATM - M^3/Mole
Di-n-Octyl Phthalate				3.0×10^{-7} (19)
Dibromomethane (methylene bromide)				
1,2-Dichlorobenzene	220	2.2% (31)		1.93×10^{-3} (33)(12)
1,3-Dichlorobenzene		2.2% (31)	300 (30)	3.61×10^{-3} (33)(12)
1,4-Dichlorobenzene		2.2% (31)	450 (30)	3.1×10^{-3} (33)(12)
Dichlorobromomethane				2.41×10^{-3} (12)
Dichlorodifluoromethane	000		4950 (30)	2.98×10^{0} (12)
1,1-Dichloroethane		5.6% (3)	810 (30)	4.26×10^{-3} (12)
trans-1,2-Dichloroethylene	232	9.7% (31)	790 (30)	6.7×10^{-2} (12)
2,4-Dichlorophenol				2.8×10^{-6} (33)
2,4-Dichlorophenoxyacetic acid (2,4-D)			10 (30)	2×10^{-10} (19)
1,2-Dichloropropane	230	3.4% (8)	350 (30)	2.31×10^{-3} (12)
1,3-Dichloropropene		5.3% (50)	5 (30)	1.33×10^{-3} (12)
Dieldrin			0.25 (30)	4.57×10^{-10} (12)
Diethyl phthalate	010		5 (30)	1.2×10^{-6} (33)
Dimethyl phthalate			5 (30)	2.15×10^{-6} (33)
2,4-Dimethylphenol (2,4-xylenol)				1.7×10^{-5} (33)
2,4-Dinitrotoluene	313		1.5 (30)	4.5×10^{-6} (33)
1,2-Diphenylhydrazine				3.4×10^{-9} (12)

TABLE G-1. HAZARD CLASSIFICATIONS AND VAPOR PHASE EFFECTS* (Continued)

	NFPA Hazard Classifications(45)**	Explosivity (LEL, % v/v)	Fume Toxicity (TWA mg/m^3)	Henry's Law Constant ATM - M^3/Mole
Endosulfan			0.1 (30)	1.0 X 10^{-5} (12)
Endrin	310		0.1 (30)	4.0 X 10^{-7} (33)(12)
Ethyl Benzene	230	1.0% (31)	435 (30)	6.6 X 10^{-3} (33)(12)
Ethylene dibromide (EDB)	300			
Ethylene dichloride	230	6.2% (3)	40 (30)	9.14 x 10^{-4} (33)
Fluoranthene				6.5 x 10^{-6} (33)
Fluorene	320			1.1 x 10^{-3} (12)
Formaldehyde	220	7.0% (50)	1.5 (30)	5.1 x 10^{-4} (54)
Heptachlor			0.5 (30)	4.0 x 10^{-3} (33)
Heptachlor Epoxide				
Hexachloro-1,3-butadiene			0.24 (30)	2.56 x 10^{-2} (33)
Hexachlorobenzene				6.8 x 10^{-4} (33)
Hexachlorocycholexane (Lindane)	210			2.56 x 10^{-2} (33)
Hexachloroethane			100 (30)	2.49 x 10^{-3} (33)
Indeno(1,2,3-cd)pyrene				6.95 x 10^{-8} (33)
Isobutyl alcohol	130	1.7% (31)	150 (30)	1.03 x 20^{-5} (19)
Isophorone		0.84% (31)	25 (30)	5.75 x 10-6 (12)
Lead			0.15	
Malathion			10 (30)	
Mercury			0.05 (30)	
Methoxychlor				

TABLE G-1. HAZARD CLASSIFICATIONS AND VAPOR PHASE EFFECTS* (Continued)

	NFPA Hazard Classifications(45)**	Explosivity (LEL, % v/v)	Fume Toxicity (TWA mg/m^3)	Henry's Law Constant ATM - M^3/Mole
Methyl ethyl ketone	130	2% (31)	590 (30)	5.8×10^{-5} (19)
Methylene chloride	210	4.0% (50)	350 (30)	2.03×10^{-3} (33)
4,4′-Methylenebis(2-chloroaniline)			0.22 (30)	
Naphthalene	220	0.9% (31)	50 (30)	4.6×10^{-4} (33)
Nickel			1 (30)	
Nitrobenzene	320			1.31×10^{-5} (12)
2-Nitrophenol				7.56×10^{-6} (12)
PCB (Polychlorinated biphenyls)***				
Pentachloroethane				2.17×10^{-3} (19)
Pentachlorophenol	300		0.5 (30)	2.8×10^{-6} (33)
Phenanthrene				2.26×10^{-4} (12)
Phenol	320		19 (30)	4.54×10^{-7} (33)
Pyrene				5.1×10^{-6} (12)
Pyridine	230		15 (30)	7×10^{-9}(19)
Selenium			0.2 (30)	
Silver			0.1 (30)	
1,1,1,2-Tetrachloroethane				1.1×10^{-2} (19)
1,1,2,2-Tetrachloroethane				3.8×10^{-4} (33)
Tetrachloroethylene (Perchlorethylene)			335 (30)	1.53×10^{-2} (12)
Tetrachlorophenol				

TABLE G-1. HAZARD CLASSIFICATIONS AND VAPOR PHASE EFFECTS* (Continued)

	NFPA Hazard Classifications(45)**	Explosivity (LEL, % v/v)	Fume Toxicity (TWA mg/m^3)	Henry's Law Constant ATM - M^3/Mole
Thallium			1.5 (30)	
Toluene	230	1.27% (31)	375 (30)	6.66×10^{-3} (33)
Toxaphene			0.5 (30)	2.1×10^{-1} (33)
1,2,4-Trichlorobenzene		2.5% (50)		2.3×10^{-3} (12)
1,1,1-Trichloroethane (methyl chloroform)		7.5% (50)		3×10^{-2} (33)
1,1,2-Trichloroethane		3.0% (50)	45 (30)	7.42×10^{-4} (33)
Trichloroethylene			270 (30)	9.1×10^{-3} (33)
Trichlorofluoromethane			5,600 (30)	1.1×10^{-1} (12)
2,4,5-Trichlorophenol				
2,4,6-Trichlorophenol				4×10^{-6} (33)
Trichlorophenoxy-2-propionic acid (Silvex)				
Vinyl chloride (chloroethylene)	241	3.6% (31)	10 (30)	8.14×10^{-2} (33) (12)
Vinylidene chloride (1,1-dichloroethylene)	242	6.5% (50)	20 (30)	1.9×10^{-1} (12)
Zinc				

* Numbered references refer to reference list provided at the end of this document.

** NFPA Codes are as follows:

Leftmost digit = Health Hazard Classification Ranking
Center digit = Flammability Classification Ranking
Rightmost digit = Reactivity Classification Ranking

The Glossary provides definitions for each NFPA ranking.

TABLE G-1. HAZARD CLASSIFICATIONS AND VAPOR PHASE EFFECTS*

***Henry's Law Constants for PCBs:

Aroclor 1016	3.3×10^{-4} (12)
Aroclor 1221	1.7×10^{-4} (12)
Aroclor 1232	1.13×10^{-5} (12)
Aroclor 1242	1.98×10^{-3} (12)
Aroclor 1248	3.6×10^{-3} (12)
Aroclor 1254	2.6×10^{-3} (12)
Aroclor 1260	7.4×10^{-1} (12)

TABLE G-2. FATE OF POLLUTANTS IN POTWS

	Biodegradability in Aerobic Treatment Systems++	Biodegradability in Anaerobic Treatment Systems++
Acenaphthene		
Acenaphthylene	M	M
Acrylonitrile	R	R
Aldrin		M
Anthracene		
Antimony		
Arsenic		
Barium		
Benz(a)anthracene		
Benzene	M	M
Benzo(b)fluoranthene		
Benzo(k)fluoranthene		
Benzo[a]pyrene		
Benzo(g,h,i)perylene		
Beryllium		
Bis(2-chloroethoxy)methane	O	O
Bis(2-ethylhexyl)phthalate	M	M
Bromoform	S	
Bromomethane (methyl bromide)	M	
Butyl benzyl phthalate	R	R
Cadmium		
Carbon disulfide	M	M
Carbon tetrachloride	M	M
Chlordane	O	
p-Chloro-m-cresol	R	M

TABLE G-2. FATE OF POLLUTANTS IN POTWS (Continued)

	Biodegradability in Aerobic Treatment Systems++	Biodegradability in Anaerobic Treatment Systems++
Chlorobenzene	M	M
Chlorodibromomethane		
Chloroethane (ethyl chloride)	S	S
Chloroform	M	S
Chloromethane (methyl chloride)	M	M
2-Chlorophenol	R	R
Chromium		
Cobalt		
Copper		
Cyanide	M	
DDE (Dichlorodiphenyldichloroethylene)		
DDT (Dichlorodiphenyltrichloroethane)		
Di-n-Butyl Phthalate	R	R
Di-n-Octyl Phthalate	M	M
Dibromomethane (methylene bromide)	S	S
1,2-Dichlorobenzene	S	
1,3-Dichlorobenzene	S	
1,4-Dichlorobenzene	S	
Dichlorobromomethane		
Dichlorodifluoromethane	M	
1,1-Dichloroethane	M	M
trans-1,2-Dichloroethylene	M	M
2,4-Dichlorophenol	M	M
2,4-Dichlorophenoxyacetic acid (2,4-D)	R	R
1,2-Dichloropropane	S	

TABLE G-2. FATE OF POLLUTANTS IN POTWS (Continued)

	Biodegradability in Aerobic Treatment Systems[++]	Biodegradability in Anaerobic Treatment Systems[++]
1,3-Dichloropropene		
Dieldrin		
Diethyl phthalate	R	R
Dimethyl phthalate		
2,4-Dimethylphenol (2,4-xylenol)	R	R
2,4-Dinitrotoluene		
1,2-Diphenylhydrazine		
Endosulfan		
Endrin	D	M
Ethyl Benzene	R	R
Ethylene dibromide (EDB)		
Ethylene dichloride	M	M
Fluoranthene		
Fluorene		
Formualdehyde	R	R
Heptachlor		
Heptachlor Epoxide		
Hexachloro-1,3-butadiene	S	S
Hexachlorobenzene		
Hexachlorocyclohexane (Lindane)		
Hexachloroethane	S	S
Indeno(1,2,3-cd)pyrene		
Isobutyl alcohol	R	M
Isophorone		
Lead		
Malathion		

TABLE G-2. FATE OF POLLUTANTS IN POTWS (Continued)

	Biodegradability in Aerobic Treatment Systems[++]	Biodegradability in Anaerobic Treatment Systems[++]
Mercury		
Methoxychlor	S	M
Methyl ethyl ketone	R	R
Methylene chloride	R	M
4,4′-Methylenebis(2-chloroaniline)		
Naphthalene	M	M
Nickel		
Nitrobenzene	R	R
2-Nitrophenol		
PCB (Polychlorinated biphenyls)	S-0	
Pentachlorophenol	M	S
Phenanthrene		
Phenol	R	R
Pyrene		
Pyridine	M	
Selenium		
Silver		
1,1,1,2-Tetrachloroethane	S	
1,1,2,2-Tetrachloroethane	S	
Tetrachloroethylene (Perchlorethylene)	M	
Tetrachlorophenol		
Thallium		
Toluene	R	R
Toxaphene		
1,2,4-Trichlorobenzene	S	

TABLE G-2. FATE OF POLLUTANTS IN POTWS (Continued)

	Biodegradability in Aerobic Treatment Systems[++]	Biodegradability in Anaerobic Treatment Systems[++]
1,1,1-Trichloroethane (methyl chloroform)	R	
1,1,2-Trichloroethane	S	
Trichloroethylene	M	S
Trichlorofluoromethane	M	
2,4,5-Trichlorophenol		
2,4,6-Trichlorophenol	M	M
Trichlorophenoxy-2-propionic acid (Silvex)		
Vinyl chloride (chloroethylene)	M	M
Vinylidene chloride (1,1-dichloroethylene)		
Zinc		

[++] R = Rapid; M = Moderate; S = Slow; 0 = Resistant

-- Reference (54)

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA*

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
Acenaphthene	1700 (25)				
Acenaphthylene					
Acrylonitrile	7550 (25)				
Aldrin	3.0 (25)			X (41)	
Anthracene					
Antimony	9000 (25)				
Arsenic	360 (25)	50 (42)	.05	X (41)	X (43)
Barium		1800 (42)	1.0		X (43)
Benz(a)anthracene				X (41)	
Benzene	5300 (25)	NA (42)	0 (RMCL)	X (41)	X (43)
Benzo[a]pyrene				X (41)	
Benzo(b)fluoranthene					
Benzo(k)fluoranthene					
Benzo(g,h,i)perylene					
Beryllium	130 (25)			X (41)	
Bis(2-chloroethoxy)methane					X (43)

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA* (Continued)

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
Bis(2-ethylhexyl)phthalate	940 (25)**			X (41)	
Bromoform	11000 (25)***				
Bromomethane (methyl bromide)	11000 (25)***				
Butyl benzyl phthalate	940 (25)**				
Cadmium	3.9^{+} (25)	18 (42)	.01	X (41)	X (43)
Carbon disulfide					X (43)
Carbon tetrachloride	35200 (25)	— (42)	0 (RMCL)	X (41)	X (43)
Chlordane	2.4 (25)	— (42)		X (41)	X (43)
p-Chloro-m-cresol	30 (25)				
Chlorobenzene	250 (25)****	3150 (42)			X (43)
Chlorodibromomethane	11000 (25)***				
Chloroethane (ethyl chloride)					
Chloroform	28900 (25)			X (41)	X (43)
Chloromethane (methyl chloride)	11000 (25)***				
2-Chlorophenol	4380 (25)				
Chromium	16 (HEX)(25) 1700 (TRI)(25)	170 (42)	.05	X (41)	X (43) X (43)

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA* (Continued)

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
Cobalt				X (41)	
Copper	18^{+} (25)			X (41)	
Cyanide	22 (25)	750 (42)		X (41)	
DDE (Dichlorodiphenyldichloroethylene)	1050 (25)			X (41)	
DDT (Dichlorodiphenyltrichloroethane)	1.1 (25)			X (41)	
Di-n-Butyl Phthalate	940 (25)**				
Di-n-Octyl Phthalate	940 (25)**				
Dibromomethane (methylene bromide)	11000 (25)***				
1,2-Dichlorobenzene	1120 (25)	3125 (42)			X (43)
1,3-Dichlorobenzene	1120 (25)	3125 (42)			
1,4-Dichlorobenzene	1120 (25)	3750 (42)			X (43)
Dichlorobromomethane	11000 (25)***				
Dichlorodifluoromethane	11000 (25)***				
1,1-Dichloroethane					
trans-1,2-Dichloroethylene		250 (42)			
2,4-Dichlorophenol	2020 (25)				

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA* (Continued)

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
2,4-Dichlorophenoxyacetic acid (2,4-D)		350 (42)	.1	X (41)	X (43)
1,2-Dichloropropane	23000 (25)	— (42)			
1,3-Dichloropropene	6060 (25)				
Dieldrin	2.5 (25)			X (41)	
Diethyl phthalate	940 (25)**				
Dimethyl phthalate	940 (25)**				
2,4-Dimethylphenol (2,4-xylenol)	2120 (25)				
2,4-Dinitrotoluene	330 (25)				X (43)
Diphenylhydrazine	270 (25)				
Endosulfan	.22 (25)				
Endrin	.18 (25)	1.6 (42)	.0002	X (41)	X (43)
Ethyl Benzene	32000 (25)	3400 (42)			
Ethylene dibromide (EDB)		NA (42)			
Ethylene dichloride	118000 (25)				X (43)
Fluoranthene	3980 (25)				
Fluorene					

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA* (Continued)

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
Formaldehyde					
Heptachlor	.52 (25)	— (42)		X (41)	X (43)
Heptachlor Epoxide					
Hexachloro-1,3-butadiene	90 (25)				X (43)
Hexachlorobenzene	250 (25)****	— (42)		X (41)	X (43)
Hexachlorocyclohexane (Lindane)	2.0 (25)			X (41)	
Hexachloroethane	980 (25)				X (43)
Indeno(1,2,3-cd)pyrene					
Isobutyl alcohol					X (43)
Isophorone	117000 (25)				
Lead	82+ (25)	20 ug/day (42)	.05	X (41)	X (43)
Malathion				X (41)	
Mercury	2.4 (25)	5.5 (42)		X (41)	X (43)
Methoxychlor		1700 (42)			
Methyl ethyl ketone		860 (42)		X (41)	X (43)
Methylene chloride	11000 (25)***			X (41)	X (43)

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA* (Continued)

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
4,4'-Methylenebis(2-chloroaniline)				X (41)	
Naphthalene	2300 (25)				
Nickel	1400$^+$ (25)	350 (42)		X (41)	
Nitrobenzene	27000 (25)				X (43)
2-Nitrophenol					
PCB (Polychlorinated biphenyls)	2 (25)	— (42)		X (41)	
Pentachloroethane	7240 (25)				
Pentachlorophenol	20 (25)	1050 (42)		X (41)	X (43)
Phenanthrene				X (41)	
Phenol	10200 (25)			X (41)	X (43)
Pyrene					
Pyridine					X (43)
Selenium	260 (25)	.01 (42)		X (41)	X (43)
Silver	4.1$^+$ (25)	.05 (42)			X (43)
1,1,1,2-Tetrachloroethane	9320 (25)				X (43)
1,1,2,2-Tetrachloroethane	9320 (25)				X (43)

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA* (Continued)

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
Tetrachloroethylene (Perchlorethylene)	5280 (25)	— (42)		X (41)	X (43)
Tetrachlorophenol					
Thallium	1400 (25)				
Toluene	17500 (25)	10100 (42)			X (43)
Toxaphene	0.73 (25)	— (42)	.005	X (41)	X (43)
1,2,4-Trichlorobenzene	250 (25)****				
1,1,1-Trichloroethane (methyl chloroform)	18000 (25)	— (42)	.2		X (43)
1,1,2-Trichloroethane	18000 (25)				X (43)
Trichloroethylene	45000 (25)	— (42)	0 (RMCL)	X (41)	
Trichlorofluoromethane	11000 (25)***				
2,4,5-Trichlorophenol					
2,4,6-Trichlorophenol				X (41)	X (43)
Trichlorophenoxy-2-propionic acid (Silvex)					
Vinyl chloride (chloroethylene)		NA (42)	.01 (RMCL)	X (41)	X (43)

TABLE G-3. ENVIRONMENTAL TOXICITY AND CRITERIA* (Continued)

	Water Quality Criteria ug/l	EPA Drinking Water Advisories — Lifetime — ug/l per 70 kg human body wt.	SDWA Maximum Contaminant Levels (MCLs) mg/l (14)	Under Consideration for Municipal Sludge Regulation	Proposed for Inclusion in RCRA TCLP Test
Vinylidene chloride (1,1-dichloroethylene)	11600 (25)				X (43)
Zinc	120⁺ (25)			X (41)	

*Numbered references refer to reference list provided at the end of this document.
**Criterion for phthalate esters as a class of compounds.
***Critrion for halomethanes as a class of compounds.
****Criterion for chlorinated benzenes as a class of compounds.

