Guidance Document for the Discharge of Petroleum Distribution Terminal Effluents to Publicly Owned Treatment Works

API PUBLICATION 1612
FIRST EDITION, NOVEMBER 1996

American Petroleum Institute

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Manufacturing, Distribution and Marketing Department

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FOREWORD

Petroleum product terminals receive bulk shipments of gasoline, middle distillates, aviation gas, lube oil, and specialty products from pipelines, tankers, barges, railcars, and trucks. The products are stored in tanks and warehouses and distributed to service stations, truck stops, and other points of use. There are approximately 1700 pipeline and petroleum product terminals in the United States.

Terminals generate wastewaters consisting primarily of tank bottom water and stormwater runoff from product transfer areas. The various wastewaters are treated by an oil/water separator to recover any free product, and the treated wastewater is discharged as terminal effluent. Often, because of geographic location, low effluent volume, or operating limitations, the most practical disposal option for terminal effluent will be discharge to the local publicly owned treatment works (POTW). Effluent discharge to a POTW usually requires a permit or agreement from the POTW, specifying conditions under which the discharge is acceptable.

In some cases, POTWs may have significant concerns regarding the acceptance of terminal effluent. Concerns include the following:

a. Terminal effluent may contain flammable liquids, creating an explosion hazard in the sewers or wastewater treatment plant.
b. Treatment effluent contaminants may harm the treatment process, hindering the treatment plant's ability to function effectively.
c. Terminal effluent contaminants may not be treatable by the treatment plant and may thus be discharged to the environment in excessive quantities.
d. Terminant effluent discharges may not be adequately controlled, leading to slugs of oil, contaminants, or volume entering the sewers.
e. Terminal effluent contaminants may exposes POTW operators to health hazards.

These are important concerns for POTWs, but terminals can successfully address them. The concerns are more logically associated with major industrial dischargers, as opposed to petroleum product terminals, which typically generate only small volumes of terminal effluents, have systems in place to prevent flammable liquid discharges, and can readily implement effective discharge controls.

This guidance document is written to assist the terminal through the negotiations of a pretreatment discharge permit or agreement with the local POTW. The document describes key systems at POTWs and terminals, explains POTW concerns, and presents reasonable methods for addressing the concerns.

This document is organized into seven sections addressing key issues involved in obtaining a pretreatment discharge permit. The sections are as follows:

a. Section 1—POTW Characteristics—Explains the main components of POTWs—the sewer system and the treatment plant. POTW performance requirements are described, as well as operating limits, giving the terminal an understanding of the sources of POTW concerns regarding the acceptance of terminal effluents.
b. Section 2—Pretreatment Requirements—Discusses the pretreatment program, which is the framework for regulating industrial discharges to POTWs. It describes the constraints POTWs may impose on terminal effluent discharges.
c. Section 3—Characteristics of Terminal Effluent—Describes sources of terminal effluent and typical effluent compositions. Factors affecting effluent volume and contaminant loading are addressed.
d. Section 4—POTW Concerns—Discusses specific concerns POTWs may have about accepting terminal effluents. Measures for mitigating the concerns are described.
e. Section 5—Relations with POTW Management—Guides the reader through the discharge application process, from initial contact to securing the permit to maintaining good relations with the POTW after discharge commences.

f. Section 6—Terminal Pretreatment Options—Addresses methods to reduce terminal effluent volume and to treat the effluent to reduce contaminant levels.
g. Section 7—Associated Costs—Outlines costs associated with discharging terminal effluent to a POTW.

Two appendixes provide information that may be useful in preparing for a pretreatment permit negotiation:

a. Appendix A—Mass Balance Calculations: This appendix shows how to calculate contaminant concentrations in terminal effluent and demonstrate the insignificant impact of the contaminants on a POTW.
b. Appendix B—Petroleum Product Terminal Wastewater Characterization Data: This appendix summarizes available data on specific terminal wastewaters and composite terminal effluents.

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Suggested revisions are invited and should be submitted to the director of the Manufacturing, Distribution and Marketing Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

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Guidance Document for the Discharge of Petroleum Distribution Terminal Effluents to Publicly Owned Treatment Works

SECTION 1—POTW CHARACTERISTICS

1.1 Introduction

A publicly owned treatment works (POTW) collects and treats wastewater. Its two main components are a wastewater conveyance (sewer) system and a wastewater treatment system. Terminals may be more successful negotiating and implementing a program to discharge effluents to a POTW when they understand POTW components and limitations.

This section discusses the POTW conveyance system, treatment system processes, typical requirements of a POTW's operating permit, and operating limitations of POTWs. The information is the basis for the POTW concerns described in Section 4.

1.2 Components of a POTW System

This section discusses the sewer and treatment systems. These systems are typically designed for managing residential wastewater (domestic sewage). Depending on the community, however, the POTW may also anticipate receiving a contribution of wastewater from industrial and commercial sources.

1.2.1 POTW SEWER SYSTEM COMPONENTS

Wastewater flows through a network of sewers and pump stations that deliver wastewater to a treatment plant. The sewers typically convey wastewater by gravity and thus flow only partially full. Consequently, there is an air space in the pipe above the wastewater surface. If flammable gases such as hydrogen sulfide collect in this airspace or in a manhole, an explosion hazard can result.

Pump stations are used to transfer wastewater over long distances or to "lift" wastewater so it can flow by gravity again. Pump station wetwells hold wastewater until the level activates the pumps. While the wastewater accumulates in the wetwell, gases can volatilize and collect in the air space. Pump stations have moving metal parts that can cause sparking. While the moving parts are usually kept in a separate drywell compartment, gases such as hydrogen sulfide can migrate into this area, posing an explosion hazard.

Sewer workers need to access the conveyance system via manholes for routine maintenance and emergency work. Manholes and pump stations require confined space entry because gases exist in all municipal wastewater conveyance systems receiving domestic sewage. Many gases, such as hydrogen sulfide, are toxic; however, nontoxic gases are also of concern to the POTW, as they displace air from the sewer system. Likewise, POTW operators are also concerned about exposure to volatile and possibly toxic contaminants discharged by industrial users.

1.2.2 TYPICAL WASTEWATER TREATMENT SYSTEM COMPONENTS

Wastewater treatment plants typically purify wastewater using a combination of solids settling, biological degradation of dissolved contaminants, and disinfection of pathogenic organisms. Plant complexity, configuration, and process selection vary from POTW to POTW. Most plants are constructed for liquid and sludge treatment. However, some plants now include air and odor treatment as well. Key processes are described below, with POTW concerns noted. Figure 1 shows a typical arrangement of many of these processes at a wastewater treatment plant.

1.2.2.1 Influent Pumping

At some plants, an influent pumping station lifts wastewater to a higher elevation so wastewater can flow by gravity through the plant. These pumps have hydraulic limitations. Overloading can result in sewer backups and possible wastewater overflows. Since an influent pumping chamber is the low point in the conveyance system and the treatment plant, vapors heavier than air can collect here. Therefore, a POTW may be concerned about explosion hazards at the influent pumping chamber.

1.2.2.2 Equalization Basin

Treatment processes work better with stable inputs of flow and waste. Wastewater flows to POTWs tend to follow a "diurnal curve," as shown in Figure 2. Typically this diurnal curve has high sewer flows at somewhat predictable times of day related to the workday. Peaks normally occur after the morning and afternoon commute hours. Low flows occur at normally inactive times such as after midnight. This variation between peak and low flows is more pronounced in smaller POTWs; larger POTWs serve larger communities and tend to have a wider variety of water use patterns that buffer the peak and low periods. Treatment plants receiving a high variation in flow or waste strength may use an equalization basin to dampen out effects it might have on the rest of the treatment system.

1.2.2.3 Headworks

The headworks, located early in the process train, screen out large debris that can clog or otherwise damage equipment downstream. Equipment may include a bar screen, which acts

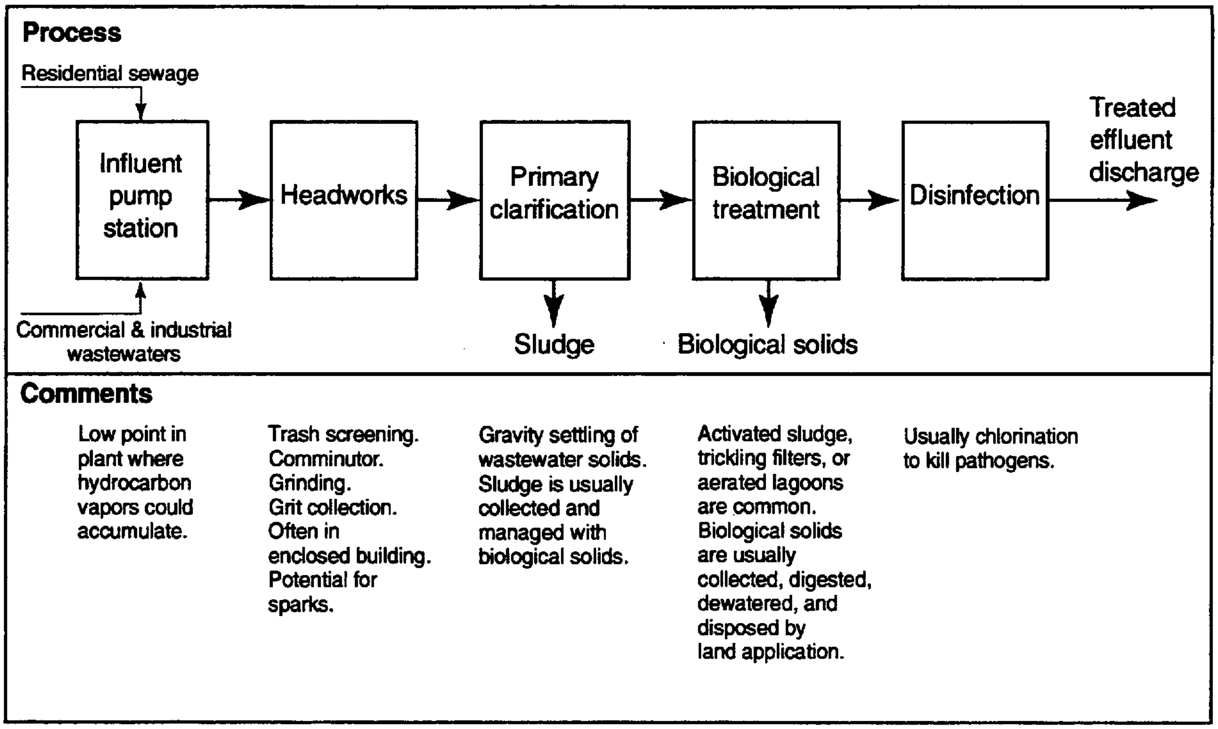

Figure 1—Typical Municipal Wastewater Treatment Plant Process (With Issues Related to Terminals Noted)

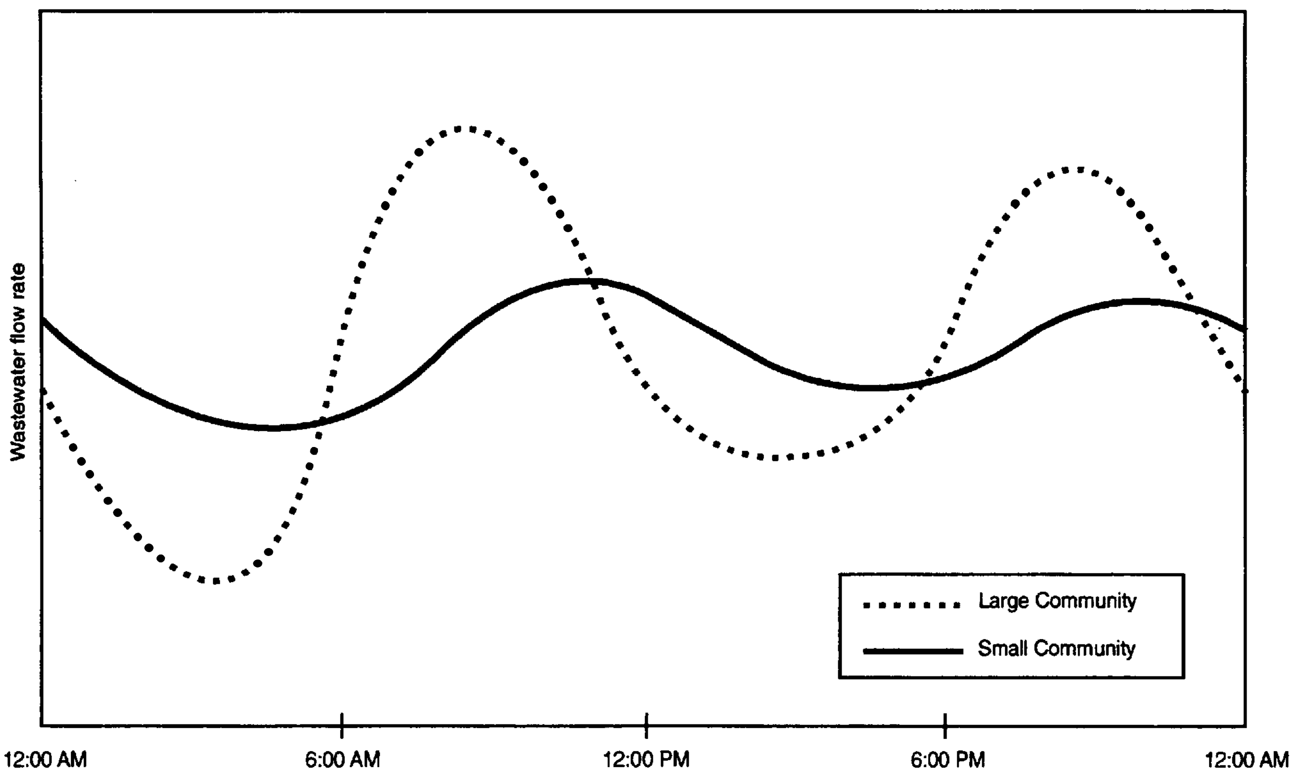

Figure 2—Typical Treatment Plant Inflow Curves (Weekday, Residential, Conditions)

like a trash rack, and a comminutor, which acts like a garbage disposal grinding up debris. Often, headworks equipment is located in an enclosed building. The mechanical moving parts and the enclosed space both create explosion concerns.