⁺ at 100 mg/l $CaCO_3$

APPENDIX H

TOXIC ORGANIC POLLUTANTS

- 126 Priority Pollutants
- RCRA Appendix IX

APPENDIX H

Throughout this guidance document the reader is directed to monitor for the presence of, and evaluate the potential impacts of toxic organic compounds. While the number of organic compounds which could be considered to be toxic is immense, POTWs may wish to use organics on the two attached lists as a starting point; these being: 1) the list of 126 priority pollutants, and 2) the list of compounds on RCRA Appendix IX - taken from FR Vol. 52, No. 131, pp. 25942-25953. Analytical methods exist for all pollutants on these lists.

CLEAN WATER ACT PRIORITY POLLUTANTS

PRIORITY POLLUTANTS

Volatile Compounds

002	Acrolein	088	Vinyl Chloride
004	Benzene	003	Acrylonitrile
006	Carbon Tetrachloride	047	Bromoform
051	Chlorodibromomethane	007	Chlorobenzene
019	2-Chloroethylvinyl Ether	016	Chloroethane
048	Dichlorobromomethane	023	Chloroform
010	1,2-Dichloroethane	013	1,1-Dichloroethane
032	1,2-Dichloropropane	029	1,1-Dichloroethylene
038	Ethylbenzene	033	1,3-Dichloropropylene
045	Methyl Chloride	046	Methyl Bromide
015	1,1,2,2-Tetrachloroethane	044	Methylene Chloride
086	Toluene	085	Tetrachloroethylene
011	1,1,1-Trichloroethane	030	1,2-Trans-Dichloroethylene
087	Trichloroethylene	014	1,1,2-Trichloroethane

Acid Compounds

024	Chlorophenol	031	2,4-Dichlorophenol
034	2,4-Dimethylphenol	060	4,6-Dinitro-O-Cresol
059	2,4-Dinitrophenol	057	2-Nitrophenol
058	4-Nitrophenol	022	P-Chloto-M-Cresol
064	Pentachlorophenol	065	Phenol
021	2,4,6-Trichlorophenol		

Base/Neutral Compounds

001	Acenaphthene	077	Acenaphtylene
078	Anthracene	005	Benzidine
072	Benzo(a)Anthracene	073	Benzo(a)Pyrene
074	Benzo(b)Fluoranthene	079	Benzo(ghi)Perylene
075	Benzo(k)Fluoranthene	043	Bis(2-Chloroethoxy)Methane
018	Bis(2-Chloroethyl)Ether	042	Bis(2-Chloroisopropyl)Ether
017	Bis(chloromethyl)Ether	041	4-Bromophenyl Phenyl Ether
066	Bis(2-Ethylhexyl)Phthalate	020	2-Chloronaphthalene
067	Butyl Benzyl Phthalate	076	Chrysene
040	4-Chlorophenyl Phenyl Ether	025	1,2-Dichlorobenzene
082	Dibenzo(a,h)Anthracene	027	1,4-Dichlorobenzene
026	1,3-Dichlorobenzene	070	Diethyl Phthalate
028	3,3-Dichlorobenzidine	068	Di-N-Butyl Phthalate
071	Dimethyl Phthalate	036	2,6-Dinitrotoluene
035	2,4-Dinithrotoluene	037	1,2-Diphenylhydrazine (as Azobenzene)
069	Di-N-Octyl Phthalate	009	Hexachlorobenzene
039	Fluoranthene	053	Hexachlorocyclopentadiene
080	Fluorene	083	Indeno(1,2,3-cd)Pyrene
052	Hexachlorobutadiene	055	Naphthalene
012	Hexachloroethane	061	N-Nitrosodimethylamine
054	Isophorone	062	N-Nitrosodiphenylamine
056	Nitrobenzene	084	Pyrene
063	N-Nitrosodi-N-Propylamine	008	1,2,4-Trichlorobenzene
081	Phenanthrene		

PRIORITY POLLUTANTS (Continued)

Pesticides and PCBs

089	Aldrin
102	Alpha-BHC
103	Beta-BHC
092	4,4′ DDT
094	4,4′-DDD
095	Alpha-endosulfan
097	Endosulfan Sulfate
099	Endrin Aldehyde
101	Heptachlor Epoxide
107	PCB-1254
109	PCB-1232
111	PCB-1260
113	Toxaphene
104	Gamma-BHC
105	Delta-BHC
091	Chlordane
093	4,4′ DDE
090	Dieldrin
096	Beta-Endosulfan
098	Endrin
100	Heptachlor
106	PCB-1242
108	PCB-1221
110	PCB-1248
112	PCB-1016

Metals and Cyanide

114	Antimony
117	Beryllium
119	Chromium
122	Lead
124	Nickel
126	Silver
128	Zinc
115	Arsenic
118	Cadmium
120	Copper
123	Mercury
125	Selenium
127	Thallium
121	Cyanide

Miscellaneous

129	2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD)
116	Asbestos

RCRA APPENDIX IX LIST

APPENDIX IX—GROUND-WATER MONITORING LIST [1]

Common name [2]	CAS RN [3]	Chemical abstracts service index name [4]	Suggested methods [5]	PQL (μg/L) [6]
Acenaphthene	83-32-9	Acenaphthylene, 1,2-dihydro-	8100	200
			8270	10
Acenaphthylene	208-96-8	Acenaphthylene	8100	200
			8270	10
Acetone	67-64-1	2-Propanone	8240	100
Acetophenone	98-86-2	Ethanone, 1-phenyl-	8270	10
Acetonitrile; Methyl cyanide	75-05-8	Acetonitrile	8015	100
2-Acetylaminofluorene; 2-AAF	53-96-3	Acetamide, N-9H-fluoren-2-yl-	8270	10
Acrolein	107-02-8	2-Propenal	8030	5
			8240	5
Acrylonitrile	107-13-1	2-Propenenitrile	8030	5
			8240	5
Aldrin	309-00-2	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro- (1α,4α,4aβ,5α,8α,8aβ)-	8080	0.05
			8270	10
Allyl chloride	107-05-1	1-Propene, 3-chloro-	8010	5
			8240	100
4-Aminobiphenyl	92-67-1	[1,1'-Biphenyl]-4-amine	8270	10
Aniline	62-53-3	Benzenamine	8270	10
Anthracene	120-12-7	Anthracene	8100	200
			8270	10
Antimony	(Total)	Antimony	6010	300
			7040	2,000
			7041	30
Aramite	140-57-8	Sulfurous acid, 2-chloroethyl 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester	8270	10
Arsenic	(Total)	Arsenic	6010	500
			7060	10
			7061	20
Barium	(Total)	Barium	6010	20
			7080	1,000
Benzene	71-43-2	Benzene	8020	2
			8240	5
Benzo[a]anthracene; Benzanthracene	56-55-3	Benz[a]anthracene	8100	200
			8270	10
Benzo[b]fluoranthene	205-99-2	Benz[e]acephenanthrylene	8100	200
			8270	10
Benzo[k]fluoranthene	207-08-9	Benzo[k]fluoranthene	8100	200
			8270	10
Benzo[ghi]perylene	191-24-2	Benzo[ghi]perylene	8100	200
			8270	10
Benzo[a]pyrene	50-32-8	Benzo[a]pyrene	8100	200
			8270	10
Benzyl alcohol	100-51-6	Benzenemethanol	8270	20
Beryllium	(Total)	Beryllium	6010	3
			7090	50
			7091	2
alpha-BHC	319-84-6	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1α,2α,3β,4α,5β,6β)-	8080	0.05
			8250	10
beta-BHC	319-85-7	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1α,2β,3α,4β,5α,6β)-	8080	0.05
			8250	40
delta-BHC	319-86-8	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1α,2α,3α,4β,5α,6β)-	8080	0.1
			8250	30
gamma-BHC; Lindane	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-,(1α,2α,3β,4α,5α,6β)-	8080	0.05
			8250	10
Bis(2-chloroethoxy)methane	111-91-1	Ethane, 1,1'-[methylenebis (oxy)]bis[2-chloro-	8270	10
Bis(2-chloroethyl)ether	111-44-4	Ethane, 1,1'-oxybis[2-chloro-	8270	10
Bis(2-chloro-1-methylethyl) ether; 2,2'-Dichlorodiisopropyl ether	108-60-1	Propane, 2,2'-oxybis[1-chloro-	8010	100
			8270	10
Bis(2-ethylhexyl) phthalate	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl)ester	8060	20
			8270	10
Bromodichloromethane	75-27-4	Methane, bromodichloro-	8010	1
			8240	5
Bromoform; Tribromomethane	75-25-2	Methane, tribromo-	8010	2
			8240	5

APPENDIX IX—GROUND-WATER MONITORING LIST [1]—Continued

Common name [2]	CAS RN [3]	Chemical abstracts service index name [4]	Suggested methods [5]	PQL (µg/L) [6]
4-Bromophenyl phenyl ether	101-55-3	Benzene, 1-bromo-4-phenoxy-	8270	10
Butyl benzyl phthalate; Benzyl butyl phthalate	85-68-7	1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester	8060	5
			8270	10
Cadmium	(Total)	Cadmium	6010	40
			7130	50
			7131	1
Carbon disulfide	75-15-0	Carbon disulfide	8240	5
Carbon tetrachloride	56-23-5	Methane, tetrachloro-	8010	1
			8240	5
Chlordane	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-	8080	0.1
			8250	10
p-Chloroaniline	106-47-8	Benzenamine, 4-chloro-	8270	20
Chlorobenzene	108-90-7	Benzene, chloro-	8010	2
			8020	2
			8240	5
Chlorobenzilate	510-15-6	Benzeneacetic acid, 4-chloro-α-(4-chlorophenyl)-α-hydroxy-, ethyl ester	8270	10
p-Chloro-m-cresol	59-50-7	Phenol, 4-chloro-3-methyl-	8040	5
			8270	20
Chloroethane; Ethyl chloride	75-00-3	Ethane, chloro-	8010	5
			8240	10
Chloroform	67-66-3	Methane, trichloro-	8010	0.5
			8240	5
2-Chloronaphthalene	91-58-7	Naphthalene, 2-chloro-	8120	10
			8270	10
2-Chlorophenol	95-57-8	Phenol, 2-chloro-	8040	5
			8270	10
4-Chlorophenyl phenyl ether	7005-72-3	Benzene, 1-chloro-4-phenoxy-	8270	10
Chloroprene	126-99-8	1,3-Butadiene, 2-chloro-	8010	50
			8240	5
Chromium	(Total)	Chromium	6010	70
			7190	500
			7191	10
Chrysene	218-01-9	Chrysene	8100	200
			8270	10
Cobalt	(Total)	Cobalt	6010	70
			7200	500
			7201	10
Copper	(Total)	Copper	6010	60
			7210	200
m-Cresol	108-39-4	Phenol, 3-methyl-	8270	10
o-Cresol	95-48-7	Phenol, 2-methyl-	8270	10
p-Cresol	106-44-5	Phenol, 4-methyl-	8270	10
Cyanide	57-12-5	Cyanide	9010	40
2,4-D; 2,4-Dichlorophenoxyacetic acid	94-75-7	Acetic acid, (2,4-dichlorophenoxy)-	8150	10
4,4'-DDD	72-54-8	Benzene 1,1'-(2,2-dichloroethylidene)bis(4-chloro-	8080	0.1
			8270	10
4,4'-DDE	72-55-9	Benzene 1,1'-(dichloroethylidene)bis(4-chloro-	8080	0.05
			8270	10
4,4'-DDT	50-29-3	Benzene 1,1'-(2,2,2-trichloroethylidene)bis(4-chloro-	8080	0.1
			8270	10
Diallate	2303-16-4	Carbamothioic acid, bis(1[illegible]thylethyl)-, S- (2,3-dichloro-2-propenyl) ester	8270	10
Dibenz[a,h]anthracene	53-70-3	Dibenz[a,h]anthracene	8100	200
			8270	10
Dibenzofuran	132-64-9	Dibenzofuran	8270	10
Dibromochloromethane; Chlorodibromomethane	124-48-1	Methane, dibromochloro-	8010	1
			8240	5
1,2-Dibromo-3-chloropropane; DBCP	96-12-8	Propane, 1,2-dibromo-3-chloro-	8010	100
			8240	5
			8270	10
1,2-Dibromoethane; Ethylene dibromide	106-93-4	Ethane, 1,2-dibromo-	8010	10
			8240	5
Di-n-butyl phthalate	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester	8060	5
			8270	10
o-Dichlorobenzene	95-50-1	Benzene, 1,2-dichloro-	8010	2
			8020	5
			8120	10
			8270	10

APPENDIX IX—GROUND-WATER MONITORING LIST[1]—Continued

Common name[2]	CAS RN[3]	Chemical abstracts service index name[4]	Suggested methods[5]	PQL (μg/L)[6]
m-Dichlorobenzene	541-73-1	Benzene, 1,3-dichloro-	8010 8020 8120 8270	5 5 10 10
p-Dichlorobenzene	106-46-7	Benzene, 1,4-dichloro-	8010 8020 8120 8270	2 5 15 10
3,3'-Dichlorobenzidine	91-94-1	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-	8270	20
trans-1,4-Dichloro-2-butene	110-57-6	2-Butene, 1,4-dichloro-, (E)-	8240	5
Dichlorodifluoromethane	75-71-8	Methane, dichlorodifluoro-	8010 8240	10 5
1,1-Dichloroethane	75-34-3	Ethane, 1,1-dichloro-	8010 8240	1 5
1,2-Dichloroethane; Ethylene dichloride	107-06-2	Ethane, 1,2-dichloro-	8010 8240	0.5 5
1,1-Dichloroethylene; Vinylidene chloride	75-35-4	Ethene, 1,1-dichloro-	8010 8240	1 5
trans-1,2-Dichloroethylene	156-60-5	Ethene, 1,2-dichloro-, (E)-	8010 8240	1 5
2,4-Dichlorophenol	120-83-2	Phenol, 2,4-dichloro-	8040 8270	5 10
2,6-Dichlorophenol	87-65-0	Phenol, 2,6-dichloro-	8270	10
1,2-Dichloropropane	78-87-5	Propane, 1,2-dichloro-	8010 8240	0.5 5
cis-1,3-Dichloropropene	10061-01-5	1-Propene, 1,3-dichloro-, (Z)-	8010 8240	20 5
trans-1,3-Dichloropropene	10061-02-6	1-Propene, 1,3-dichloro-, (E)-	8010 8240	5 5
Dieldrin	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα,2β,2aα,3β,6β,6aα,7β,7aα)-	8080 8270	0.05 10
Diethyl phthalate	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester	8060 8270	5 10
O,O-Diethyl O-2-pyrazinyl phosphorothioate; Thionazin	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester	8270	10
Dimethoate	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester	8270	10
p-(Dimethylamino)azobenzene	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-	8270	10
7,12-Dimethylbenz[a]anthracene	57-97-6	Benz[a]anthracene, 7,12-dimethyl-	8270	10
3,3'-Dimethylbenzidine	119-93-7	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-	8270	10
alpha, alpha-Dimethylphenethylamine	122-09-8	Benzeneethanamine, α,α-dimethyl-	8270	10
2,4-Dimethylphenol	105-67-9	Phenol, 2,4-dimethyl-	8040 8270	5 10
Dimethyl phthalate	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester	8060 8270	5 10
m-Dinitrobenzene	99-65-0	Benzene, 1,3-dinitro-	8270	10
4,6-Dinitro-o-cresol	534-52-1	Phenol, 2-methyl-4,6-dinitro-	8040 8270	150 50
2,4-Dinitrophenol	51-28-5	Phenol, 2,4-dinitro-	8040 8270	150 50
2,4-Dinitrotoluene	121-14-2	Benzene, 1-methyl-2,4-dinitro-	8090 8270	0.2 10
2,6-Dinitrotoluene	606-20-2	Benzene, 2-methyl-1,3-dinitro-	8090 8270	0.1 10
Dinoseb; DNBP; 2-sec-Butyl-4,6-dinitrophenol	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-	8150 8270	1 10
Di-n-octyl phthalate	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester	8060 8270	30 10
1,4-Dioxane	123-91-1	1,4-Dioxane	8015	150
Diphenylamine	122-39-4	Benzenamine, N-phenyl-	8270	10
Disulfoton	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)- S-[2-ethyl]ester	8140 8270	2 10
Endosulfan I	959-98-8	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3α,5aβ,6α,9α,9aβ)-	8080 8250	0.1 10