1.2.2.4 Grit Chamber

The grit chamber follows the headworks and settles out inorganic solids such as stones that find their way into the conveyance system. Grit removal functions to protect downstream equipment from abrasive materials.

1.2.2.5 Primary Settling or Clarification

Gravity settling of wastewater solids provides primary treatment by removing readily settleable organic material. Liquid overflows to the next process, the biological treatment unit. The sludge collected from the clarifier bottom is pumped to sludge processing units.

1.2.2.6 Biological Treatment

This process, also referred to as secondary treatment, removes the majority of organic contaminants. Biological treatment involves the use of living microorganisms (bacteria) to consume organic matter as their food. The microorganisms in POTWs normally get the overwhelming bulk of their food from organic contaminants of domestic origin (household sewage), so that the microorganisms that evolve in a biological treatment process acclimate primarily to these domestic contaminants. POTWs are concerned that nondomestic wastewater discharges may contain unusual contaminants that can harm (kill or inhibit the growth of) the microorganisms or contain contaminants that the microorganisms cannot degrade. Harming the microorganisms is called *interference*; sending untreated contaminants through the treatment plant is called *pass-through*. These two terms are discussed further in Section 2.

Several process configurations are commonly used in POTWs: activated sludge, trickling filters, rotating biological contactors, and lagoons. Each configuration provides a way of contacting the microorganisms with the wastewater, supplying air (oxygen) to the microorganisms, and controlling the microorganism population to maintain effective treatment capability.

Activated sludge, one of the most common biological treatment processes, uses continuous-flow aeration basins for mixing the wastewater, microorganisms, and air together. Microorganism communities (flocs) grow in the basins as they consume the wastewater contaminants, reaching macroscopic levels and becoming the primary component of the solids in the basin. The mixed, solids-containing contents of the basin flow into a clarifier, where the microorganism solids (sludge) settle out, and the treated, clarified liquid overflows to a downstream treatment process. Some of the settled microorganism solids are returned to the aeration basin to treat additional incoming wastewater, while some are removed from the process and managed for disposal. Careful process control is necessary to maintain proper aeration basin conditions and to provide optimal growth conditions for the microorganisms.

Trickling filters use a stationary media—such as plastic or stones—to support microorganism growth. The wastewater is distributed over the media, and the microorganisms, growing as a slime layer on the media, degrade the contaminants as the wastewater flows past. The treated wastewater is directed to a clarifier to settle out portions of the slime layer that slough off the media.

Rotating biological contactors also use a plastic framework to support microorganism growth. In this case, the microorganisms grow on discs that contact the wastewater by rotating, partially submerged in a basin. The microorganisms are exposed to air as they rotate out of the wastewater. Again, a clarifier follows the aeration portion of the process.

Lagoons are the simplest biological treatment configuration, consisting of ponds, normally mixed and aerated with splash-type mechanical devices. Solids are not removed by a clarifier; instead, solids are allowed to settle either to the bottom of an unmixed portion of the pond or to the bottom of a separate, unmixed pond. Lagoons are normally larger than the basins associated with activated sludge, trickling filters, or rotating biological contactors; however, the concentration of microorganisms is normally lower. Lagoon systems require minimal operator attention and are more typical of smaller POTWs.

1.2.2.7 Nutrient Removal/Advanced Treatment

Some POTWs are required to remove ammonia, a plant growth nutrient. Ammonia removal can be integrated into the biological phase of treatment or can involve a process after biological treatment. Biological ammonia removal, called nitrification, is accomplished by a very small number of bacteria species within the overall microorganism community, and these nitrifying species have a relatively slow growth rate. Interference is a concern with nitrification, because the nitrifying bacteria might be susceptible to adverse impacts from certain contaminants of industrial origin.

1.2.2.8 Disinfection

Pathogens, including bacteria and viruses, exist in wastewater due to the discharge of human waste, and may cause an assortment of highly infectious diseases. Disinfection is used to kill pathogens common in human wastewater. Chlorination is currently the most common disinfection method. A key operating factor is the amount of time the wastewater stays in contact with the disinfecting process. Hydraulic overloads can impact the effectiveness of this process.

1.2.2.9 Effluent Disposal

POTWs discharge final effluent to surface waters—a stream, lake, or ocean—in accordance with permit conditions, discussed in 1.3.

1.2.2.10 Sludge Handling

The solid by-product of the treatment system is sludge, or biosolids, from the clarifiers. All POTWs generate sludge and need to dispose of it in some way, normally by land application. EPA regulations have tightened the maximum concentrations of certain contaminants that can be applied to land. The regulations focus on metals and polynuclear aromatic hydrocarbons (PAHs), because these contaminants tend to associate with the sludge during biological treatment. POTW compliance with these regulations requires careful control of the sludge quality. Depending on which contaminants are found in the sludge, the POTW may not be able to pursue certain sludge disposal options.

1.2.2.11 Air Emission Control

This issue addresses the control and treatment of air toxics and odors. With the Clean Air Act Amendments of 1990, POTWs are now beginning to review their treatment plants with regard to air emissions from open channels and basins, such as tanks, lagoons, and conveyance systems. Volatile organics (VOCs) can escape to the atmosphere, creating air emissions from the wastewater system. Basins associated with enhanced biological treatment, such as activated sludge aeration tanks, have fewer VOC emissions than lagoons, for example, because of the high concentration of microorganisms that metabolize the VOCs in solution before they volatilize.

1.3 Performance Requirements of POTWs

POTWs, like terminals, are part of the regulated community. Treatment plant discharges must comply with National Pollutant Discharge Elimination System (NPDES) permit conditions. Permit violations can lead to regulatory agency intervention, fines, and enforcement actions. Environmental lawsuits initiated by third parties can also result from violations of the NPDES permit. NPDES permits include a variety of requirements, categorized as flow limits and concentration limits.

1.3.1 CONCENTRATION LIMITS

NPDES permits stipulate maximum concentrations for specific contaminants. The basis for determining concentration limits is either technology or water quality. Technology based limits are intended to reflect the capabilities of treatment processes; for example, biological treatment might be expected to remove approximately 85 percent of influent organic contaminants. Water quality based limits are intended to ensure that discharged contaminants do not impair the health or designated use of the receiving water; for example, limits may represent the maximum allowable contaminant load that does not create toxic conditions for aquatic life.

The POTW's discharge is routinely analyzed for regulated contaminants. Any exceedences associated with industrial discharges indicate that the POTW may not be effectively treating the industrial contaminant, meaning that pass-through is creating permit violations for the POTW.

1.3.2 FLOW LIMITS

An NPDES permit specifies the maximum flow rate that a POTW may discharge. Wastewater flow rates approaching this limit trigger requirements for the POTW to investigate a treatment plant expansion. Thus, POTWs monitor the residential and industrial hook-ups, stormwater discharge, and groundwater infiltration into sewers. POTWs are becoming increasingly unwilling to accept stormwater, because it is considered a nonwastewater stream that could push the POTW toward a hydraulic expansion.

1.4 Operating Limits of POTWs

Sustained successful performance of the wastewater treatment plant requires control of the two primary operating constraints: hydraulic (flow) loading and mass (contaminant) loading.

1.4.1 FLOW LIMITATIONS

Flow limitations may apply to the sewer system and the treatment plant. Pumps and process units located at the treatment plant are designed to handle specified hydraulic capacities. Hydraulic overloading of pumps or sewers can cause overflows. High flows prevent sufficient hydraulic detention in disinfection processes, leading to insufficient pathogen destruction. Terminal effluent volumes are very low, as described in 3.4, and should have a negligible impact on a POTW influent flow rate. It is unlikely that terminal effluents have a high enough volume to create hydraulic problems at a POTW.

1.4.2 MASS LOADING LIMITATIONS

Treatment plant process units are designed for an expected influent loading—pounds per day—of contaminants. Higher loadings can upset the processes. Terminal effluent mass loadings are very low, as shown in the example mass balance in Appendix A, and should have a negligible impact on a POTW influent composition. It is unlikely that terminal effluents have a high enough loading to upset a POTW process.

1.5 Referenced Publications

Unless otherwise noted, the latest edition or revision of the following publications shall, to the extent specified herein, form a part of this publication. When specific parts (for example, numbered paragraphs or tables) of other documents are referenced in this text, the edition current when this publication was issued shall apply.

API

Publ 4602 *Minimization, Handling, Treatment, and Disposal of the Petroleum Products Terminal Wastewater*

Brown and Caldwell[1]

Treatment of Petroleum Marketing Effluent in a Publicly Owned Treatment Facility

EPA[2]

440/1-82/303 *Fate of Priority Pollutants in Publicly Owned Treatment Works*

40 *Code of Federal Regulations*, Parts 122, 303, and 403

Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program Industrial User Permitting Guidance Manual

SECTION 2—PRETREATMENT REQUIREMENTS

2.1 Introduction

POTWs must ensure that their systems can effectively manage and treat complex wastewaters consisting of domestic and industrial discharges. With most system components designed for domestic wastewaters, POTWs need a way to control industrial discharges. Control is achieved by the pretreatment program, which authorizes and, in fact, requires the POTW to regulate the quality and quantity of discharges from industries. This section describes the pretreatment programs, industrial user classifications, and typical pretreatment requirements likely to affect petroleum terminals, and the development of local limits.

2.2 Pretreatment Programs

2.2.1 EPA REGULATIONS

EPA's National Pretreatment Program was established to regulate the introduction of contaminants from nondomestic sources into POTWs. The program is intended to be implemented on a local level, by the POTW itself, according to guidelines set forth in federal EPA regulations (40 CFR Part 403). Many states are approved to administer the POTWs' programs, keeping the regulatory oversight closer to home, where local interests receive their proper attention. Figure 3 identifies which states have EPA-approved pretreatment programs. States without approved programs must adhere to the national program.

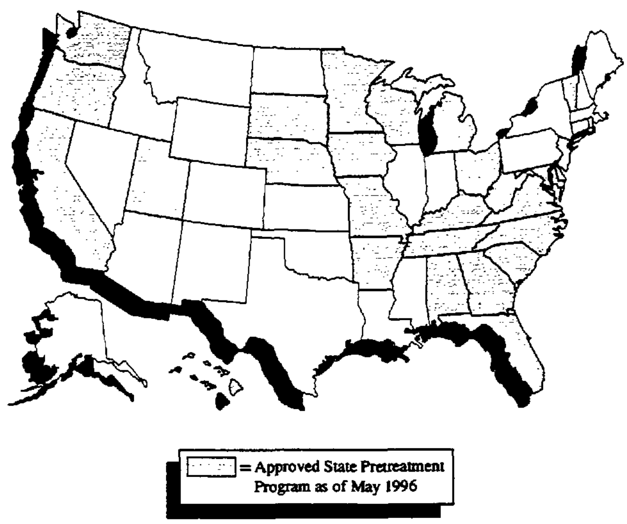

Figure 3—EPA-Approved State Pretreatment Program

The normal procedure for implementing the program is for the POTW to prepare the pretreatment program (the elements of which are described in this section) and submit it for approval to either the state or EPA. In unusual cases, the state or EPA takes responsibility for program preparation from the POTW. The terminal should identify the agency having authority for implementing the program.

2.2.2 OBJECTIVES

There are a number of objectives that the pretreatment program attempts to achieve, including the following:

a. To prevent contaminants that interfere with the POTW's normal operation from entering the sewer system. Such *interference* can result in plant upsets by harming the treatment process microorganisms.

b. To prevent inadequate treatment of contaminants that *pass through* into the environment. Pass-through occurs when the treatment plant is unable to remove a contaminant effectively, and either the contaminant has an effluent concentration exceeding the POTW's permit limit or the contaminant causes an exceedance of water quality standards applicable to the POTW's receiving stream.

c. To ensure sewer worker safety and health, preventing explosive and toxic working conditions in the sewer system and at the treatment plant. The discharge to the sewers of flammable and/or noxious materials is prohibited.

d. To prevent restriction or limitation of the POTW's sludge disposal options, owing to contaminant concentrations in the sludge.

e. To reduce the introduction of clean water into the sewer system, preserving the hydraulic capacity of the sewer system and the plant for wastewater.

f. To ensure that oily or viscous discharges do not damage the POTW by clogging pipes or coating equipment.

[1]Brown and Caldwell, P.O.Box 8045, Walnut Creek, California 94596-1220.

[2]Environmental Protection Agency. The *Code of Federal Regulations* (CFR) is available from the U.S. Government Printing Office, Washington, D.C. 20402.

g. To prohibit the discharge of corrosive and/or reactive materials to the POTW.

These major objectives are achieved through local ordinances, industrial pretreatment programs, and industrial discharge limits.

Other objectives for the pretreatment program are to implement, administer, and enforce a fee program in compliance with federal and state law; implement an enforcement plan aimed at ensuring compliance with the sewer ordinance; and make information and data on industrial discharges available to the public.

2.3 Industrial User Classifications

As part of the pretreatment program, a POTW identifies the most significant industrial dischargers and focuses discharge controls on them. These dischargers are called *significant industrial users* (SIUs).

It is important for a terminal to become familiar with its POTW's policy for designating SIUs. Under normal conditions, terminal effluents should not significantly contribute to the contaminant or hydraulic loading to a POTW; therefore, the terminal should take steps—through a combination of communication with the POTW and appropriate wastewater management at the terminal—to avoid an unrealistic designation as an SIU.

2.3.1 SIU DEFINITION

Federal regulations 40 CFR Part 303 establish the criteria for being an SIU. Figure 4 presents these criteria in a flowchart, and the following text describes them in detail:

a. Any categorical industry as defined in 40 CFR Part 403 and 40 CFR Chapter I, Subchapter N, EPA developed standard regulations and limits for more than 40 "categorical industries" identified as large contaminant dischargers. Terminals are not a categorical industry, but petroleum refineries are identified as large contaminant dischargers.

b. Any industry with an average discharge of 25,000 gallons per day (gpd) of process wastewater (excluding sanitary, noncontact cooling water, and boiler blowdown wastewater).

c. Any industry that contributes a flow rate exceeding 5 percent of the average dry weather hydraulic capacity of the POTW.

d. Any industry that contributes a waste load exceeding 5 percent of the organic capacity of the POTW. *Organic capacity* means the design influent biochemical oxygen demand (BOD) loading.

e. Any industry that has the reasonable potential to cause a permit violation for the POTW.

f. Any industry that has the reasonable potential for adversely affecting the POTW's operation.

g. Any industry that has the reasonable potential for violating any pretreatment standard or requirement.

Terminals are not likely to trigger an SIU designation with the first five criteria—concerning flow or contaminant loading. It is the last two criteria—concerning potentially creating a problem—that may cause a POTW to designate a terminal as an SIU. A primary purpose of this guidance document is to provide both terminals and POTWs with the knowledge and tools to avoid this inappropriate designation.

In most states, when an industry is determined to be an SIU, the industry or the POTW can request that the SIU designation be removed. To do this, the industry must prove that there is no reasonable potential for the industrial discharge to impact the POTW or violate the pretreatment program or standards.

2.3.2 TYPICAL REQUIREMENTS FOR NONSIGNIFICANT INDUSTRIAL USERS

Pretreatment programs establish discharge requirements common to both non-SIUs and SIUs. The common requirements are presented in this section, and the SIU-specific requirements are presented in 2.3.3.

The common industrial discharge requirements address local limits, spill prevention, POTW inspection access, waste disposal, and fees. In most cases, non-SIUs are not required to monitor, sample, or report on their discharges, although initial characterization of waste and documentation of flow may be necessary.

2.3.2.1 Local Limits

All industrial dischargers must meet local discharge limits. The local limits define maximum amounts of contaminants in industrial discharges (see 2.4).

2.3.2.2 Spill Prevention

Spill prevention and control procedures and safeguards are required of all industrial dischargers. Terminals implement such procedures due to other regulations.

2.3.2.3 Access

All industrial dischargers must provide the POTW with access to the wastewater discharge. This is usually accomplished by constructing a control manhole either outside the terminal fenceline or in the city right-of-way. If the manhole is constructed inside the terminal fenceline, the POTW will expect to have access to it.

2.3.2.4 Proper Disposal of Wastes

Pretreatment permits usually contain a clause addressing waste residues from pretreatment processes. Any such waste residues must be disposed of properly.

2.3.2.5 Fees

Users pay for the cost of administering the pretreatment program through user fees, surcharges, and sometimes fines.

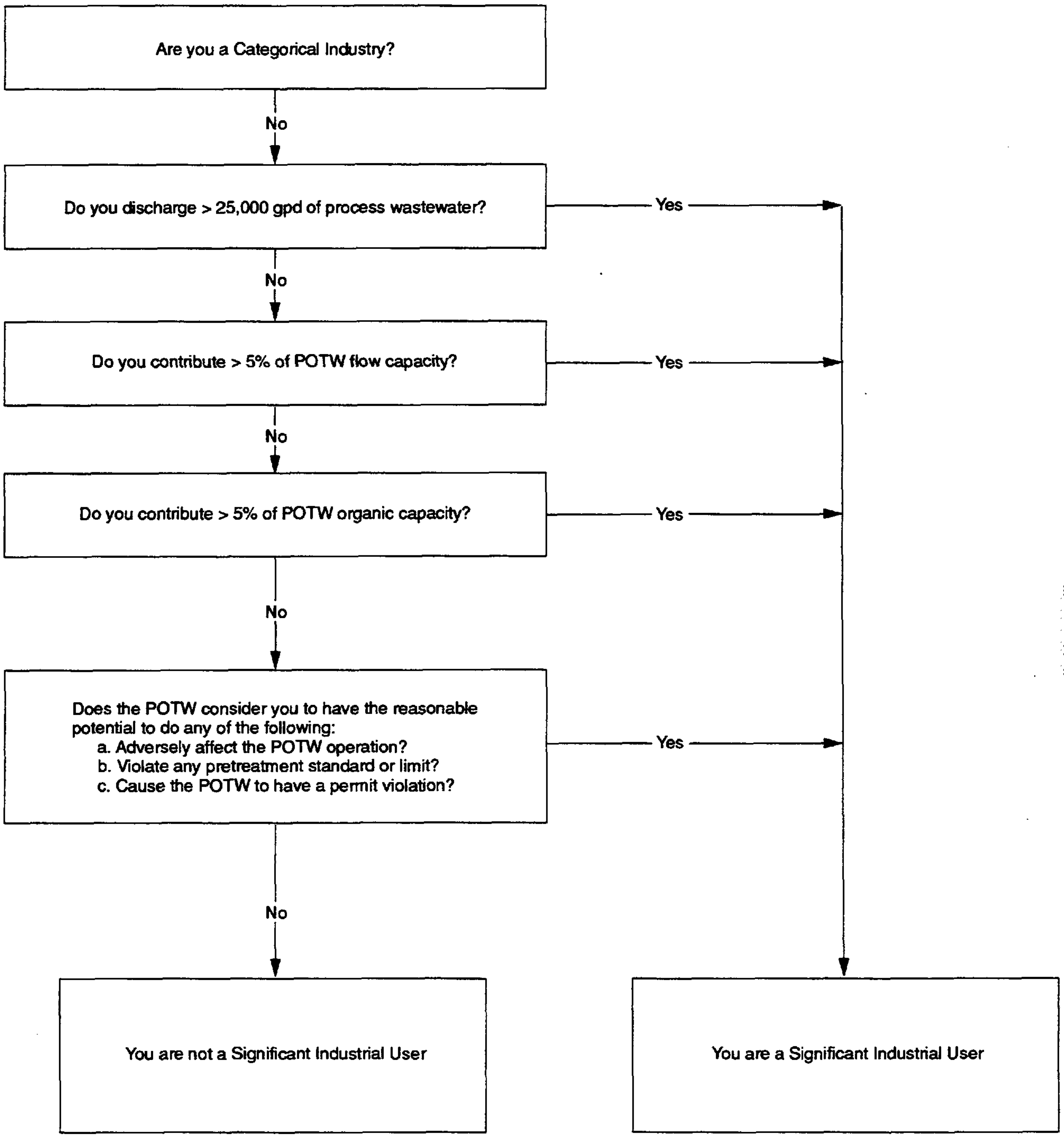

Figure 4—Determination of Industrial User Classification

2.3.3 TYPICAL SIU REQUIREMENTS

An SIU definition results in a considerable amount of work for an industrial discharger. Furthermore, each additional SIU in a POTW's system adds a considerable burden to POTW staff as well. Typical requirements for an SIU are described in this section.

2.3.3.1 Flow Estimation

SIUs should determine the average daily and peak discharge rates of effluents.

2.3.3.2 Contaminant Sampling and Analysis

The characteristics of the discharge must be monitored. Many POTWs conduct periodic compliance monitoring of its SIUs' discharges, in addition to routine self-monitoring conducted by the SIUs themselves. Monitoring data are used by the POTW to verify compliance with local limits.

2.3.3.3 Reporting

Estimates of flow and sample analysis results must be reported to the POTW, usually on a semiannual basis.

2.3.3.4 Discharge Controls

Flow controls are used to prevent slug or raw product discharges of high concentrations of contaminants that could endanger sewer workers or treatment processes downstream. SIUs may be required to install flow controls to prevent such discharges. These controls should be in place before discharge to the sewer commences.

2.4 Development of Local Limits

Each POTW develops local limits that set maximum levels of contaminants in industrial discharges. The limits are placed on contaminants of concern to the specific POTW, based on the POTW's treatment capabilities and the profile of contaminants in the industries it serves. EPA's *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program* spells out step-by-step procedures for calculating local limits; terminals may wish to become familiar with this document.

The basic premise for calculating local limits is to determine, for each industrial contaminant, the maximum allowable contaminant loading at the headworks of the plant and the maximum safe concentration in sewers. Maximum allowable contaminant levels are established by considering the design capacity of the treatment plant processes, removal efficiencies for local industrial contaminants, NPDES permit limits, water quality standards for the POTW's receiving stream, standards and guidelines for the POTW's sludge disposal practice, biological treatment process inhibition data, and potential worker exposures in the sewers and at the treatment plant. Local limits are calculated from the allowable headworks loading in the following way:

a. Once the maximum allowable headworks loadings for all contaminants have been determined, a safety factor is subtracted from each one to account for projected growth in industrial discharges, errors in measurement, and slug loadings.

b. POTWs investigate industrial and commercial discharges to the sewers, attempting to quantify the nondomestic wastewater contribution in terms of flow rate and contaminant load. POTWs then identify the most important nondomestic dischargers (SIUs), characterize those individual loadings, and focus pretreatment controls on them.

c. The POTW collects data throughout the sewer system to determine the typical concentrations of contaminants for domestic service areas. These values are then used to represent the mass loading from domestic sources. Domestic mass loadings are then subtracted from the maximum allowable headworks loading to determine what is allowable from industry.

d. The total allowable contaminant load from industry is then partitioned to the individual industrial discharges. These are the *local limits*. EPA recommends various methods for generating local limits for the various industrial dischargers based on the allowable total industrial headworks mass loadings. The two methods most relevant to terminals are the following:

1. The *uniform concentration method* is the most commonly used method, because it is easy for the POTW to develop and implement. It limits all industrial dischargers to the same maximum contaminant concentrations. In effect, the method allocates the allowable industrial headworks contaminant loading to the industrial users on the basis of each industry's discharge flow rate. Thus, small-volume dischargers are allocated only a small portion of the allowable industrial discharge loading.
2. In the *mass proportion method*, the maximum allowable headworks loading from industry is allocated to each industry based on the industry's current mass loading. The result is a mass loading limit. The terminal may conclude that this type of limit is more appropriate, because it acknowledges the low-volume, high-concentration nature of terminal effluents.

Although the uniform concentration method is the easiest method for the POTW, in terms of both calculation procedure and program implementation, it may not be appropriate for terminals. Terminal effluent is typically a small-volume wastewater with a low mass loading of contaminants; however, concentrations of contaminants may be relatively high. Thus, concentration limits may be difficult to meet in spite of the low mass loading. For such a case, mass-based limits may be a more logical way to address terminal effluents. POTWs should recognize that the mass proportion method is a valid and appropriate way to establish terminal discharge limits.

Other limits may address occupational health standards for sewer workers. These limits are difficult to calculate, and their inclusion in sewer ordinances is not yet common.

Recently, a parameter called total toxic organics (TTO) has been included in local limits as a simple way to regulate a variety of common industrial organic compounds. TTO parameters originated with specific industrial categories, such as semiconductor manufacturing, and normally include about a dozen chlorinated hydrocarbons and aromatics, with limits in the range of 2 parts per million (ppm) to 4 parts per million for the group. The logic of applying TTO limits to terminals is not clear. Nonetheless, TTO limits are common. Contaminants of interest to terminals in a typical TTO list are benzene, toluene, ethylbenzene, and xylene (BTEX), as well as phenol and naphthalene. A mass limit on these TTO compounds would be more logical than a concentration limit for a terminal.

2.5 Typical Pretreatment Requirements Likely to Affect Terminals

This section presents pretreatment requirements likely to affect terminals. The connection to the POTW, self-monitoring, flow control, waste disposal, spill prevention, pretreatment, and fees are discussed.

2.5.1 POTW CONNECTION

The connection to the POTW sewer system is done at the terminal's expense. The terminal should also install a monitoring manhole or other structure to enable POTW staff to monitor flow and take samples. This monitoring manhole should be downstream of any pretreatment facilities. The permitting authority requires access to the monitoring manhole at any time.

2.5.2 SELF-MONITORING

Self-monitoring is required by most pretreatment programs to ensure that the industry is meeting the local limits. Several steps should be followed:

a. Estimate the flow rate of discharge periodically. Given the periodic discharge of most terminals, this might be estimated and recorded for each discharge. Most of the effluent discharged from terminals is from batch processes, such as tank draws. In this situation, batches can be held in a tank to prevent the discharge for product and to measure the volume. Installation of a flow meter for such an intermittent discharge would be inappropriate unless it measures total flow. The terminal should plan to demonstrate to the POTW how tank gauging is used to estimate the volume.

b. Sample and analyze for each contaminant listed in the local limits. This is normally done twice per year. Analysis should be performed either by an independent lab or a lab at the terminal. Some authorities analyze samples collected by the discharger. However, analysis costs are paid by the discharger.

c. If the terminal is determined to be an SIU, the POTW is required to inspect the terminal and collect samples of the discharge annually.

d. Some programs specify whether to use grab, flow-weighted composite, or time-weighted composite sampling techniques. Grab samples are more appropriate for batch discharges.

e. The discharger must report to the POTW the results of all analyses performed for determining compliance with the local program. This requirement ensures that submitted data are not biased or sanitized.