APPENDIX IX—GROUND-WATER MONITORING LIST [1]—Continued

Common name [2]	CAS RN [3]	Chemical abstracts service index name [4]	Suggested methods [5]	PQL (μg/L) [6]
Endosulfan II	33213-65-9	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro- 1,5,5a,6,9,9a-hexahydro-, 3-oxide, (3α,5aα,6β,9β,9aα)-	8080	0.05
Endosulfan sulfate	1031-07-8	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro- 1,5,5a,6,9,9a-hexahydro-, 3,3-dioxide.	8080 8270	0.5 10
Endrin	72-20-8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aα, 2β,2aβ,3α,6α, 6aβ,7β,7aα)-	8080 8250	0.1 10
Endrin aldehyde	7421-93-4	1,2,4-Methenocyclopenta[cd]pentalene-5-carboxaldehyde, 2,2a,3,3,4,7-hexachlorodecahydro-, (1α,2β,2aβ,4β,4aβ,5β,6aβ,6bβ,7R*)-	8080 8270	0.2 10
Ethylbenzene	100-41-4	Benzene, ethyl-	8020 8240	2 5
Ethyl methacrylate	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester	8015 8240 8270	10 5 10
Ethyl methanesulfonate	62-50-0	Methanesulfonic acid, ethyl ester	8270	10
Famphur	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl]-O,O-dimethyl ester	8270	10
Fluoranthene	206-44-0	Fluoranthene	8100 8270	200 10
Fluorene	86-73-7	9H-Fluorene	8100 8270	200 10
Heptachlor	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-	8080 8270	0.05 10
Heptachlor epoxide	1024-57-3	2,5-Methano-2H-indeno[1,2-b]oxirene, 2,3,4,5,6,7,7-heptachloro-1a,1b,5,5a,6,6a,-hexahydro-, (1aα,1bβ,2α,5α,5aβ,6β,6aα)	8080 8270	1 10
Hexachlorobenzene	118-74-1	Benzene, hexachloro-	8120 8270	0.5 10
Hexachlorobutadiene	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	8120 8270	5 10
Hexachlorocyclopentadiene	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	8120 8270	5 10
Hexachloroethane	67-72-1	Ethane, hexachloro-	8120 8270	0.5 10
Hexachlorophene	70-30-4	Phenol, 2,2'-methylenebis[3,4,6-trichloro-	8270	10
Hexachloropropene	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-	8270	10
2-Hexanone	591-78-6	2-Hexanone	8240	50
Indeno(1,2,3-cd)pyrene	193-39-5	Indeno[1,2,3-cd]pyrene	8100 8270	200 10
Isobutyl alcohol	78-83-1	1-Propanol, 2-methyl	8015	50
Isodrin	465-73-6	1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a hexahydro-(1α,4α,4aβ,5β,8β,8aβ)-	8270	10
Isophorone	78-59-1	2-Cyclohexen-1-one, 3,5,5-trimethyl-	8090 8270	60 10
Isosafrole	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-	8270	10
Kepone	143-50-0	1,3,4-Metheno-2H-cyclobuta- [cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-	8270	10
Lead	(Total)	Lead	6010 7420 7421	40 1,000 10
Mercury	(Total)	Mercury	7470	2
Methacrylonitrile	126-98-7	2-Propenenitrile, 2-methyl-	8015 8240	5 5
Methapyrilene	91-80-5	1,2,Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-	8270	10
Methoxychlor	72-43-5	Benzene, 1,1'-(2,2,2,trichloroethylidene)bis[4-methoxy-	8080 8270	2 10
Methyl bromide; Bromomethane	74-83-9	Methane, bromo-	8010 8240	20 10
Methyl chloride; Chloromethane	74-87-3	Methane, chloro-	8010 8240	1 10
3-Methylcholanthrene	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-	8270	10
Methylene bromide; Dibromomethane	74-95-3	Methane, dibromo-	8010 8240	15 5
Methylene chloride; Dichloromethane	75-09-2	Methane, dichloro-	8010 8240	5 5

APPENDIX IX—GROUND-WATER MONITORING LIST [1]—Continued

Common name [2]	CAS RN [3]	Chemical abstracts service index name [4]	Suggested methods [5]	PQL (µg/L) [6]
Methyl ethyl ketone; MEK	78-93-3	2-Butanone	8015	10
			8240	100
Methyl iodide; Iodomethane	74-88-4	Methane, iodo-	8010	40
			8240	5
Methyl methacrylate	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester	8015	2
			8240	5
Methyl methanesulfonate	66-27-3	Methanesulfonic acid, methyl ester	8270	10
2-Methylnaphthalene	91-57-6	Naphthalene, 2-methyl-	8270	10
Methyl parathion; Parathion methyl	298-00-0	Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester	8140	0.5
			8270	10
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	2-Pentanone, 4-methyl-	8015	5
			8240	50
Naphthalene	91-20-3	Naphthalene	8100	200
			8270	10
1,4-Naphthoquinone	130-15-4	1,4-Naphthalenedione	8270	10
1-Naphthylamine	134-32-7	1-Naphthalenamine	8270	10
2-Naphthylamine	91-59-8	2-Naphthalenamine	8270	10
Nickel	(Total)	Nickel	6010	50
			7520	400
o-Nitroaniline	88-74-4	Benzenamine, 2-nitro-	8270	50
m-Nitroaniline	99-09-2	Benzenamine, 3-nitro-	8270	50
p-Nitroaniline	100-01-6	Benzenamine, 4-nitro-	8270	50
Nitrobenzene	98-95-3	Benzene, nitro-	8090	40
			8270	10
o-Nitrophenol	88-75-5	Phenol, 2-nitro-	8040	5
			8270	10
p-Nitrophenol	100-02-7	Phenol, 4-nitro-	8040	10
			8270	50
4-Nitroquinoline 1-oxide	56-57-5	Quinoline, 4-nitro-, 1-oxide	8270	10
N-Nitrosodi-n-butylamine	924-16-3	1-Butanamine, N-butyl-N-nitroso-	8270	10
N-Nitrosodiethylamine	55-18-5	Ethanamine, N-ethyl-N-nitroso-	8270	10
N-Nitrosodimethylamine	62-75-9	Methanamine, N-methyl-N-nitroso-	8270	10
N-Nitrosodiphenylamine	86-30-6	Benzenamine, N-nitroso-N-phenyl-	8270	10
N-Nitrosodipropylamine; Di-n-propylnitrosamine	621-64-7	1-Propanamine, N-nitroso-N-propyl-	8270	10
N-Nitrosomethylethylamine	10595-95-6	Ethanamine, N-methyl-N-nitroso-	8270	10
N-Nitrosomorpholine	59-89-2	Morpholine, 4-nitroso-	8270	10
N-Nitrosopiperidine	100-75-4	Piperidine, 1-nitroso-	8270	10
N-Nitrosopyrrolidine	930-55-2	Pyrrolidine, 1-nitroso-	8270	10
5-Nitro-o-toluidine	99-55-8	Benzenamine, 2-methyl-5-nitro-	8270	10
Parathion	56-38-2	Phosphorothioic acid, O,O-diethyl-O-(4-nitrophenyl) ester	8270	10
Polychlorinated biphenyls; PCBs	See Note 7	1,1'-Biphenyl, chloro derivatives	8080	50
			8250	100
Polychlorinated dibenzo-p-dioxins; PCDDs	See Note 8	Dibenzo[b,e][1,4]dioxin, chloro derivatives	8280	0.01
Polychlorinated dibenzofurans; PCDFs	See Note 9	Dibenzofuran, chloro derivatives	8280	0.01
Pentachlorobenzene	608-93-5	Benzene, pentachloro-	8270	10
Pentachloroethane	76-01-7	Ethane, pentachloro-	8240	5
			8270	10
Pentachloronitrobenzene	82-68-8	Benzene, pentachloronitro-	8270	10
Pentachlorophenol	87-86-5	Phenol, pentachloro-	8040	5
			8270	50
Phenacetin	62-44-2	Acetamide, N-(4-ethoxyphenyl)	8270	10
Phenanthrene	85-01-8	Phenanthrene	8100	200
			8270	10
Phenol	108-95-2	Phenol	8040	1
			8270	10
p-Phenylenediamine	106-50-3	1,4-Benzenediamine	8270	10
Phorate	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester	8140	2
			8270	10
2-Picoline	109-06-8	Pyridine, 2-methyl-	8240	5
			8270	10
Pronamide	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-	8270	10
Propionitrile; Ethyl cyanide	107-12-0	Propanenitrile	8015	60
			8240	5
Pyrene	129-00-0	Pyrene	8100	200
			8270	10
Pyridine	110-86-1	Pyridine	8240	5
			8270	10

APPENDIX IX—GROUND-WATER MONITORING LIST [1]—Continued

Common name [2]	CAS RN [3]	Chemical abstracts service index name [4]	Suggested methods [5]	PQL (µg/L) [6]
Safrole	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-	8270	10
Selenium	(Total)	Selenium	6010	750
			7740	20
			7741	20
Silver	(Total)	Silver	6010	70
			7760	100
Silvex; 2,4,5-TP	93-72-1	Propanoic acid, 2-(2,4,5-trichlorophenoxy)-	8150	2
Styrene	100-42-5	Benzene, ethenyl-	8020	1
			8240	5
Sulfide	18496-25-8	Sulfide	9030	10,000
2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-	8150	2
2,3,7,8-TCDD; 2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	Dibenzo[b,e][1,4]dioxin, 2,3,7,8-tetrachloro-	8280	0.005
1,2,4,5-Tetrachlorobenzene	95-94-3	Benzene, 1,2,4,5-tetrachloro-	8270	10
1,1,1,2-Tetrachloroethane	630-20-6	Ethane, 1,1,1,2-tetrachloro-	8010	5
			8240	5
1,1,2,2-Tetrachloroethane	79-34-5	Ethane, 1,1,2,2-tetrachloro-	8010	0.5
			8240	5
Tetrachloroethylene; Perchloroethylene; Tetrachloroethene	127-18-4	Ethene, tetrachloro-	8010	0.5
			8240	5
2,3,4,6-Tetrachlorophenol	58-90-2	Phenol, 2,3,4,6-tetrachloro-	8270	10
Tetraethyl dithiopyrophosphate; Sulfotepp	3689-24-5	Thiodiphosphoric acid ([(HO)$_2$P(S)]$_2$O), tetraethyl ester	8270	10
Thallium	(Total)	Thallium	6010	400
			7840	1,000
			7841	10
Tin	(Total)	Tin	7870	8,000
Toluene	108-88-3	Benzene, methyl-	8020	2
			8240	5
o-Toluidine	95-53-4	Benzenamine, 2-methyl-	8270	10
Toxaphene	8001-35-2	Toxaphene	8080	2
			8250	10
1,2,4-Trichlorobenzene	120-82-1	Benzene, 1,2,4-trichloro-	8270	10
1,1,1-Trichloroethane; Methylchloroform	71-55-6	Ethane, 1,1,1-trichloro-	8240	5
1,1,2-Trichloroethane	79-00-5	Ethane, 1,1,2-trichloro-	8010	0.2
			8240	5
Trichloroethylene; Trichloroethene	79-01-6	Ethene, trichloro-	8010	1
			8240	5
Trichlorofluoromethane	75-69-4	Methane, trichlorofluoro-	8010	10
			8240	5
2,4,5-Trichlorophenol	95-95-4	Phenol, 2,4,5-trichloro-	8270	10
2,4,6-Trichlorophenol	88-06-2	Phenol, 2,4,6-trichloro-	8040	5
			8270	10
1,2,3-Trichloropropane	96-18-4	Propane, 1,2,3-trichloro-	8010	10
			8240	5
O,O,O-Triethyl phosphorothioate	126-68-1	Phosphorothioic acid, O,O,O-triethyl ester	8270	10
sym-Trinitrobenzene	99-35-4	Benzene, 1,3,5-trinitro-	8270	10
Vanadium	(Total)	Vanadium	6010	80
			7910	2,000
			7911	40
Vinyl acetate	108-05-4	Acetic acid, ethenyl ester	8240	5
Vinyl chloride	75-01-4	Ethene, chloro-	8010	2
			8240	10
Xylene (total)	1330-20-7	Benzene, dimethyl-	8020	5
			8240	5
Zinc	(Total)	Zinc	6010	20
			7950	50

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[1] The regulatory requirements pertain only to the list of substances; the right hand columns (Methods and PQL) are given for informational purposes only. See also footnotes 5 and 6.

[2] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

[3] Chemical Abstracts Service registry number. Where "Total" is entered, all species in the ground water that contain this element are included.

[4] CAS index names are those used in the 9th Cumulative Index.

[5] Suggested Methods refer to analytical procedure numbers used in EPA Report SW-846 "Test Methods for Evaluating Solid Waste", third edition, November 1986. Analytical details can be found in SW-846 and in documentation on file at the agency. CAUTION: The methods listed are representative SW-846 procedures and may not always be the most suitable method(s) for monitoring an analyte under the regulations.

[6] Practical Quantitation Limits (PQLs) are the lowest concentrations of analytes in ground waters that can be reliably determined within specified limits of precision and accuracy by the indicated methods under routine laboratory operating conditions. The PQLs listed are generally

stated to one significant figure. CAUTION: The PQL values in many cases are based only on a general estimate for the method and not on a determination for individual compounds. PQLs are not a part of the regulation.

[1] Polychlorinated biphenyls (CAS RN 1336-36-3); this category contains congener chemicals, including constituents of Aroclor-1016 (CAS RN 12674-11-2), Aroclor-1221 (CAS RN 11104-28-2), Aroclor-1232 (CAS RN 11141-16-5), Aroclor-1242 (CAS RN 53469-21-9), Aroclor-1248 (CAS RN 12672-29-6), Aroclor-1254 (CAS RN 11097-69-1), and Aroclor-1260 (CAS RN 11096-82-5). The PQL shown is an average value for PCB congeners.

[2] This category contains congener chemicals, including tetrachlorodibenzo-p-dioxins (see also 2,3,7,8-TCDD), pentachlorodibenzo-p-dioxins, and hexachlorodibenzo-p-dioxins. The PQL shown is an average value for PCDD congeners.

[3] This category contains congener chemicals, including tetrachlorodibenzofurans, pentachlorodibenzofurans, and hexachlorodibenzofurans. The PQL shown is an average value for PCDF congeners.

PART 270—AMENDED

1. The authority citation for Part 270 is revised to read as follows:

Authority: Secs. 1006, 2002(a), 3001, 3004, and 3005, of the Solid Waste Disposal Act, as amended, 42 U.S.C. 6905, 6912(a), 6924 and 6925.

2. Section 270.14 is amended by revising paragraph (c)(4)(ii) to read as follows:

§ 270.14 Contents of Part B: general requirements.

* * * * *

(c) * * *

(4) * * *

(ii) Identifies the concentration of each Appendix IX, of Part 264 of this chapter, constituent throughout the plume or identifies the maximum concentrations of each Appendix IX constituent in the plume.

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APPENDIX I

LOCAL LIMITS DERIVATION EXAMPLE

APPENDIX I

LOCAL LIMITS DERIVATION EXAMPLE

In this appendix, local limits for a hypothetical POTW are derived. This POTW is a conventional activated sludge plant, with anaerobic sludge digestion. POTW characteristics are as follows:

- POTW influent flow = 3.35 MGD
- POTW sludge flow to disposal = 0.01 MGD
- POTW sludge flow to digester = 0.015 MGD
- Percent solids of sludge to disposal = 7.5%
- Receiving stream flow = 47 MGD (7Q10)
  26 MGD (1Q10)

In the first section of this appendix, local limits will be derived for four metals. The second section of this appendix discusses the identification of organic pollutants of concern, and details the calculation of local limits for these organic pollutants.

DERIVATION OF LOCAL LIMITS FOR METALS

The derivation of local limits for metals (cadmium, chromium, copper and lead have been selected as representative) is demonstrated in this section. The methodology for deriving local limits for these metals entails:

- Acquisition of representative removal efficiency data
- Identification of applicable treatment plant/environmental criteria and conversion of criteria into allowable headworks loadings
- Allocation of maximum allowable headworks loadings to domestic and industrial sources, thereby setting local limits

Representative Removal Efficiency Data

Representative removal efficiency data are crucial to the development of allowable headworks loadings. In this section, the acquisition of representative metal pollutant removal efficiencies for the hypothetical POTW is discussed.

The POTW has monitored its effluent and sludge for the metals cadmium and copper on a monthly basis over the past year. Tables I-1 and I-2 present these monthly effluent and sludge monitoring data, respectively. Corresponding monthly removal efficiency data can be derived from the monthly effluent and sludge monitoring data shown in Tables I-1 and I-2. In order to derive removal efficiencies from the Table I-1 and I-2 data, the following equation can be used:

$$R_{EFF} = \frac{(C_{SLDG})\ (PS/100)\ (Q_{SLDG})\ (100)}{(C_{SLDG})\ (PS/100)\ (Q_{SLDG}) + (C_{EFF})\ (Q_{POTW})}$$

where: R_{EFF} = POTW removal efficiency, percent
C_{SLDG} = Sludge level, mg/kg dry sludge
PS = Percent solids of sludge to disposal
Q_{SLDG} = Sludge flow to disposal, MGD
C_{EFF} = POTW effluent level, mg/l
Q_{POTW} = POTW flow, MGD

This removal efficiency expression was derived from the removal efficiency equation for metals presented in Section 3.2.4. The above equation is based upon the assumption for metals that the POTW influent pollutant loading is equal to the sum of the POTW's effluent and sludge pollutant loadings.

Table I-3 presents site-specific removal efficiencies derived from the above removal efficiency equation, the Table I-1 and I-2 data, and the following POTW operational data:

- POTW flow = 3.35 MGD
- Sludge flow to disposal = 0.01 MGD
- Percent solids of sludge to disposal = 7.5%

TABLE I-1. MONTHLY POTW EFFLUENT MONITORING DATA FOR METALS (MG/L)

Pollutant	Detection Limit*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cd	0.001	ND**	ND	ND	ND	0.03	ND	ND	0.02	ND	ND	0.27	ND
Cu	0.001	0.10	0.06	0.09	0.02	0.14	0.02	0.05	0.06	0.03	0.06	0.13	0.07

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*From "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," USEPA Environmental Monitoring and Support Laboratory, Cincinnati, OH, July 1982 (EPA 600/4-82-057).