2.5.3 FLOW CONTROL

Industrial dischargers must be able to control both the rate and the timing of the discharge.

2.5.4 WASTE DISPOSAL

Proper disposal of sludge and solid waste is a common requirement of local programs. Such wastes at terminals could be associated with the residues of effluent treatment processes. A plan for proper handling of these wastes is required, as well as documentation of waste disposition.

2.5.5 SPILL PREVENTION

Many POTWs require that spill prevention and control measures be implemented to prevent slug discharge of highly concentrated waste. It is reasonable to expect that a petroleum product terminal will be required to implement such measures prior to connection to the POTW.

2.5.6 PRETREATMENT/WASTE MINIMIZATION

If the data gathered on the strength of the wastewater indicate that it does not meet the local mass or concentration limits, the terminal may need to perform more intense waste minimization or install pretreatment facilities. These pretreatment facilities should be chosen to suit the specific contaminant to be removed. Section 6 provides methods for determining what pretreatment processes are appropriate for removing specific contaminants.

2.5.7 FEES

Fees are collected from the discharger based on several factors. Typically there is a hook-up fee to the sewer, an annual permit administration fee (which includes the annual inspection for an SIU), analysis costs (if sample analysis is done by the POTW), and any surcharges that might apply. These surcharges are normally applied to high-strength discharges with excessive concentrations of biochemical oxygen demand (BOD) and suspended solids. There may also be fees for low and high pH.

SECTION 3—CHARACTERISTICS OF TERMINAL EFFLUENT

3.1 Introduction

POTWs are interested in the characteristics of industrial wastewaters discharged to their systems because of potential impacts to the sewers or treatment plant. This section describes terminal effluents, the wastewaters from petroleum product terminals to be discharged to a POTW. The section discusses sources, volumes, contaminants, and typical compositions of terminal effluents. The section begins with a brief review of petroleum product terminals.

3.2 Background on Petroleum Product Terminals

Petroleum product terminals are part of the vast petroleum transportation network. Terminals store gasoline, diesel, heating oil, jet fuel, oxygenates, fuel additives, and heavy oils. Terminal components include tanks, product loading racks, piping systems, and sometimes ancillary areas such as warehouses, wharfs, maintenance shops, truck washes, and laboratories.

The products stored come from pipelines, tankers, trucks, and railway cars. Commonly, terminals are associated with refineries, pipelines, or harbors. The final destinations for products include service stations, truck stops, and other industrial and commercial facilities. The majority of product is delivered to the customer by truck, but railroad cars may also be used.

There are five main types of terminals: pipeline originating stations, pipeline distribution stations, marketing terminals, airport terminals, and marine terminals. For a detailed explanation of the differences among these terminals, see API Publication 4602.

3.3 Terminal Effluent Sources

Terminals typically collect wastewaters from various sources and direct them to an oil/water separator. The separator recovers any free product, and the separator's aqueous discharge is the terminal effluent.

There are two major sources of terminal effluent: tank bottom water and stormwater from potentially contaminated areas. Other effluent sources may also be present at a terminal and are described in this section.

3.3.1 TANK BOTTOM WATER

Water in the product separates out during storage and settles to the bottom of the tank. Sources of this water include water dissolved in the product, rainwater leaking through tank roof seals, tank breathing, and water entrained into the product. Entrained water may come from manufacturing processes and tanker ballast.

3.3.2 STORMWATER

Stormwater can become contaminated by contacting product or vehicle maintenance areas. Stormwater from the area around the product loading facilities is the primary concern at many terminals.

Many POTWs do not accept clean stormwater because it may strain the hydraulic capacity in the sewer system or the treatment plant. Clean stormwater can usually be discharged to surface or groundwater, but a permit may be required.

3.3.3 OTHER EFFLUENT SOURCES

There may be other sources of effluent at a petroleum product terminal, which are briefly described in this section. For a complete description of these sources, see API Publication 4602.

3.3.3.1 *Ballast water*: Occurs at terminals with ship tanker fueling capabilities. When tankers or barges with noncompartmentalized storage take on ballast water during product transport, it mingles with the product and becomes contaminated. The ballast water is discharged to the terminal when the tanker takes on product, creating a wastewater.

3.3.3.2 *Haulback material*: Generated at the bottom of service station tanks containing a product/water mixture of off-specification products.

3.3.3.3 *Hydrostatic test water*: Occurs when a tank or pipeline is filled with water to test for leaks. This is an infrequent, high-volume, low-concentration discharge.

3.3.3.4 *Pipeline maintenance wastewater*: Generated during emergency response activities associated with pipeline failures. Rainwater, groundwater, or surface water may contact released product, creating a wastewater. To facilitate rapid pipeline repair and minimize product migration, released product is removed by vacuum truck and returned to the terminal's wastewater system. This wastewater is most commonly associated with pipeline distribution terminals and stations.

3.3.3.5 *Produced (remediation) groundwater*: Generated when groundwater below a terminal is managed for contaminant control. The groundwater is collected, possibly treated, and discharged. Special regulations may apply for permitting the discharge of this water to the POTW.

3.3.3.6 *Spill containment wastewaters*: Occurs at rail or truck loading racks or other product transfer points. In the unlikely event of a spill, runoff of unrecovered material could become part of terminal effluent. Terminals have systems in place to collect potential spills and direct them to oil recovery processes.

3.3.3.7 *Truck maintenance wastes*: Includes incidental drainage from crankcases, transmission and differential lubricants, antifreeze, brake fluid, and solvents. These materials can be collected and kept out of the drain system.

3.3.3.8 *Truck wash water*: Generated at terminals that maintain a fleet of distribution trucks and operate a truck washing operation. This wastewater may contain detergent, fine solids, and oils.

3.3.3.9 *Vapor recovery water*: Occurs when vapor recovery is performed to reduce the amount of hydrocarbons released to the atmosphere. When air is cooled to condense hydrocarbon and water vapors, the resulting wastewater is similar to tank bottom water.

Other smaller effluent sources include boiler blowdown, steam condensate, sanitary wastes, detergents, and laboratory wastes. The sum of these sources is normally small compared to other sources.

3.4 Terminal Effluent Volumes

Tank bottom water and contaminated stormwater are the two main sources of terminal effluent. Chapter 7 of API Publication 4602 provides detailed methods for evaluating and managing these sources. The following text summarizes key points from that reference.

3.4.1 TANK BOTTOM WATER

Tank bottom water volumes are a function of tank size and configuration, roof design, local climatic conditions, and water entrainment. According to API Publication 4602, a moderate-sized terminal with 7 large storage tanks might draw 5000 gallons of bottom water per tank per year, for an annual terminal total of 35,000 gallons. On an average daily basis, that corresponds to approximately 100 gallons per day or 3000 gallons per month for the entire terminal.

Reducing tank bottom water volumes can be achieved by decreasing rainwater infiltration and the amount of water entrained into the product. There are both operating and mechanical methods for accomplishing these objectives. Many of these measures have already been implemented at terminals to minimize effluent generation. Presented here are short descriptions of some of the methods from API Publication 4602, Chapter 7:

a. Devices such as sight glasses can be used to determine the amount of water collected at the bottom of the tank, thus preventing overdrawing the tank and releasing product.
b. Devices such as vortex eliminators or vortex barriers can prevent product entrainment during water draw-off.
c. Geodesic domes eliminate rainfall infiltration through floating-roof covers.
d. Reducing the frequency of drawing water from the bottom of the tank reduces the likelihood of releasing product. However, longer contact between water and product tends to cause higher contaminant concentrations in the water.
e. Meters can monitor tank draw-off and minimize product discharge.
f. Routine maintenance minimizes leaking from tank seals, pumps, valve stem packing, and piping.

3.4.2 STORMWATER

Stormwater volumes are a function of rainfall and runoff area. Both factors are highly variable or site-specific.

The best way to control the volume of contaminated stormwater is to reduce and isolate contaminated or industrial activity areas. Best management practices (BMPs) are methods for preventing the contamination of stormwater. BMPs commonly adopted at terminals include covers over loading racks and dikes around above-ground tanks, as well as vegetated stormwater channels and detention ponds. Section 7.2 of API Publication 4602 presents more detail on stormwater minimization techniques and BMPs.

Terminals may also wish to consider filing a notice on intent to be covered by an NPDES general stormwater permit for discharging stormwater. Regulations are still evolving for these permits; however, currently they typically have less stringent monitoring and reporting requirements than pretreatment permits and generally do not require expensive treatment facilities. In states that have explicitly followed the EPA regulations for industrial stormwater permits, terminals only require stormwater permits if airport deicing operations, equipment cleaning operations, or vehicle maintenance shops are on the same property. Terminals without these specific industrial activities do not require a permit to discharge stormwater to surface or ground waters; however, some local ordinances may apply, so terminals should investigate all applicable regulations. Terminals with the identified industrial activities would need an industrial stormwater permit, but only for the portions of the property where the industrial activity occurs (40 CFR Part 122). If a terminal can cease the activity or separate other terminal stormwater from this stormwater, the amount of work and expense required for the stormwater discharge permit can be significantly diminished.

3.4.3 OTHER EFFLUENT SOURCES

The amount of wastewater generated from sources other than tank bottom water or stormwater can be reduced. This can be accomplished via the following activities:

a. Rigorous spill prevention practices can be implemented. Dry materials can be used to clean up any spills that do occur.
b. Terminals with truck washing facilities can reduce the frequency and number of trucks washed. If detergents are used, truck wash water should be kept separate from oil-contaminated wastewater to prevent emulsions that challenge the oil/water separation process. Truck wash water might be com-

pletely eliminated if washing trucks at a commercial terminal is an option.

c. Marine terminals can revisit policies regarding the acceptance of tanker ballast water.

d. Proper handling of truck maintenance wastes reduces this source.

e. A separate plant sewer system for sanitary, noncontact cooling water, and boiler blowdown allow this water to be discharged directly to the POTW without pretreatment.

f. Reducing leaks from pump seals, valve stem packing, pump and valve maintenance, and piping decreases the degree of contamination in terminal effluent.

g. Improved equipment draining techniques and drain valve locations can reduce the amount of oil contributing to terminal effluent. Truck maintenance wastes can be isolated from the plant effluent sewer as they contain compounds which affect oil/water separation processes. This waste should be stored in drums and disposed of properly.

3.5 Terminal Effluent Contaminants

Terminal effluent contaminants can be categorized as conventional and nonconventional. Conventional contaminants are those traditionally used to measure the strength of wastewater, including the following:

a. Biochemical oxygen demand (BOD).
b. Total suspended solids (TSS).
c. Ammonia.
d. pH.
e. Temperature.
f. Oil and grease.
g. Fecal coliform.

Nonconventional contaminants include the following:

a. Chemical oxygen demand (COD).
b. Total organic carbon (TOC).
c. Total petroleum hydrocarbons (TPH).
d. Phenols.
e. Benzene, toluene, ethylbenzene, and xylene (BTEX).
f. Oxygenates.
g. Metals.

COD and TOC, like the conventional BOD parameter, measure the overall organic content of a wastewater. TPH, phenols, and BTEX relate more directly to the petroleum origin of terminal effluents. Ammonia, oxygenates, and metals may exist in certain terminal effluents, depending on terminal products and management, as well as operations at the source refinery.

3.6 Typical Terminal Effluent Composition

Terminal effluent composition depends on effluent sources, volume, and contaminants. All of these factors vary widely from terminal to terminal; therefore, it is not possible to estimate "average" concentrations for terminal effluent or effluent source wastewaters. Roof designs, rainfall, terminal facilities, and wastewater management are factors that could lead to order-of-magnitude variations in terminal effluent volume and contaminant load.

For a summary of various terminal effluent and source wastewater compositions, refer to Appendix B, which summarizes available concentration data for the following potential terminal streams:

a. Tank draws from tanks storing various products.
b. Loading rack water.
c. Tank dike stormwater.
d. Oil/water separator effluent including tank bottom water.
e. Oil/water separator effluent excluding tank bottom water.

It is important for each terminal to conduct its own effluent characterization, representing the site-specific factors of terminal activities, waste reduction, product slate, and weather. Guidelines for successfully characterizing terminal wastewaters include the following:

a. Collect representative samples of typical terminal wastewaters. This may mean sampling during a storm event to characterize, for example, loading rack water.

b. Document terminal operations during the sampling activities, so that wastewater concentrations are linked with specific sources. For example, when sampling separator effluent, note the most recent wastewater discharges to the separator.

c. Analyze the sample for enough parameters to describe the effluent. Consider which parameters are important to the POTW, such as BOD, oil and grease, ammonia, COD, and BTEX, as well as parameters in the local limits.

d. Develop reasonable estimates of the volumes of the sampled streams. Both volume and concentration are needed to calculate contaminant loadings (in pounds). The low loadings of terminal effluent should demonstrate the small impact the terminal effluent will have on the POTW.

Table 1 presents two order-of-magnitude examples of typical terminal effluent compositions. One example is for terminal effluent associated primarily with tank bottom water and loading rack water; the other example is for terminal effluent associated primarily with loading rack water. The table lists assumptions regarding source wastewaters, wastewater volumes, and contaminant concentrations, and presents calculated mass loadings of effluent contaminants. Refer to Appendix A for how to calculate contaminant loadings from wastewater volume and concentration data. Appendix B presents the complete wastewater characterization summaries used for Table 1 calculations.

A review of Table 1 leads to the following observations:

a. The contaminant loadings for both examples are associated with intermittent wastewater generation events—a tank

Table 1—Examples of Terminal Effluent Contaminant Loadings

Example 1
Terminal Effluent Consisting of Tank Draws and Loading Rack Water

Assumptions:

Tank draw volume is 3600 gallons, based on a 1-inch draw from a 50,000-barrel tank
Loading rack water volume is 27,000 gallons, based on 1 inch of rain over a 1-acre area
Tank draw contaminant concentrations are the "typical" concentrations of "various fuel tank" draws in Appendix B, Table B-1
Loading rack water concentrations are "typical" concentrations from Appendix B, Table B-2

Contaminant Mass Loading
Pounds per tank draw and storm event, as described above:

Parameter	Loading in pounds
Oil and Grease	3
BOD	38
TSS	8
Phenols	0.8
BTEX	2
Lead	0.1

Example 2
Terminal Effluent Consisting of Loading Rack Water

Assumptions:

Loading rack water volume is 27,000 gallons, based on 1 inch of rain over a 1-acre area
Loading rack water concentrations are "typical" concentrations from Appendix B, Table B-2

Contaminant Mass Loading
Pounds per storm event, as described above:

Parameter	Loading in pounds
Oil and Grease	0.7
BOD	2
TSS	2
Phenols	<0.1
BTEX	1
Lead	<0.1

draw or storm runoff from a loading rack area. The frequency of these events varies from terminal to terminal. For some terminals, days may pass between the discharges; for others, months may pass. Thus, there would be many days with no discharges from the terminal.

b. The contaminant loadings from terminal effluent are insignificant compared with typical loadings to a POTW. For example, a municipal wastewater treatment plant with an average flow rate of 10 million gallons per day (mgd)—a typical flow rate for a community of 100,000 people—would receive 18,000 pounds per day of BOD from domestic sources. A terminal's intermittent discharge of 38 pounds of BOD would have no impact on the treatment plant influent.

Upon completing their own characterizations, terminals can compare effluent compositions with the values in Table 1. Terminals should anticipate differences, perhaps significant differences, between their actual data and the typical values in the table.

SECTION 4—POTW CONCERNS

4.1 Introduction

POTW concerns may dictate the severity of the discharge permit conditions. Some concerns may be based on a good knowledge of terminal effluent characteristics, but other concerns may arise from unfamiliarity with terminals.

It is important for the terminal to understand POTW concerns and address them as well as possible. In some cases, a concern may be shown to be unwarranted. In other cases, the terminal may need to implement some kind of safeguard to convince the POTW that the terminal adequately controls the cause of the concern.

This section discusses a POTW's most likely concerns: flammable discharges, contaminants, flow loading, and worker exposure. Each concern is described, and for each, several methods to alleviate the concern are given. Methods are listed in order of how they address an increasing level of concern from the POTW.

4.2 Flammable Discharges

POTWs are concerned with the potential for fires and explosions related to the discharge of gasolines, fuels, and other flammable materials typically stored at terminals. Concerns address not only the products in the liquid state, but also volatilized hydrocarbons.

POTWs may not be familiar with how terminals operate and how they manage effluent for the recovery of free product. When initiating contact with the POTW, a terminal may find that safeguards already in place address the concerns of the POTW. If not, Table 2 contains a guide for identifying safeguards for mitigating several POTW concerns.

The basic issue of free product entering the sewer system is addressed by the standard terminal procedure of recovering product in a separator. Issues regarding separator efficiency can be addressed by storing separated effluent in tanks for batch discharge to the POTW. A variety of options are available to ensure that batch discharges are free of oil, including visual inspection, oil interface sensors, and oil sensors in the discharge line. Some petroleum-related facilities successfully use these interface sensors, though industry experience is inconsistent. Batch effluent management options include operating two tanks (one for continued effluent collection and the other to be tested for POTW approval), clearing discharges with the POTW, and characterizing discharges before seeking discharge clearance.

The issue of volatilizing hydrocarbons can be addressed by measuring the concentration of flammable vapors in the monitoring manhole, using a lower explosive limit (LEL) meter. A more drastic step would be to permanently mount an LEL meter at the monitoring manhole, with instrumentation and controls to block the discharge valve at a target high reading.

4.3 Contaminants

POTWs are concerned about how terminal effluent contaminants could adversely affect the operation and performance of the wasewater treatment plant. The three basic contaminant concerns are interference, pass-through, and sludge contamination. In all three cases, concerns should be shown clearly to be unwarranted by a mass balance that calculates the contaminant mass load. Example mass balance calculations are provided in Appendix A.

4.3.1 INTERFERENCE

POTWs are concerned that terminal effluent constituents will harm or *interfere* with the health, growth, and biodegradation abilities of the treatment plant's biological processes. The interference concentrations (*threshold inhibition levels*) apply to the concentrations that reach the biomass. Because terminal effluents combine with the large wastewater flows in the sewer, contaminant concentrations at the POTW are usually orders of magnitude less than in full-strength terminal effluent. For most contaminants, terminal effluent is an insignificant contribution to the threshold inhibition level.

This issue is important for terminals that reduce effluent volume through waste control measures. Minimizing effluent generation tends to concentrate the contaminants in a smaller volume, leading to higher contaminant concentrations. The concentration may appear high, while the mass may actually be less than it was before flow minimization took place. Terminals must emphasize this to the POTW.

Some POTWs may be concerned about oxygenates, such as ethanol and MTBE. These compounds are added to gasoline to improve combustion and may partition slightly into tank bottom water. Pilot treatability tests show that these contaminants are nontoxic and do not upset biological treatment processes.

Table 3 presents increasing steps that terminals can take to alleviate POTW concerns over interference. The mass balances should be very effective in demonstrating the small loadings associated with terminal effluent.

4.3.2 PASS-THROUGH

As with all contaminant-related concerns, the issue of pass-through should be readily dealt with by a mass balance. Terminal effluent contaminant loadings are so small they should not be a significant portion of the POTW contaminant profile. Further, most terminal effluent constituents, such as phenol, are readily biodegradable and are thus well treated in the plant (see case studies presented in API Publication 4602,

Table 2—Safeguards Against Flammable Liquid Discharge

Step	Primary/Remaining POTW Concern	Terminal Response
1	Flammable liquid discharge from terminal	Standard procedure of routing tank draws through separator prior to discharge
2	Separator may not be sufficient protection against flammable liquid discharge	Route separator effluent to a holding tank with a manual flow control valve preventing continuous discharge
3	Holding tank discharges may not be adequately controlled	Clear each discharge with POTW by batch characterization and free product tests
4	Explosive vapors from dissolved contaminants can cause explosive conditions in POTW system	Conduct LEL testing or perform calculations of LEL levels from typical effluent composition
5	Calculated LEL values may not represent reality	Mount LEL meter in monitoring manhold to detect explosive vapor concentrations. For example, a preset LEL reading could close an automatic discharge valve

Table 3—Steps to Alleviate Interference Concerns

Step	Primary/Remaining POTW Concern	Terminal Response
1	Contaminants discharged from terminal may interfere with operation of the treatment system	Provide a mass balance example using typical terminal contaminant concentrations and actual treatment plant flows
2	Typical terminal data may not reflect concentrations at the specific terminal	Collect data for the specific contaminant and use it in mass balance example

Table B-1). This is why it is important for local limits to focus on the contaminant mass loading, which is the key issue for successful POTW operation, rather than on concentration limits, which are only meant to represent the mass loading; in the case of terminals, concentrations are misleading.

Table 4 lists increasing steps a terminal can take to alleviate POTW concerns over pass-through. The basic approach to alleviating pass-through concerns is to demonstrate, using mass balances, that terminal effluent loadings are so low that they will not significantly increase the concentrations of contaminants in the POTW influent. If concerns still remain, subsequent alleviation steps involve controlling terminal effluent discharges to further reduce their impact on POTW wastewater composition.

4.3.3 SLUDGE CONTAMINATION

The contaminants that partition to the sludge—metals and PAHs—are not major components of typical terminal effluent. A mass balance should demonstrate that terminal effluents normally contain negligible amounts of heavy metals and PAHs; therefore, terminal effluents will not lead to restrictions on POTW sludge disposition. Table 5 lists increasing steps a terminal can take to alleviate POTW concerns over sludge contamination.

4.4 Flow Loading

There are three major flow loading concerns, all related to the normal batch- or storm-related generation of terminal effluents:

a. Terminal effluent contaminants arriving in a slug load at the treatment plant may impact operation.
b. Stormwater discharges may challenge the hydraulic capacity of processes or equipment.
c. The timing of the discharge may impact the plant.

4.4.1 SLUG LOADING

As a terminal generates the majority of its wastewaters from tank bottoms or stormwater runoff, the discharge is usually in batches. Slug loads challenge treatment systems by creating a large change in plant influent composition. Table 6 presents several methods to alleviate concerns regarding slug loading.

Table 4—Steps to Alleviate Pass-Through Concerns

Step	Primary/Remaining POTW Concern	Terminal Response
1	Contaminants discharged from terminal will pass through the treatment system	Provide a mass balance example using typical terminal contaminant concentrations, typical biodegradation effects, and POTW flows
2	Typical terminal data may not reflect concentrations at the specific terminal	Collect data for the specific contaminant and use it in a mass balance example as in Step 1
3	Mass balance examples do not make POTW reasonably certain that pass-through will not occur	Each discharge will be stored until approved by POTW
4	Stored effluents, although small in volume, contain high enough contaminant concentrations that discharge must be metered into the sewer	Terminal will meter discharges into the sewer at a controlled rate at a time of day chosen by the POTW

Table 5—Steps to Alleviate Sludge Contamination Concerns

Step	Primary/Remaining POTW Concern	Terminal Response
1	Heavy metals are biologically untreated and partition to the sludge	Demonstrate the low concentration of heavy metals in the terminal effluent with values presented in Section 3
2	Other contaminants contained in terminal effluent will contaminate sludge	Provide a mass balance example using typical terminal contaminant concentrations, showing that, even if all metals and PAHs partition to the sludge, the contaminant loading is negligible

Table 6—Steps to Alleviate Slug Loading Concerns

Step	Primary/Remaining POTW Concern	Terminal Response
1	Slug loading may create a large, rapid change in POTW treatment plant influent composition	Present terminal effluent data and provide a mass balance calculation to show how small terminal effluent loadings are
2	Calculations may not cover all discharge possibilities	Send all batch effluents to a final holding tank; manually control discharge over a period of time that the POTW will accept
3	Discharge of free product slugs will upset the biological treatment process	Oil/water separation, slop oil recovery, and discharge controls prevent free product discharge

4.4.2 STORMWATER DISCHARGE

A method of alleviating concerns regarding stormwater discharge volumes is to compare the peak stormwater flow from the terminal to the average treatment plant influent flow rate. In most cases this ratio is very small indicating little impact to the plant. A similar comparison can be provided for pipes and pump stations in the system between the terminal and the plant.

Methods of controlling and implementing management practices to minimize the quantity of contaminated stormwater are provided in Section 6 of this document and Chapter 7 of API Publication 4602. Table 7 presents several methods to alleviate concerns regarding stormwater discharge

4.4.3 TIMING OF DISCHARGE

The timing of batch terminal effluent discharges may be a concern to some POTWs for two reasons: hydraulic loading and contaminant loading. If downstream hydraulic structures are already near their hydraulic capacity, the POTW may request that batch discharges occur after the peak flow in the sewer or pump station (refer to the diurnal curve on Figure 2). For contaminant discharge considerations, two POTW concerns may exist. On one hand, a POTW may want a terminal to discharge during peak hours of the day to increase dilution of contaminants reaching the treatment plant. On the other hand, the POTW may want the discharge at off-peak hours when traditional (domestic) discharges are low. Several steps available for reducing the concerns over timing of the discharge are provided in Table 8.

4.5 Worker Exposure

The basic concern is that treatment plant operators and sewer workers may be exposed to vapors that volatilize from wastewater. OSHA has established a system of identifying hazardous conditions caused by chemicals in the workplace. These hazards are categorized by either short-term or long-term potential impacts to the worker. Short-term impacts occur over short periods of time and are the result of very high concentrations of toxic material. Long-term impacts are the result of lower chemical exposures over an extended period, such as 70 years. Domestic sewage—without any contribution from terminals or other industrial sources—contains hydrogen sulfide and other potential health hazards, so that entry into sewers and manholes by POTW employees is already governed by substantial safety precautions. Terminal effluents may introduce volatile contaminants to the POTW

Table 7—Steps to Alleviate Stormwater Discharge Concerns

Step	Primary/Remaining POTW Concern	Terminal Response
1	Volume of stormwater may overwhelm plant, sewers, and pump stations	Demonstrate the small amount of terminal stormwater volume relative to the POTW and conveyance system design flows
2	Uncontaminated stormwater should not be discharged to the POTW sewer	Segregate uncontaminated stormwater from the sewer system discharging to the POTW; this is already done at most terminals
3	The volume of contaminated stormwater is too large	Implement additional best management practices to reduce the volume of contaminated stormwater

Table 8—Steps to Alleviate Timing of Discharge Concerns

Step	Primary/Remaining POTW Concern	Terminal Response
1	Timing of discharge will overwhelm treatment processes or hydraulic features	Prepare a mass balance for flow demonstrating that the terminal discharge volumes and peak rates are too small to cause an impact
2	Special limiting features of the POTW create conditions in which even terminal effluents could have an impact	Negotiate a time of day to discharge effluent manually

system, but they would not be independently responsible for worker exposure to hazardous conditions.