**ND = Not detected.

TABLE I-2. MONTHLY DIGESTED SLUDGE MONITORING DATA FOR METALS (MG/KG DRY SLUDGE)

Pollutant	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cd	55.	50.	35.	44.	60.	65.	26.	30.	30.	11.	42.	26.
Cu	205.	185.	200.	340.	325.	340.	150.	120.	410.	80.	240.	16.

TABLE I-3. MONTHLY REMOVAL EFFICIENCY DATA FOR METALS (PERCENT)

Pollutant	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cd	96	96	94	95	31	97	92	25	93	83	3	92
Cu	31	41	33	79	34	79	40	31	75	23	29	5

Notes: Calculated using data in Tables I-1 and I-2. Pollutant levels indicated in Table I-1 as below detection were set equal to one-half the detection limit.

As surrogates for Table I-1 pollutant levels designated as below detection, pollutant levels corresponding to one-half the analytical detection limit (i.e., Cd = 0.0005 mg/l) were used in the removal efficiency calculations.

Section 3.2.4.2 of the manual suggests the use of removal efficiency deciles in deriving allowable headworks loadings. Following these procedures, the second and eighth removal efficiency deciles for cadmium and copper can be obtained from the Table I-3 removal efficiency data. Table I-4 presents second and eighth decile removal efficiency data for these two pollutants, as well as literature decile removal efficiency data for the additional metals chromium and lead. The removal efficiencies shown in this table will be used in deriving allowable headworks loadings for the four metals.

Removal efficiencies for the four metals across primary treatment will also be needed, to derive allowable headworks loadings based on activated sludge inhibition threshold data. The POTW conducted an additional monitoring effort to obtain representative primary removal efficiencies for the four metals. The result of this effort is the median primary removal efficiency data shown in Table I-5. Primary removals varied only slightly from month to month; as a consequence, the POTW elected to use median primary removals and did not consider the use of the removal efficiency decile approach to be necessary.

Derivation of Allowable Headworks Loadings

Having obtained removal efficiency data, allowable headworks loadings are now derived, based on the following treatment plant/environmental criteria:

- NPDES permit limits
- Water quality standards
- Activated sludge inhibition data
- Anaerobic digester inhibition data
- Sludge disposal criteria

TABLE I-4. REPRESENTATIVE REMOVAL EFFICIENCIES FOR THE HYPOTHETICAL POTW

Pollutant	Second Decile Removal	Eighth Decile Removal
Cd	29%	96%
Cr	68%*	91%*
Cu	27%	77%
Pb	39%*	76%*

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*Literature value from Table 3-9.

TABLE I-5. REPRESENTATIVE PRIMARY TREATMENT REMOVAL EFFICIENCES FOR THE HYPOTHETICAL POTW

Pollutant	Median Removal Across Primary Treatment
Cd	21%
Cr	31%
Cu	23%
Pb	12%

The derivation of allowable headworks loadings on each of the above-listed bases are discussed in this section.

NPDES Permit Limits

The following equation is used to derive allowable headworks loadings based on NPDES permit limits (from Section 3.2.1.1 of the manual):

$$L_{IN} = \frac{(8.34)(C_{CRIT})(Q_{POTW})}{(1-R_{POTW})}$$

where:

L_{IN} = Allowable headworks loading, lbs/d

C_{CRIT} = NPDES permit limit, mg/l

Q_{POTW} = POTW flow, MGD

R_{POTW} = Removal efficiency across POTW based on second decile

The hypothetical POTW has only one metal pollutant NPDES permit limit, a 0.5 mg/l limit for cadmium. To calculate the corresponding allowable headworks loading of cadmium for the hypothetical POTW, the following values have been established: C_{CRIT} = 0.5 mg/l, Q_{POTW} = 3.35 MGD, and R_{POTW} = 0.29 (from Table I-4). Thus, the allowable headworks loading for cadmium, based on the NPDES permit limit, is:

$$L_{IN} = \frac{(8.34)(0.5)(3.35)}{(1-0.29)} = 19.7 \text{ lbs/d}$$

Water Quality Standards

The following equations are used to derive allowable headworks loadings based on water quality standards (from Section 3.2.1.2 of the manual):

$$L_{IN/C} = \frac{(8.34)[C_{CWQ}(Q_{7Q10} + Q_{POTW})-(C_{STR}Q_{7Q10})]}{(1-R_{POTW})}$$

$$L_{IN/A} = \frac{(8.34)[C_{AWQ}(Q_{1Q10} + Q_{POTW})-(C_{STR}Q_{1Q10})]}{(1-R_{POTW})}$$

where: $L_{IN/C}$ = Allowable headworks loading based on chronic toxicity standard, lbs/d

$L_{IN/A}$ = Allowable headworks loading based on acute toxicity standard, lbs/d

C_{CWQ} = Chronic toxicity standard, mg/l

C_{AWQ} = Acute toxicity standard, mg/l

Q_{7Q10} = Lowest 7-day average receiving stream flow over the past 10 years, MGD

Q_{1Q10} = Lowest single day receiving stream flow over the past 10 years, MGD

Q_{POTW} = POTW flow, MGD

C_{STR} = Background (upstream) pollutant level in receiving stream, mg/l

R_{POTW} = Removal efficiency across POTW based on second decile

The POTW contacted the State environmental agency and obtained the following receiving stream flow data for deriving allowable headworks loadings based on water quality standards:

Q_{7Q10} = 47 MGD

Q_{1Q10} = 26 MGD

The POTW also obtained from the State agency the applicable water quality standards and receiving stream background level data presented in Table I-6. The Table I-6 water quality standards are converted into corresponding allowable headworks loadings, by means of the above equations. These calculations are illustrated below for cadmium:

$$L_{IN/C} = \frac{(8.34)[(0.001)(47 + 3.35)-(0)(47)]}{(1-0.29)} = 0.59 \text{ lbs/d}$$

$$L_{IN/A} = \frac{(8.34)[(0.005)(26 + 3.35)-(0)(26)]}{(1-0.29)} = 1.72 \text{ lbs/d}$$

TABLE I-6. WATER QUALITY STANDARDS AND RECEIVING STREAM BACKGROUND LEVELS FOR THE HYPOTHETICAL POTW

Pollutant	Chronic Water Quality Standard, mg/l	Acute Water Quality Standard, mg/l	Receiving Stream Background Level, mg/l
Cd	0.001	0.005	0.0*
Cr	0.012	0.025	0.002
Cu	0.015	0.05	0.003
Pb	0.005	0.008	0.001

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*Assumed. No data available.

The chronic toxicity-based allowable headworks loading (0.59 lbs/d) is more stringent and is selected as the POTW's overall water quality standard-based allowable headworks loading for cadmium.

The water quality standard-based allowable headworks loadings for the remaining three metals are calculated in an identical fashion. The water quality standard-based allowable headworks loadings for all four metals are listed in Table I-8.

Biological Treatment Process Inhibition

The following equations are used to derive allowable headworks loadings based on biological treatment process inhibition (from Section 3.2.2.1 of the manual):

$$L_{IN/AS} = \frac{(8.34)(C_{IN/AS})(Q_{POTW})}{(1-R_{PRIM})}$$

$$L_{IN/AD} = \frac{(8.34)(C_{IN/AD})(Q_{DIG})}{R_{POTW}}$$

where:

$L_{IN/AS}$ = Allowable headworks loading based on activated sludge process inhibition, lbs/d

$C_{IN/AS}$ = Activated sludge inhibition threshold level, mg/l

Q_{POTW} = POTW flow, MGD

R_{PRIM} = Median primary removal efficiency (Table I-5)

and:

$L_{IN/AD}$ = Allowable headworks loading based on anaerobic digester inhibition, lbs/d

$C_{IN/AD}$ = Anaerobic digester inhibition threshold level, mg/l

Q_{DIG} = Sludge flow to digester, MGD

R_{POTW} = Removal efficiency across POTW based on eighth decile (Table I-4)

The inhibition threshold levels provided in Tables 3-4 and 3-6 of the text are used in these calculations. The sludge flow to the digester (Q_{DIG}) is 0.015 MGD.

Demonstrating the use of the above equations in calculating allowable headworks loadings for cadmium:

- From Table 3-3, $C_{IN/AS} = 1$ mg/l
- From Table 3-6, $C_{IN/AD} = 20$ mg/l
- $Q_{POTW} = 3.35$ MGD
- $Q_{DIG} = 0.015$ MGD
- $R_{PRIM} = 0.21$ (Table I-5)
- $R_{POTW} = 0.96$ (Table I-4)

$$L_{IN/AS} = \frac{(8.34(1)(3.35)}{(1-0.21)} = 35.4 \text{ lbs/d}$$

$$L_{IN/AD} = \frac{(8.34)(20)(0.015)}{(0.96)} = 2.6 \text{ lbs/d}$$

The activated sludge and anaerobic digester inhibition-based allowable headworks loadings for all four metals are presented in Table I-8.

Sludge Disposal Criteria

The POTW land-applies 0.01 MGD of sludge (7.5% consistency) to 500 acres of cropland (soil pH = 7.0, cation exchange capacity = 12 meq/100g). The site life is estimated at 20 years. The POTW contacted the State environmental agency, which advised the POTW that the sludge disposal criteria presented in Table I-7 apply to the POTW's current sludge disposal practices.

Two sludge disposal criteria must be compared for each pollutant: 1) the sludge disposal limit taken directly from Table I-7, and 2) the corresponding sludge disposal limit based on the cumulative application limit from Table I-7. The latter sludge disposal limit is calculated from the following equation (from Section 3.2.2.2 of the manual):

$$C_{LIM(C)} = \frac{(CAR)(SA)}{(SL)(Q_{SLDG})(PS/100)(3046)}$$

where: $C_{LIM(C)}$ = Sludge disposal limit based on cumulative application rate limit, mg/kg dry sludge

CAR = Cumulative application rate limit, lbs/acre over the site life

TABLE I-7. SLUDGE DISPOSAL CRITERIA FOR LAND APPLICATION OF SLUDGE BY THE HYPOTHETICAL POTW

Pollutant	Sludge Limit, mg/kg dry weight	Cumulative Application Limit, lbs/acre
Cd	25	8.92
Cu	1000	223.1
Pb	1000	892.2

SA = Site area, acres

SL = Site life, years

Q_{SLDG} = Sludge flow to disposal, MGD

PS = Percent solids of sludge to disposal

Demonstrating the use of this equation for cadmium:

- From Table I-7, $CAR = 8.92$ lbs/acre
- $SA = 500$ acres
- $SL = 20$ years
- $Q_{SLDG} = 0.01$ MGD
- $PS = 7.5\%$

$$C_{LIM(C)} = \frac{(8.92)(500)}{(20)(0.01)(7.5/100)(3046)} = 97.6 \text{ mg/kg dry sludge}$$

Since the sludge disposal limit listed in Table I-7 (25 mg/kg) is more stringent than the above-calculated limitation, the 25 mg/kg limit should be used in deriving the sludge disposal-based allowable headworks loading for cadmium. Similar calculations show that the sludge disposal limits listed in Table I-7 are more stringent for the other two metals as well.

In order to convert a sludge disposal criterion into an allowable headworks loading, the following equation is used (from Section 3.2.2.2 of the manual):

$$L_{IN} = \frac{(8.34)(C_{SLCRIT})(PS/100)(Q_{SLDG})}{R_{POTW}}$$

where:

L_{IN} = Allowable headworks loading, lbs/d

C_{SLCRIT} = Sludge disposal criterion, mg/kg dry sludge

PS = Percent solids of sludge to disposal

Q_{SLDG} = Sludge flow to disposal, MGD

R_{POTW} = Removal efficiency across the POTW, based on eighth decile

For cadmium:

- From above, C_{SLCRIT} = 25 mg/kg
- PS = 7.5%
- Q_{SLDG} = 0.01 MGD
- From Table I-4, R_{POTW} = 0.70

$$L_{IN} = \frac{(8.34)(25)(7.5/100)(0.01)}{(0.70)} = 0.16 \text{ lbs/d}$$

Allowable headworks loadings based on sludge disposal criteria are listed in Table I-8 for the three metals.

Table I-8 presents a comparison of allowable headworks loadings for the four metals, derived on all five bases. As can be seen from Table I-8, the smallest loading for each pollutant is selected as the pollutant's maximum allowable headworks loading. Local limits are to be derived from these maximum allowable headworks loadings.

Allocating Maximum Allowable Headworks Loadings

The allocation of maximum allowable headworks loadings entails:

- Incorporation of a safety factor and subtraction of domestic/background wastewater loadings
- Allocation of resulting maximum allowable industrial loadings to individual industrial users

Four methods for allocating allowable industrial loadings are demonstrated in this section:

- Uniform concentration method
- Industrial contributory flow method
- Mass proportion method
- Selected industrial reduction method

TABLE I-8. COMPARISON OF ALLOWABLE HEADWORKS LOADINGS FOR METALS

		Allowable Headworks Loading (lbs/d) Based on:				
Pollutant	NPDES Limit	Water Quality Standard	Activated Sludge Inhibition	Anaerobic Digester Inhibition	Sludge Disposal Criterion	Maximum Allowable Headworks Loading, lbs/d
Cd	19.7	0.59	35.4	2.6	0.16	0.16
Cr	-	13.3	40.5	15.1	-	13.3
Cu	-	7.0	36.3	6.5	8.1	6.5
Pb	-	2.8	3.2	56.0	8.2	2.8

The uniform concentration method derives limits which apply to all industrial users, whereas the other three methods are IU-specific, in that derived limits only apply to those industrial users known to be discharging a given pollutant at greater than the domestic/background level.

Incorporation of a Safety Factor/Subtraction of Domestic Loadings

The following equation is used to convert maximum allowable headworks loadings into maximum allowable industrial loadings, through 1) the incorporation of a safety factor, and 2) the subtraction of the total pollutant loading from domestic/background sources:

$$L_{ALL} = (1-SF)L_{MAHL} - L_{DOM}$$

where:

L_{ALL} = Maximum allowable industrial loading, lbs/d

L_{MAHL} = Maximum allowable headworks loading, lbs/d

SF = Safety factor, decimal

L_{DOM} = Domestic/background wastewater pollutant loading, lbs/d (uniform concentration method)

or,

L_{DOM} = Domestic/unregulated wastewater pollutant loading, lbs/d (IU-specific methods)

It can be seen from the above equation that the domestic/background loading (L_{DOM}) for each pollutant depends on the allocation method selected. For the IU-specific allocation methods, IUs which do not discharge the particular pollutant are considered as background sources, discharging at normal domestic/background pollutant levels. Therefore for the IU-specific allocation methods, L_{DOM} for each pollutant includes background pollutant loadings from these IUs. As a result, L_{DOM} for the IU-specific allocation methods is greater than L_{DOM} for the uniform concentration allocation method.

Table I-9 presents a summary of industrial user and domestic/background wastewater flow, concentration, and pollutant loading data for the hypothetical POTW. The distinction between the two types of domestic/background

TABLE I-9. INDUSTRIAL USER MONITORING DATA FOR METALS

Industrial Uses	Flow, MGD	Cd		Cr		Cu		Pb	
		mg/l	lbs/d	mg/l	lbs/d	mg/l	lbs/d	mg/l	lbs/d
Chemical Manufacturer	0.5	0.0018*	-	0.023*	-	0.40	1.67	0.011*	-
Equipment Rebuilder	0.085	0.010	0.007	2.24	1.59	0.20	0.14	3.75	2.66
Ceramic Manufacturer	0.155	0.0015*	-	0.85	1.10	0.05*	-	1.25	1.62
Total Industrial	0.74		0.007		2.69		1.81		4.28
Domestic Wastewater	2.61	0.002	0.044	0.075	1.63	0.080	1.74	0.015	0.33
Domestic Plus Unregulated Wastewater			0.054		1.95		1.84		0.39

---

*Pollutant level less than domestic wastewater level. IU discharge flow is considered part of the unregulated wastewater flow for the pollutant.

wastewater loadings is evident from the Table I-9 data; the domestic/background loadings for the IU-specific method are increased to account for industrial user background loadings. The amount of this increase equals the flow from those industries not discharging the pollutant times the domestic wastewater background concentration.

The calculation of maximum allowable industrial loadings, using domestic/background pollutant loading data from Table I-9, is demonstrated below for cadmium:

- From Table I-8, L_{MAHL} = 0.16 lbs/d
- From Table I-9, L_{DOM} = 0.044 lbs/d (Uniform Concentration Method)
- From Table I-9, L_{DOM} = 0.054 lbs/d (IU-specific methods)
- SF = 0.10 (ten percent safety factor assumed)

$$L_{ALL} = (1-0.10)(0.16) - 0.044 = 0.10 \text{ lbs/d (Uniform Concentration Method)}$$

$$L_{ALL} = (1-0.10)(0.16) - 0.054 = 0.09 \text{ lbs/d (IU-specific methods)}$$

Table I-10 presents maximum allowable industrial loadings for the four metals. These loadings were derived from the above equation, incorporating a ten percent safety factor and using the domestic/background pollutant loading data presented in Table I-9.

Allocation of Maximum Allowable Industrial Loadings

Table I-11 to I-13 present local limits for each of the hypothetical POTW's industrial users, derived by application of the four industrial loading allocation methods discussed in Chapter 3 of the manual. The equations and calculations pertinent to the derivation of these local limits are discussed in the following sections.