Terminal effluent volumes are so low that contaminant load to the sewers would constitute nearly a negligible contribution of volatile organics concentrations (VOCs). Appendix B provides an example mass balance that demonstrates the relatively small amount of contaminants. Therefore, standard POTW safety precautions should easily address concerns regarding worker exposure to terminal effluent constituents. Methods to alleviate concerns regarding worker exposure at treatment plants and in sewers are presented in Table 9.

SECTION 5—RELATIONS WITH POTW MANAGEMENT

5.1 Introduction

Obtaining a discharge permit with a POTW requires a negotiation process. Adequate preparation for the negotiation will improve the likelihood that discharge conditions are agreeable to both the terminal and the POTW. This section discusses ways to develop a relationship with the POTW that fosters a good climate for negotiation and subsequent interaction. Preparing for permit application, applying for the permit, and maintaining the relationship are discussed.

5.2 Preparing for Permit Application

5.2.1 PRELIMINARY STEPS

The first step in initiating contact is identifying who has the authority to implement the pretreatment program. Typically it is the municipality, but sometimes a sewerage agency. Contact this agency, request a copy of the local sewer ordinance, and identify the pretreatment coordinator. The sewer ordinance contains a description of the pretreatment program, local limits, surcharge policies for flow and contaminants, and a definition of significant industrial user (SIU).

It is also helpful to communicate with others knowledgeable in negotiating with this POTW. Specifically, talk with other industrial dischargers, preferably terminals or other petroleum-based industries.

5.2.2 CHARACTERIZE TERMINAL EFFLUENT

After reviewing the pretreatment ordinance, characterize the terminal effluent. Confirm that the terminal is not an SIU based on the numerical criteria. Data on POTW plant contaminant mass and flow loading are necessary to do this.

Perform a flow balance indicating the relative contributions of tank bottom water, stormwater, and other wastewater. Chapter 6 of API Publication 4602 provides methods for characterizing the terminal effluent, in terms of volume, composition, and frequency of generation. Compare flow rate and mass loading results with 25,000 gpd and 5 percent of the POTW's average dry weather hydraulic and organic loading capacities—the numerical SIU criteria. Evaluate effluent management procedures for how they may create concerns for the POTW.

It may also be useful to become familiar with the POTW, learning the typical flow rate and processes used at the treatment plant. Identify locations where hydrocarbon volatilization may be of concern, such as the influent pump station or an enclosed headworks building.

After the terminal's effluent has been characterized, the terminal may want to arrange a meeting with POTW representatives to discuss the pretreatment program, local limits, and the application process. The attending POTW personnel should include the pretreatment coordinator and, preferably, the POTW manager or other senior operations staff member, so that decisions critical to the terminal are based on comprehensive POTW input. Concerns can be aired and addressed. The terminal should obtain a permit application.

It is also important to find out what the key concerns are for the POTW. The POTW may be at its limit for some individual contaminant. In this case, the terminal should demonstrate the absence or presence of this contaminant in terminal effluent.

Table 9—Steps to Alleviate Worker Exposure Concerns

Step	Primary/Remaining POTW Concern	Terminal Response
1	Discharge from terminal may be hazardous to sewer workers	Present sewer atmosphere is probably hazardous already, and low volatile organics concentrations in terminal effluent will not appreciably increase the hazard
2	Slug discharges of terminal products may release higher concentrations of volatile organics	Provide product discharge safeguards on final effluent tank
3	Terminal discharge will impact sewer workers in area	Terminal agrees that once notified in advance of sewer entry, effluent discharge will be held until workers have left the sewer
4	Uncomfortable with terminal discharge timing	Terminal management calls POTW before each batch discharge of effluent

5.3 Applying for the Permit

For most POTWs, dischargers fill out a screening application, designed to identify SIUs. The questions on this application revolve around the local definition of SIU. At this level, POTWs want to know the amount of effluent discharged, how the effluent is generated, what sort of manufacturing processes take place on the premises, a contaminant profile, and whether contaminated groundwater and stormwater are discharged with the effluent.

5.3.1 SIU APPLICATIONS

If the terminal is determined to be an SIU, more steps may be involved. The terminal may need to fill out a more complex application requiring detailed information about the discharge.

For terminals determined to be SIUs, the POTW may develop a fact sheet upon which pretreatment requirements are based and issue a draft permit for terminal review. The draft permit should also contain limitations or requirements for discharge volume, composition, monitoring, and reporting. Draft permits are distributed to the terminal, other interested parties, and the public for comment. After receipt and consideration of comments, the POTW issues the final permit. At this point, the terminal typically has an opportunity to appeal the permit to an administrative or judicial review body.

5.3.2 REQUIREMENTS OF NONSIGNIFICANT INDUSTRIAL USERS

If the discharger is not determined to be an SIU, the POTW may issue what is sometimes called an industrial discharge authorization. This authorization still requires the discharger to comply with local limits and some parts of the pretreatment program (see 2.3.2), but effluent monitoring and analysis are not required. After authorization is granted, the terminal can connect to the POTW system.

It should be noted that although non-SIUs are to comply with local limits, the POTW considers non-SIUs to discharge at concentrations near that of domestic wastewater. Non-SIUs consistently discharging at concentrations (or loadings) near the local limits are liable to be eventually reclassified by the POTW as SIUs.

5.3.3 DISCUSSIONS WITH POTW

During this process, POTWs do not normally negotiate pretreatment conditions. However, they should respond to attempts at dialogue. Petroleum product terminals are not categorical dischargers, nor should they be designated as SIUs based on flow or contaminant loadings; therefore, their POTW discharge permit applications should be dealt with on a case-by-case basis, taking into account site-specific issues. The following are potential topics for discussion:

a. Describe the characteristics of the proposed discharge: volume, contaminant concentration, mass loading, and frequency.

b. Address the POTW's concerns as they arise:

1. Explain the safeguards against free product discharge (spill control plan, discharge release controls, monitoring).
2. Present the mass balance data. Use facts and visual aids derived from this guidance document to show that interference, pass through, and sludge contamination are not problems.
3. Describe stormwater management and flow controls to address flow loading concerns.
4. Use data to demonstrate the low contaminant loadings in terminal effluent.

c. State the rationale for mass-based limits, referring again to the low mass loadings associated with the effluent.

5.3.4 LEGAL REQUIREMENTS

It may be useful to consult with company legal experts on various permitting issues specific to the locality. For instance, all pretreatment applications require the signature of an authorized representative of the terminal. By signature, this person certifies under penalty of law that information contained in the application was prepared under his or her direction and is correct and complete. The signing individual must be aware of the penalties that are assessed for omissions or misrepresentations in the application.

5.4 Connecting to the System

After obtaining approval for discharge, either through authorization or permit, the terminal can connect to a POTW sewer. A control manhole may need to be constructed in the terminal effluent discharge sewer connecting to the POTW to provide the POTW with observation or sampling access to the terminal's connection. In the manhole, a flow meter may also be required by the POTW. Terminals discharging in batches from a final effluent tank may be able to use the tank as a replacement for the control manhole. The cost of the connection to the POTW sewer, including the control manhole, is paid by the terminal.

5.5 Maintaining the Relationship

It is in the best interest of the terminal to maintain a positive relationship with the POTW. This is accomplished by meeting the conditions of the discharge permit or authorization and notifying the POTW when discharge conditions change at the terminal. What is required of the terminal depends on whether it is an SIU.

5.5.1 PERMIT COMPLIANCE

For non-SIUs, there usually is not an official permit. There may be a discharge authorization that contains some elements of a complete SIU permit. These requirements typically include spill prevention and programs to ensure proper disposal of wastes.

For SIUs, discharge monitoring reports are the primary communication link between the terminal and the POTW. These reports, required as often as monthly, should present effluent discharge data, including flow rate or volume, sampling activities, and analytical results. For batch discharges, the time and date of discharge and sample collection may also be required.

5.5.2 SAMPLING AND ANALYSIS

Sampling and analysis considerations include batch and continuous sampling techniques, effluent characterization, and typical sampling and analysis lists to perform prior to POTW contact.

5.5.2.1 Batch Versus Continuous

The POTW may require the terminal to determine if its effluent meets local limits. The type of discharge dictates the appropriate sampling technique. Batch discharges generally warrant grab sampling. Composite sampling may be appropriate for continuous discharges.

5.5.2.2 Effluent Characterization

Terminals should attempt to negotiate a permit with as few analyses as necessary to characterize the effluent. POTWs may not know what contaminants best characterize terminal effluents and may want the terminal to test for all parameters in the local limits, as well as petroleum hydrocarbons. All POTWs have local limits for oil and grease discharges.

If the POTW initially establishes an unnecessarily extensive and frequent sampling program for terminal effluents, the terminal can pursue a phased reduction in requirements. The number of monitored parameters could be reduced by demonstrating that a few parameters adequately characterize the contamination. The frequency of analysis could be reduced by demonstrating the relative stability of effluent composition. One approach is to begin with quarterly characterization for a period of one year. After demonstrating the consistent nature of terminal effluent and minimal risk to the POTW, semi-annual characterization could be negotiated.

Some POTWs must meet limits for toxicity to aquatic organisms. Those that fail the *biomonitoring tests* are required to find the source of the toxic contaminant in a process called Toxicity Reduction Evaluation (TRE). Biomonitoring testing may be used on industrial discharges as an early screening device to indicate industries that may cause the POTW effluent toxicity problems. The terminal should use mass balances to demonstrate that a relatively high dilution would be appropriate for this test.

5.5.2.3 Sampling and Analysis to Perform Prior to POTW Contact

This sampling effort is the initial characterization mentioned in 2.3.2. All samples intended for comparison to local limits should be collected prior to discharge to the POTW sewer. This approach ensures that all industrial (nondomestic) wastewater is sampled separately. The terminal may wish to analyze for all contaminants listed in the pretreatment ordinance, as well as BOD, oil and grease, ammonia, COD, and BTEX. The terminal should ask the POTW to specify what test procedures should be used for sample analysis. The type of products stored at the terminal may indicate that more tests, such as lead, are necessary. For details on tests to use for detecting certain contaminants, consult API Publication 4602, Tables 6-1a and 6-1b.

In some cases the POTW will perform some of the sampling and analysis. If self-monitoring is required by the permit, proper presentation of results by the terminal is recommended. These results should indicate person sampling, time of sample, whether discharge was occurring (important if manual, batch discharge is done), what was sampled for, preservation techniques used for the sample (if necessary), and whether a field blank was taken. Self-monitoring requires more effort from the terminal, but provides a good opportunity to become familiar with effluent discharges, which may be useful in discussions with the POTW.

See the terminal survey/checklist form included in Appendix A of API Publication 4602. This form is useful in identifying sources of effluent and existing forms of pretreatment.

5.5.3 REPORTING CHANGES IN DISCHARGE

POTWs want to maintain a good understanding of influent composition in order to operate their systems reliably. Certain POTW process control procedures depend on treatment plant influent flow rate and composition. Terminals with pretreatment permits should report changes in operation that will either increase or decrease effluent volume or change the effluent character.

SECTION 6—TERMINAL PRETREATMENT OPTIONS

6.1 Introduction

In the process of negotiating a pretreatment agreement, a POTW may determine that effluent from a petroleum product terminal should not be discharged without pretreatment or preliminary contaminant reduction. This section discusses pretreatment options to reduce the contaminant load in terminal effluent. These options include waste minimization, flow control, monitoring discharges, and treatment.

6.2 Effluent Minimization

The cost and effort of treating terminal effluent can usually be reduced by effluent minimization, in terms of both effluent volume and contamination. Minimization measures can lead to smaller treatment systems, lower operating hours (for batch operations), less process complexity, less treatment process residue, and more control and flexibility regarding discharges to the POTW. Effluent minimization is discussed in 3.4 of this document, and in greater detail in API Publication 4602. Table 10 presents reference locations in API Publication 4602 for key topics related to effluent minimization

6.3 Discharge Control Methods

Some POTWs may be sensitive to the control and timing of batch discharges such as tank bottom water. This section serves as a guide for controlling discharges.

As a point of negotiation, the terminal may agree to control the discharge so that it is extended over a period of hours. Another possibility is the POTW requesting that discharge occur during peak hours for dilution of the waste or during off-peak hours so that the treatment plant is not hydraulically overloaded. However, some terminals are only staffed during the day shift; in such cases, the terminal and POTW may wish to consider whether it is good practice to discharge effluent to the POTW when the terminal is unmanned.

Table 10—Oil-Contamination Reduction Techniques Reference

Topic	Chapter of API Publication 4602
Stormwater minimization	7.2
Tank bottom water	7.2
Tank bottom water oil contamination	7.4.1
Equipment leaks	7.4.2
Equipment drainage	7.4.3
Product sampling	7.4.4

6.3.1 INDUSTRIAL DISCHARGE FLOW CONTROL

Some POTWs may require that a control manhole be provided by significant industrial dischargers. The manhole may need a device, such as a valve or gate, to prevent discharge completely. The terminal may prefer to demonstrate to the POTW that flow control can be provided from a final holding tank on the terminal property.

6.3.2 FLAMMABLE LIQUID DISCHARGE SAFEGUARDS

Safeguarding against flammable liquid discharge can be accomplished in several ways, described in 4.2 of this document and Chapter 7.4.1 of API Publication 4602.