Uniform Concentration Allocation Method

The uniform allocation method derives local limits which apply to all three of the hypothetical POTW's industrial users. The equation for this method is (from Figure 3-2 of the manual):

$$C_{LIM} = \frac{L_{ALL}}{(8.34)(Q_{IND})}$$

TABLE I-10. MAXIMUM ALLOWABLE INDUSTRIAL LOADINGS, LBS/D

Pollutant	Uniform Concentration Method	IU-Specific Allocation Methods
Cd	0.10	0.09
Cr	10.34	10.02
Cu	4.11	4.01
Pb	2.19	2.13

TABLE I-11. LOCAL LIMITS FOR THE HYPOTHETICAL CHEMICAL MANUFACTURER

	Local Limit, mg/l			
Pollutant	Uniform Concentration	Industrial Contributory*	Mass Proportion*	Selected Industrial Reduction**
Cd	0.02	-	-	-
Cr	1.68	-	-	-
Cu	0.67	0.82	0.89	-
Pb	0.35	-	-	-

---

*Local limits not derived for pollutants discharged by the IU at levels below the domestic sewage background concentration. The IU would be notified that it is not allowed to increase its discharge above the domestic sewage background level.

**Calculation of limits by the selected industrial reduction method is illustrated for lead only.

TABLE I-12. LOCAL LIMITS FOR HYPOTHETICAL EQUIPMENT REBUILDER

	Local Limit, mg/l			
Pollutant	Uniform Concentration	Industrial Contributory*	Mass Proportion*	Selected Industrial Reduction**
Cd	0.02	0.13	0.13	-
Cr	1.68	5.01	8.35	-
Cu	0.67	0.82	0.44	-
Pb	0.35	1.06	1.87	1.0

---

*Local limits not derived for pollutants discharged by the IU at levels below the domestic sewage background concentration. The IU would be notified that it is not allowed to increase its discharge above the domestic sewage background level.

**Calculation of limits by the selected industrial reduction method is illustrated for lead only.

TABLE I-13. LOCAL LIMITS FOR HYPOTHETICAL CERAMIC MANUFACTURER

Industrial User:

	Local Limit, mg/l			
Pollutant	Uniform Concentration	Industrial Contributory*	Mass Proportion*	Selected Industrial Reduction**
Cd	0.02	-	-	-
Cr	1.68	5.01	3.17	-
Cu	0.67	-	-	-
Pb	0.35	1.06	0.62	1.0

---

*Local limits not derived for pollutants discharged by the IU at levels below the domestic sewage background concentration. The IU would be notified that it is not allowed to increase its discharge above the domestic sewage background level.

**Calculation of limits by the selected industrial reduction method is illustrated for lead only.

where: C_{LIM} = Uniform concentration limit, mg/l

L_{ALL} = Maximum allowable industrial loading, lbs/d

Q_{IND} = Total industrial flow, MGD

As an example, for chromium:

L_{ALL} = 10.34 lbs/d (See Table I-10)

Q_{IND} = 0.74 MGD (Table I-9)

$$C_{LIM} = \frac{(10.34)}{(8.34)(0.74)} = 1.68 \text{ mg/l}$$

This limit applies to all three industrial users of the hypothetical POTW (See Tables I-11 to I-13).

Industrial Contributory Flow Method

The industrial contributory flow method derives local limits which apply only to those industrial users discharging the particular pollutant at greater than the normal background concentration in domestic sewage. The equation for this method is (from Figure 3-2 of the manual):

$$C_{LIM} = \frac{L_{ALL}}{(8.34)(Q_{CONT})}$$

where:

C_{LIM} = Industrial contributory flow-based limit, mg/l

L_{ALL} = Maximum allowable industrial loading, lbs/d

Q_{CONT} = Industrial contributory flow, MGD

As an example, for chromium:

L_{ALL} = 10.02 lbs/d (See Table I-10)

Q_{CONT} = flow from chromium dischargers = 0.085 + 0.155 = 0.24 MGD (See Table I-9)

$$C_{LIM} = \frac{10.02}{(8.34)(0.24)} = 5.01 \text{ mg/l}$$

This limit applies only to the hypothetical equipment rebuilding and ceramic manufacturing industrial users. (See Tables I-11 to I-13).

Mass Proportion Method

The mass proportion method allocates allowable industrial loadings to individual IUs in direct proportion to each IU's current pollutant loading. This allocation method is also IU-specific. The equation for this method is (from Figure 3-2 of the manual):

$$C_{LIM(x)} = \frac{(L_{CURR(x)}/L_{CURR(t)})}{(8.34)(Q_{(x)})} \times L_{ALL}$$

where:

$C_{LIM(x)}$ = Local limit for industrial user (x), mg/l

L_{ALL} = Maximum allowable industrial loading, lbs/d

$L_{CURR(x)}$ = Current loading from industrial user (x), lbs/d

$L_{CURR(t)}$ = Total industrial loading, lbs/d

$Q_{(x)}$ = Industrial user (x) discharge flow, MGD

As an example, for chromium:

L_{ALL} = 10.02 lbs/d (Table I-10)

$L_{CURR(t)}$ = 2.69 lbs/d (Table I-9)

Equipment Rebuilder:

$L_{CURR(x)}$ = 1.59 lbs/d

$Q_{(x)}$ = 0.085 MGD

$$C_{LIM(x)} = \frac{(1.59/2.69)}{(8.34)(0.085)} \times (10.02) = 8.35 \text{ mg/l}$$

Ceramic Manufacturer:

$L_{CURR(x)}$ = 1.10 lbs/d

$Q_{(x)}$ = 0.155 MGD

$$C_{LIM(x)} = \frac{(1.10/2.69)}{(8.34)(0.155)} \times (10.02) = 3.17 \text{ mg/l}$$

The above limits apply only to the industrial users indicated (See Tables I-11 to I-13).

Selected Industrial Reduction Method

The selected industrial reduction method is based upon the reduction of current industrial user discharge loadings by the installation of treatment technologies. As an example of the application of this method, selected industrial reduction limits for lead will be derived in this section.

From Table I-9, the current total industrial loading of lead is 4.28 lbs/d. The maximum allowable industrial loading, from Table I-10, is 2.13 lbs/d. The required industrial loading reduction is:

4.28 lbs/d - 2.13 lbs/d = 2.15 lbs/d

Appendix L (Table L-1) and Table 6-1 in Chapter 6 document that a reduction of lead to less than 1.0 mg/l can be achieved through the installation of precipitation technologies. This concentration limit may be imposed upon the POTW's current lead dischargers as long as it results in the minimum required industrial loading reduction of 2.15 lbs/d. That this loading reduction can be achieved with a 1.0 mg/l limit is demonstrated as follows:

- For the equipment rebuilder, current lead loading = 2.66 lbs/d (from Table I-9)

  At 1.0 mg/l, the IU's lead loading is reduced to:

  (8.34)(1.0 mg/l)(0.085 MGD) = 0.71 lbs/d

  The lead loading reduction effected by the equipment rebuilder equals:

  2.66 lbs/d - 0.71 lbs/d = 1.95 lbs/d

- For the ceramic manufacturer, current lead loading = 1.62 lbs/d (from Table I-9)

  At 1.0 mg/l, the IU's lead loading is reduced to:

  (8.34)(1.0 mg/l)(0.155 MGD) = 1.29 lbs/d

The lead loading reduction effected by the ceramic manufacturer equals:

1.62 lbs/d - 1.29 lbs/d = 0.33 lbs/d

- The combined lead loading reduction brought about by the two industrial users equals:

  1.95 lbs/d + 0.33 lbs/d = 2.28 lbs/d

Since this lead loading reduction of 2.28 lbs/d exceeds the required loading reduction of 2.15 lbs/d, the 1.0 mg/l lead limit may be imposed upon the equipment rebuilder and the ceramic manufacturer (see Tables I-11 to I-13).

DERIVATION OF LOCAL LIMITS FOR ORGANICS

The derivation of organic pollutant local limits for the hypothetical POTW entails:

- Identification of organic pollutants of concern for which local limits may be needed
- Derivation of maximum allowable headworks loadings
- Allocation of maximum allowable headworks loadings
- Establishing local limits to address pollutant flammability/explosivity and fume toxicity concerns

Each of the above tasks are discussed in the following sections.

Identification of Organic Pollutants of Concern

The first step in deriving organic pollutant local limits for the hypothetical POTW will be to identify organic pollutants of concern for which local limits may be needed. As discussed in Chapter 2 of this manual, the first step involves completion of a thorough industrial user survey which identifies chemicals used, produced, stored, or disposed by the IUs. Then, sampling of IU discharges and at the POTW is performed to screen for the presence of those pollutants reasonably expected to be present in significant quantities. Based on the results of this preliminary sampling, some quick rules of thumb may be used to determine whether more extensive coordinated influent/effluent/sludge sampling for particular pollutants is needed to provide data necessary for calculation of local limits. For example, the following conservative rules of thumb could be used to decide which pollutants would warrant further consideration:

- Water quality-based local limits - Does the result of a receiving stream dilutional analysis based on maximum POTW effluent concentration exceed State water quality standards?
- Inhibition-based local limits - Does the maximum POTW influent grab sample concentration exceed one-half, or the maximum POTW influent 24-hour composite sample concentration exceed one-fourth, of the activated sludge inhibition threshold level?

  Does the maximum POTW influent concentration exceed one five-hundredth of the anaerobic digester inhibition threshold level?
- Sludge disposal criteria-based local limits - Does the maximum concentration of the pollutant in POTW sludge exceed one-half of the State sludge disposal criterion?
- Flammability/explosivity and fume toxicity-based local limits - Are IU discharge levels in excess of flammability/explosivity - and/or fume toxicity-based discharge screening levels?

The above pollutant evaluation scheme is based on the chemical-specific approach to identifying pollutant of concern, discussed in Section 2.3.3.1 and Figure 2-2 of the manual, and the flammable/explosive and fume toxic pollutant screening techniques discussed in Sections 4.1.1.5 and 4.2.3 of the manual. This evaluation scheme focuses on POTW influent and IU discharge data, but also incorporates the use of effluent and sludge data. As discussed in Section 2.3.3.1 of the manual, the POTW should perform at least a limited amount of effluent and sludge monitoring as part of its preliminary sampling program, in order to screen for pollutants which have concentrated to detectable levels in effluent or sludge even though not detectable in the influent.

Table I-14 and I-15 summarize organic pollutant monitoring data for the hypothetical POTW's influent and effluent, respectively, and Table I-16 summarizes organic pollutant monitoring data for the POTW's principal industrial user, an organic chemical manufacturing facility. The monitoring data presented in these tables will be used in demonstrating the above-described pollutant evaluation scheme. The application of each step of the pollutant evaluation scheme is demonstrated in the following sections.

TABLE I-14. POTW INFLUENT MONITORING DATA FOR ORGANIC POLLUTANTS

Pollutant	Number of Detections in Grab Samples	Concentration Range, mg/l	Number of Detections in Composite Samples	Concentration Range, mg/l
Priority Pollutant Organics:				
Chlorobenzene	2	0.24 - 1.16	6	0.04 - 0.74
Chloroform	1	0.06	6	0.002 - 0.38
Ethylbenzene	1	0.003	4	0.001 - 0.005
Methyl Chloride	1	3.48	7	0.001 - 0.69
Methylene Chloride	2	0.001 - 0.03	3	0.006 - 0.11
Nitrobenzene	0		2	0.087 - 0.28
Phenol	1	0.0002	1	0.036
Toluene	1	0.008	8	0.001 - 0.043
Non-priority Pollutant Organics:				
Acetone	1	0.1	1	2.62
Aniline	1	0.76	3	0.6 - 2.0
Benzoic Acid	0		2	0.27 - 0.7
3-(Dimethylamino) phenol	1	1.56	0	
N,N-Dimethylaniline	1	0.67	1	0.2
N,N-Dimethyl Formamide	1	1.4	0	
Quinaldine	1	2.7	2	0.4 - 1
Resourcinol Dimethyl Ether	0		3	0.1 - 0.47
Hydroquinone Monomethyl Ether	0		1	0.41
Methyl Isobutyl Ketone	1	0.018	1	0.12

TABLE I-15. POTW EFFLUENT MONITORING DATA FOR ORGANIC POLLUTANTS

Pollutant	Number of Detections in Grab Samples	Concentration Range, mg/l	Number of Detections in Composite Samples	Concentration Range, mg/l
Priority Pollutant Organics:				
Chlorobenzene	6	0.39 - 23.0	5	0.05 - 1.36
Chloroform	4	0.04 - 0.83	5	0.01 - 0.09
Ethylbenzene	2	0.002 - 4.6	5	0.001 - 0.008
Methyl Chloride	1	1.58	5	0.002 - 1.16
Methylene Chloride	2	0.007 - 0.014	1	0.021
Nitrobenzene	0		1	0.028
Phenol	0		2	0.001 - 0.037
Toluene	5	0.005 - 0.048	7	0.004 - 0.01
Non-priority Pollutant Organics:				
Acetone	1	0.1	1	9.73
Aniline	1	0.4	2	0.1 - 0.82
Benzoic Acid	0		1	0.55
3-(Dimethylamino) phenol	1	0.56	0	
N,N-Dimethylaniline	0		1	0.3
N,N-Dimethyl Formamide	1	0.15	0	
Quinaldine	1	0.53	1	0.4
Resourcinol Dimethyl Ether	0		1	0.2
Resourcinol Monomethyl Ether	0		1	0.1
Hydroquinone Monomethyl Ether	0		1	0.41

TABLE I-16. IU DISCHARGE MONITORING DATA FOR ORGANIC POLLUTANTS

Pollutant	Number of Detections in Grab Samples	Concentration Range, mg/l	Number of Detections in Composite Samples	Concentration Range, mg/l
Priority Pollutant Organics:				
Chlorobenzene	1	10.99	26	0.18 - 13.8
Chloroform	1	0.69	17	0.04 - 0.9
2,4-Xylenol	0		1	6.1
Ethylbenzene	0		1	12.2
Methyl Chloride	1	39.27	6	0.09 - 13.9
Methylene Chloride	1	0.73	4	0.016 - 2.4
Nitrobenzene	1	1.49	23	0.11 - 34.0
Phenol	0		10	0.01 - 17.0
Toluene	1	0.014	6	0.06 - 0.62
Non-priority Pollutant Organics:				
Aniline	0		22	0.18 - 108.0
Benzoic Acid	0		1	3.8
3-(Dimethylamino) phenol	0		4	0.088 - 6.0
4-(Dimethylamino)benzaldehyde	1	1.99	4	0.045 - 3.6
N,N-Dimethylaniline	1	1.89	4	0.2 - 4.0
N,N-Dimethyl Formamide	0		1	9.6
Hydroquinone Monomethyl Ether	0		1	2.2

TABLE I-16. IU DISCHARGE MONITORING DATA FOR ORGANIC POLLUTANTS (CONTINUED)

Pollutant	Number of Detections in Grab Samples	Concentration Range, mg/l	Number of Detections in Composite Samples	Concentration Range, mg/l
Non-Priority Pollutant Organics:				
3-(Hydroxyphenyl) Ethanol	1	0.78	0	
Methyl Acetate	0		3	0.01 - 1.7
Methyl Benzoate	0		2	0.085 - 0.64
Quinaldine	1	10.53	3	0.75 - 6.3
Resourcinol Dimethyl Ether	1	5.56	3	0.27 - 2.3
Resourcinol Monomethyl Ether	0		3	0.1 - 0.89
Tridecanol	1	2.72	0	
Methyl Ethyl Ketone	1	0.9	0	
Methyl Isobutyl Ketone	1	0.15	1	1.44

Screening of Organic Pollutants on the Basis of Water Quality Standards

The first step of the evaluation scheme consists of a receiving stream dilutional analysis to identify pollutants of potential water quality concern. The equation for conducting this dilutional analysis is as follows:

$$C_{PROJ} = C_{EFF} \times \left(\frac{Q_{POTW}}{Q_{STR} + Q_{POTW}}\right)$$

where:

C_{PROJ} = Projected downstream level, mg/l

C_{EFF} = Maximum POTW effluent level, from Table I-15, mg/l

Q_{POTW} = POTW flow, MGD

Q_{STR} = Receiving stream flow, MGD

- 7Q10 flow for comparison to chronic criteria
- 1Q10 flow for comparison to acute criteria

Projected downstream levels calculated from the above equation are compared with State water quality standards. Table I-17 presents organic pollutant State water quality standards for the POTW.

The screening technique is demonstrated below for chlorobenzene:

Q_{POTW} = 3.35 MGD

Q_{STR} = 47 MGD (7Q10)
26 MGD (1Q10)

C_{EFF} = 23 mg/l (Table I-15)

Chronic: $$C_{PROJ} = 23 \times \left(\frac{3.35}{3.35 + 47}\right) = 1.5 \text{ mg/l}$$

Acute: $$C_{PROJ} = 23 \times \left(\frac{3.35}{3.35 + 26}\right) = 2.6 \text{ mg/l}$$

Table I-17 indicates that the chronic water quality standard for chlorobenzene is 0.026 mg/l and the acute standard is 0.59 mg/l. Since the above-derived projected in-stream levels exceed these water quality standards, the development of water quality-based local limits for chlorobenzene is warranted.

TABLE I-17. ORGANIC POLLUTANT WATER QUALITY STANDARDS FOR THE POTW

Pollutant	Acute Water Quality Standard, mg/l	Chronic Water Quality Standard, mg/l
Acetone	550	78
Chlorobenzene	0.59	0.026
Chloroform	1.8	0.079
Ethylbenzene	1.4	0.062
Methylene Chloride	9.7	0.43
Phenol	5.3	0.37
Toluene	2.4	1.7
Nitrobenzene	27.0	- *

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*No standard available.

Based on this screening technique, the POTW determined that water quality-based local limits should be developed for the following organic pollutants:

- Chlorobenzene
- Ethylbenzene

Screening of Organic Pollutants on the Basis of Biological Process Inhibition

The second step of the pollutant evaluation scheme entails the comparison of POTW influent levels of organic pollutants with activated sludge and anaerobic digester inhibition threshold data, as follows:

- Maximum level in grab sample of POTW influent compared with one-half of the activated sludge inhibition threshold
- Maximum level in composite sample compared with one-fourth of the activated sludge inhibition threshold
- Maximum POTW influent level compared with one-five hundredth of the anaerobic digester inhibition threshold

Activated sludge inhibition data are provided in Table 3-2 of the manual. Comparing POTW influent data from Table I-14 with inhibition threshold cutoffs derived from the Table 3-2 data:

Pollutant	Maximum Grab Sample Level, mg/l	One-half of Inhibition Threshold, mg/l	Maximum Composite Sample Level, mg/l	One-fourth of the Inhibition Threshold, mg/l
Ethylbenzene	0.003	100	0.005	50
Nitrobenzene	Not detected	15	0.28	7.5
Phenol	0.002	25	0.036	12.5
Toluene	0.008	100	0.043	50

The above-listed organics are present in the POTW influent at levels well below their corresponding cutoffs. Local limits for these organics need not be developed from activated sludge process inhibition data.

Table 3-5 of the manual presents anaerobic digester threshold inhibition data. Comparing maximum POTW influent levels with anaerobic digester inhibition cutoffs derived from Table 3-5 data:

Pollutant	Maximum Influent Level, mg/l	One-five hundredth of the Digester Inhibition Level, mg/l
Chlorobenzene	1.16	0.002
Chloroform	0.38	0.002
Methyl Chloride	3.48	0.007

All three pollutants are present in the POTW influent at levels in excess of their cutoffs. Based on this screening analysis, local limits based on anaerobic digester inhibition may be needed for all three pollutants. The POTW should therefore perform the additional sampling necessary to perform a headworks loading analysis. It would also be wise for the POTW to sample for pollutants in the digester to determine whether inhibition threshold levels are currently exceeded.

Screening of Organic Pollutants on the Basis of Sludge Disposal Criteria

The hypothetical POTW contacted the State environmental agency to determine if any State sludge disposal guidelines had been established for organic pollutants in land-applied sludge. The POTW was informed that State sludge disposal guidelines for organic pollutants had not been established. The hypothetical POTW concluded that without sludge disposal criteria, no basis existed for a sludge disposal criteria analysis.

Screening of Organic Pollutants Based on Flammability/Explosivity and Fume Toxicity

The final step of the pollutant evaluation scheme is to compare industrial user discharge levels with IU discharge screening levels based on pollutant flammability/explosivity and fume toxicity. These screening levels are developed as per the methodologies presented in Sections 4.1.1.5 and 4.2.3 of the manual.

Table I-18 presents a comparison of IU discharge levels (from Table I-16) with discharge screening levels developed in accordance with the Section 4.1.1.5 and Section 4.2.3 methodologies. The comparison suggests that fume toxicity-based local limits may be needed for the following pollutants:

- Chlorobenzene
- Chloroform
- Ethylbenzene
- Methyl chloride
- Nitrobenzene

The comparison also suggests that flammability/explosivity-based local limits may be needed for methyl chloride.

Derivation of Maximum Allowable Headworks Loadings

The pollutant evaluation scheme identified the following pollutants for which allowable headworks loadings should be developed:

Water Quality-based Headworks Loadings

- Chlorobenzene
- Ethylbenzene

Anaerobic Digester Inhibition-based Headworks Loadings

- Chlorobenzene
- Chloroform
- Methyl chloride

Earlier in this appendix, allowable headworks loadings for metals were derived from State water quality standards. The same procedures can be followed here to derive water quality-based allowable headworks loadings for chlorobenzene and ethylbenzene. Based on the following data:

- Receiving stream flow, 7Q10 = 47 MGD
- Receiving stream flow, 1Q10 = 26 MGD
- POTW flow = 3.35 MGD

TABLE I-18. COMPARISON OF IU DISCHARGE LEVELS WITH IU DISCHARGE SCREENING LEVELS

Pollutant	Maximum IU Discharge Level, mg/l	Flammability/ Explosivity-Based Screening Level, mg/l	Fume Toxicity-Based Screening Level, mg/l
Chlorobenzene	13.8	403.	2.35
Chloroform	0.9	- *	0.42
Ethylbenzene	12.2	158.	1.59
Methyl Chloride	39.27	11.	0.007
Methylene Chloride	2.4	5760.	4.15
Nitrobenzene	34.0	98035.	5.41
Phenol	17.0	- *	688.4
Toluene	0.62	173.	1.35
Aniline	108.0	712086.	143.9
N,N-Dimethylaniline	4.0	- *	71.4
Methyl Acetate	1.7	21531.	140.0
Methyl Ethyl Ketone	0.9	24848.	249.0
Methyl Isobutyl Ketone	0.15	24601.	88.0

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*Screening level not developed (LEL data not available)

- Receiving stream background levels = 0 (i.e., not available)
- Chlorobenzene chronic standard = 0.026 mg/l
- Chlorobenzene acute standard = 0.59 mg/l
- Ethylbenzene chronic standard = 0.062 mg/l
- Ethylbenzene acute standard = 1.4 mg/l
- Chlorobenzene removal efficiency = 90%*
- Ethylbenzene removal efficiency = 67% (Table 3-10)

Allowable headworks loadings of 109.2 lbs/d chlorobenzene and 78.9 lbs/d ethylbenzene are derived.

The following equation is used to derive allowable headworks loadings for organic pollutants based on anaerobic digester inhibition data (from Section 3.2.2.1 of the manual):

$$L_{IN} = L_{INF} \times \left(\frac{C_{CRIT}}{C_{DIG}} \right) = \frac{(8.34)(Q_{POTW})(C_{INF})}{(C_{DIG})} \times C_{CRIT}$$

where: L_{IN} = Allowable headworks loading, lbs/d

L_{INF} = POW influent pollutant loading, lbs/d

C_{CRIT} = Anaerobic digester inhibition threshold level, mg/l

C_{DIG} = Pollutant level in sludge to digester, mg/l

Q_{POTW} = POTW flow, MGD

C_{INF} = POTW influent level, mg/l

Table 3-11 presents anaerobic digester inhibition levels (C_{CRIT}) for incorporation into the above expression; however, C_{INF}/C_{DIG} data must be obtained through site-specific monitoring. C_{DIG} data are not currently available for the hypothetical POTW. For the three pollutants of concern (chlorobenzene, chloroform, methyl chloride), the hypothetical POTW should perform coordinated monitoring of the POTW influent and the sludge to the digester, in order to obtain C_{INF}/C_{DIG} data for incorporation into the above expression.

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*From Reference [19].

Allocation of Maximum Allowable Headworks Loadings

Requisite pollutant loading reductions for nonconservative pollutants can be calculated from the following equation:

$$R = \frac{L_{INF} - L_{IN}}{L_{INF}} (100)$$

where:

R = Requisite pollutant loading reduction, percent

L_{INF} = Current POTW influent loading of the pollutant, lbs/d

L_{IN} = Maximum allowable headworks loading, lbs/d

Use of the above equation requires that the current POTW influent loading of the particular pollutant exceeds the maximum allowed ($L_{INF} > L_{IN}$).

The application of the above equation is demonstrated below for chlorobenzene:

- Recent composite sampling of the hypothetical POTW quantified the current POTW influent level of chlorobenzene at 4.50 mg/l. Therefore:

  $$L_{INF} = (8.34)(Q_{POTW})(C_{INF}) = (8.34)(3.35)(4.50) = 125.7 \text{ lbs/d}$$

- Uncontrollable sources of chlorobenzene have been assessed to be negligible
- The allowable headworks loading for chlorobenzene (water quality-based). is 109.2 lbs/d
- Required removal is:

  $$R = \frac{125.7 - 109.2}{125.7} (100) = 13.1\%$$

- The hypothetical POTW's chemical manufacturing IU is the only known discharger of chlorobenzene to the POTW. For this IU:
  - Discharge flow = $Q_{(X)}$ = 0.5 MGD
  - Discharge level = $L_{CURR(X)}$ = 13.8 mg/l (Table I-16)

  $$L_{CURR(T)} = (8.34)(Q_{(X)})(L_{CURR(X)}) = (8.34)(0.5)(13.8) = 57.5 \text{ lbs/d}$$

- The IU's chlorobenzene discharge limit is derived as follows:

$$C_{LIM(X)} = \frac{L_{CURR(X)} - (1 - R)}{(8.34)(Q_{(X)})}$$

$$C_{LIM(X)} = \frac{57.5 - (1 - 0.131)}{(8.34)(0.5)} \quad = 12.0 \text{ mg/l}$$

The above minimum discharge limit should be incorporated into the industrial user's permit.

This minimum industrial reduction may need to be increased further to account for domestic/background sources if the assumption that these sources are negligible is not accurate. These limits should be reassessed during routine evaluation of local limit effectiveness. If subsequent evaluation of the actual influent loading indicates insufficient reduction has been achieved, the POTW should consider whether the industrial reduction needs to be increased.

Local Limits to Address Pollutant Flammability/Explosivity and Fume Toxicity Concerns

The pollutant evaluation scheme determined that the hypothetical POTW's chemical manufacturing IU is discharging potentially fume toxic levels of the following five pollutants:

- Chlorobenzene
- Chloroform
- Ethylbenzene
- Methyl chloride
- Nitrobenzene

The POTW decided to adopt the Cincinnati MSD volatile organic pollutant local limit procedure (See Sections 4.1.1.2 and 4.2.1, and Appendix J) and impose a volatile organic pollutant local limit on the chemical manufacturer's discharge. The MSD volatile organic pollutant local limit consist of a 300 ppm hexane equivalent limit on volatile organics in headspace gases collected over an equilibrated wastewater sample.

In addition to imposing the volatile organic pollutant local limit, the POTW has planned a comprehensive inspection of the chemical manufacturer's industrial processes. This inspection is to identify IU chemical management practice deficiencies which might account for the presence of the above-listed volatile organics in the IU's discharge. The POTW plans to impose chemical management practice requirements on the IU to correct these deficiencies and prevent the IU from discharging flammable/explosive and fume toxic levels of the five organics.

APPENDIX J

SAMPLE HEADSPACE MONITORING ANALYTICAL PROCEDURE

ANALYTICAL PROCEDURE

A vapor standard is prepared by injecting 1.6 uL (microliter) of hexane into a one (1) liter flask or bottle fitted with a septum stopper. The hexane is vaporized by heating the flask to 90°F (32°C) for 30 minutes. The flask is allowed to cool to room temperature. A one (1) mL aliquot of the vapor is removed with a gas-tight syringe. The vapor is injected into the GC. The area under the curve is integrated electronically.

The GC is equipped with a packed column and a flame ionization detector. (If a capillary column were used, the sensitivity would increase and the run time would decrease). Good separation will be achieved by using a 2mm ID glass or stainless steel column 6 feet long, packed with 1% SP-1000 on Carbopak-B 60/80 mesh (Supelco, Inc.). The GC oven temperature is programmed as follows: 45°C for 3 minutes, 6°C/minute to 220°C, hold at 220°C for 6 minutes.

I. Sampling Procedure

All samples will be grab samples.

A. Sample Vial Preparation

Forty mL vials (as described in 44FR 69468, 12/3/79; Pierce No. 13075) equipped with open top screw cap and Teflon-coated silicone septum (Pierce No. 12722). Vials must be washed with detergent, rinsed with tap water followed by distilled water and then dried at 105°C for one (1) hour.

B. Sampling

1. A clean vial is immersed in the wastewater and is filled until the liquid forms a convex surface with respect to the bottle. The bottle is capped and then inverted to check for an air bubble. If a bubble is present, repeat the process until no bubbles are present when the bottle is inverted after being filled and capped. Store the sample at 4°C (ice) and transport to the laboratory.
2. If it is not possible to fill the 40 mL vial directly from the waste stream, the following procedure may be employed. Using a quart glass per that has been washed with detergent, rinsed with tap water and then distilled water and dried at 105°C for one hour, fill thejar with the wastewater. Transfer a portion of the water to the 40 mL vial and proceed as described above.

This method is useful when the waste stream is not readily accessible for sampling. For example, the quart jar may be attached to a pole and the sample obtained by immersing the bottle below the surface of the waste stream.

II. ANALYSIS

A 40 mL vial containing the sample is removed from the refrigerator and warmed to room temperature. Using a syringe (20 mL or larger) remove 20 mL from the sample bottle. It will be necessary to replace the liquid withdrawn. Nitrogen is preferred, to avoid contamination. The 20 mL of liquid removed can be discarded or injected into another 40 mL vial and used as a duplicate sample. It will be necessary to vent air from the second vial as it is filled.

The vial is equilibrated at 24 ± 2°C for 1 hour, shaken for 30 seconds and held quiescent at 24 ± 2°C for 10 minutes.

Using a gas-tight syringe, withdraw a one (1) mL aliquot of headspace gas and inject into the GC. The column and temperature programming should be as specified for the hexane standard. The carrier gas is nitrogen at a flow rate of 30 mL/minute.

The total peak area of the chromatogram will be used to calculate the ppm hexane to which the area is equivalent.

Samples with a total peak area equivalent to 300 ppm hexane or more may be screened by GC.MS to identify whether major peaks represent substances classified as Priority Pollutants by the EPA.

III. CALCULATIONS

The vapor concentration of the hexane standard is calculated as follows:

$$\text{ppm} = \frac{10^6 \cdot w/MW}{V/\bar{v}} \qquad \bar{V} = 24.47 \times \left(\frac{760}{P}\right)\left(\frac{t+273}{298}\right)$$

w = weight of hexane (density x volume (mL))

MW = molecular weight of hexane

$\bar{v}$ = gram molecular volume of mixture in liters

P = ambient pressure in mm

t = ambient temperature, °C

V = Volume of mixture in liters

The concentration of total organics in the head space is calculated as follows:

$$\text{ppm} = \frac{(\text{ppm hexane std})\ (\text{total peak area of sample})}{(\text{total peak area of hexane std})}$$

The value is reported as hexane.

APPENDIX K

EXAMPLE FORMAT FOR AN IU ASPP PLAN

EXAMPLE FORMAT FOR AN IU ASPP PLAN

I. GENERAL INFORMATION

Facility Name ______________________________

Address ______________________________

____

____

ASPP Plan contact ____________________ Title ______________

Work phone no. ______________ After hours phone no. ______________

Emergency response contact ______________ Title ______________

Work phone no. ______________ After hours phone no. ______________

Secondary contact ____________________ Title ______________

Work phone no. ______________ After hours phone no. ______________

Type of Business/Manufacturer ______________________________

Operating Schedule ______________________________

Number of employees: 1st shift ________ 2nd shift ________ 3rd shift ________

Average daily discharge of wastewater (Identify continuous and batch discharges): ______________________________

Identify all categorical pretreatment standards applicable to your facility:

____

Description of previous spill events and remedial measures taken to prevent their reoccurrence ______________________________

____

____

____

____

Description of security provisions and warning signs at the facility:

____

____

II. FACILITY LAYOUT AND FLOW DIAGRAMS

Attach drawings (suggested no larger than 36" x 50") of the facility which show the following:

- General layout of the facility
- Property boundaries
- Entrance and exit routes to facility
- Areas occupied by manufacturing or commercial activities
- Hazardous materials process and storage areas
- Waste handling, storage, and treatment facilities
- Loading and unloading areas
- Direction of drainage from hazardous material and waste handling, process, storage, and treatment areas
- Floor drains, pipes, and channels which lead away from potential leak or spill areas [identify by coding, footnotes, or narratives where these drain to (e.g., sanitary sewer, holding tank pumped out by hazardous waste hauler, etc.)].
- Flow diagram(s) showing chemical and wastewater flow including piping and instrumentation, flow rates, tanks and capacities, treatment systems and final destinations of flows.

Please provide narrative discussions where needed to clarify any of the above items.

III. HAZARDOUS MATERIAL DATA

Hazardous Material	Location in Plant	Maximum Volume	Container Volume	Type Container[1]	Remarks[2]

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[1] The facility should provide information on the type of container or tank used (e.g., steel drum, fiberglass carboy, etc.) and the materials of construction of the container or tank.

[2] Remarks should include comments concerning the toxicity or hazards associated with the hazardous material and any special precautions needed to handle the material properly. The remarks should also include brief discussions of the compatibility of the materials of construction of the container or tank with its contents, the condition of the container, and whether it is open or closed top.

IV. SPILL AND LEAK PREVENTION EQUIPMENT AND PROCEDURES

Equipment

Identify the location and provide a description of all spill prevention structures and equipment employed (such as dikes, berms, sealed drains, alarms, leak detection equipment at the facility, diversionary structures, etc.). Reference to the location should be made with the layout drawings required in the previous section.

Procedures

Discuss all routine operation and maintenance procedures geared to minimize spills and leaks at the facility. Include descriptions of the type and frequency of inspections and monitoring for leaks or other conditions that could lead to spills.

V. EMERGENCY RESPONSE EQUIPMENT AND PROCEDURES

Equipment

Provide an up-to-date list of available emergency response equipment including its location (the location can be indicated on a facility layout) and a physical description. This list of equipment should include the following:

- Communication equipment and alarms
- Spill containment and control equipment and tools
- Spilled material storage containers
- Protective clothing and respirators

- First Aid kits
- Decontamination equipment
- Ventilation equipment.

Procedures

Provide a detailed description of procedures to be followed in responding to a spill at the facility. This description should cover the following items:

- Notification of facility personnel responsible for responding to spills
- Chain of command for spill response
- Evacuation procedures
- Notification of response agencies and contractors
- Spill assessment and response procedures
- Procedures for preventing contact between incompatible materials
- Procedures for disposing or treating spilled materials.

VI. SPILL REPORTING AND ASPP MODIFICATION PROCEDURES

Describe procedures for reporting spills (attach any forms used) and for modifying the ASPP Plan where procedures were inadequate or where changes at the facility warrant modification.