6.4 Monitoring Discharges

Self-monitoring of effluent discharges is required by most pretreatment permits. This includes measuring the amount of effluent, sampling the effluent, and analyzing it to confirm compliance with local limits.

POTWs want to know how much effluent is discharged from each SIU. Effluent flow rates and volumes can be estimated in several ways. Flow rates are typically measured with magnetic meters for pressure pipe flows and with weirs for open channel flows. The accuracy of the measurement can depend on the hydraulic stability of the flow at that location, so the placement of the flow meter should be considered carefully. A less complicated alternative is to measure the total flow volume discharged. This estimate can be based on a tank gauge if flows are held prior to discharge.

Effluent sampling is required by self-monitoring provisions in most pretreatment permits. Sampling locations should be chosen to reduce their number. If there are several discharge points to the POTW sewer, but each has similar tributary processes, it may be possible to negotiate for one representative site. Where several wastewater streams combine, it is recommended that sampling be performed well downstream of this point to allow for adequate mixing. Automatic samples are more suitable for discharges which are continuous and not subject to large flow variations. Some permits require flow-composite sampling which is either relative to time or flow rate. In the latter case, a flow meter is required at the sample site.

Laboratory analysis should be conducted according to approved methods using a certified laboratory. Refer to Table 6-1 in API Publication 4602 for detailed guidance on sampling procedures (sample volumes, containers, preservatives, holding times) and analytical methods.

6.5 Effluent Treatment

When terminal effluent quality does not meet local pretreatment discharge limits, treatment may be required. Chapter 9 of API Publication 4602 provides detail on treatment process selection and design. In general, treatment process should be chosen based on the contaminants requiring removal. Effluent characterization performed for the pretreatment application identifies which contaminants may not meet local limits. Table 11 provides recommendations on process selection. The treatment process selection numbers shown in the table represent the approximate order of suitability of a treatment for a specific contaminant.

SECTION 7—ASSOCIATED COSTS

7.1 Introduction

This section identifies the costs involved in discharging petroleum product terminal effluent to POTWs. These costs can be categorized as permit compliance costs, user costs, and pretreatment costs.

7.2 Permit Compliance Costs

Types of compliance costs include sampling, laboratory analysis, and recordkeeping.

7.2.1 SAMPLING AND LABORATORY ANALYSIS

Some POTWs only require the installation of a flow control manhole, and the POTW takes all flow measurements and samples and performs all laboratory analyses. The user rates then reflect the cost of this program. Other POTWs require the SIU to install the control manhole and to perform and pay for all sampling and analyses. In this case, the following components comprise the sampling costs:

a. Flow control manhole.
b. Flow meter (if necessary).
c. Automatic sampler (if necessary).
d. Sampling labor.
e. Sampling kits.
f. Laboratory analysis.

Depending on the variation in the terminal effluent, automatic samplers may be appropriate. Automatic samplers can be programmed as flow-dependent or time-dependent. These samplers have pumps that deliver samples to a large container or an individual container for each sample event. Typical installation costs for automatic sampling equipment are between $5000 and $10,000. A typical cost for connecting to the POTW sewer is approximately $5000 for a connection starting at the plant property line and extending to the center of the street. This cost does not include the permit fee for the connection.

Representative laboratory rates for typical analyses are provided in Table 12. For activities conducted on site, costs will include any time required to calibrate and maintain the sampling equipment, such as pH and flow meters

Table 11—Treatment Process Selection

Treatment Technology	Organics (BOD)	BTEX	Separable Oil	Emulsified Oil	Suspended Solids	Soluble Metals	Ammonia	pH	Organic Toxicity
Oil separation tank			1						
Oil/water separator			2						
Air flotation				2	3				
Biotreatment	1	1		1	1	1	1		1
Chemical oxidation	2	2							2
Activated carbon	2	2		3		3			2
Air stripper		1							
Filtration				4	2				
Precipitation						2			
Alkaline stripping							2		
Chlorination							3		
pH Control								1	
Biological polishing	3			5	4	3	4		3

Note: 1 = most suitable, 2 = next most suitable, etc. Blanks mean not suitable.
Source: API Publication 4602, Table 9-2

Table 12—Representative Analytical Costs

Parameter	Method	Cost Range in Dollars
BOD	EPA 405.1	21-50
COD	EPA 410.1	19-55
TSS	EPA 160.2	9-30
TOC	EPA 415.1	16-60
Oil and grease, gravimetric	EPA 413.1	36-70
Phenol, total	EPA 420.1	36-65
Priority pollutant metals	EPA 6010/7000 series	175-270
BTEX and MTBE[a]	EPA 8020	60-100
TPH	EPA 418.1	50-80

Source: Fee schedules from several established United States analytical laboratories.
[a]MTBE analysis can be performed during BTEX analysis for a nominal additional fee.

7.2.2 RECORDKEEPING

Compiling sampling and discharge monitoring reports can be time-consuming, depending on the frequency required by the permit. Generally, the material cost is insignificant but labor cost can be large depending upon the number of times batch discharges occur during a reporting cycle.

7.3 User Costs

Types of user costs include industrial service fees, flow-specific fees, contaminant-specific charges, and surcharges for high strength waste. POTWs establish this structure to get adequate compensation for capital and operating expenses required for conveyance and treatment of wastewater. The rate structure is usually progressively designed so that those industries discharging more contaminants and flow pay a larger share of the costs.

7.3.1 CONNECTION FEES

These fees are paid by all industrial dischargers for the service of wastewater conveyance, treatment, and disposal. It is similar to the flat domestic charges people pay monthly for sewer service.

7.3.2 FLOW-SPECIFIC FEES

Flows in excess of a certain average daily rate will have a surcharge placed on them by most POTWs. The threshold and the fee structure above the flat rate vary from POTW to POTW.

7.3.3 CONTAMINANT-SPECIFIC FEES

These fees are used to target industries that discharge contaminants that are difficult to dispose of or remove. This may include oil and grease, heavy metals, phosphates, and ammonia. Typically there is a threshold amount that is tolerable from each discharger; above that concentration, the fee applies.

7.3.4 HIGH-STRENGTH SURCHARGE

The main contaminants for which treatment plants are designed are biochemical oxygen demand (BOD) and total suspended solids (TSS). Most POTWs apply surcharges when an industry discharges more than threshold amounts of these two contaminants. In many cases the fee is based on the cost to treat each additional increment of BOD or TSS.

7.4 Pretreatment Costs

Costs of pretreatment include capital costs and operating costs. This section assists the terminal in identifying cost components so that terminal-specific cost estimates can be developed.

7.4.1 CAPITAL COSTS

Capital costs include construction, engineering, and permitting. Engineering and permitting are normally 15 percent of construction. Construction costs must be broken down into types of treatment process or other pretreatment element. API Publication 4602 provides guidance on estimating these costs.

7.4.1.1 Piping

Piping costs depend on the type of material and the diameter of the pipe. Care should be taken in the choice of pipe to convey wastewater at the terminal. Piping costs generally are given per foot, with any excavation requirements for subsurface installation extra.

7.4.1.2 Tanks

Tank costs are a function of size, construction material, and location. Internal piping, valves, and control equipment may be required and should be figured into the cost.

7.4.1.3 Oil/Water Separators

This form of pretreatment is already common at petroleum product terminals. There are various types which vary in cost. Most are commercially available from product vendors who also sell prefabricated tanks. The cost of these separators is also a function of design flow rate.

7.4.1.4 Pumps

The cost of pumps vary with the type of pump, the flow rate, and the vertical distance the flow must be lifted. All pumps must be constructed with intake and discharge piping, valves, a motor, power supply, and control features.

7.4.1.5 Other Equipment

Other equipment required for the operation of a pretreatment plant can include sampling equipment, monitoring equipment, chemical feed equipment, sludge dewatering equipment, power supply, and controls. The cost of these can range dramatically, and the terminal should request specific information from a design engineer familiar with the specific application or an equipment supplier.

7.4.1.6 Package Treatment Plants

Some manufacturers are capable of designing and building prefabricated treatment plants (called package plants). These plant designs are usually based on domestic wastewater treatment. Treating industrial wastewater may require more tailored design concepts. These plants are often skid-mounted or housed in a single structure. Costs vary with the design flow rate, the contaminants that must be treated, the mass loading to the plant, and the complexity of the controls for the process.

7.4.2 OPERATING COSTS

Operating costs include labor, materials, and power. For nonsignificant industrial users, pretreatment operating costs consist primarily of labor for effluent management and basic recordkeeping. For SIUs, more substantial costs could be incurred due to more frequent regulatory interaction and possibly for pretreatment system operation and maintenance.

7.4.2.1 Labor

Labor costs are incurred with maintenance of the treatment system. This maintenance may be very small if a simple system is installed. Less investment in automatic controls will result in higher labor costs for monitoring the process. More investment in labor for preventive maintenance will reduce the material costs for replacing neglected equipment.

7.4.2.2 Materials

Material costs are generated by parts needing periodic replacement and consumed materials. Chemicals used in the treatment process are an example of consumed materials. The operating costs of these vary with the expense of the material and the rate at which it is used.

7.4.2.3 Power

There are no power requirements for pretreatment systems that flow by gravity. However, systems relying on pumps and other moving equipment can draw considerable power. The cost of power varies across the country.

7.4.2.4 Waste Disposal

Pretreatment processes often produce waste residues. Disposal costs for residues vary significantly depending on whether the waste is hazardous.

APPENDIX A—MASS BALANCE CALCULATIONS

A.1 Composite Terminal Effluent Calculation Example

A.1.1 GENERAL

This example shows how to calculate contaminant concentrations in terminal effluent comprised of tank water draws and loading rack water. Example contaminants are BOD, benzene, and phenols, but the procedure applies to any contaminant.

Tank draw calculations involve assumptions (given in the example) regarding tank size and water draw volume. Loading rack water calculations involve assumptions regarding run-off area and rain intensity.

This calculation procedure would be used to characterize a composite terminal effluent, based on known values or estimates of tank draw and loading rack water features.

Note: The following abbreviations apply to the calculations: bbl = barrel(s); gal = gallons(s); ft = foot (feet); in. = inch(es); ppm = parts per million; lb = pounds; mgd = million gallons per day; hr = hour(s); conc. = concentrations.

A.1.2 TANK DRAW CALCULATION

Tank Data

Volume of tank:	50,000 bbl = 2,100,000 gal = 280,750 ft^3
Height of tank:	48 ft
Diameter of tank:	86 ft
Area of tank at water depth:	5810 ft^2

Tank Draw Data

Depth of water withdrawn:	1 in. = 0.0833 ft
Volume of water withdrawn:	0.0833 ft × 5810 ft^2 = 484 ft^3 = 3,600 gal

Contaminant Data (from Appendix B, Table B-1)

Contaminants:	BOD, benzene, and phenols
BOD concentration:	1200 ppm
Benzene concentration:	13 ppm
Phenols concentration:	27 ppm

Calculation Method

$$V \times C = \text{mass loading}$$

Where:

V = volume of water draw, gal.

C = contaminant concentration, ppm.

and:

ρ = water density = 62.4 lbs/ft^3 = 8.34 lbs/gal.

1 ft^3 = 7.48 gal.

For BOD:

$$3600 \text{ gal} \times \frac{1200 \text{ lb}}{10^6 \text{ lb}} \times \frac{8.34 \text{ lb}}{\text{gal}} = 36 \text{ lb}$$

BOD mass loading = 36 lb per tank draw

Benzene and phenols mass loadings calculated by same method to yield:

Benzene mass loading = 0.4 lb per tank draw
Phenols mass loading = 0.8 lb per tank draw

A.1.3 LOADING RACK WATER CALCULATION

Loading Rack Water Volume

Assumed runoff collection area:	1 acre
Assumed rain per storm:	1 in.

Calculation method:

$$1 \text{in.} \times \frac{1 \text{ ft}}{12 \text{ in.}} \times 1.0\, ac \times 43{,}560\, \frac{\text{ft}^2}{ac} = 3630 \text{ ft}^3$$

Volume per storm:

$$3630 \text{ ft}^3 \times \frac{7.48 \text{ gal}}{\text{ft}^3} = 27,000 \text{ gal}$$

Contaminant Data (from Appendix B, Table B-2)

Contaminants:	BOD, benzene, and phenols
BOD concentration:	10 ppm
Benzene concentration:	0.8 ppm
Phenols concentration:	0.1 ppm

For BOD:

$$27,000 \text{ gal} \times \frac{10 \text{ lb}}{10^6 \text{ lb}} \times \frac{8.34 \text{ lb}}{\text{gal}} = 2 \text{ lb}$$

BOD mass loading = 2 lb per storm

Benzene and phenols mass loadings calculated by same method to yield:

Benzene mass loading = 0.2 lb per storm
Phenols mass loading = 0.2 lb per storm

A.1.4 TOTAL EFFLUENT CALCULATION

Assume Effluent Consists of Tank Draw and Loading Rack Water

Total volume of effluent:	3,600 + 27,000	= 30,600 gal
Total BOD mass loading:	36 + 2	= 38 lb
Total benzene mass loading:	0.4 + 0.2	= 0.6 lb
Total phenols mass loading:	0.8 + 0.2	= 0.8 lb

The equation to convert terminal effluent loading to a composite concentration is:

$$\frac{\text{Mass loading}}{\text{Effluent volume}} = \text{Concentration}$$

For BOD:

$$\frac{38 \text{ lb}}{30,600 \text{ gal}} \times \frac{1 \text{ gal}}{8.34 \text{ lb}} \times \frac{10^6 \text{ parts}}{\text{million parts}} = 150 \text{ ppm}$$

BOD concentration = 150 ppm

Benzene and phenols mass loadings calculated by same method to yield:

Benzene concentration: 2 ppm
Phenols concentration: 3 ppm

A.2 Terminal Effluent Contaminant Concentrations at the POTW Calculation Example

A.2.1 GENERAL

This example shows how to calculate the impact of terminal effluent on the composition of POTW influent. The example contaminants are BOD, benzene, and phenols, using values derived from the previous example.