VII. TRAINING PROGRAM

Outline, in detail, the training program given to employees which will enable them to understand the processes and materials with which they are working, the safety and health hazards, and the procedures and practices for preventing and responding to spills. A discussion of the appropriateness of training provided to each employee or group of employees (e.g. chemical handling personnel, plating department supervisor, etc.) should also be included.

VIII. CERTIFICATIONS

I certify that the information provided in this document is to the best of my knowledge true and that the accidental spill prevention measures described in the document will be implemented as described.

Name/Title
(an authorized representative of the industry responsible for the ASPP)

Date

I certify that the spill prevention and control equipment installed by the industry will provide adequate protection from accidental spills when used properly.

Name

P.E. Registration Number

Date

APPENDIX L

TREATABILITY OF TOXIC POLLUTANTS

TABLE L-1. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING METALS AND CYANIDE

Inorganic Pollutant and Treatment Process	Range of Percent Removals[1]	Range of Effluent Concentrations[1] (ug/l)	Comments/Limitations[2]
ANTIMONY			
Sedimentation after lime addition	81-99	ND-180	
Sedimentation	0-86	ND-1000	
Coagulation and Flocculation	51-81	4.0-120	
Filtration	0-92	ND-1800	
Flotation	4-95	ND-230	
ARSENIC			
Sedimentation after lime addition	25->99	ND-80	• The coprecipitation of dissolved As with $Fe(OH)_3$ is generally more effective in removing AsO_4^{-3} than AsO_2^-. Therefore, AsO_2^- is frequently oxidized to AsO_4^{-3} prior to the addition of ferric salts.
Sedimentation	0->99	ND-230	
Coagulation and Flocculation	37-92	ND-62	
Filtration	0->99	ND-120	
Flotation	8->99	ND-18	
Reverse Osmosis	57->99	<1.0-15	
Coprecipitation of dissolved As with $Fe(OH)_3$ after $Fe_2(SO_4)_3$, $FeCl_3$, or $Fe(OH)_3$ addition	NA	NA	
BARIUM			
Sedimentation after $Fe_2(SO_4)_3$ and lime addition	99[2]	30[2]	• In addition to being coagulant aids, $Fe_2(SO_4)_3$ and lime precipitate dissolved barium as $BaSO_4$ and $BaCO_3$, respectively. • Extremely high dissolved Ba removals can be obtained using ion exchange; however, ion exchange is 4-8 times more expensive than the use of $Fe_2(SO_4)_3$.
Precipitation of dissolved Ba as $BaSO_4$ after $Fe_2(SO_4)_3$ addition	70-99[2]	30-2600[2]	
Precipitation of dissolved Ba as $BaCO_3$ after lime addition	98[2]	150[2]	
Ion Exchange	98->99.9[2]	NA	

TABLE L-1. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING METALS AND CYANIDE (Continued)

Inorganic Pollutant and Treatment Process	Range of Percent Removals[1]	Range of Effluent Concentrations[1] (ug/l)	Comments/Limitations[2]
BERRYLIUM			
Sedimentation after combined unspecified chemical addition	11->99	ND-<10	
Sedimentation	0->98	ND-20	
Filtration	0-71	<0.04-<10	
CADMIUM			
Sedimentation after lime addition	22->99	ND-80	• The optimal pH for $Cd(OH)_2$ precipitation generally is within the range of pH 9.5 to 12.5. • High cyanide levels such as those found in electroplating wastes inhibit Cd precipitation; cyanide pretreatment may be required. • Ion exchange is commonly used to remove and recover dissolved Cd. • *Other possible treatment/recovery processes* for Cd include electrolytic recovery, reverse osmosis, freeze concentration, and evaporative recovery. All appear to be technically feasible based on pilot studies.
Sedimentation after unspecified chemical addition	0-99	5.0-100	
Sedimentation	0->99	ND-200	
Coagulation and Flocculation	>99	ND-20	
Filtration	0->99	ND-97	
Flotation	0->99	ND-<72	
Precipitation of dissolved Cd (II) as $Cd(OH)_2$ after lime addition or as CdS after sulfide addition	NA	0.7-1000[2]	
Coprecipitation of dissolved Cd(I) with $Fe(OH)_3$ after ferric salt additions	>99[2]	8.0[2]	
Ion Exchange[2]	NA	NA	
Electrolytic recovery, reverse osmosis, freeze concentration, evaporative recovery[2]	NA	NA	

TABLE L-1. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING METALS AND CYANIDE (Continued)

Inorganic Pollutant and Treatment Process	Range of Percent Removals[1]	Range of Effluent Concentrations[1] (ug/l)	Comments/Limitations[2]
CHROMIUM			
Sedimentation after alum addition	13-95	34-280	• The reduction of Cr (VI) to Cr (III) followed by the precipitation of Cr (III) as $Cr(OH)_3$ after lime addition is the more common method of removing dissolved Cr from Cr specific wastes. The most common reducing agent used is SO_2, although bisulfite and metabisulfite are also used. • Cation exchange is commonly used to remove Cr (III) whereas anion exchange is used to remove Cr (VI). • Evaporative recovery can be used to recover Cr from plating wastes.
Sedimentation after lime addition	47-<99	ND-250	
Sedimentation	0->99	ND-3.0×10^4	
Coagulation and Filtration	72->99	17-1300	
Filtration	0->99	<4.0-320	
Flotation	20->99	2.0-620	
Granular activated carbon adsorption	10-95	<4.0-260	
Chemical reduction of Cr (VI) to Cr (III), precipitation of Cr (III) as $Cr(OH)_3$ after lime addition	56->99[2]	ND-100[2]	
Ion Exchange	90->99[2]	ND-25[2]	
Evaporative Recovery, Reverse Osmosis, Freeze Concentration	50->99[2]	NA	
COPPER			
Sedimentation after combined chemical addition	43-98	9.0-<320	• In addition to being a coagulant aid, lime can precipitate dissolved Cu (II) as $Cu(OH)_2$. • The precipitation of dissolved Cu (II) as $Cu(OH)_2$ or CuS is inhibited by high levels of complexing agents such as cyanide and ammonia; pretreatment may be necessary. • Evaporative recovery is commonly used to recover Cu from electroplating wastes. • High removal percentages can be achieved with ion exchange, but generally it is not economically advantageous.
Sedimentation after lime addition	34->99	ND-700	
Sedimentation	0->99	ND-1100	
Coagulation and Flocculation	0->99	<10-170	
Filtration	0->99	<4.0-4500	
Flotation	9-98	5.0-660	

TABLE L-1. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING METALS AND CYANIDE (Continued)

Inorganic Pollutant and Treatment Process	Range of Percent Removals[1]	Range of Effluent Concentrations[1] (ug/l)	Comments/Limitations[2]
COPPER (Continued)			
Precipitation of dissolved Cu as $Cu(OH)_2$ after lime addition or as CuS[2] after sulfide addition[2]	NA	NA	
Ion Exchange[2]	NA	NA	
Evaporative Recovery[2]	NA	NA	
Electrolytic Recovery[3]	NA	NA	
CYANIDE			
Sedimentation after lime addition	52->99	ND-5500	• The most common method of treating cyanide specific wastes is through oxidation of the cyanide by Cl_2 or hypochlorite. The oxidations are most effective at pH>10. • Iron and nickel interferes with the oxidation of cyanide by forming stable complexes with the cyanide. • Electrolytic decomposition of cyanide is often employed to treat wastes with high cyanide concentrations. High sulfate concentrations cause scaling at the anode and a large decrease in the efficiency of electrolytic decomposition.
Sedimentation after unspecified chemical addition	0->99	ND-5200	
Sedimentation	20->99	ND-4500	
Filtration	0->99	2.0-260	
Oxidation with Chlorine	98-100[2]	ND-1700[2]	
Electrolytic Decomposition	98->99.9[2]	100-500[2]	
LEAD			
Sedimentation after lime addition	0->99	ND-440	
Sedimentation after unspecified chemical addition	26-99	ND-1000	
Sedimentation	0->99	ND-1.6×10^4	

TABLE L-1. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING METALS AND CYANIDE (Continued)

Inorganic Pollutant and Treatment Process	Range of Percent Removals[1]	Range of Effluent Concentrations[1] (ug/l)	Comments/Limitations[2]
LEAD (Continued)			
Coagulation and Flocculation	0->99	ND-580	
Filtration	0->99	ND-2100	
Flotation	9->99	ND-1000	
Precipitation of dissolved Pb (II) as Pb $(OH)_2$ after lime addition[2]	NA	NA	
Precipitation of dissolved Pb (II) as $PbCO_3$ after Na_2CO_3 addition[2]	NA	NA	
Precipitation of dissolved Pb and Pb_3 $(PO_4)_2$[2]	NA	NA	
Ion Exchange[2]	NA	NA	
MERCURY			
Sedimentation after alum addition	6-93	1.7-4000	• The minimum achievable Hg concentration using sulfide precipitation is 10-20 mg/l. • Excessive use of sulfide may lead to resolubilization of the Hg
Sedimentation after lime addition	75->96	0.1-8.0	
Sedimentation after unspecified chemical addition	0-99	<1.0-140	
Sedimentation	0->97	ND-84	
Precipitation of dissolved Hg as HgS[2]	NA	NA	
Ion Exchange[2]	NA	NA	
NICKEL			
Sedimentation after lime addition	6->99	ND-5200	• High cyanide levels interfere with Ni precipitation by forming stable nickel cyanide complexes. Therefore, prior oxidation of the cyanide may be required for effective precipitation.
Sedimentation after unspecified chemical addition	8->99	9.0-6400	
Sedimentation	0->99	BDL-2000	
Filtration	0->99	BDL-700	

TABLE L-1. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING METALS AND CYANIDE (Continued)

Inorganic Pollutant and Treatment Process	Range of Percent Removals[1]	Range of Effluent Concentrations[2] (ug/l)	Comments/Limitations[2]
NICKEL (Continued)			
Flotation	0->99	ND-270	• Ion exchange is commonly used for Ni recovery but is often not an economical treatment process. • Evaporative recovery requires high Ni concentrations to be cost effective. • Pilot studies indicate that removal percentages >99% can be obtained with reverse osmosis.
Precipitation of dissolved Ni (II) as $Ni(OH)_2$ after lime addition[2]	NA	NA	
Precipitation of dissolved Ni (II) as $NiCO_3$[2]	NA	NA	
Ion Exchange[2]	NA	NA	
Evaporative Recovery[2]	NA	NA	
Reverse Osmosis	>99%[2]	NA	
SELENIUM			
Sedimentation after lime	>99	ND-87	
Sedimentation	0-98	<2.0-32	
Ion Exchange	>99%[2]	NA	
SILVER			
Sedimentation after lime addition	>99	ND	• High cyanide levels interfere with the precipitation of AgCl. Therefore, prior to AgCl precipitation, cyanide is generally oxidized with Cl_2. • Due to the value of silver, several recovery treatment processes are economically advantageous including ion exchange, electrolytic reduction, and reductive exchange between silver and iron or zinc.
Sedimentation	>50-96	1.0-<100	
Filtration	0-91	BDL-<100	
Precipitation of dissolved Ag (I) as AgCl[2]	NA	NA	
Ion exchange[2]	NA	NA	
Reductive exchange with Fe or Zn[2]	NA	NA	
Electrolytic Reduction	90[2]	NA	

NA = Data not available
ND = Not detected
BDL = Identified, but below quantification limit

1) All data taken from Reference (57) unless otherwise specified
2) From Reference (58)

TABLE L-2. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING POLYNUCLEAR AROMATIC HYDROCARBONS

PAH	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
ACENAPHTHENE			
	Activated Carbon	97	BDL
	Sedimentation after other chemical addition	NM	ND
	Sedimentation	>99	ND-53
	Filtration	73->99	ND-<10
	Reverse Osmosis	57->99	BDL-3.0
	Activated Sludge	>99	ND-2.0
ACENAPHTHYLENE			
	Sedimentation after lime addition	NM	BDL
	Sedimentation after other chemical addition	75	BDL
	Sedimentation	>99	ND-19
	Filtration	NM	500
	Solvent Extraction	50	1600
ANTHRACENE			
	Activated Carbon	50-98	BDL-0.4
	Chemical Oxidation	98	BDL-0.4
	Sedimentation after lime addition	92->99	ND-BDL
	Sedimentation after other chemical addition	92->99	ND-0.01
	Sedimentation	0-73	BDL-40

TABLE L-2. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING POLYNUCLEAR AROMATIC HYDROCARBONS (Continued)

PAH	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/1)
ANTHRACENE (Continued)			
	Filtration	0-70	ND-3200
	Flotation	45->98	0.2-600
	Reverse Osmosis	77-99	BDL-0.7
	Activated Sludge	NM	500
BENZO(a)ANTHRACENE			
	Activated Carbon	95	BDL
	Sedimentation after lime addition	NM	ND
	Sedimentation after other chemical addition	NM-80	ND-BDL
	Sediment	NM	10-13
	Filtration	NM	7300
	Solvent Extraction	NM	ND
BENZO(a)PYRENE			
	Activated Carbon	NM	0.8
	Chemical Oxidation	95	BDL
	Sedimentation after lime addition	NM	ND
	Sedimentation after other chemical addition	91	BDL
	Sedimentation	83->99	ND-10
	Filtration	NM	0.2-0.8

TABLE L-2. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING POLYNUCLEAR AROMATIC HYDROCARBONS (Continued)

PAH	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
BENZO(a)PYRENE			
	Solvent Extraction	98	13
	Activated Sludge	NM	BDL
BENZO(b)FLUORANTHENE			
	Sedimentation	86	BDL
BENZO(ghi)PERYLENE			
	Sedimentation	>99	ND
BENZO(k)FLUORANTHENE			
	Activated Carbon	90	BDL
	Chemical Oxidation	90	BDL
	Sedimentation	99->99	ND-BDL
	Filtration	NM	0.1
FLUORANTHENE			
	Activated Carbon	88-95	BDL
	Chemical Oxidation	50	0.1
	Sedimentation after lime addition	NM	ND-BDL
	Sedimentation after other chemical addition	99->99	ND-BDL
	Sedimentation	64->99	ND-33

TABLE L-2. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING POLYNUCLEAR AROMATIC HYDROCARBONS (Continued)

PAH	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
FLUORANTHENE (Continued)			
	Filtration	20-50	0.05-93
	Flotation	NM	0.5-<10
	Reverse Osmosis	75-97	BDL
	Solvent Extraction	49	500
	Activated Sludge	NM	BDL
FLUORENE			
	Activated Carbon	NM	BDL
	Sedimentation after lime addition	>99	ND-1.0
	Sedimentation after other chemical addition	94-99	BDL
	Sedimentation	40->99	ND-12
	Filtration	NM	$0.05-1.0 \times 10^4$
	Flotation	NM	14
	Solvent Extraction	75	190
	Activated Sludge	>99	ND
INDENO(1,2,3-cd)PYRENE			
	Activated Sludge	>99	ND
NAPHTHALENE			
	Activated Carbon	51-98	5.0-78
	Sedimentation after lime addition	NM	ND-BDL

TABLE L-2. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING POLYNUCLEAR AROMATIC HYDROCARBONS (Continued)

PAH	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
NAPHTHALENE (Continued)			
	Sedimentation after other chemical addition	NM,>33-97	BDL-1300
	Sedimentation	>99	ND-<55
	Filtration	83-<99	ND-160
	Flotation	33->99	ND-840
	Reverse Osmosis	99	BDL
	Solvent Extraction	NM	5900
	Activated Sludge	2->99	ND-260
PHENANTHRENE			
	Activated Carbon	98-99	BDL
	Sedimentation after lime addition	92->99	ND-BDL
	Sedimentation after other chemical addition	NM	ND-BDl
	Sedimentation	0	BDL-40
	Filtration	67	ND-3200
	Flotation	45->98	0.2-600
	Reverse Osmosis	99	BDL
	Solvent Extraction	66	280
	Activated Sludge	NM	BDL
PYRENE			
	Activated Carbon	95-98	BDL
	Chemical Oxidation	67	0.1
	Sedimentation after lime addition	90	1.0

TABLE L-2. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING POLYNUCLEAR AROMATIC HYDROCARBONS (Continued)

PAH	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
PYRENE (Continued)			
	Sedimentation after other chemical addition	94->99	ND-BDL
	Sedimentation	75->99	ND-21
	Filtration	0-10	0.09-3200
	Flotation	0	0.3-18
	Reverse Osmosis	99->99	BDL
	Activated Sludge	78	BDL-0.3

1) All data taken from Reference (59).

TABLE L-3. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING AROMATICS

Aromatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
BENZENE			
	Activated Carbon	64->90	BDL-210
	Sedimentation after other chemical addition	>99	ND-310
	Sedimentation after lime addition	>99	ND-1.0
	Sedimentation after other chemical addition	35->99	ND-3800
	Sedimentation	>33-56	BDL-96
	Filtration	29->99	ND-200
	Flotation	33	5.0-200
	Reverse Osmosis	50-80	0.4-1.0
	Solvent Extraction	58-97	$2.4 \times 10^3-1.2 \times 10^4$
	Activated Sludge	75->99	ND-64
CHLOROBENZENE			
	Activated Carbon	98	BDL
	Filtration	98	0.1-470
	Flotation	NM	57
	Activated Sludge	0->99	ND-100

TABLE L-3. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING AROMATICS (Continued)

Aromatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
1,2-DICHLOROBENZENE			
	Activated Carbon	99	BDL-54
	Sedimentation after alum addition	>99	ND
	Sedimentation after other chemical addition	99	BDL-33
	Filtration	44-55	0.5-5.8
	Activated Sludge	69->99	ND-69
1,3-DICHLOROBENZENE			
	Sedimentation after other chemical addition	>99	ND
	Activated Sludge	NM	BDL
1,4-DICHLOROBENZENE			
	Filtration	37	94
	Activated Sludge	76->99	ND-21
2,4-DINITROTOLUENE			
	Sedimentation	80	10
	Activated Sludge	NM	100
2,6-DINITROTOLUENE			
	Sedimentation	80	10
	Activated Sludge	NM	200

TABLE L-3. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING AROMATICS (Continued)

Aromatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
ETHYLBENZENE			
	Activated Carbon	50	BDL-1.3
	Sedimentation after alum addition	70->99	ND-4600
	Sedimentation after lime addition	NM	3.0
	Sedimentation after other chemical addition	81-98	ND-3.8 x 10^4
	Sedimentation	>99	ND
	Filtration	33->99	ND-2.0
	Flotation	3->99	ND-970
	Solvent Extraction	97	4000-4400
	Activated Sludge	16->99	ND-3000
HEXACHLOROBENZENE			
	Sedimentation	64->99	ND-2000
	Activated Sludge	>99	ND-0.8
NITROBENZENE			
	Sedimentation after alum addition	68	35
	Sedimentation after other chemical addition	>99	ND
	Sedimentation	>99	ND

TABLE L-3. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING AROMATICS (Continued)

Aromatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
NITROBENZENE (Continued)			
	Filtration	>99	ND
	Activated Sludge	0	BDL-<30
TOLUENE			
	Activated Carbon	23-99	BDL-630
	Sedimentation after alum addition	0-73	3-2900
	Sedimentation after lime addition	0->99	ND-5.0
	Sedimentation after other chemical addition	NM, 39-96	ND-4200
	Sedimentation	17-83	BDL-1000
	Filtration	0->99	ND-200
	Flotation	10->99	ND-2100
	Reverse Osmosis	12	0.7-29
	Solvent Extraction	94-96	$1600-1.0 \times 10^4$
	Activated Sludge	17->99	ND-1400
1,2,4-TRICHLOROBENZENE			
	Activated Carbon	>99	ND-94

TABLE L-3. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING AROMATICS (Continued)

Aromatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
1,2,4-TRICHLOROBENZENE (Continued)			
	Sedimentation after alum addition	91	150
	Sedimentation after other chemical addition	91	150
	Filtration	NM	ND-84
	Activated Sludge	49->99	ND-920

1) All data taken from Reference (59).

TABLE L-4. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PHENOLS

Phenolic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
P-CHLORO-M-CRESOL			
	Activated Carbon	92	BDL
	Sedimentation after other chemical addtion	44	62
	Sedimentation	NM	10
	Filtration	NM	BDL-1.1
	Solvent Extraction	>99	ND
	Activated Sludge	>99	NO-1.6
2-CHLOROPHENOL			
	Sedimentation after other chemical addition	NM	BDL
	Sedimentation	>99	ND-BDL
	Filtration	0	2.0
	Flotation	NM	2.0
	Oil Separation	>99	ND
	Activated Sludge	92->99	ND-100
2,4-DICHLOROPHENOL			
	Activated Carbon	NM	BDL-BDL
	Sedimentation after other chemical addition	>99	ND

TABLE L-4. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PHENOLS (Continued)

Phenolic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
2,4-DICHLOROPHENOL (Continued)			
	Sedimentation	>98	10-48
	Filtration	67->99	ND-2.0
	Flotation	NM	6.0
	Activated Sludge	>99	ND
2,4-DIMETHYLPHENOL			
	Activated Carbon	NM	BDL-0.9
	Sedimentation after other chemical addition	48-88	BDL-11
	Sedimentation	>99	ND
	Filtration	NM	BDL-29
	Flotation	>99	ND-28
	Solvent Extraction	>99	ND
	Activated Sludge	>99	ND-9.0
4,6-DINITRO-O-CRESOL			
	Sedimentation	>99	ND-BDL
	Solvent Extraction	>99	ND

TABLE L-4. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PHENOLS (Continued)

Phenolic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
2,4-DINITROPHENOL			
	Sedimentation after other chemical addition	>99	ND
	Ultrafiltration	NM	47
2-NITROPHENOL			
	Activated Carbon	NM	3.0
	Sedimentation	>99	ND
	Ultrafiltration	>99	21
	Activated Sludge	>99	ND-BDL
PENTACHLOROPHENOL			
	Activated Carbon	59-98	BDL-49
	Sedimentation after other chemical addition	99	<10-100
	Sedimentation	55->99	ND-24
	Filtration	>99	ND-12
	Flotation	19	8.0-30
	Ultrafiltration	NM	<5.0
	Activated Sludge	67->99	ND-3100
	Aerated Lagoons	>99	ND
PHENOL			
	Activated Carbon	18-98	BDL-49
	Sedimentation after other chemical addition	>33->99	ND-140

TABLE L-4. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PHENOLS (Continued)

Phenolic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations (ug/l)
PHENOL (Continued)			
	Sedimentation	33->99	BDL-670
	Filtration	22->99	ND-3.4 x 10^4
	Flotation	0-80	5-2400
	Oil Separation	>99	ND-820
	Solvent Extraction	3->99	77.96 x 10^6
	Ultrafiltration	NM	55-9700
	Activated Sludge	8->99	ND-1400
	Aerated Lagoons	25->99	ND-24
2,4,6-TRICHLOROPHENOL			
	Sedimentation after other chemical addition	NM	BDL
	Sedimentation	37->99	ND-2.0
	Filtration	80	69
	Flotation	NM	3.0
	Oil Separation	>99	ND
	Solvent Extraction	>99	ND
	Ultrafiltration	99	ND
	Activated Sludge	>37->99	ND-4300
	Aerated Lagoons	>99	ND

1) All data taken from Reference (59).

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
BROMOFORM			
	Activated Sludge	NM	3.0
CARBON TETRACHLORIDE			
	Activated Carbon	64	BDL-BDL
	Sedimentation after alum addition	94	<10-1800
	Sediment after lime addition	NM	ND-BDL
	Sedimentation	>99	ND
	Filtration	88->99	ND-55
	Activated Sludge	98	BDL-0.1
	Aerated Lagoons	NM	61
CHLORODIBROMOMETHANE			
	Sedimentation after alum addition	NM	ND
	Sedimentation	>99	ND-1.0
	Filtration	NM	<10

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
CHLOROETHANE			
	Activated Carbon	27->99	ND-2.4×10^5
	Sedimentation after alum addition	NM	17
CHLOROFORM			
	Activated Carbon	74->99	ND-18
	Sedimentation after alum addition	46->99	ND-550
	Sedimentation after lime addition	>99	ND-BDL
	Sedimentation	0-74	2.0-230
	Filtration	50	BDL-500
	Stripping	99->99	ND-6.5×10^4
	Activated Sludge	9->99	ND-58
	Aerated Lagoons	0->99	ND-1000
	Reverse Osmosis	0-93	BDL-31
	Solvent Extraction	NM	ND
CHLOROMETHANE			
	Sedimentation after alum addition	NM	38
	Sedimentation	84	BDL-39
	Reverse Osmosis	NM	45

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
DICHLOROBROMOMETHANE			
	Activated Carbon	NM	BDL
	Sedimentation	NM	2.0
	Filtration	NM	BDL-<10
	Activated Sludge	>99	ND-1.5
1,1-DICHLOROETHANE			
	Activated Carbon	42->99	ND-4.5×10^4
	Sedimentation after lime addition	NM	4.0
	Sedimentation	0	2.0
	Filtration	0.>99	ND-180
	Activated Sludge	>99	ND
1,2-DICHLOROETHANE			
	Activated Carbon	21->99	ND-7.6×10^5
	Sedimentation after alum addition	>99	ND-90
	Filtration	NM	170

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal^1	Range of Effluent Concentrations^1 (ug/l)
1,2-DICHLOROETHANE (Continued)			
	Stripping	70-99	$22-4.4 \times 10^5$
	Activated Sludge	>99	ND-290
	Solvent Extraction	84->99	$<2.7 \times 10^4-9.7 \times 10^4$
1,1-DICHLOROETHYLENE			
	Activated Carbon	>99	ND-1.4
	Sedimentation after alum addition	>99	ND-<10
	Sedimentation	87	40-70
	Filtration	40-76	ND-130
	Activated Sludge	41	<1.7-5.8
1,2-trans-DICHLOROETHYLENE			
	Activated Carbon	84-98	1.1-1100
	Sedimentation after alum addition	27	190
	Sedimentation	38-44	5.0-19
	Filtration	NM	31-690
	Stripping	9->99	$ND-1.3 \times 10^6$

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
1,2-trans-DICHLOROETHYLENE (Continued)			
	Activated Sludge	32->99	ND-8.2
1,2-DICHLOROPROPANE			
	Activated Carbon	65->99	ND-BDL
	Filtration	NM	BDL
	Activated Sludge	>99	ND
1,3-DICHLOROPROPENE			
	Activated Sludge	NM	3.9-5.6
METHYLENE CHLORIDE			
	Activated Carbon	0-92	1.8-940
	Sedimentation after alum addition	90->99	ND-1.3×10^4
	Sedimentation after lime addition	33	BDL-2.0
	Sedimentation	17->99	BDL-1100
	Filtration	5->99	ND-3.1×10^4
	Stripping	54-87	$9.0 \times 10^4 - 3 \times 10^5$

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
METHYLENE CHLORIDE (Continued)			
	Activated Sludge	38-99	0.9-250
	Aerated Lagoons	0-97	<5-2000
	Reverse Osmosis	0-64	4.0-6.0
1,1,2,2-TETRACHLOROETHANE			
	Activated Carbon	>99	680
	Filtration	NM	0.7-18
	Stripping	99->99	ND-7.8 x 10^4
	Activated Sludge	>99	ND-BDL
	Solvent Extraction	91	4200
TETRACHLOROETHYLENE			
	Activated Carbon	68	BDL-32
	Sedimentation after alum addition	>99	ND-700
	Sedimentation after lime addition	NM	ND-1.0
	Sedimentation	50->99	ND-93

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
TETRACHLOROETHYLENE (Continued)			
	Filtration	0->99	ND-210
	Stripping	37->99	ND-6800
	Activated Sludge	55->99	ND-40
	Aerated Lagoons	>99	ND
1,1,1-TRICHLOETHANE			
	Activated Carbon	>99	ND-1.9
	Sedimentation after alum addition	>55	10-<170
	Sedimentation after lime addition	NM	ND-28
	Sedimentation	19-88	2.0-2500
	Filtration	86->99	ND-4400
	Stripping	9	4.2×10^4
	Activated Sludge	94->99	ND-33
	Aerated Lagoons	96	22

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
1,1,2-TRICHLOROETHANE			
	Activated Carbon	>99	ND
	Sedimentation after alum addition	NM	<11
	Sedimentation after lime addition	NM	ND
	Filtration	NM	7.0-2100
	Stripping	98->99	ND-200
	Activated Sludge	NM	BDL
	Solvent Extraction	90	1.6×10^4
TRICHLOROETHYLENE			
	Sedimentation after alum addition	10-<99	ND-190
	Sedimentation after lime addition	>99	ND-0.1
	Sedimentation	21-93	33-3000
	Filtration	0->99	ND-2000
	Stripping	23->99	ND-3.4×10^4
	Activated Sludge	0->99	ND-84

TABLE L-5. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING HALOGENATED ALIPHATICS (Continued)

Halogenated Aliphatic Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
TRICHLOROETHYLENE (Continued)			
	Reverse Osmosis	17	BDL-0.4
TRICHLOROFLUOROMETHANE			
	Activated Carbon	NM	BDL-69
	Filtration	NM	BDL-6..0
	Activated Sludge	96	1.7-2700
	Aerated Lagoons	>99	ND
VINYL CHLORIDE			
	Activated Sludge	52	1100

1) All data taken from Reference (59).

TABLE L-6. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PHTHALATES

Phthalate Ester Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
BUTYL BENZYL PHTHALATE			
	Activated carbon	53-99	BDL-17
	Sedimentation after lime	NM	ND-BDL
	Sedimentation after other chemical addition	93->99	BDL-36
	Sedimentation	95->99	ND-BDL
	Filtration	52->99	ND-<10
	Flotation	97->99	ND-42
	Reverse Osmosis	98	BDL
	Activated Sludge	NM	11
DIBUTYL PHTHALATE			
	Activated Carbon	0-99	BDL-11
	Sedimentation after lime	NM	ND-BDL
	Sedimentation after other chemical addition	NM, 0->99	ND-550
	Sedimentation	0-83	BDL-36
	Filtration	0-96	0.43-9300
	Flotation	0->99	ND-300
	Reverse Osmosis	20->99	BDL-1.0
	Activated Sludge	84->99	ND-58

TABLE L-6. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PHTHALATES (Continued)

Phthalate Ester Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
DIETHYL PHTHALATE			
	Activated Carbon	5	1.2-9.5
	Sedimentation after lime	56-99	ND-73
	Sedimentation after other chemical addition	NM, 76-96	ND-92
	Sedimentation	NM	ND-44
	Filtration	60->99	ND-1.1 x 10^4
	Flotation	>99	ND
	Reverse Osmosis	18->99	BDL-170
	Activated Sludge	>99	ND-200
DIMETHYL PHTHALATE			
	Activated Carbon	NM	BDL
	Sedimentation after other chemical addition	>99	ND
	Sedimentation	97	BDL-93
	Filtration	99->99	ND-BDL
	Reverse Osmosis	18->99	BDL-170
	Activated Sludge	>99	ND-200
DIOCTYL PHTHALATE			
	Activated Carbon	20	4.0
	Sedimentation after lime	NM	ND-BDL
	Sedimentation after other chemical addition	ND, >99	ND-5.0

TABLE L-6. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PHTHALATES (Continued)

Phthalate Ester Pollutant	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
DIOCTYL PHTHALATE (Continued)			
	Filtration	50->99	ND-4.0
	Flotation	61->99	ND-33
	Activated Sludge	NM	5000
BIS(2-ETHYLHEXYL)PHTHALATE			
	Activated Carbon	0-99	3.9-410
	Sedimentation after lime	41-97	ND-40
	Sedimentation after other chemical addition	ND, 16->99	ND-80
	Sedimentation	14-80	BDL-170
	Filtration	20-98	BDL-1.6 x 10^4
	Flotation	10-98	30-1100
	Reverse Osmosis	25-99	BDL-31
	Activated Sludge	15->99	ND-230

1) All data taken from Reference (59).

TABLE L-7. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING NITROGEN COMPOUNDS

Nitrogen Compound	Treatment Process	Range of Percent Removal[1]	Range of Effluent Concentrations[1] (ug/l)
1,2-DIPHENYLHYDRAZINE			
	Solvent Extraction	36	3000
N-NITROSODIMETHYLAMINE			
	Sedimentation after other chemical addition	>99	ND

1) All data were taken from Reference (59).

TABLE L-8. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING OXYGENATED COMPOUNDS[1]

Oxygenated Compound	Treatment Process	Range of Percent Removal	Range of Effluent Concentrations (ug/l)
ACROLEIN			
	Filtration	>99	ND
	Flotation	NM	360
ISOPHORONE			
	Sedimentation after lime addition	7	ND-560
	Sedimentation	35->99	ND-110
	Flotation	>99	ND
	Activated Sludge	NM	BDL

1) All data taken from Reference (59).

TABLE L-9. PERFORMANCE OF TREATMENT TECHNOLOGIES IN REMOVING PESTICIDES[1,2]

Pesticide	Treatment Process	Range of Percent Removal	Range of Effluent Concentrations (ug/l)
PESTICIDES	Chemical Oxidation	54->99	<10-3200
	Biological Oxidation	8.2->99	$<0.1-<2.7 \times 10^4$
	Activated Carbon	36->99	$<1.0-1.5 \times 10^4$
	Hydrolysis	87->99	$<1.0-9.1 \times 10^4$

[1]) Range of percent removal and range of effluent concentration are for individual, unspecified pesticides

2) All data taken from Reference (60).

LIMITATIONS TO THE APPLICATION OF ORGANIC CHEMICALS TREATMENT TECHNOLOGIES

Air Stripping

- A principal consideration in electing to install air stripping units is that costly air pollution controls are generally required to reduce air emissions of organics. (Reference 61)

- The percentage removal of volatile organics using air stripping generally decreases with increasing concentrations above 5 mg/l. Therefore, air stripping is generally not used to remove volatile organics at concentrations greater than 100 mg/l. (Reference 61)

- Compounds with Henry's constants $>10^{-3}$ $atm \cdot m^3/mol$ are generally sufficiently volatile to be efficiently removed by air stripping. (Reference 62)

Activated Carbon Adsorption

- To avoid clogging, the use of activated carbon adsorption is generally restricted to waste streams with suspended solids <100 mg/l, calcium and magnesium concentrations <500 mg/l and oil and grease <200 mg/l. (Reference 62)

- The carbon requires periodic regeneration to maintain high removal percentages; regeneration typically involves thermal oxidation of the adsorbed organics. (References 57 and 62)

  Other carbon regeneration techniques, such as the application of alkali, acids, steam, etc. can permit reuse of desorbed organics in some instances. (Reference 62)

Activated Sludge

- The main disadvantage of activated sludge as an organic chemicals treatment technology is that activated sludge systems are subject to upset caused by variations in hydraulic, organic, and toxic metal loadings. (Reference 57)

Dissolved Air Flotation

- Flotation is generally effective in removing suspended solids with densities less than or only slightly greater than water. Flotation is used primarily in the treatment of oily wastewaters. (Reference 57)

Gravity Oil Separation

- Gravity oil separation involves the skimming of insoluble and/or emulsified organics from the surface of wastewaters. Gravity separation has been used to treat wastewaters from many industrial operations, including petroleum refining wastewaters and wastewaters from the rolling of steel. (Reference 57)

  Gravity separation only removes those organics and metals associated with a floating oil layer. Therefore, effluents from gravity oil separators frequently require further treatment. (Reference 57)

APPENDIX M

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REFERENCES

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