The calculation procedure involves estimating the POTW influent flow rate, based on the population served by the POTW. It compares the relatively small BOD loading from terminal effluent to the BOD loading already entering the plant from domestic sources. The procedure also shows how the low loadings of benzene and phenols from terminal effluent have a negligible impact on interference and pass-through concerns at the POTW.

A.2.2 ASSUMPTIONS

Population:	100,000 people
Per capita average sewage flow:	100 gal/capita/day
Average daily plant flow:	10,000,000 gal/day = 10 mgd
Domestic BOD concentration:	220 ppm
Terminal flow and mass loadings:	See previous example

A.2.3 TREATMENT PLANT LOADING

Average daily flow: 10 mgd

Calculation method:

$$\text{Flow rate} \times \text{Concentration} = \text{mass loading}$$

For BOD:

$$\frac{10 \times 10^6 \text{ gal}}{\text{day}} \times \frac{220 \text{ lb}}{10^6 \text{ lb}} \times \frac{8.34 \text{ lb}}{\text{gal}} = 18,300 \frac{\text{lb}}{\text{day}}$$

BOD mass loading = 18,300 lb per day

Assume a terminal's tank draw batch discharge spreads out over time and reaches the plant in 3 hours.

Terminal tank draw BOD mass loading: 38 lb (from previous example)

Calculation method:

$$\frac{\text{Terminal tank draw BOD}}{\text{Plant BOD}} = \frac{38 \text{ lb}}{18{,}300 \dfrac{\text{lb}}{\text{day}} \times \dfrac{1 \text{ day}}{24 \text{ hr}} \times 3 \text{ hr}} = 0.02 = 2\%$$

Ratio of terminal BOD to plant BOD: 2 percent for the 3-hour period associated with the batch discharge of the tank draw

A.2.4 INTERFERENCE TEST

Interference is an adverse impact on the POTW biomass caused by high contaminant concentrations. This calculation shows how low terminal effluent contaminant concentrations are at the POTW treatment plant. The calculation methodology involves determining POTW concentrations from tank draw concentrations and comparing the result with accepted values of interference, or *threshold inhibition*, concentrations. To be conservative, this example focuses only on tank bottom water, a relatively high strength wastewater. The inhibition levels are derived from EPA's *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program.*

Activated sludge benzene threshold inhibition level = 100 ppm
Activated sludge phenol threshold inhibition level = 50 ppm

Tank draw benzene concentration:	13 ppm (from previous example)
Tank draw phenol concentration:	27 ppm (from previous example)

The tank bottom water volume is 3600 gallons (from previous example). Assume this volume is discharged over a 3-hour period.

Wastewater plant volume over 3-hour period is 10,000,000 × 3⁄24 = 1,250,000 gal

Calculation method:

$$\text{Plant contaminant concentration} = \frac{\text{Terminal volume} \times \text{terminal contaminant concentration}}{\text{POTW volume} + \text{terminal volume}}$$

Plant benzene concentration due to terminal:
(assume terminal is only contributor)

$$\text{Plant benzene concentration} = \frac{3600 \text{ gal} \times 3 \text{ ppm}}{1,250,000 \text{ gal} + 3600 \text{ gal}} = 0.04 \text{ ppm}$$

The benzene concentration at the POTW associated with the terminal effluent discharge is 0.04 ppm, much lower than the activated sludge benzene threshold inhibition level of 100 milligrams/liter.

Using the same calculation method, the plant phenol concentration associated with the terminal effluent discharge is 0.08 ppm, much lower than the activated sludge benzene phenol concentration of 50 milligrams/liter.

A.2.5 PASS-THROUGH TEST

Pass through occurs when a contaminant is inadequately treated in the POTW treatment plant and thus has an unacceptably high concentration in the plant effluent. This calculation shows how low terminal effluent contaminant concentrations are in POTW effluent, because the contaminants are so readily biodegradable.

Assume the following contaminant removals in a POTW with activated sludge based on EPA's *Fate of Priority Pollutants in Publicly Owned Treatment Works.*

Benzene:	77 percent
Phenol:	89 percent

Calculate: Benzene and phenol concentrations in POTW effluent.

Calculation method:

$$\text{Effluent benzene conc.} = (1 - 0.77) \times 0.04 \text{ ppm} = 0.009 \text{ ppm}$$

Effluent phenol concentration (same method) = 0.008 ppm.

APPENDIX B—PETROLEUM PRODUCT TERMINAL WASTEWATER CHARACTERIZATION DATA

This appendix summarizes available data characterizing various terminal wastewaters. The summaries are presented in four tables:

a. Table B-1 presents compositions of tank bottom waters from tanks storing various products.
b. Table B-2 presents compositions of loading rack water.
c. Table B-3 presents compositions of tank dike containment water.
d. Table B-4 presents compositions of terminal effluents from oil/water separators. Summaries address terminals that direct tank draws to the separator and terminals that exclude tank draws from terminal effluent.

The tables present compositions in terms of ranges of concentrations for different parameters, as well as "typical" values. When possible, the typical value is the arithmetic mean of the available data. However, the data sources sometimes present composition summaries in terms of median values, rather than mean values; median values are assumed to be mean values for the purpose of combining data from more than one source. Typical values are rounded off to no more than two significant digits.

Sources used to develop the summary tables are listed below, with numbers keyed to the reference footnotes in the tables:

1. *Terminal Effluent Characterization Study*, by Environmental Science and Engineering, Inc., prepared for American Petroleum Institute, December 1986.
2. *Minimization, Handling, Treatment, and Disposal of Petroleum Products Terminal Wastewaters*, API Publication 4602, by Texaco, Inc., Environmental Research Section of Port Arthur Research Laboratories, prepared for American Petroleum Institute, August 1994.
3. *Evaluation of Technologies for the Treatment of Petroleum Product Marketing Terminal Wastewater*, API Publication 4581, by Texaco Inc., Environmental Research Section of Port Arthur Research Laboratories, prepared for American Petroleum Institute, May 1989.
4. Internal American Petroleum Institute member company data, 1994.
5. Internal American Petroleum Institute survey data, 1986.
6. Internal American Petroleum Institute data, 1992.

Table B-1—Marketing Terminal Wastewater Concentrations From Tank Bottom Draws

	Various Fuel Tanks[a]				Premium Unleaded Tanks[b]			
		Concentration, ppm				Concentration, ppm		
Parameter	No. of samples	Range		Typical	No. of samples	Range		Typical
Oil and Grease	6	17	240	80	6	<2	42	5
BOD	5	180	2600	1200	–	–	–	–
TOC	6	290	1980	900	6	583	4040	1700
COD	4	1700	6000	3900	–	–	–	–
TSS	6	45	768	180	–	–	–	–
Ammonia	4	0.1	116	20	–	–	–	–
Phenols	6	0.4	100	27	6	1.2	26	5
Phenol	–[d]	–	–	–	6	0	6	0.5
Benzene	6	0.8	52	13	6	12	42	30
Toluene	6	0.11	60	17	6	25	240	69
Ethylbenzene	5	0.18	2	5	6	1.9	54	3
Xylene	6	0.01	14	5	12	4	110	6
Arsenic	6	0.03	0.43	0.2	6	0.003	0.9	0.1
Lead	6	0.06	1	0.4	–	–	–	–

Notes:
[a]Source: References 2 and 5. Source. Source did not specify the type of product in tanks.
[b]Source: Reference 1.
[c]Source: References 1 and 2.
[d]Dashes mean no data available.

Table B-1—Marketing Terminal Wastewater Concentrations From Tank Bottom Draws (continued)

	Regular Unleaded Tanks[a]				Regular Leaded Tanks[b]			
		Concentration, ppm				Concentration, ppm		
Parameter	No. of samples	Range		Typical	No. of samples	Range		Typical
Oil and Grease	3	>2	32	5	4	2	36	10
BOD	–	–	–	–	–	–	–	–
TOC	3	731	5570	1200	4	553	1550	870
COD	–	–	–	–	–	–	–	–
TSS	–	–	–	–	–	–	–	–
Ammonia	–	–	–	–	–	–	–	–
Phenols	3	7.9	80	58	4	19	70	45
Phenol	3	0.6	18	13	4	0.3	16	8
Benzene	3	12	42	26	4	12	52	20
Toluene	3	40.0	51	42	4	8	60	26
Ethylbenzene	3	1.9	3.5	2	4	<0.17	2.6	3
Xylene	6	3.5	7.5	6	8	<1.4	3.7	3
Arsenic	3	0.153	0.419	0.4	4	0.098	0.193	0.1
Lead	–	–	–	–	4	<0.001	0.754	0.4

Notes:
[a]Source: References 2 and 5. Source. Source did not specify the type of product in tanks.
[b]Source: Reference 1.
[c]Source: References 1 and 2.
[d]Dashes mean no data available.

Table B-1—Marketing Terminal Wastewater Concentrations From Tank Bottom Draws (continued)

	Diesel/Fuel Oil Tanks[a]				Jet Fuel Tanks[b]			
		Concentration, ppm				Concentration, ppm		
Parameter	No. of samples	Range		Typical	No. of samples	Range		Typical
Oil and Grease	2	241	265	250	4	<2	131	70
BOD	2	992	1617	1300	–	–	–	–
TOC	4	546	2381	1300	4	55	2560	60
COD	2	8200	9175	8700	–	–	–	–
TSS	–	–	–	–	–	–	–	–
Ammonia	–	–	–	–	–	–	–	–
Phenols	2	5.6	42	24	4	0.40	27	1.2
Phenol	2	0.66	16.00	8.3	–	–	–	–
Benzene	2	0.41	0.46	0.4	4	0.03	0.05	0.3
Toluene	2	0.35	0.92	0.6	4	0.19	10	1.2
Ethylbenzene	–	–	–	–	4	0.02	0.38	0.1
Xylene	–	–	–	–	8	–	1.50	0.4
Arsenic	2	0.11	0.21	0.2	–	–	–	–
Lead	–	–	–	–	4	<0.02	4.18	0.03

Notes:
[a]Source: References 2 and 5. Source. Source did not specify the type of product in tanks.
[b]Source: Reference 1.
[c]Source: References 1 and 2.
[d]Dashes mean no data available.

Table B-2—Marketing Terminal Wastewater Concentrations for Loading Rack Water

		Concentration, ppm		
Parameter	No. of samples	Range		Typical
Oil and Grease	2	2	4	3
BOD	1	10	10	10
TOC	2	13	180	100
COD	–	–	–	–
TSS	2	4	18	11
Ammonia	–	–	–	–
Phenols	2	0.05	0.14	0.1
Phenol	–	–	–	–
Benzene	2	0.064	1.6	0.8
Toluene	2	0.07	3.3	2
Ethylbenzene	2	0.001	0.3	0.2
Xylene	2	0.166	4	2
Arsenic	1	–	0.03	0.03
Lead	2	0.007	0.01	0.01

Notes:
Source: References 5.

Table B-3—Marketing Terminal Wastewater Concentrations for Tank Containment Water

		Concentration, ppm		
Parameter	No. of samples	Range		Typical
Oil and Grease	63	0.2	18	5
BOD	14	1	342	30
TOC	24	2	23	10
COD	5	9	55.6	30
TSS	24	4	1100	80
Ammonia	10	0.05	0.2	0.2
Phenols	–	–	–	–
Phenol	2	5	5	5
Benzene	20	0.00013	0.0005	0.003
Toluene	17	0.0006	0.039	0.006
Ethylbenzene	16	0.0009	0.02	0.005
Xylene	16	0.0009	0.037	0.07
Arsenic	4	0.02	0.2	0.1
Lead	–	–	–	–

Notes:
Source: References 5 and 6.

Table B-4—Marketing Terminal Wastewater Concentrations From Oil/Water Separator Effluents

Parameter	No. of samples	Concentration, ppm Range		Typical
Tank Draws Sent to Separator				
Oil and Grease	33	< 0.5	110	20
BOD	18	180	12,000	2,200
TOC	26	6.9	1,100	–
COD	17	1,730	17,000	3,800
TSS	18	22	110	50
Ammonia	1	–	–	20
Phenols	25	0.0001	39	8
Phenol	6	0.03	8	2
Benzene	28	0.00004	30	13
Toluene	28	0.0005	52	10
Ethylbenzene	28	0.0009	5	2
Xylene	12	0.001	35	3
Arsenic	8	0.0005	0.08	0.02
Lead	13j	0.003	0.2	0.1
Tank Draws Not Sent to Separator				
Oil and Grease	6	< 2	2,390	25
BOD	–	–	–	–
TOC	6	7	180	45
COD	–	–	–	–
TSS	–	–	–	–
Ammonia	–	–	–	–
Phenols	6	0.001	0.21	0.1
Phenol	6	0.0006	0.09	0.004
Benzene	6	0.00002	7	0.2
Toluene	6	0.001	38	0.2
Ethylbenzene	6	0.02	0.3	0.03
Xylene	6	0.003	28	0.2
Arsenic	–	–	–	–
Lead	6	< 0.001	0.1	0.02

Note:
Source: References 1, 3, 4, and 5.

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